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ACQUISITIONS, MANAGEMENT, AND EFFICIENCY IN RWANDA'S COFFEE INDUSTRY

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ABSTRACT

Well-functioning markets allocate assets to owners that improve firms' management and performance. We study the effects of ownership changes on coffee mills in Rwanda – an industry in which managing relationships with farmers and seasonal workers is important and that has seen many ownership changes in recent years. We combine administrative data, a survey panel of mills and an original survey of acquirers that allows us to construct acquirer-specific and target-specific control groups. A difference-in-differences design reveals that ownership changes do not improve performance unless the mill is acquired by a foreign firm. Our preferred interpretation – supported by detailed survey evidence that considers alternative hypotheses – is that foreign firms successfully implement management changes in key operational areas. Upon acquisition, both domestic and foreign owned mills attempt to implement similar changes, but domestic firms face resistance from workers and farmers. Domestic owners have relationships with their local communities, which can create opportunities to establish new mills and acquire existing ones. However, these same relationships create pressure to maintain status-quo relational arrangements, which makes it harder to implement managerial changes.

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1 Introduction

Firms, even within narrowly defined sectors, vary widely in management and performance (Syverson (2011)), especially in low-income countries (Hsieh and Klenow (2009), Bloom et al. (2012)). What constraints the diffusion of better management practices in these countries? And what can be done to alleviate those constraints? One approach is to encourage firms' take-up of management training and consulting programs. Most programs, however, target micro and small enterprises (McKenzie et al. (2021)) while the majority of capital is invested, and output produced, in larger firms (Hsieh and Olken (2014)).[1] A different approach is to encourage market reforms that increase competition, so as to force poorly performing firms to either improve (Schmitz (2005)) or exit (Syverson (2004)). In environments with weak institutions, however, competition might worsen performance (Rodrik (2008)), for example by reducing rents that underpin relationships with workers, customers and suppliers (Macchiavello and Morjaria (2021)).

This paper explores a third channel: the market for firms. In theory, a well-functioning market allocates assets to owners that are able to implement better management practices and improve performance. In practice, however, this process might not operate as smoothly in developing countries.[2] Few firms are publicly traded and, among non-listed firms, family firms and SOEs dominate the landscape. Private equity – which has contributed to productivity increases in the U.S. (Davis et al. (2014)) – is less developed (Lerner and Schoar (2005)).

Three challenges have stunted progress in understanding the effects of firms' ownership changes in low income countries. First, ownership changes are rare events (Mckinsey (2014)). Second, there are few industries with reliable data on performance and management for sufficiently many large firms. Finally, target selection criteria are typically unobserved, hindering the construction of suitable counterfactuals.

We study the effects of ownership changes on the performance and management of coffee mills in Rwanda. Coffee is the main source of livelihood for millions of farmers worldwide, has many commonalities with other agricultural chains and is an important export industry in many developing counties. Besides its intrinsic interest, the context allows us to overcome the three empirical challenges mentioned above. First, we reconstruct the ownership history of all coffee mills since the beginning of the industry in the early 2000s. Mills frequently changed owners – a third of the 310 mills that have ever been established have changed ownership at least once during our 15-year sample period, with many of those acquired by domestic and

[1] Evidence on the impact of training programs on larger firms is limited because there are fewer of them and the required interventions expensive. Bloom et al. (2012) and Bloom et al. (2019) find long-run positive impacts from a management intervention offered by a leading consulting company on textile mills in India. Giorcelli (2019) finds long-run positive effects on firm performance from a program that sponsored management-training trips to the U.S. for Italian firms in the 1950s. Bruhn et al. (2018) and Iacovone et al. (2019) provide recent examples of less expensive interventions for SMEs.

[2] In advanced economies, this hypothesis has received empirical support (Maksimovic and Phillips (2001)) but is still debated due to difficulties in measuring productivity and the possibility that market power (Blonigen and Pierce (2016)) and/or managers' desires to run larger firms (Gompers et al. (2003)) drive acquisitions.

foreign owned downstream exporters. Second, we combine administrative data and several rounds of tailored survey to trace mills' practices and performance across time. Knowledge of the industry production process facilitates the measurement of performance, technology and management in key operational areas. Finally, we design and conduct a survey of *acquirers* in the industry. This survey – to our knowledge the first of its kind – elicits information on the criteria used to identify targets, on failed acquisitions and on alternative targets considered by the acquirer. This allows us to construct a variety of counterfactual targets and assuage selection concerns.

We find that acquisitions can be a potent vehicle to improve mills' performance and management. Strikingly, however, ownership changes are associated with improvement in performance only if the mill is acquired by a foreign group. Our preferred interpretation is that foreign groups are better able to implement management changes in key operational areas. Many of the required changes involve managing relationships with farmers and seasonal workers. Upon acquisition, both domestic and foreign owned mills attempt to implement similar changes. Unlike foreign groups, however, domestic firms face resistance from workers and farmers when attempting to implement these changes. Survey evidence suggests that domestic owners' "embeddedness" in the local communities might make it harder to implement these changes due to pre-existing relationships.

Section 2 provides background information on the industry, its evolution, the process of acquisitions and our sources of data. In 2002, only 3 mills existed and they were owned by indigenous stand-alone firms. Rwanda almost exclusively exported low quality coffee processed by farmers. By 2017, a total of 310 mills had been constructed. This expansion was accompanied by many ownership changes. Around a third of all mills switched ownership at least once since being established. Over the years, an increasing share of mills began to be owned by *groups*, defined as companies owning at least two mills. By 2011, some domestic exporters had integrated backward and owned 35% of the 200 mills constructed until then. The rest of the industry were stand-alone mills owned by local companies. Starting in 2012, foreign exporters also started acquiring mills. By 2017, they owned 17% of the mills constructed in the country.[3]

Section 3 presents our main results. We explore how acquisitions relate to mills' performance within a difference-in-differences framework that controls for both mill and year fixed effects. We focus on comparing mill's outcomes when owned by domestic versus foreign groups relative to stand alone mills. Upon acquisition, group ownership by both domestic and foreign groups is associated with an increase in both the likelihood that the mill operates and in installed capacity. However, while foreign-owned mills expand the amount of coffee cherries sourced from farmers and increase capacity utilization, domestic mills do not and, if anything, suffer lower capacity utilization. The relatively simple production technology and the survey allow us to track the evolution of other aspects of mills' performance. Besides lower capital utilization, domestic groups use higher volumes of coffee cherries and more workers to produce

[3]Note that both domestic and foreign groups were already active as coffee exporters in the industry before the consolidation process took off. The change in mills' ownership was thus not accompanied by equally significant changes in the concentration and composition of exporters.

a unit of output (parchment coffee). Physical efficiency in all key inputs (capital, labor and raw materials) is thus lower under domestic group ownership relative to foreign ownership. Domestic and foreign mills do not differ in the prices paid to farmers nor the daily wages paid to seasonal workers.[4]

Section 3 then subjects our main results to a variety of robustness checks. Because of the staggered nature of the "acquisition" treatment and the possibility of heterogeneous treatment effects across mills and over time, we check our results under alternative event-study specifications around the time of acquisition (de Chaisemartin and D'Haultfœuille (2022)). Results are generally robust. If anything, foreign groups appear to target poorly managed mills and turn them around. We also explore the robustness of our results to alternative counterfactual scenarios constructed using the acquirer survey. The survey assigns to each acquirer and, sometime, to each acquired mill, a set of control mills not acquired by the acquirer. For example, we consider failed acquisitions reported by the acquirer, existing independent suppliers of the acquirer and even mills identified by the acquirer as alternative targets to each acquired mill. This strategy allows us to compare the evolution of acquired mills to these more restricted (and, arguably, more similar) control groups and to include acquirer-year (or pair-year) fixed effects that can control for certain time-varying confounders. Results are generally robust despite substantial reductions in sample size in these restrictive comparisons. Alongside a variety of standard robustness tests, these checks assuage selection concerns and make us reasonably confident of having identified a positive impact on operational efficiency of being acquired by a foreign group relative to a domestic group.

Section 4 explores mechanisms. While foreign firms might have better access to technology, finance and markets (see, e.g., Guadalupe et al. (2012), Antràs and Caballero (2009) and Manova et al. (2015)), our survey reveals that these factors are unlikely to explain the results. Foreign groups appoint managers with higher education and cognitive skills, but controlling for managers' characteristics explains only a part of the difference in performance.

Our preferred interpretation is that mills owned by foreign groups are better managed. Differences in management could arise due to differences in *knowledge* ("what to do"), *incentives* ("wanting to do it"), or *implementation* ("how to do it") (Gibbons and Henderson (2012)). It is generally hard to distinguish between these hypotheses, since standard datasets only include information on whether a certain practice is adopted or not, while untangling implementation challenges requires knowledge of attempted changes. We overcome this challenge by asking mill managers about the process of implementing management changes in key operational areas. We find no difference in the amount and type of changes that managers in domestic and foreign groups attempted, suggesting that differences in knowledge or incentives are unlikely to drive results. Instead, we find that many of the attempted changes require altering the mills' relationships with farmers and workers, and managers in domestic groups face more resistance

[4]Mills owned by groups deliver output within a vertically integrated chain precluding a comparison of output prices (and thus of revenue productivity) between foreign and domestic groups. We find modest evidence that foreign ownership, however, is associated with increases in quality attributes that usually command a premium at the export gate.

to these changes from both. Thus, differences in implementation might be key. Additional evidence suggests that domestic owners' "embeddedness" (Uzzi (1999)) in the local communities might entail a previously unnoticed trade-off. On the one hand, it opens up opportunities to establish new mills or acquire existing ones (similar to the "special deals" in (Bai et al. (2020)). On the other hand, it creates pressure to maintain status-quo relational arrangements, thereby hindering the process of management change at the mills. Related cultural norms are discussed in Platteau (2015).

Section 5 provides concluding remarks. Although our results come from a specific context, many features of the coffee sector (e.g., the importance and challenges of establishing long-term relationships with farmers; managing a seasonal labor force; organizing processes to meet quality specifications) are common to agri-processors in other supply chains. The idea that management practices can diffuse through acquisitions of poorly performing plants by foreign groups also extends well beyond agriculture. As just one example, *CEMEX* – the Mexican cement company – perfected management practices at home before acquiring poorly performing plants abroad (Lessard and Lucea (2009)). The company developed a highly standardized *post*-acquisition process to implement best practices in acquired firms. We have provided a systematic exploration of these forces in coffee – a sector that, like cement, is characterized by limited technological progress. While a set of standard practices to effectively run mills exists, implementation is nevertheless complicated by the need to adapt existing relationships.

Related Literature. This paper contributes to several strands of literature. First, to the literature on firms' ownership and performance.[5] Braguinsky et al. (2015) study acquisitions of cotton mills in early twentieth century Japan – an industry that, like ours, witnessed rapid expansion and many ownership changes. They find that targets were not on average less physically productive than plants of the acquirer before acquisition. Acquisitions, however, increased profitability through better management of demand uncertainty. Our results paint a similarly nuanced picture of the acquisition process.

We find that acquisitions do not lead to increases in efficiency unless they involve foreign groups. Given the nature of acquisitions in our context, our findings also relate to the literature on vertical integration and firm's performance. In the U.S. cement and ready-mixed concrete industry, Hortaçsu and Syverson (2007) also find efficiency gains associated with large (and typically vertically integrated) firms. In China's steel sector, Brandt et al. (2022) find differences in productivity across upstream and downstream stages between integrated and non-integrated chains, mostly due to differential access to raw materials and technology. In the Costa Rican coffee sector – a more mature setting than ours – Macchiavello and Miquel-Florensa (2018) show that backward integration facilitates supply assurance of large volumes of coffee by curbing suppliers ability to default on forward contracts. Relative to the literature, we complement administrative datasets with detailed surveys of both plants and acquirers to

[5] A large literature studies M&A activity and acquisitions across sectors (see, e.g., Maksimovic and Phillips (2001), Guadalupe et al. (2012)). We focus our review on selected industry studies.

dissect the changes that take place upon acquisition, construct counterfactuals and explore alternative hypotheses.[6]

We contribute to the literature on firm performance in low-income economies (see Verhoogen (2021) for a review). We consider acquisitions and consolidation, a channel that might have been under studied due to data limitations.[7] Bassi et al. (2022) uncovers an active rental market for machines using a novel survey of small manufacturing firms in Uganda. The rental market improves the efficiency with which machines are utilized. Our paper considers more permanent transfers of asset ownership in larger firms. The role of foreign multinationals in improving efficiency of local mills also complements evidence on the impact of multinationals on suppliers upgrading. Alfaro-Ureña et al. (2022) provides a state-of-the-art example in this vast literature.[8]

Finally, we contribute to debates between the "contingent" and "best practice" view of management practices by focusing explicitly on the challenges of implementing management changes.[9] The contingent view argues that firms select management practices to respond to differences in business environment. In contrast, the best practice view points at the existence of certain management practices that are better than others independently of contextual details (see, e.g., Bloom et al. (2014)). In our industry, there appears to be a set of standard practices that, if implemented, increase mill's performance. At the same time, these practices require building, managing and – if needed – changing "relational contracts" with workers and farmers. Challenges in implementing these management practices are thus specific to the situation at each mill (Gibbons and Henderson (2012)). Atkin et al. (2017) experimentally introduce a cutting technology that reduced material waste and found that it was resisted by cutters because the traditional piece-rate system did not compensate them for the time spent learning the new technology. Macchiavello et al. (2020) found that a program aimed at promoting women to managerial roles in Bangladeshi garment factories was resisted by existing male supervisors. We complement these studies measuring directly attempted changes, implementation challenges and sources of resistance and highlighting social "embeddedness" as a previously unnoticed barrier to implementation of management changes that require altering existing relationships.[10]

[6] In the Peruvian fish-meal export industry, Hansman et al. (2020) find that vertical integration enables downstream processing plants to increase quality sourced from suppliers. In our context, vertical integration *per se* does not increase quality. We find only modest evidence of quality improvements associated with foreign groups. It is however important to note that – unlike Hansman et al. (2020) – our exporters integrate processing plants, rather than producers of raw materials.

[7] Due to poorer institutions and imperfect markets, it has been hypothesized that diversified conglomerates (business groups) have superior performance in emerging markets (see, e.g., Khanna and Palepu (2000) for a study of Indian conglomerates and Khanna and Yafeh (2007) for a review). These structures have however also been associated with weaker governance and expropriation of outside investors (see, e.g., Bertrand et al. (2002)).

[8] Macchiavello and Miquel-Florensa (2019) study a buyer-driven program that led to quality upgrading in the Colombia coffee chain. Méndez-Chacón et al. (2021) find positive short- and long-run effects of the United Fruit Company's concession in Costa Rica on living standards.

[9] See Dessein and Prat (2022) and Verhoogen (2021) for a synthesis and further references.

[10] Macchiavello (2022) reviews an emerging body of evidence on the importance of relational arrangements in developing countries. This projects builds on our earlier work on relational contracts in

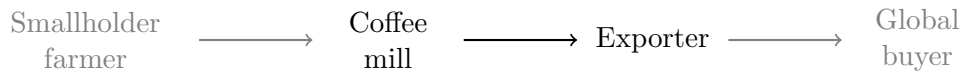
2 Industry Background

This section provides background information on the industry. We first describe the supply chain. We then focus on the industry evolution and the process of entry and acquisitions in the industry. We conclude describing the data used in the analysis.

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 23% of the country's agricultural export value.[11] Figure 1 provides a stylized description of the supply chain in Rwanda.

Figure 1: 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 dry hull parchment coffee into green coffee, sort, hull and polish 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.

Farmer Harvesting. In 2015, the most recent census, there were around 350,000 smallholder farmers growing coffee on an average of less than 0.25 hectare of land holding. Coffee cherries are the fruits of the coffee tree and they are harvested when turning from green to red. The harvest season typically lasts four months, with variation depending on both geographical and weather conditions. 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: home-processed

the sector. In Macchiavello and Morjaria (2021), which relies on the 2012 survey, we argued that relational contracts with farmers are essential to run coffee mills and tested the hypothesis that increased competition hinders these relationships. As the industry kept expanding, stakeholders confirmed that developing relational contracts with farmers was becoming ever more difficult and that the industry was consolidating. We thus returned to the field in 2015 and in 2017 to conduct extensive surveys and collect all administrative data available.

[11] 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.

and wet-mill method. In the home-processed method, farmers de-pulp cherries at home using rather rudimentary tools before drying the bean on tarpaulin. This process produces coffee parchment of lower and less consistent quality.

In the wet method, coffee cherries are taken to a wet mill within hours of being harvested, otherwise they start to ferment and rot. Mills are therefore scattered around the countryside (Figure 2, top-left). Farmers closest to the mill often take cherries to the mill's gate directly. Farmers further afield bring cherries to collection points where traders, known as coffee "collectors", load coffee cherries and take them to a mill. Collectors may buy coffee on their own account and/or on behalf of a mill.

Farmers report that selling cherries to wet mills is more profitable but home processing gives them the ability to sell some of their coffee a few months after harvest (Macchiavello and Morjaria (2021)). Home processing is thus an inefficient saving tool. At the export gate, wet-processed coffee (known as fully washed coffee) earns a significantly higher price premium than dry-processed coffee. After accounting for processing costs, the wet-method still yields significantly higher domestic value addition (Macchiavello and Morjaria (2015)). For this reason the government tried to promote the expansion of wet-processing. Despite those efforts, relatively poor performance of many coffee wet mills has stunted progress.

Descriptive Statistics of Mills. Table 1 reports descriptive statistics for all operating mills in each year for which we have survey information (2012 to 2017). In the average year, there were 253 operating mills processing on average nearly 270 tons of coffee cherries. Average installed capacity is higher at 424 tons. The average mill employs around 5 permanent workers and 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)).

Mill Technology. The wet-processing technology is relatively simple and has seen only minor innovations since the Rwanda industry took off. Mills require specific equipment and substantial quantities of clean water. Upon receipt of cherries, the skin and pulp are removed with a pulping machine (Figure 2, top-right) before being sorted by immersion in water. The most common type of technology in East Africa is a disc pulper that separates parchment coffee from the pulp squeezing the coffee cherries against a rotating disc. Each disc can generally process around 1,000 kg of cherries per hour. There are relatively few brands in the market. McKinnons are the most common, followed by Eco-pulper machines (the Pinhalense, Penagos or Toto brand). These account for the vast majority of installed capacity in the industry.[12]

The coffee bean is then left to ferment for around 30 hours to remove remaining skin layers. When fermentation is complete, beans are thoroughly washed in large water tanks (Figure 2, bottom-left), carefully laid out on drying tables and frequently turned by seasonal laborers until uniformly dried (Figure 2, bottom-right). The recommended capacity of water tanks and surface of drying tables are proportional to the capacity of the pulping machines. Generally speaking, one disk requires between 5 and 6 fermentation tanks of standard capacity

[12]Mills also require electricity. The majority relies on a generator, some on the grid.

(approximately $8m^3$) and 6 to 7 drying tables of standard size (approximately $27-41m^2$). The fermentation, drying and sorting processes need to be managed with care to ensure quality and can take up to 15 days. Once the drying process is completed coffee (now converted to parchment) is bagged and stored.

Figure 2: MILL INFRASTRUCTURE AND PROCESSING

Note: This figure depicts pictures of the prototypical mill infrastructure and processing steps to convert cherries (input) into parchment coffee (output). Top-left illustrates a typical mill, top-right is a standard pulping machine, bottom-left are large water tanks to allow the fermentation process, and bottom-right are the drying tables for careful sorting before bagging and storing.

The relative simplicity of the production process allows us to measure key aspects of mill's performance. The three key inputs are capital (installed capacity), labor (seasonal workers) and material (coffee cherries). Generally speaking, it takes between 5.5 and 6 kgs of cherries to obtain a kg of parchment. The conversation ratio thus provides a measure of physical efficiency. Tons of output per tons of capacity installed (per worker) provide physical efficiency measures with respect to capital (labor). Technology is also easily measured: capacity and type of the pulping machine, the capacity of water tanks and drying tables, and their ratios.

Mill Management. Despite a common technology, mills widely differ in their performance. A survey we conducted in the 2012 harvest season found that the inter-quartile range of capacity utilization ranged from 41% to 80%. Similarly, the p75/p25 (respectively, p90/p10) ratio of unit processing costs, which are relatively easy to calculate given the simple technology, was 1.22 (respectively 1.50), not dissimilar from those found in the literature (Syverson (2011)).

This substantial differences in performance suggest that management is important.

The mill manager is responsible for overseeing all steps involved in converting coffee cherries into parchment during harvest season: sourcing, processing (which includes de-pulping, fermentation, drying and sorting), quality monitoring, finance and accounting and security. The mill manager typically supervises and coordinates 5 to 6 key employees each in charge of these functions.

Sourcing coffee cherries from farmers is a critical activity overseen by mill managers. Sourcing is complicated by two factors. First, in many regions of the country, there is intense competition for cherries between mills. Second, to ensure adequate and regular volumes of deliveries, mills would ideally develop relationships with surrounding farmers (see Macchiavello and Morjaria (2021)). Developing these relationships requires the mill manager to organize activities before, during and after the harvest season. For example, managers might organize farmers training on agricultural practices and certifications, extension services, facilitate access to seedling, fertilizers and loans. Post harvest, managers are responsible for ensuring farmers receive bonuses and second payments, if any had been promised during harvest. Macchiavello and Morjaria (2021) show that such relationships with farmers, which depends on the implementation of management practices at the mill, strongly correlate with capacity utilization, output per worker and unit costs.

Managers also oversee hiring of the seasonal workers and coffee collectors. A key challenge is to coordinate the number of seasonal workers available with the inflow of cherries: too many workers increase costs; too few might reduce quality by compromising drying and sorting. Managers are also responsible for ensuring workers handle properly the cherry reception before de-pulping and coordination through the different steps. Processed coffee is also stored at the mill before being transported to exporters' warehouses. Poor storage conditions and theft are also concerns the manager has to pay attention to.

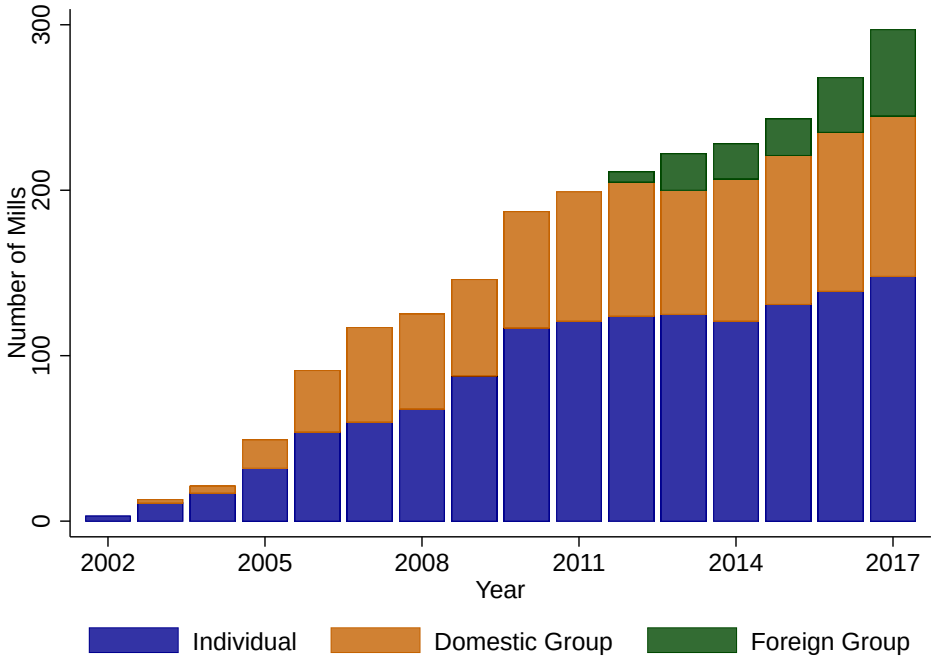
Purchases of pulping machine and generators are generally managed by the owner of the mill. However, managers handle payments to farmers and to workers, by far the two largest outlays of cash in the operation of a mill. They are also in charge of smaller cash expenditures, like rehabilitating storage facilities, paying incentive to workers and collectors, repairing drying tables and petty cash items. Owners often feel managers must be monitored in order to prevent misuse of cash.

Exporter. After processing at the wet mill, the bagged parchment coffee is ready to be transported to the exporters warehouse in the capital city. A so-called dry mill further hulls, sorts, polishes and grades the coffee bean by size and weight. In 2017, the last year in our sample, large exporters owned 12 dry mills located near the capital city. Smaller exporters pay a usage fee for dry mill services. The output, known as "green coffee", is then 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 Ownership Changes

Industry Expansion. Figure 3 illustrates the evolution of the industry since its beginning. In 2002, there were 3 stand-alone mills owned by indigenous Rwandan companies. Rwanda, therefore, almost exclusively exported low quality dry coffee processed by farmers. By 2017, the last year in our sample, a total of 310 mills had been constructed.

Figure 3: **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 52 mills of which majority of their portfolio is composed of brownfield investments (83%). In terms of domestic groups there are 45 groups owning a total of 97 mills of which 86% are greenfield.

The Emergence of Backward Integrated Groups. The ownership of mills has also changed over time. Mills are scattered around the country-side at locations that are easily identified by the installed equipment (pulping machines, water tanks, drying and sorting tables). It is thus possible to reconstruct the entire ownership history of these physical assets. Shortly after the beginning of the industry, domestic exporters begun to integrate backward owing mills. These exporters formed *domestic groups*, defined as indigenous Rwandan companies who own at least two-mills. By 2011, domestic exporters owned 35% of the 200 mills constructed until then. The rest of the industry were stand-alone mills owned by smaller local companies.

Starting in 2012, foreign exporters also begun to integrate backward and own mills. These

exporters include large global companies like Sucafina (Switzerland), Olam (Singapore), Westrock (U.S.) as well as smaller players with affiliates in other countries like Dormans (Kenya) and Café de Gisagara (South Korea) among others. By 2017, these foreign groups – analogously defined as companies controlled by multinational exporters that own at least two-mills – owned 17% of the mills constructed in the country.

The emergence of groups in Rwanda is part of a broader trend towards backward integration in the global coffee industry. Exporters seek to gain more control over their supply chains to ensure reliable supplies of large volumes of (sometime higher quality) coffee. Due to the difficulty in enforcing forward sale contracts in the coffee industry (Blouin and Macchiavello (2019)), backward vertical integration facilitates supply assurance, particularly for large volumes of coffee (Macchiavello and Miquel-Florensa (2018)). At the same time, it is important to note that groups, both domestic and foreign, were already active as exporters in the industry before the consolidation process took off. The change in mills' ownership was thus not accompanied by similar changes in concentration and composition of exporters. Between 2012 and 2017 the top exporters accounted for a relatively stable share of exports (around 60-70%).[13]

Ownership Changes. This study focuses in understanding the consequences of changes in ownership for mill's operations.[14] Different types of ownership changes are observed in the industry. Besides the backward integration strategy of both domestic and foreign groups, stand alone mills (i.e., those that are not part of groups) also change ownership.

Table 2 describes ownership dynamics and the variation in the data. Column (1) shows the ownership of mills at entry. At the time of construction, 70% of the mills are built by stand-alone firms (owned by locals), 27% of the mills are built by domestic groups and only 3% of mills are built by foreign groups. Column (2) provides a snapshot of ownership status at the end of our sample period, in 2017. Stand-alone mills have fallen to 50% of the industry, domestic groups account for 33% of the industry and foreign groups for the remaining 18%.[15] The comparison of column (1) and (2) reveals two different process of backward integration: foreign groups predominantly acquire brownfield mills (83%); domestic groups backward integrate by mainly building greenfield investments (86%).

The rest of the Table provides further details on the transitions of mills across ownership types. Column (3) details how many mill ownership changes have taken place across the three types of owners. The majority of ownership changes have taken place under one-mill ownership (58%). The buyers of these mills 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

[13]Forward integration, in which the mill directly exports to a foreign buyer, is rare in Rwanda. A handful of (mainly NGO-supported) mills exports directly and account for less than 5% of exports.

[14]Sometime exporters rent mills from the owner: they are in charge of mill's operations without owning its assets. During our study period only 30 out of the 310 mills eventually constructed in the industry have been rented at some point. We therefore bundle ownership and rental agreements of mills into a unique category and, for simplicity, refer to it as ownership. Results are robust to excluding rented mills from the ownership definition.

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

(4c). Domestic group mills have also seen substantial ownership changes (41%). Columns (4a) to (4c) shows that the main (52%) new owners of domestic group owned mills are foreign groups and the rest of their mills have been sold to local one-mill firms (25%) and other domestic groups (23%). Only one mill has exited foreign group status in the last 15 years, and this was a rental mill that was returned to its owner.[16]

In sum, the process of expansion radically differs between domestic and foreign groups: domestic groups mainly expand through greenfield and also sell many mills; foreign groups grow exclusively through acquisition and rarely sell mills. Section 3 will explore whether these different types of ownership also differ in their consequences for mills' operation. Before we do so, we briefly describe our data sources.

2.3 Data

Mill Surveys. Our main source of data is bespoke mill-level surveys we designed and implemented in collaboration with the National Agricultural Exporting Board (NAEB) – the government institution in charge of the coffee sector. The survey was implemented towards the end of the harvest season 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. Our surveys covered nearly all mills operating in the survey round harvest season. In all three surveys the response rate was close to 100% – a rather unusual feature for firms of this size.

The three rounds of surveys enable us to construct a mill-level panel data-set with detailed information on mill operations and managers for the period 2012-2017. All three survey rounds contain information on processing capacity of the mill; inputs (prices and quantity of cherries processed) and 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 samples of mills output (parchment coffee) and assessed its quality attributes at a coffee laboratory. Other aspects of the surveys, instead, differed across waves.

Manager Surveys. Our survey modules covered manager characteristics and their career history in the coffee industry. We observe experience; gender; martial status; district of birth; education achievements; cognitive skills (raven test scores and numeracy skills) and trust questions, similar to the World Value Surveys. We are able to construct a matched manager-mill panel for the years 2012-1017.

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

[16]Note that 86 (91%) mills experience an ownership change once, 6 (6%) mills experience ownership change twice, and 3 (3%) mills experience ownership change three times.

understand the phenomenon, the 2017 survey fielded an additional module on management changes at the mill. This module asked questions about key operational areas in running a mill. For each area we asked whether a 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 how much *autonomy* the mill manager had in changing the practice.

Administrative Data. We complement our surveys with administrative records. We compiled from multiple sources all the available data for the years 2002-2017. Given the industry's importance as a foreign exchange earner, mills are required to report yearly installed capacity and tons of coffee cherries processed. We obtain a list of owner names from various government agencies (Rwanda Development Board and the Commercial Registration Agency) and, in combination with our detailed interviews, we reconstruct the ownership history of each mill from its establishment. We observe which firm and type (one-mill owner, domestic group, and foreign group) owns each mill at a given time.

Survey of Exporters. To understand the motives of the acquirer groups to integrate backward, the process of selecting target mills and their relationships with other mills, in 2017 we interviewed all exporters and group HQs. Due to the complexity of the survey and the need to establish a trusting relationship with the respondent, it was not possible to outsource this survey. One of the authors interviewed face-to-face all the exporters over 4-6 hour interviews. Our sample consists of 41 CEOs/MDs of groups, representing 91% of the export market. We collected systematic 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. To the best of our knowledge, this is the first survey to elicit targets and motives of acquisition for an entire industry in a systematic way. This unique survey provides us several advantages. It gives us a detailed understanding of the context, the players involved and their motives and a better understanding of the selection process through which mills are acquired. Furthermore, the information in the survey allows us to explore a variety of counterfactual targets for each acquisition and check the validity of our empirical strategy.

3 Empirical Analysis

This section investigates the effect of groups' acquisitions on mill performance. We first describe the baseline specification. We then present the main results, using the administrative data (which track a limited number of outcomes during the entire industry evolution) and the surveys (which, instead, track a broader set of outcomes for the period 2012-2017 only). We then explore robustness of the main results. We present event-study designs, changes to the baseline's specification and sample, as well as tests that are enabled by our acquirer survey. The main finding is that ownership by a foreign group is associated with better performance while ownership by a domestic group is not. Section 4 explores factors that might account for this difference.

3.1 Acquisitions and Mill Performance

Empirical Specification. We construct a mill-level panel to explore how group ownership relates to mill performance. Our baseline specification is

$$y_{it} = \phi_i + \eta_t + \sum_{g \in \{d,f\}} \beta^g \times \mathbf{I}^g_{it} + \epsilon_{it}$$

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, $\mathbf{I}^g_{it}$, are dummies taking value equal to 1 when mill i is owned by a either a domestic (d) or foreign (f) group ($g \in \{d, f\}$) at time t. We report standard errors clustered at the mill level, but results are robust to alternative modeling of the error term, e.g., two-way clustering at the mill and group-year.

The coefficients β^g capture average changes in mill's outcomes y associated with ownership by group of type g, relative to stand-alone ownership. The identification relies on transitions in- and out- of group status. As noted above, groups own 149 of the 297 mills constructed by 2017 (Figure 3) and they have partaken in 75 of the 107 mill ownership changes (Table 2). Given the differences in the acquisition processes between domestic and foreign groups documented in Section 2, it is important to distinguish between the two groups. Of the 75 acquisitions by groups, 41 mills (55%) are completed by foreign groups and 34 mills (45%) by domestic groups. Our Tables therefore report in Panel A the simple comparison between mills belonging to groups versus one-mill firms and in Panel B the split between *domestic* and *foreign* groups with associated p-values for the joint test of equality, $\beta^d = \beta^f$.[17]

The coefficients β^g captures average changes in mill performance that potentially mask dynamics occurring either before or after the acquisition. For example, a positive coefficient could be due to a genuinely better performance relative to stand alone mills, or to the fact that groups targets poorly performing mills and turn them around. Both cases are of course economically interesting. We will also explore event-study designs around the time of acquisition. A recent literature has also noted that our baseline two-way fixed-effects (TWFE) specification may produce misleading estimates if the effect of ownership is heterogeneous across mills or over time (de Chaisemartin and D'Haultfœuille (2022)). We will therefore also explore robustness to those concerns. Finally, we will explore robustness to alternative samples and counterfactuals constructed from the acquirer survey.

Mill Operations (Administrative Data). We start by considering performance differences on operational outcomes measured in the administrative data and therefore available for the period 2002-2017. Table 3 reports the results. 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 are operating and equal to 0 otherwise. On average, in any given year, 91% of the mills operate. It is thus not unusual for mills to undergo operational difficulties so severe as to not even open during harvest. Panel

[17] The remaining 32 out of 107 acquisitions were undertaken by one-mill firms and thus do not introduce variation in ownership type. We will thus control for these acquisition and provide suggestive evidence that they are also not associated with changes in performance.

A shows that ownership to a group is associated with a 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 3% increase, but not statistically significant at conventional levels. Ownership of mills by foreign groups is instead associated with a 13% coefficient and highly statistically significant. The two estimates are significantly different from each other (p-value$<$ 0.01). In practice, mills owned by foreign groups are always operating. We will later document that foreign groups target particularly under-performing mills for acquisition, including those that are not operating at all.

Columns (2) to (4) explore other outcomes, conditional on the mill operating. Column (2) shows that mills that belong to *foreign*, but not to *domestic* groups, process more cherries conditional on being operational. The dependent variable y_{it} is the (log of) tons of cherries processed. Panel A shows that ownership to a group is associated with a 4% increase in cherries processed, not statistically significant at conventional levels. Panel B unpacks this coefficient and finds that a significant difference between the two types of groups. Ownership of mills by foreign groups is associated with a large 59.3%-age points increase in processed coffee cherries. Ownership by a domestic group, instead, is associated with a negative 11.5%-age points, albeit not statistically significant at conventional levels. The two estimates are significantly different from each other (p-value $<$ 0.01).

Column (3) considers mill's capacity, measured as the (the log of) tons of cherries that can be processed during a harvest season. Mills that belong to *foreign* or *domestic* groups increase capacity by 7% (Panel A). Panel B shows that this is equally driven by both types of group ownership. The group dummy estimates for the domestic and foreign groups are nearly identical (p-value 0.948). The literature has noted that MNCs often have better access to finance. Instead, this result provides suggestive evidence that access to finance across the two types of groups is unlikely to be a key factor. Pulping machines are the largest single most expensive investment in fixed capital at a mill. The two types of groups, however, might differ in access to working capital finance. We return to this issue in Section 4.

Column (4) explores capacity utilization, defined as the ratio of processed tons of cherries divided by mill's capacity. Panel A shows that ownership to a group is not associated with changes in capacity utilization. Panel B shows that mills that belong to *foreign*, but not to *domestic*, groups have higher capacity utilization. Given the low baseline level of capacity utilization in the industry, the 52%-age points increase translates into a 23% higher capacity utilization. Ownership by a domestic group is associated with a reduction in utilization (6.4%), nearly statistically significant at conventional levels. The two estimates are significantly different from each other (p-value $<$ 0.01).

Mill Operations (Survey Data). We now turn to performance differences in outcomes measured in the surveys and therefore available for the period 2012-2017 only. Relative to the administrative data, the survey contains information on output (tons of parchment produced by the mill) and costs (including prices paid for the main inputs). This information allows us to explore drivers of physical productivity. Given our detailed understanding of the mills'

technology, we refrain from estimating production functions and TFP. We instead focus on reduced form results relating group ownership to key drivers of efficiency at the mill.

Table 4 reports the results. Column (1) looks at the conversion ratio – a measure of physical efficiency in the utilization of intermediate inputs. We expect limited, if any, variation given it takes between 5.5 and 6 kg of cherries to obtain a kg of parchment. Panel A finds no difference between groups and stand-alone mills. Panel B, however, detects a 3%-age points lower conversion ration among domestic groups, statistically different from foreign groups (p-value 0.08). We interpret this result as reflecting poorer management in the storage of parchment at the mill, both in terms of physical conditions and possibly security (i.e., theft).

Column (2) looks at the (ln) ratio of reported output (tons of parchment coffee) to capital (installed capacity). Since the amount of parchment coffee produced is a nearly constant fraction of cherries processed, this provides a measure of fixed capital efficiency akin to capacity utilization. Results are indeed consistent with those in column (4) of Table 3. The difference between the two driven by the different samples between the administrative data and the survey data. Panel A shows that group ownership is associated with an 18% lower ratio of output to capacity, statistically significant. Panel B shows that this reduction masks an increase (22%) for foreign groups and a reduction (-28%) for domestic groups. The difference between the two is statistically significant (p-value=0.014).

Column (3) considers a measure of labor efficiency. The main type of labor at the mill are seasonal workers employed in receiving, drying and sorting coffee cherries. The majority of seasonal workers are women that turn and sort parchment as they dry on tables. Theoretically, there should be a fixed proportion between the amount of cherries processed and the number of workers employed in those processes. We consider the (ln) ratio of reported output to seasonal labor as the dependent variable. Panel A shows that group ownership is associated with a 20%-age point lower ratio, highly significant. Panel B finds that the difference is entirely driven by domestic groups. Mills that belong to *foreign* groups increase the number of seasonal workers hired to match the proportional increase in processed cherries documented in Table 3. Domestic groups, instead, expand the number of seasonal workers to match the *theoretical* increase in capacity, but not the *actual* sourcing of coffee cherries. This could be due to either poor management, or to higher social pressure on domestic groups to provide jobs and hire workers in the rural communities – as we further discuss in Section 4.

The reduced-form results in Columns (1), (2) and (3) reveal that, relative to foreign groups, domestic groups produce less output (*i*) per ton of cherries sourced, (*ii*) per ton of installed capacity and (*iii*) per seasonal worker. Given that these are the main inputs in the production process, these results imply that domestic groups are less efficient than foreign groups *regardless* of how inputs are aggregated into a production function. Furthermore, the results also indicate that foreign groups are *not* more efficient than stand alone mills in turning coffee cherries and seasonal labor into output. The processing technology is simple and well-understood. Foreign groups, however, do source more cherries from farmers and increase capacity utilization.

We have so far compared different types of ownership along proxies for physical efficiency.

It is not possible to construct equivalent measure of revenue efficiency at the mill level without making strong assumptions: for mills owned by groups an output price for parchment coffee is not observed as sales become an internal transaction within an integrated firm.[18]

While revenues are hard to observe, we can look at costs. We do so in two ways. A first way, explored in column (4), asks the manager to focus on cash flow outlays, rather than more complex accounting considerations. The seasonal nature of the industry facilitates this approach. We estimate the total costs of producing one kilo of parchment, obtaining a measure of unit cost that includes both variable and fixed production costs (e.g., water tanks and sorting/drying tables frequently require maintenance). Panel A reveals that mills that are owned by groups do not have different unit costs relative to stand alone mills. However, Panel B finds that mills owned by *foreign* groups have 10% lower unit costs than stand alone mills and 14% lower unit costs than mills belonging to *domestic* groups. The difference between domestic and foreign groups is statistically significant (p-value <0.01). Given this approach in measuring costs, the result likely reflects better capacity utilization of fixed assets and labor.

Columns (5) takes 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. The cost of producing 1 kg of parchment coffee is the sum of (i) the price paid to farmers for cherries and (ii) other operating costs (including labor, capital, procurement, transport, marketing and overheads). The cost of cherries accounts for roughly 65-70%, labor for around 15-20% and other costs (mainly transport, collectors and energy) for the rest. Despite the radically different approach in measuring costs, we find consistent results. Column (5) shows slightly higher costs for domestic groups relative to foreign groups (p-value 0.14), reflecting the lower labor efficiency of domestic groups.[19]

Finally, Column (6) and (7) turn to input prices: the average price paid for a kilo of cherries, and the average wage paid to seasonal workers. Given mills are scattered around the country side, they might have market power on farmers and/or workers. The extent of market power in either of those two input markets could differ between groups. We find that not to be the case: the average price paid for cherries and wage paid to seasonal workers are no different across the three types of ownership.

[18] Table A1 in the Appendix explores quality upgrading and finds that foreign ownership is associated with an increase in the likelihood that the mill acquires certification (Fair Trade certification is for cooperative mills and is thus a placebo test). Regarding the physical quality of coffee, we find modest increases in the share of grade A coffee (column 8, not statistically significant at conventional levels) and a positive coefficient on scores obtained from cupping tests of samples of coffee from the mills (column 7). This variable, however, is only available in a cross-section and provides less conclusive evidence.

[19] We exclude the costs of financing the working capital necessary to purchase cherries from the farmers. This is because the managers of mills owned by groups are not able to report the cost of funds born by HQ to finance working capital. We consider costs of working capital in Section 4 elicited from the exporter/acquirer survey. The main takeaway is that access to, and the cost of, working capital is not different across the two types of groups.

Foreign groups are able to significantly expand the procurement of cherries *without* increasing prices paid to farmers. This is consistent with evidence in Macchiavello and Morjaria (2021) that, despite the significant expansion in capacity in the industry, there is plenty of coffee to be sourced in many areas of the country – with many farmers still processing coffee at home. Foreign mills might also increase sourcing starting (closing) operations earlier (later) in the season and by engaging more directly with farmers outside the harvest season.

In sum, Tables 3 and 4 find that mills acquired by foreign groups perform better after acquisition: they are more likely to operate and have higher capacity utilization. Consistent with the fact that the production process and the technology are simple and well understood, foreign owned mills have similar output per worker and conversion ratio than stand alone mills. Their superior performance is entirely due to being able to source more coffee from farmers – despite not paying higher prices.

In contrast, mills owned by domestic groups expand capacity and employment accordingly, but fail to secure adequate supply of cherries – thereby having lower output per unit of capital invested and per worker. There is also some indication that they have lower conversion ratios. Relative to foreign groups, domestic groups appear to mismanage operations in procurement, processing (sorting and drying) and storage. Section 4 will explore potential drivers of these differences. Before we do so, we subject these findings to a battery of robustness checks.

3.2 Robustness Checks

We explore the robustness of our main results along a number of dimensions. First, we explore event-study specifications and differences in trends pre-acquisition. We then investigate concerns arising in two-way fixed-effects specifications like our baseline. Finally, we explore robustness considering different control samples and construct alternative counterfactual using the acquirer survey.

Event-study. The baseline analysis has focused on a difference-in-difference (DID) specification with mill and year fixed effects. As in standard DID specifications, a natural question is whether results are driven by differences in pre-trends. Section 2 revealed that domestic and foreign groups follow radically different expansion strategies. Later, in Section 4, we will also discuss evidence suggesting that the two types of groups use slightly different criteria to select targets. Exploring pre-trends is thus important to better understand the acquisition process. We explore the specification

$$y_{its} = \phi_i + \eta_t + \sum_{s \neq -1} \sum_{g \in \{d,f\}} \beta_s^g \times \mathbf{I}_{its}^g + \epsilon_{its} \tag{1}$$

which is analogous to our baseline specification after allowing for the estimated coefficients β_s^g to vary relative to the time s the acquisition took place. To explore pre-trends and the dynamic impact of acquisitions, we consider a 4 year lead period and a 5 year lag period, relative to the time of acquisition, i.e., we let $s \in \{-5, -4, ..., +4\}$ be the difference between

year t and the year of acquisition.[20]

Figures 5 reports the results. The Figure reports twelve panels of estimated coefficients. In each panel, the zero on the x-axis indicates the year in which the mill gets acquired (the year of purchase), while -1 indicates the year before the purchase and its coefficient is thus normalized to zero. Each row reports coefficients estimated for the three main outcomes in the administrative data: mill's operating status (panel A), installed capacity (panel B), and capacity utilization (panel C).

A recent literature has noted that our baseline two-way fixed-effects specification may produce misleading estimates if the effect of ownership is heterogeneous across target mills or over time. (see, e.g., de Chaisemartin and D'Haultfœuille (2022)).[21]

Each column, therefore, reports coefficient estimated under different assumptions. The left column reports the baseline event study specification with two-way fixed effects (TWFE). The second column reports results from the estimator in Sun and Abraham (2021), which relies on weaker assumptions on parallel trends and only uses never-treated mills as controls. Columns (3) and (4) report results using the de Chaisemartin and D'Haultfœuille (2020) estimators that rely on the observations that switch treatment status excluding and including linear trends for each mill respectively.

The main results are robust to the event study analysis. With respect to whether the mill is operational (the top row), the event study specifications seem to suggest that foreign groups acquire mills that were less likely to be operating in the year before the acquisition. Foreign groups might target mills that have severe operational problems and turn them around. With respect to installed capacity (middle row), the event study specification shows that, if anything, it is domestic groups that acquire mills that were already on a positive pre-trend. In contrast, the increase in installed capacity associated with foreign ownership appears to kick-off only after the acquisition. Finally, with regards to utilization (bottom row), there is no clear pre-trend. If anything, the acquisition by a foreign group turns around a pre-existing negative pre-trend. The effect takes a couple of years to materialize likely as increasing sourcing from farmers requires a number of management changes that take time.

Alternative Control Samples. Table 5 and Table 6 perform additional checks changing the sample of counterfactual mills. Table 5 reports checks implemented using information that is typically available in staggered DID designs. Table 6, instead, relies on the acquirer survey to construct alternative, target-specific, counterfactuals. Both Tables focus on the four main administrative outcomes: whether the mill is operational (dummy variable, panel A), cherries processed (log tons, panel B), installed capacity (log tons, panel C), and capacity utilization (ratio, panel D). For ease of comparison, Column 1 reports our baseline specification.

[20] This analysis can only be adequately performed on the administrative data that span the entire industry evolution over the years 2002−2017. Survey data are only available for 2012-2017, preventing an event analysis with an adequate number of lead and lag periods.

[21] 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. 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.

Taken together, the two Tables explore robustness of our baseline specification across 16 different samples and counterfactuals. The baseline results are qualitatively very robust: when we test for equality of coefficients between domestic versus foreign group ownership, only 2 (out of $16 \times 3 = 48$) coefficients turn from being statistically significant different in the baseline to a p-value above 0.2 in the robustness analysis (and only one of the 16 insignificant coefficients turns significant at conventional levels). Appendix Tables A2 and A3 report the same checks for the survey outcomes. Results are also qualitatively robust, however the smaller sample size available in the survey implies that 11 estimates (out of 48) are no longer significant in the robustness analysis.

Column (2) in Table 5 reports our baseline results controlling for whether a mill in the stand-alone control was acquired in that year. We let this dummy to have differential effects across years, to capture the possibility that the type of stand-alone acquisitions in the market have changed over time. As noted above, 30% (32 out of 107) acquisitions were undertaken by one-mill firms. A concern is thus that we are comparing mills that change ownership against a control group of stand-alone mills some of which also experience changes in ownership, while others do not. For all the main outcomes, results are virtually unchanged. This is consistent with stand-alone ownership changes not being associated with significant changes in outcomes for the mill. This conjecture is supported by Appendix Table A4. The Table compares changes between the year immediately prior and the year following the acquisition in several outcomes, distinguishing by type of acquisition. Although these specifications are somewhat noisier, across the board we fail to detect any statistically significant change in mills' outcomes associated with changes in ownership between stand-alone firms. This stands in contrast to changes in ownership that involve groups.

Column (3) considers robustness to the definition of ownership. 30 out of the 310 mills eventually constructed in the industry have been rented by a group at some point. For simplicity, the baseline analysis bundled ownership and rental agreements into a unique category. We drop rented mills from the sample and, across all main outcomes, find nearly identical results. If anything, the coefficients on coffee processed, installed capacity and utilization under foreign ownership get stronger, suggesting that these groups might focus changes in mills they own (as opposed to rent).

Column (4) restricts the sample to mills that have switched ownership at some point during their existence. The rationale for this robustness check is that one might be concerned that mills that are never acquired are on different trajectories (e.g., because they give substantial benefits of control to owners). This restriction cuts the sample by more than half (from over 2,300 observations to less than a 1,000). While we lose some precision in the estimates for whether the mill is operating (the p-value for the test of equality between foreign and domestic groups goes from 0.00 to 0.15), results are, again, very robust.

Column (5) restricts the sample to include only mills that have belonged to a group at some point in time. The rationale for this check is that mills that end up in groups might have specific characteristics that put them on different trends. Again, the sample size drops by

about a half. Note that, relative to column (4), this checks excludes mills that have changed ownership but remained stand-alone. On the other hand, it includes mills that have always been part of a group. Again, results are qualitatively robust and, if anything, more precisely estimated for some outcomes.

Column (6) restricts the sample to only include mills that have changed ownership and whose new owner is a group. Column (7) runs the estimator proposed by de Chaisemartin and D'Haultfœuille (2020) discussed above. Results are qualitatively robust, despite the sample being only one third of its original size. Both specifications fail to detect an expansion in capacity following acquisition by a group.

Counterfactuals from the Acquirer Surveys. The tests in Table 5 deal with potential selection concerns by exploring the robustness of the results to changes in the sample of control mills. Table 6 pursues a different approach taking advantage of the acquirer survey. During the survey, one of the authors interviewed CEOs and managing directors of all groups. Detailed questions about the group acquisition strategy were discussed. Besides gaining a comprehensive understanding of the acquisition process of each group, these questions allow us to assign to each acquirer and, sometime, to each acquired mill, a set of control mills not acquired by the acquirer. These provide sets of alternative target mills that the group either considered, or could have reasonably considered, for acquisition at the time the mill had been acquired. We consider failed acquisitions reported by the acquirer and existing independent suppliers of the acquirer. These provide two distinct sets of acquirer-specific control mills. For each acquired mill, we also ask the acquirer to identify mills that could have been alternative targets to the acquired mill at the time of acquisition. The survey yields a total of 61 target mills identified by an acquirer as equivalent target to one or more of the mills actually acquired by the group (a mill could be named as target for more than one mill and by more than one group).

Besides comparing the evolution of acquired mills to these more restricted (and arguably more similar) control groups, this strategy allows us to include acquirer-year (or pair-year) fixed effects that control for time varying group level confounders. Note that the baseline specification cannot include these fixed effects as they would absorb variation in the our independent variables of interest, $\mathbf{I}^g_{it}$. We modify our baseline specification to

$$y_{iat} = \phi_i + \eta_{at} + \sum_{g \in \{d,f\}} \beta^g \times \mathbf{I}^g_{iat} + \epsilon_{iat} \tag{2}$$

where mill i is assigned to acquirer a if either it has been acquired by a (in which case $\mathbf{I}^g_{iat} = 1$ post acquisition and $= 0$ before) or, depending on the specification, if (a) it has been reported by a as a failed acquisition, (b) as a supplier or (c) as an alternative target for any of the mills acquired by a (in which case $\mathbf{I}^g_{iat} = 0$ always). The time fixed effects are now replaced by acquirer-year fixed effects η_{at} and, in case (c), by pair-year fixed effects. That is, we identify the effects of interest out of within mill variation in group ownership over time in a "within-group" DID run over the set of mills assigned to the group by the acquirer survey.

Table 6 reports the results. For ease of comparison, Column (1) reports our baseline

specification from Table 3. Column (2) repeats the baseline specification focusing on the sample of mills that are either owned by a group or that were reported as potential counterfactual targets. This restriction nearly halves the sample size. This specification confirms that, relative to domestic groups, foreign groups increase sourcing of cherries and capacity utilization (p-value 0.02 and 0.01 respectively). On the other hand, relative to this restricted control group, group ownership is no longer associated with a significant increase in the likelihood that the mill operates (Panel A) or with an increase in installed capacity (Panel C).

In column (3) we construct pairs of mills (acquired and its counterfactual target) and include interactions of pair and year-fixed effects as controls. Effectively, we are comparing the trajectory of acquired mills relative to the counterfactual target mill allowing for common year effects in each pair. Because of the significant drop in degrees of freedom due to the inclusion of pair-year fixed effects, results are somewhat less precisely estimated, but confirm the general patterns of the main analysis with respect to the likelihood that the mill is operating (p-value 0.06) and the increase in capacity utilization (p-value 0.17).

Column (4) focuses on failed acquisitions in the set of potential counterfactuals and includes acquirer-year fixed effects as controls. The acquirer survey reveals that 40% of all targets in the acquirer survey were accompanied by a failed acquisition (i.e., the acquirer had also tried to buy a different mill at the time of the acquisition). The main reasons for a failed acquisitions were that the asset seller had changed their mind or that the price of the asset was too high. Results on whether the mill is operational, on cherry procurement and on capacity utilization are qualitatively similar to the baseline specification. As in Columns (2), however, we no longer detect an increase in capacity associated with group ownership.

In many cases, group owners learn about, and identify, potential targets among their existing suppliers. We elicited all mills supplying to each exporter and restrict potential counterfactuals to all non-owned supplying mills in column (5). Column (6) also includes acquirer-year fixed effects. Results from these specifications are qualitatively similar to those from the baseline specification. Exporters sometime establish long-term relationships with certain suppliers (e.g., to negotiate forward sales contracts and pre-financing arrangements). Columns (7) and (8) restrict the sample of counterfactual to these mills. Both specifications yield results similar to the baseline with respect to the mill being in operation (p-value 0.129 and 0.245 respectively), cherry sourcing and capacity utilization. However, we fail again to detect increases in capacity installed associated with group ownership.

Finally, we construct scores for the likelihood that a mill is suitable for acquisition based on a set of mill's fixed characteristics. Appendix Table A5 reports the estimates. We construct three alternative scores: (1) predicting the likelihood a mill is ever acquired, (2) conditional on that, predicting whether the mill was acquired by a group, and (3) conditional on that, whether the mill was acquired by a foreign group. Installed capacity of the mill is correlated with group acquisition. Socio-economic development (poverty headcount, local financial development, trust level) do not predict whether a mill is acquired or not.[22] Columns (9), (10), and

[22]A test of joint significance reveals yield statistically significant results in models (1) and (2), but

(11) in Table 6 include the interactions between year-fixed effects and these predicted scores (which we define in the tables as "Selection Criteria") to control for time-varying ways through which characteristics associated with being a target influence outcomes of interest. Across the different specifications, results are nearly identical to (and sometimes more precisely estimated than in) the baseline specification.

In sum, following acquisition by a *foreign* group, the performance of the mill significantly improves. This is mostly due to an increase in cherries sourced and, therefore, to higher capacity utilization. In contrast, acquisitions by *domestic* groups are not associated with improvements in performance: if anything, domestic groups expand capacity but lower the amount of cherries processed. Despite the differences in the acquisition process between domestic and foreign groups documented in Section 2, the robustness checks in this subsection assuage concerns that unobservable differences in trajectories across mills acquired by different groups drive the results. We are thus reasonably confident of having identified a difference in the impact of foreign versus domestic group ownership on mill's performance. These results raise the question of what might account for such difference. The next section turns to this question.

4 Mechanisms

This section investigates mechanisms behind the superior post-acquisition performance of foreign groups relative to domestic ones. First, we discuss differences in access to *technology*, *finance* and *markets* – factors often highlighted as distinctive advantages of affiliates of foreign multinationals. We argue that those factors are unlikely to account for the results. We then show that foreign groups appoint managers with different characteristics but those explain only a part of the differences in performance. We then turn to management changes and challenges faced in implementing them.

4.1 Access to Technology, Finance and Markets

Technology. Access to better technology often is a distinctive advantage of affiliates of foreign multinationals relative to domestic firms (see, e.g., Guadalupe et al. (2012)). Appendix Table A6 explores in detail the technology available at the mill. The Table uses detailed information from the 2017 survey and, therefore, focuses on cross-sectional specifications only. As mentioned in Section 2, the pulping machine is the most important piece of equipment at the mill. We thus begin exploring differences in the capacity and type of pulping machines between domestic and foreign groups before turning to other types of assets.

Column (1) considers the number of discs of the installed pulping machine – the main driver of the mill's pulping capacity. Section 3 found some evidence that group ownership might be associated with increased capacity, however some of the robustness checks failed to

not in model (3). This suggests that observable characteristics are not strong predictors for whether a mill is acquired by a foreign or a domestic group, conditional on being acquired by a group.

detect such a result. The cross-sectional specification in Table A6 confirms that mills owned by groups have pulping machines with more discs. The result, however, is almost entirely driven by the larger capacity of mills owned by domestic groups, with the difference relative to foreign owned mills significant at conventional levels (p-value 0.05).

Columns (2) to (4) explore differences in the brand of the pulping machine installed at the mill. The dependent variable is a dummy equal to 1 if the mill has a standard machine (McKinnon) in column (2), or an eco-pulper machine (Pinhalense, Penagos or Toto) in column (3). Most mills have one of these two types of machines. Column (4) is a dummy variable taking value of 1 if the mill has any other type of machine (typically a non-branded i.e. generic make) and 0 otherwise. There is no difference in pulping machines across mills owned by domestic and foreign groups.

Columns (5) to (9) focus on other aspects of the fixed capital invested at the mill. First, we consider access to electricity, which is needed to operate the pulping machine and other basic functions at the mill. The dependent variable in Column (5) is a dummy equal to 1 if the mill has direct access to the grid, while column (6) explores whether the mill has a generator. In both cases, there is no difference between mills owned by domestic and foreign groups.

Besides pulping, washing and fermentation in water tanks and then drying and sorting on tables are the other two key processes undertaken at the mill. Column (7) explores water tank capacity, column (8) the average size of drying and sorting tables, and column (9) the ratio of water tanks capacity and the total surface of sorting and drying tables as some practitioners have indicated that insufficient drying and sorting tables is sometime a bottleneck in production that also jeopardizes quality. We find no difference between domestic and foreign groups across all these physical assets. In sum, mills owned by foreign and domestic groups do not differ in the amount and type of fixed capital invested at the mill. To the extent that any difference is detected, mills owned by domestic groups appear to be slightly more capital intensive than mills owned by foreign groups.[23]

Access to Finance. Besides technology, access to finance is another advantage of foreign firms relative to domestic firms (see, e.g., Antràs and Caballero (2009) and Manova et al. (2015)). The evidence on installed capacity and fixed capital invested at the mill suggests that the two types of firms are unlikely to differ in their ability to finance investment in fixed capital. Mills, however, also require substantial amounts of working capital to pay farmers for cherries and seasonal workers during the harvest season. Working capital is typically funded by either seasonal loans from banks, other financial institutions or from advance payments from downstream exporters, with retained earnings and trade credit from farmers playing a significantly more limited role in the Rwandan context (Macchiavello and Morjaria (2021)).

Measuring access to working capital finance for mills owned by groups is complicated by the fact that the mill is a plant within a larger firm and thus doesn't access finance directly from external sources. Mill managers do not report differences in problems with paying farmers or workers during the harvest season across the two types of groups. This suggests that liquidity,

[23]We explore differences in IT when discussing differences in management.

and the operational challenges to make payments in the countryside, are no different between domestic and foreign owned mills.

The acquirer survey explores sources of finance for working capital. Appendix Table A7 reports the results. Columns (1) to (4) find no difference in the likelihood that the acquirer reports having accessed bank loans, internal funds, trade credit from farmers or loans from other friends or partners. Column (5) finds that domestic groups are *more* likely to obtain advance purchase finances from foreign buyers – a common practice in the industry. The equivalent financing channel for foreign groups is to receive working capital finance from their foreign HQ which often source directly a large share of the coffee exported by their subsidiaries.

Market Access. Domestic and foreign groups might also differ in access to export markets. Various considerations suggest that such differences are unlikely to account for differences in the operational performance of mills in domestic and foreign groups.

First, it is important to note that groups, both domestic and foreign, were already active as exporters in the industry before the consolidation process took off. In other words, the process of consolidation in mills' ownership that we exploit to identify operational differences was not accompanied by similar changes in the concentration and composition of exporters. In fact, between 2012 and 2017 the top exporters accounted for a relatively stable share of exports (around 60-70%). For the most part, groups kept sourcing large volumes – from integrated mills rather than from suppliers.

Second, the acquirer survey enabled us to run specifications that include group-year fixed effects (see Table 6 above). These fixed effects control for the evolution of time-varying attributes at the group level (e.g., changes in demand) to the extent that those are shared by the target and the counterfactual targets reported by the acquirer. For example, if a group has an increase in demand for coffee that could be sourced from an acquired mill or from one of the counterfactual mills, those would be controlled for.

Finally, our understanding of the industry is that some foreign groups have relationships with foreign buyers that demand certain quality attributes. For example, some of the certification programs in Table A1 are associated with specific foreign buyers. Differences in this type of market access likely contribute to the increase in certifications associated with foreign ownership (and, possibly, to other dimension of quality although, as we noted in Table A1, the evidence on those is weaker). Most of the coffee exported from Rwanda, however, remains of standard quality and grade. In this segment, domestic groups also have established relationships with foreign buyers – and so differences in market access are significantly attenuated and unlikely to explain the general increase in operational performance at the mill which is the focus of our analysis.

4.2 Managers

Managers. A large literature has noted that foreign firms often employ a more skilled labor force. Through the surveys we have constructed a matched mill-manager panel in the industry.

Table 7 exploits this information to understand whether domestic and foreign groups differ in the characteristics of managers they appoint to lead operations. We report results from our baseline specification and explore differences in managers' characteristics controlling for year and mill fixed effects. Identification thus comes from mills switching both ownership type and managers over time. For this reason, Column (1) begins by exploring changes in mill's managers as an outcome. Both domestic and foreign groups are more likely to change the mill manager upon acquisition – the difference relative to stand-alone mills, however, is due to the ownership change.

The rest of Table 7, columns (2) to (9), explore managers characteristics. Panel A finds that, relative to stand-alone mills, groups appoint managers that are younger (column (4)), somewhat better educated (column (5) and (6)), and have higher cognitive skills (column (9)). Relative to stand-alone mills, managers of mills owned by groups do not differ in terms of experience (column (2)), gender (column (3)) and trust (column (7)). Panel B explores differences in managers appointed by domestic versus foreign groups. Foreign groups appoint managers that are more likely to have completed post-secondary (or higher) education and with higher cognitive skills.[24]

Managers and Firm Performance. It is natural to investigate the extent to which differences in manager characteristics explain the performance differences documented in Section 3. We revisit our baseline specification controlling for observable managers' characteristics. This exercise can only be implemented on the more limited survey sample for which we could reconstruct managers' work history at the mills.

Appendix Table A8 reports the results. The Table considers the main outcomes from the administrative records (whether the mill is operating, processed cherries, installed capacity and utilization). To ease the comparison, odd columns reports the estimates from the corresponding baseline specifications in Table 3 without manager controls. Even columns include manager characteristics from Table 7. Although statistical precision is somewhat limited by the more restricted sample, two patterns emerge. First, the main results are generally robust to control for observable manager characteristics. Second, the differences in cherry procurement between foreign and domestic groups – the main performance differences that are under the direct control of the manager – are only partially eaten away by the inclusion of manager characteristics. The better managers employed by foreign groups explain around a quarter of the differences in performance.

4.3 Management: Knowledge versus Implementation.

One advantage of studying a single sector with a relatively simple technology is that we can advance relatively solid hypotheses on operational areas that are most critical for mills' performance. Our earlier work in the industry (Macchiavello and Morjaria (2021)) suggests that

[24] Cognitive skills are measured with a z-score index of numeracy and Raven tests. This outcome is available for fewer observations and is significant only without controlling for mill fixed effects.

many adequate management practices rely on establishing relationships with both farmers and workers. To ensure deliveries of cherries, mills need to develop relationships with farmers that extend well beyond purchasing of coffee cherries during the harvest season.[25] Managing relationships with seasonal workers is also critical to ensure an efficient coordination between the sourcing of cherries and processing. These management practices strongly correlate with capacity utilization, output per worker and unit costs – i.e., precisely with those dimensions of performance that differ between domestic and foreign groups.

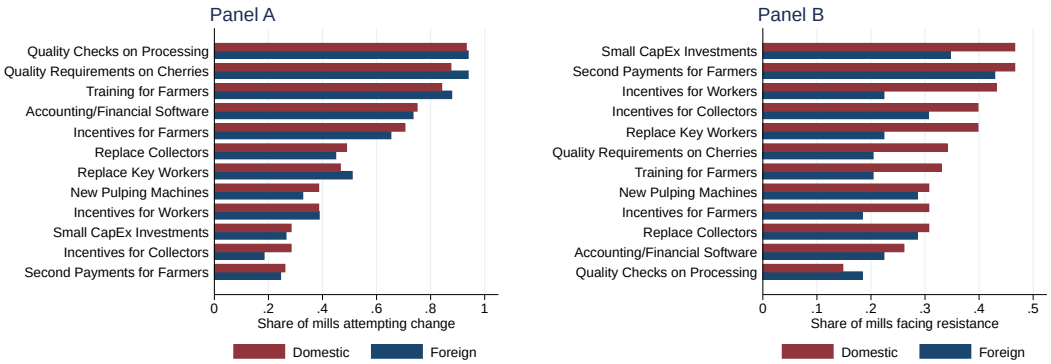
Foreign and domestic groups might thus differ in management practices. Such differences could arise due to different mechanisms. A first possibility is that managers do not *know* which management practices are required to improve performance. Another possibility is that managers do know, but do not have the *incentives* to change management practices to improve performance. Finally, it could be that managers do know about better practices, have the incentives to improve performance, but do not know how to *implement* the required changes (see Gibbons and Henderson (2012) and Bloom et al. (2012) for discussions.)

We attempt to distinguish which of these three mechanisms – knowledge, incentives and implementation – might be responsible for observed differences in performance between domestic and foreign groups. It is in general difficult to distinguish between these hypotheses since standard datasets only include information on whether a certain practice is adopted or not. In contrast, untangling implementation challenges requires knowledge of attempted changes that potentially failed. In the 2017 survey we therefore added a module in which we directly ask the managers about operational management changes that (s)he attempted to implement at the mill. This module asked questions on 12 operational aspects sub-divided into 5 key areas: (i) sourcing and relationships with farmers, (ii) managing collectors, (iii) managing permanent and seasonal workers, (iv) processes to manage input quality, and (v) mills' capex and IT investments. For each area we asked whether a change in management practices was *attempted* (and if so, when), how *difficult* it was to implement the change, if any *resistance* was faced (and if so, from whom) and how much *autonomy* the mill manager had in changing the management practice.

Figure 4 reports the percentage of managers that attempted a change in each of the 12 operational areas, distinguishing between managers in domestic and foreign groups. A striking pattern emerges: for each of the 12 operational areas, the proportion of managers that attempted to implement changes is nearly identical across the two types of mills. Table 8 confirms, within a regression framework with controls, that there is no difference in the number of attempted changes between mills owned by domestic and foreign groups. This evidence suggests that lack of knowledge of adequate management practices and/or lack of incentives

[25] Small holder farmers in developing countries typically lack access to well-functioning input and financial markets. Farmers then resort to interlinked transactions (Bardhan (1989)) in which buyers provide a variety of services. In our context, mills might provide inputs (fertilizers, seedling), loans and/or training to farmers before harvest; farmers might partially sell on credit (lowering mills' financial requirements); and mills might promise bonuses/second payments and further assistance after the end of the harvest season.

Figure 4: **KNOWLEDGE VS. IMPLEMENTATION CHALLENGES**



Note: Observations are manager responses to the management practice survey module that captures operational changes at the mill fielded in the 2017 harvest season. Responses are organized in both panels as ascending order of domestic groups answers (red bars). 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.

to implement better management practices are unlikely to be the sole drivers of differences in performance. On average, managers in both types of mills attempt a similar number of changes. This suggests that incentives to turn around mill's performance might be similar. Furthermore, not just the number, but the actual mix of attempted changes, look very similar across the two groups. This suggests that managers in domestic and foreign groups have similar knowledge of which dimensions require changes.

4.4 Implementing Management Changes.

Differences in the implementation of management changes upon acquisition might thus be a driver of the difference in performance between mills in domestic and foreign groups post-acquisition. Figure 4 Panel B directly explores challenges in implementation of attempted changes. We ask managers about instances of resistance faced in implementing changes in the different areas. Quite strikingly, managers of domestic group mills report to have faced more resistance while implementing changes relative to managers of foreign owned mills in all but one of the 12 operational areas considered. Table 8 confirms the evidence within a regression framework with controls.

We therefore explore factors that might underpin differences in mills' ability to successfully implement management changes. We first consider differences in *organizational capabilities* and then turn to domestic owners' *"embeddedness"* in local communities as a potential obstacle to implement management changes at the mill.

Organizational capabilities. Appendix Table A9 presents cross-sectional specifications in which we explore differences in a set of organizational practices between foreign and domestic owned

mills. Columns (1) to (5) explores the degree of autonomy granted by the company headquarter to the mill manager to implement changes in management practices. We focus on an aggregate index of autonomy (column 1), on autonomy granted specifically to implement changes in operations with farmers (column 2), workers and collectors (column 3), in quality processes and control and relative to HQ (column 4). Across the board, foreign groups grant more *autonomy* in implementing changes to mill managers relative to domestic groups. Managers in both types of group report lack of decision making for large capital expenditures, such as the purchase of pulping machines (column 5).

Columns (6) shows that mills owned by foreign groups are more likely to use IT systems to manage certain critical operations at the mill. Note that there is no difference between foreign and domestic mills in access to computers and software for communicating with HQ. The difference is due in the use of software to monitor deliveries from, and payments to, farmers. Based on our understanding of the sector, the use of this software is probably complementary with the autonomy granted to managers to implement changes in the relationship with farmers and collectors.

Column (7) finds that foreign mills pay higher salary to their managers. Mincer-like wage regressions in Appendix Table A10 reveals that foreign group managers earn a premium even conditional on manager characteristics (column 2), mill controls (column 3), manager and mill controls including birth location of manager (column 4), and manager fixed effects (column 5, p-value 0.235). Across the two types of groups there are no differences in incentive structure for manager pay, e.g. payment of season-end bonuses (column 8).

A common attribute – foreign ownership – correlates with multiple practices. These practices are thus likely to be *complementary* (Brynjolfsson and Milgrom (2012)) and might support managers in the implementation of the required management changes, particularly with respect to sourcing cherries from farmers. Foreign groups hire better managers and grant them more autonomy to implement changes. They make sure that managers' do not misuse their increased autonomy through a combination of monitoring (through better IT infrastructures related to sourcing and payments to farmers) and incentives (rents in the form of above market salary premium akin to an efficiency wage).

Owners' "embeddedness". Table 8, however, also shows that domestic managers face more resistance conditional on the organizational practices mentioned above. We conclude this section discussing the challenges encountered by domestic acquirers.

Besides different organizational capabilities *post*-acquisition, foreign and domestic groups also differ in their *pre*-acquisition process. The acquirer survey reveals that somewhat different considerations drive domestic and foreign groups acquisitions (see Appendix Table A11). While both domestic and foreign groups list the potential for quality and volumes in the mill's catchment areas as key drivers for target selection (consistent with the results in Table A5), personal relationships with the owner/manager of the target is an important criteria for domestic groups (while it is barely mentioned by foreigners). The importance of personal relationships in driving target selection echoes a striking differences in mill managers' birth places. The

vast majority of domestic mills (around 70%) employ managers born in the same district in which the mill is located ("insiders"), whilst foreign groups appoint "outsiders" in 80% of cases (i.e. mill managers born in Rwanda but outside the mill district).[26] In conversations, a few group owners have hinted at the possibility that outsiders have an easier time implementing changes at the mill. These anecdotes are supported by the survey. Outside managers face less resistance to changes in management from both farmers and workers – a finding that lines up with evidence that domestic mills employing "too many" seasonal workers.

A portray thus emerges in which domestic owners' "embeddedness" (Uzzi (1999)) in the local community might create a previously unappreciated trade-off. On the one hand, it creates opportunities to invest, giving domestic owners an advantage in securing "special deals" (Bai et al. (2020)) to acquire existing mills and in setting up new ones (e.g., in acquiring land from local landowners in the community or obtaining permits and licenses from local authorities). Indeed, Section 2 found that domestic firms, including groups, mostly expand through greenfield investments while foreign groups exclusively emerge from acquisitions.[27] On the other hand, domestic owners' "embeddedness" can also introduce pressures to maintain status-quo arrangements that hinder the process of management change at the mills. This might be particularly problematic when the required management changes entail changing existing relational contracts, as in our context.[28]

5 Discussion and Conclusion

Markets in low-income countries often harbour many unproductive and poorly managed firms. Consulting and training programs – many subsidized with public funds – typically target small firms and often yield disappointing results (McKenzie et al. (2021)). Market reforms can increase competition and force poorly performing firms to either improve or exit. In second-best environments characterized by multiple imperfections, however, competition can also destroy rents that are necessary to sustain relationships with customers (Brugués (2022)) and suppliers (Macchiavello and Morjaria (2021)). A well-functioning market for firms offers a potential alternative route to turn around poorly managed firms. Most firms in developing countries, however, are not publicly traded and private equity – a potent vehicle to diffuse better management practices (Davis et al. (2014) and Bloom et al. (2015)) in advanced economies – remains relatively under-developed (Lerner and Schoar (2005)).

This paper studied the market for firms among Rwandan coffee mills – an industry characterized by a relatively simple technology, widespread performance differences between mills,

[26] Foreign groups are more likely to appoint outsiders even after controlling for managers' skills. Superior HR practices to identify and select managerial talent do not fully explain the difference. Foreign groups pay higher salaries even after controlling for the manager's outsider status, suggesting that higher salaries are not simply compensating for working far from home.

[27] In other contexts, social embeddedness might also facilitate access to both private and state-owned business networks (Dai et al. (2018), Bai et al. (2020)) and increased security (Rexer (2021)).

[28] Platteau (2015) and Baland et al. (2011) discuss how similar re-distributive pressures in Sub-Saharan African societies hinder incentives to invest.

and rapid growth accompanied by frequent ownership changes. Strikingly, the frequent changes in ownership are *not* associated with improvement in performance *unless* the mill is acquired by a foreign group. Upon acquisition, foreign groups manage to expand the volumes of coffee processed and increase capacity utilization, while domestic groups increase capacity but, if anything, source less coffee from farmers. Our preferred interpretation – based on a detailed survey that explores alternative hypotheses – is that foreign groups were able to improve performance of acquired mill by successfully implementing relatively standard management changes.

While our results come from a specific context, they might apply more broadly. Besides other agro-processing sectors that share similarities with coffee, the business literature has identified case studies in which standardized management practices diffused through acquisitions of poorly performing plants in the manufacturing sector. For example, the Mexican cement company *CEMEX* developed a highly standardized, IT-supported, post-acquisition process to implement best practices in acquired firms in an industry otherwise characterized by limited technological progress (Ghemawat and Matthews (2000)). The Indian steel conglomerate, *Mittal*, similarly focused on buying poorly managed (mostly state-run) steel factories in emerging economies. *Mittal* introduced new and more efficient technology but also invested in post-acquisition processes to spread best practices across plants (Mitchell and Velamuri (2005)). In the education sector, *Bridge International Academies*, a for-profit education organization, improved pupils test scores in Kenya by implementing a highly-standardized approach involving detailed lesson guide to teachers, standardized systems for teacher monitoring and feedback provision as well as financial management (Gray-Lobe et al. (2022)).

Managing relationships with workers, customers and suppliers is an essential aspect of management in many contexts. The implementation of standardized management practices in poorly run plants to turn them around thus will often entail changing existing relational arrangements. This might be more difficult for domestic owners ("insiders"), as they belong to the local communities in which the status-quo arrangements were originally formed. Understanding these and other constraints to the diffusion of best management practices among larger firms in low income countries is a priority for future research.

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Table 1: **DESCRIPTIVE STATISTICS**

Year	2012	2014	2015	2016	2017	All years
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Mill characteristics, Administrative data						
Number of mills	211	228	243	268	297	253
Number of new mills	15	9	17	26	29	20
Number of mills (foreign group)	6	21	22	33	52	29
Number of mills (domestic group)	81	86	90	96	97	91
Operational mills (share)	0.93	0.87	0.89	0.93	0.94	0.91
Mill age (year)	9.48	9.03	8.58	7.86	7.09	8.31
Installed Capacity (cherries, tons)	411.37	407.89	415.84	441.79	436.53	424.14
Cherries processed (total, tons)	269.14	221.75	353.19	247.47	275.93	273.82
Panel B: Mill characteristics, Survey data						
Total production of parchment (tons)	60.37	58.38	82.51	58.32	65.32	65.06
Conversion ratio (output/cherries)	0.19	0.19	0.20	0.20	0.20	0.19
Total unit cost (RWF per kg)	1788.42	1523.28	1418.89	1509.18	1803.76	1611.57
Number of seasonal workers	65.75	73.73	82.07	67.53	71.05	72.03
Number of permanent workers	4.49	4.75	5.09	5.00	5.10	4.91
Output to installed capacity (ratio)	0.15	0.14	0.19	0.13	0.15	0.15
Output to labor (ratio)	0.79	0.71	0.92	0.79	0.84	0.81
Panel C: Manager characteristics, Survey data						
Manager monthly salary, USD	297.99	261.51	237.86	252.91	249.24	258.30
Male, dummy	0.91	0.90	0.89	0.84	0.86	0.88
Manager age, years	36.69	37.57	37.75	36.18	36.20	36.83
Manager experience, years	4.39	5.07	5.66	5.50	5.77	5.33
Manager with secondary education, share	0.87	0.86	0.87	0.90	0.92	0.88
Manager with post-secondary education, share	0.20	0.42	0.42	0.42	0.48	0.40
Manager raven score (z-score)	[-0.88, 0.77]	[-0.50, 0.58]	[-0.59, 0.58]	[-0.57, 0.60]	[-0.66, 0.64]	[-0.66, 0.64]
Manager general trust (z-score)	[-0.77, 0.57]	[-0.63, 0.64]	[-0.92, 0.69]	[-0.60, 0.63]	[-0.93, 0.79]	[-0.77, 0.69]

Note: This table presents the mean of all key performance measures of mills and mill managers from the compiled administrative datasets and mill surveys fielded by the authors. Mill surveys took place at the end of the harvest season in 2012, 2015, and 2017. In the 2015 and 2017 surveys we also asked for recall data of key measures from the prior seasons. Each columns provides the mean for that particular year: column (1) for 2012, column (2) for 2014 and so on. Column (6) provides average across all the years. For survey years we do not have variables, we impute the variable values. We can directly impute male manager dummy, manager age, manager experience, and education attainment from the survey data as long as the manager names are unchanged across missing years and survey years. For the manager raven (z-score) and manager general trust (z-score) we report the 25^{th} and 75^{th} percentile.

Table 2: **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	218	148	62	20	24	18
Domestic group	83	97	44	11	10	23
Foreign group	9	52	1	1	0	0
Total mills	310	297	107	32	34	41

Note: This table disentangles all changes in mill ownership that took place between 2002-2017 in the industry. For an owner to be classified as a group, they must own (and rent) more than one mill in their portfolio. Column (1) tabulates the ownership structure of the industry when a mill is constructed. One-mill firms constructed the majority of the mills 70% (218 mills). Domestic groups built 27% (83 mills) while only 3% of the mills were built by foreign groups (9 mills). Column (2) provides a snapshot of the ownership structure in 2017: mills under one-mill firms have fallen to 50% (148 mills), domestic groups have increased ownership of the industry to 33% (97 mills) and foreign groups increased ownership to 18% of the industry (52 mills). The total number of mills differ between columns (1) and (2) due to 13 mill exits, these mills were dismantled. In total across the 15 years, 107 ownership changes took place, column (3) provides these changes dis-aggregated by the original owner. Irrespective of the final buyer of the mills: 58% of ownership changes involved from one-mill firms, 41% of ownership changes involved from domestic groups and 1% involved from foreign groups. Columns (4a) to (4c) provide details on which type 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 (52%) new owners of domestic group owned mills are foreign groups and the rest of their mills hare equally likely to be bought by local one-mill firms (25%) and other domestic groups (23%).

Table 3: **MILL PERFORMANCE – ADMINISTRATIVE DATA**

Dependent Variable:	(1) Operating = 1	(2) Cherries Processed (tons, ln)	(3) Installed Capacity (tons, ln)	(4) Capacity Utilization (ratio)
Panel A: Group Ownership				
Mill belongs to group	0.050*	0.037	0.073**	-0.002
	(0.027)	(0.084)	(0.032)	(0.039)
Panel B: Foreign vs. Domestic Group Ownership				
Mill belongs to a foreign group	0.128***	0.593***	0.075*	0.226***
	(0.040)	(0.135)	(0.040)	(0.062)
Mill belongs to a domestic group	0.029	-0.115	0.072**	-0.064
	(0.028)	(0.091)	(0.035)	(0.042)
Observations	2,391	2,134	2,127	2,127
Mill and Year FE	Y	Y	Y	Y
P-value [Foreign = Domestic]	0.004	0.000	0.948	0.000

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 the last row reports p-values for the joint test of equality. All dependent variables are mill outcomes from administrative records, and thus available for all mill-years between 2002 and 2017. Column 1 is a dummy variable taking value equal to 1 if the mill is operating and equal to 0 otherwise in that season. Columns 2 to 4 samples are conditional on the mill being operational in that season, hence the reduced number of observations. Column 2 is the amount of cherries that the mill has processed in a given season (ln, tons). Column 3 is the mill's installed capacity (tons, ln) for processing cherries in a given season. Column 4, brings together dependent variables from columns 2 and 3 and creates a measure of installed capacity utilization of the mill, defined as the ratio between the amount of cherries processed in a given season to the mill's total installed capacity in the season.

Table 4: **MILL PERFORMANCE – SURVEY MEASURES**

Dependent Variable:	(1) Conversion Ratio (output/cherries, ln)	(2) Output to Installed Capacity (ln)	(3) Output to Labor (ln)	(4) Reported Cost per Kg Output (fixed + variable, ln)	(5) Calculated Cost per Kg Output (variable, ln)	(6) Average Price per Kg Cherries (ln)	(7) Daily Wage per Seasonal Worker (ln)
Panel A: Group Ownership							
Mill belongs to group	-0.023	-0.181**	-0.197***	0.018	0.034	0.004	0.008
	(0.016)	(0.084)	(0.074)	(0.027)	(0.050)	(0.016)	(0.021)
Panel B: Foreign vs. Domestic Group Ownership							
Mill belongs to a foreign group	0.009	0.226	-0.004	-0.097*	-0.034	-0.024	-0.012
	(0.026)	(0.172)	(0.119)	(0.050)	(0.067)	(0.025)	(0.032)
Mill belongs to a domestic group	-0.028*	-0.281***	-0.245***	0.036	0.045	0.008	0.012
	(0.015)	(0.095)	(0.081)	(0.028)	(0.051)	(0.017)	(0.022)
Observations	901	954	944	901	901	901	901
Mill and Year FE	Y	Y	Y	Y	Y	Y	Y
P-value [Foreign = Domestic]	0.082	0.014	0.059	0.005	0.141	0.162	0.404

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 only on mill outcomes that we could measure only during the mill surveys conducted in the years of 2012, 2015 and 2017, note we were also able to obtain responses for the prior seasons of 2014 and 2016 in the 2015 and 2017 mill surveys. Column 1 is the conversion ratio, measured by the (ln) ratio of output material (parchment coffee) to cherries (the input material). Column 2 is (ln) ratio of reported output (parchment coffee) to installed capacity (our measure of capital). Column 3 is (ln) ratio of reported output to seasonal labor. Column 4 is the mill managers best estimate of the unit total cost to produce 1 kg of output. This provides us a summary measure that includes both variable and fixed production costs to produce 1 kg of the parchment coffee. We next take advantage of the relative simplicity of the production process to ask managers directly about the structure of variable costs specifically. Column 5 uses this information to construct the variable cost to produce 1 kg of the output, i.e. the variable operating costs. Column 6 is the average price per kg of cherries (ln) and column 7 is the daily wage for a seasonal worker (ln).

Table 5: **ROBUSTNESS TO ALTERNATIVE SAMPLES, ADMINISTRATIVE DATA**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A	**Dependent Variable: Mill Operating (=1)**						
Mill belongs to a foreign group	0.128***	0.129***	0.123***	0.087	0.129**	0.145**	0.136*
	(0.040)	(0.040)	(0.039)	(0.053)	(0.052)	(0.068)	(0.079)
Mill belongs to a domestic group	0.029	0.031	0.019	0.028	0.025	0.061	0.028
	(0.028)	(0.028)	(0.027)	(0.038)	(0.031)	(0.051)	(0.051)
Observations	2,391	2,389	2,342	1,000	1,111	770	1,081
R-squared	0.338	0.339	0.344	0.306	0.292	0.322	-
Mean Dependent Variable	0.890	0.890	0.890	0.857	0.890	0.851	-
P-value [Foreign = Domestic]	0.004	0.005	0.003	0.154	0.008	0.058	-
Panel B	**Dependent Variable: Cherries Processed (ln)**						
Mill belongs to a foreign group	0.593***	0.610***	0.686***	0.394***	0.454***	0.444**	0.400*
	(0.135)	(0.136)	(0.144)	(0.146)	(0.136)	(0.174)	(0.235)
Mill belongs to a domestic group	-0.115	-0.103	-0.102	-0.206*	-0.169*	-0.207	-0.298***
	(0.091)	(0.093)	(0.097)	(0.113)	(0.086)	(0.148)	(0.083)
Observations	2,134	2,132	2,090	862	991	658	926
R-squared	0.678	0.679	0.685	0.626	0.645	0.611	-
P-value [Foreign = Domestic]	0.000	0.000	0.000	0.000	0.000	0.000	-
Panel C	**Dependent Variable: Installed Capacity (tons, ln)**						
Mill belongs to a foreign group	0.075*	0.075*	0.103**	0.040	0.023	-0.039	-0.004
	(0.040)	(0.040)	(0.043)	(0.052)	(0.049)	(0.046)	(0.016)
Mill belongs to a domestic group	0.072**	0.072**	0.080**	0.031	0.059	-0.020	0.002
	(0.035)	(0.036)	(0.037)	(0.043)	(0.036)	(0.043)	(0.018)
Observations	2,127	2,125	2,083	857	989	655	920
R-squared	0.863	0.863	0.865	0.853	0.840	0.817	-
P-value [Foreign = Domestic]	0.948	0.956	0.631	0.863	0.453	0.707	-
Panel D	**Dependent Variable: Capacity Utilization (ratio)**						
Mill belongs to a foreign group	0.226***	0.229***	0.266***	0.168**	0.201***	0.214***	0.225**
	(0.062)	(0.062)	(0.067)	(0.067)	(0.062)	(0.075)	(0.107)
Mill belongs to a domestic group	-0.064	-0.065	-0.058	-0.087*	-0.076*	-0.070	-0.105**
	(0.042)	(0.043)	(0.045)	(0.052)	(0.042)	(0.061)	(0.045)
Observations	2,127	2,125	2,083	857	989	655	920
R-squared	0.573	0.575	0.580	0.536	0.540	0.545	-
Mean Dependent Variable	0.583	0.584	0.585	0.571	0.611	0.596	-
P-value [Foreign = Domestic]	0.000	0.000	0.000	0.000	0.000	0.000	-
Sample	Baseline	Baseline	No Rented Mills	Ownership Change	Ever in Group	Acquired by Group	2WFE Alternative
Mill and Year FE	Y	Y	Y	Y	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 the main mill performance outcome from the administrative dataset: whether the mill is operational (dummy variable, panel A), cherries processed (tons ln, panel B), installed capacity (tons ln, panel C), and capacity utilization (ratio, panel D). Column 1 reports our baseline specification. Column 2 reports our baseline but also controls for acquired mill by one-mill firms interacted with year. Rented mills are treated as owned in our analysis, in column 3 we drop rented mills from the sample. Column 4 restricts the sample to mills that have switched ownership at some point during their existence. Column 5 restricts the sample to only include mills that have belonged to a group at some point in time. Column 6 restricts the sample to only include mills that have changed ownership and whose new owner is a group. Recent literature in difference-in-difference designs (de Chaisemartin and D'Haultfœuille (2020)) notes that in 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. Column 7 runs this alternative two-way fixed effects (2WFE) estimator (*did_multiplegt*). Note this estimation code separately estimates the two treatment (foreign group and domestic group) effects.

Table 6: **ROBUSTNESS TO COUNTERFACTUAL MILLS, ADMINISTRATIVE DATA**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A						**Dependent Variable: Mill Operating (=1)**					
Mill belongs to a foreign group	0.128***	0.032	0.099	0.082	0.074*	0.060	0.076*	0.061	0.125***	0.144***	0.139***
	(0.040)	(0.042)	(0.069)	(0.062)	(0.041)	(0.047)	(0.044)	(0.058)	(0.041)	(0.043)	(0.042)
Mill belongs to a domestic group	0.029	-0.027	-0.046	-0.037	0.014	0.010	0.019	0.007	0.028	0.035	0.030
	(0.028)	(0.044)	(0.038)	(0.044)	(0.028)	(0.031)	(0.034)	(0.038)	(0.028)	(0.028)	(0.028)
Observations	2,391	1,190	868	1,225	2,313	2,109	1,716	1,550	2,391	2,391	2,391
R-squared	0.338	0.308	0.613	0.439	0.291	0.376	0.288	0.389	0.341	0.345	0.341
Mean Dependent Variable	0.890	0.926	0.941	0.918	0.926	0.929	0.918	0.917	0.890	0.890	0.890
P-value [Foreign = Domestic]	0.004	0.179	0.062	0.016	0.074	0.198	0.129	0.245	0.005	0.003	0.003
Panel B						**Dependent Variable: Cherries Processed (ln)**					
Mill belongs to a foreign group	0.593***	0.360**	0.268	0.344**	0.589***	0.605***	0.572***	0.614***	0.630***	0.656***	0.678***
	(0.135)	(0.169)	(0.271)	(0.166)	(0.150)	(0.183)	(0.157)	(0.208)	(0.132)	(0.144)	(0.139)
Mill belongs to a domestic group	-0.115	-0.079	-0.054	-0.023	-0.003	0.007	0.032	0.052	-0.113	-0.096	-0.110
	(0.091)	(0.177)	(0.134)	(0.170)	(0.111)	(0.122)	(0.130)	(0.136)	(0.092)	(0.093)	(0.091)
Observations	2,134	1,104	774	1,114	2,146	1,946	1,580	1,409	2,134	2,134	2,134
R-squared	0.678	0.631	0.788	0.711	0.642	0.697	0.627	0.688	0.684	0.685	0.684
P-value [Foreign = Domestic]	0.000	0.024	0.216	0.091	0.000	0.001	0.001	0.004	0.000	0.000	0.000
Panel C						**Dependent Variable: Installed Capacity (tons, ln)**					
Mill belongs to a foreign group	0.075*	-0.001	0.076	-0.109**	0.042	0.045	0.003	-0.001	0.083**	0.106**	0.084**
	(0.040)	(0.053)	(0.118)	(0.044)	(0.047)	(0.049)	(0.046)	(0.056)	(0.041)	(0.047)	(0.042)
Mill belongs to a domestic group	0.072**	-0.032	-0.009	-0.033	0.068	0.062*	0.032	0.031	0.081**	0.080**	0.073**
	(0.035)	(0.046)	(0.096)	(0.047)	(0.045)	(0.037)	(0.047)	(0.042)	(0.035)	(0.034)	(0.033)
Observations	2,127	1,102	770	1,109	2,142	1,943	1,576	1,406	2,127	2,127	2,127
R-squared	0.863	0.840	0.914	0.867	0.842	0.878	0.855	0.892	0.866	0.868	0.866
P-value [Foreign = Domestic]	0.948	0.509	0.259	0.181	0.601	0.751	0.577	0.602	0.965	0.585	0.801
Panel D						**Dependent Variable: Capacity Utilization (ratio)**					
Mill belongs to a foreign group	0.226***	0.201**	0.168	0.251***	0.260***	0.270***	0.285***	0.314***	0.242***	0.245***	0.259***
	(0.062)	(0.097)	(0.173)	(0.080)	(0.070)	(0.091)	(0.072)	(0.099)	(0.061)	(0.065)	(0.064)
Mill belongs to a domestic group	-0.064	-0.052	-0.010	0.048	-0.019	-0.010	0.021	0.036	-0.067	-0.060	-0.069
	(0.042)	(0.077)	(0.119)	(0.078)	(0.053)	(0.058)	(0.062)	(0.067)	(0.043)	(0.043)	(0.042)
Observations	2,127	1,102	770	1,109	2,142	1,943	1,576	1,406	2,127	2,127	2,127
R-squared	0.573	0.533	0.737	0.654	0.555	0.622	0.544	0.616	0.581	0.579	0.582
Mean Dependent Variable	0.583	0.633	0.679	0.660	0.638	0.655	0.620	0.641	0.583	0.583	0.583
P-value [Foreign = Domestic]	0.000	0.013	0.170	0.038	0.000	0.002	0.000	0.003	0.000	0.000	0.000
Sample	Baseline	Potential Target Match	Potential Target Match	Failed Acquisitions	All Sourcing Mills	All Sourcing Mills	Only Relational Sourcing	Only Relational Sourcing	Baseline	Baseline	Baseline
Mill and Year FE	Y	Y	-	-	Y	-	Y	-	Y	Y	Y
Mill and Year-Pair FE	N	N	Y	-	N	-	N	-	-	-	-
Mill and Year-Acquirer FE	N	N	N	Y	N	Y	N	Y	-	-	-
Selection Criteria FE	-	-	-	-	-	-	-	-	Y	Y	Y
Selection Criteria × Year FE	-	-	-	-	-	-	-	-	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 the main mill performance outcome from the administrative dataset as discussed in Table 3. Column 1 is our baseline from Table 3. Column 2 runs our baseline specification (Column 1) but the sample is now only 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 3 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. Column 4 includes from the acquirer survey the acquisitions that fell through i.e. the failed acquisitions. In column 5 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 6 includes in addition, the acquirer-year fixed effects. Column 7 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). Column 8 includes now in addition acquirer-year fixed effects. Columns 9, 10, and 11 include the interactions between year-fixed effects and the predicted value for the acquisition, the group acquisition, and the foreign group acquisition based on the socio-economic characteristics of the district and mill characteristics, which we define as a acquirer's "Selection Criteria" measure. Column 9 uses the predicted value for the acquisition. Columns 10 uses the predicted value for the group acquisition conditional on being acquired. Column 11 uses the predicted value for the foreign group acquisition conditional on being acquired by gruop. The coefficient estimates on the socio-economic characteristics used to predict the acquisition, the group acquisition, and the foreign group acquisition are reported in Appendix Table A5. Predicted values for acquisition in columns 9, 10, and 11 in Table 6 correspond to coefficient estimates in columns 1, 2, and 3 in Appendix Table A5.

Table 7: **MANAGER CHARACTERISTICS**

Dependent Variable:	(1) Manager Change Indicator	(2) Experience in years	(3) Gender (1 = Female)	(4) Age in years	(5) Secondary Education or More	(6) Post Secondary or More	(7) Trust (z-score)	(8) Raven Score (z-score)	(9) Raven Score (z-score)
Panel A: Group Ownership									
Mill belongs to group	0.113***	-0.088	0.009	-3.512*	0.112*	0.068	-0.132	0.283	0.216**
	(0.036)	(0.753)	(0.065)	(2.079)	(0.060)	(0.090)	(0.205)	(0.244)	(0.103)
Panel B: Foreign vs. Domestic Group Ownership									
Mill belongs to a foreign group	0.152**	-0.019	-0.067	-5.500*	0.120*	0.313**	-0.180	0.544	0.501***
	(0.067)	(1.275)	(0.068)	(2.825)	(0.067)	(0.131)	(0.294)	(0.414)	(0.188)
Mill belongs to a domestic group	0.104***	-0.105	0.027	-2.990	0.109*	0.005	-0.120	0.215	0.108
	(0.036)	(0.758)	(0.072)	(2.160)	(0.062)	(0.098)	(0.217)	(0.256)	(0.103)
Observations	1,626	407	410	403	407	407	405	363	363
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mill FE	Y	Y	Y	Y	Y	Y	Y	Y	N
Cluster SE Mill Level	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mean Dependent Variable	0.167	5.684	0.122	37.699	0.877	0.356	-0.019	0.031	0.031
P-value [Foreign = Domestic]	0.419	0.941	0.224	0.322	0.785	0.027	0.833	0.421	0.038

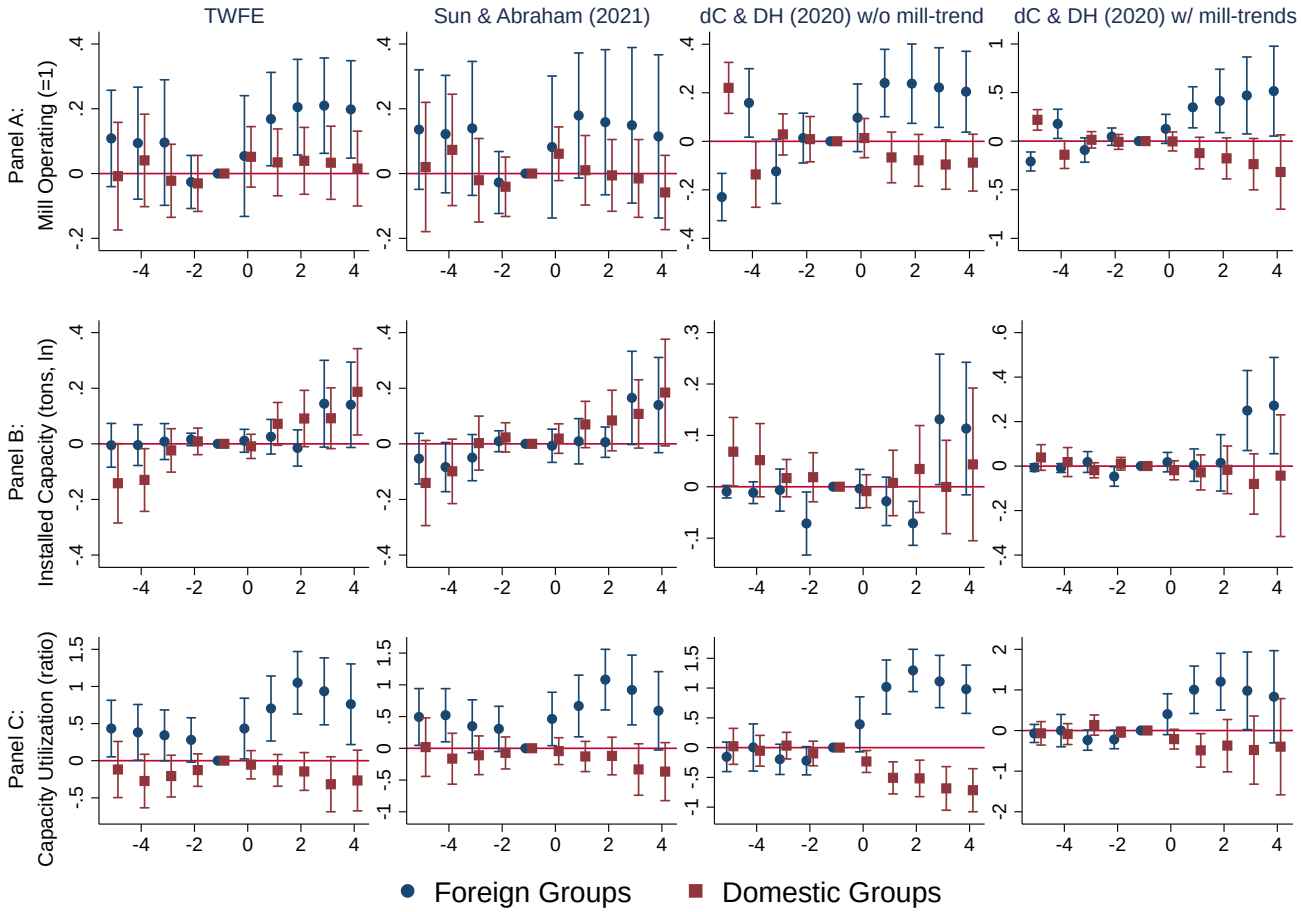
Note: Standard errors are clustered at the mill-level. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. Panel A reports results simply comparing mills belonging to groups versus not, while Panel B splits the group dummy between *domestic* and *foreign* groups and reports p-values for the joint test of equality. Dependent variables are as follows: Column 1 is a dummy variable taking a value of 1 if the manager is different from the previous season, column 2 is the manager's years of experience in the coffee industry, column 3 is a dummy variable taking a value of 1 if the manager is female, column 4 is the age of the mill manager (years), column 5 is a dummy variable taking a value of 1 if the mill manager has secondary education, column 6 is a dummy variable taking a value of 1 if they have completed post-secondary education, column 7 is a standardized z-score of general trust (similar to questions asked in World Value Surveys) and column 8 and 9 are standardized z-scores of raven tests. The sample consists of all the mill manager surveys (2012, 2015, and 2017).

Table 8: **KNOWLEDGE VS. RESISTANCE TO MANAGEMENT PRACTICES**

Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Total Attempted Management Practice				Total Resistance to Management Practice			
Panel A: Group Ownership								
Mill belongs to group	0.250	0.171	0.222	-0.129	0.622	0.778*	0.593	1.070*
	(0.292)	(0.302)	(0.294)	(0.330)	(0.423)	(0.432)	(0.423)	(0.545)
Panel B: Foreign vs. Domestic Group Ownership								
Mill belongs to a foreign group	0.375	0.252	0.327	-0.029	-0.041	0.139	-0.103	0.071
	(0.374)	(0.414)	(0.374)	(0.450)	(0.604)	(0.626)	(0.602)	(0.804)
Mill belongs to a domestic group	0.181	0.135	0.166	-0.160	0.991**	1.060**	0.972**	1.376**
	(0.337)	(0.336)	(0.339)	(0.361)	(0.467)	(0.471)	(0.468)	(0.563)
Observations	265	265	265	235	265	265	265	235
Manager Salary	N	Y	N	Y	N	Y	N	Y
Autonomy Score	N	N	Y	Y	N	N	Y	Y
Manager Controls	N	N	N	Y	N	N	N	Y
Mill Controls	N	N	N	Y	N	N	N	Y
P-value [Foreign = Domestic]	0.632	0.784	0.691	0.775	0.105	0.154	0.091	0.085

Note: Robust standard errors are estimated. $***$ (**) [*] indicates significance at the 0.01 (0.05) [0.1] level. Dependant variable in column 1-4 is the sum of all dummy variables for the attempted management practices. Dependant variable in columns 5-8 is the sum of all dummy variables for the resistance to the attempted management practices. Columns 1 and 5 are the baseline specification with a dummy variable for mills belonging to groups in Panel A and dummy variables for mills belonging to domestic and foreign groups respectively in Panel B. Columns 2 and 6 controls for the (ln) monthly salary of the manager. Columns 3 and 7 controls for the total manager autonomy score (sum of all dummy variables for management practices where the manager has autonomy). Columns 4 and 8 controls both for manager characteristics (i.e. industry experience, gender, age, educational attainment, cognitive score, and general trust) and mill controls (i.e. mill age, installed capacity, dummy for new mill, dummy for private mill, and location of the mill).

Figure 5: **EVENT STUDIES, ADMINISTRATIVE DATA**



Note: Dependent variable in Panel A is a dummy variable taking value equal to 1 if the mill is operational and equal to 0 otherwise in that season. Dependent variable in Panel B is the mill's installed capacity (ln) for processing cherries in a given season. Dependent variable in Panel C is the capacity utilization of the mill, defined as the ratio of cherries processed in a given season to the mill's total installed capacity in the season. The first figure in each panel presents the estimates from the two-way fixed effects methodology (TWFE). The second (resp. third) figure in each panel presents the estimates from Sun and Abraham (2021) (resp. de Chaisemartin and D'Haultfœuille (2022)). The fourth figure in each panel presents the estimates from de Chaisemartin and D'Haultfœuille (2022) with linear trend for each mill. Blue circles and lines indicate the point estimate and 95% confidence interval for foreign ownership effect while red squares and lines indicate the point estimate and 95% confidence interval for domestic ownership effect. The x-axis denotes the year relative to the period when the mill is acquired by foreign/domestic group. The y-axis denotes the coefficient estimate for the effects of foreign/domestic acquisition.

Appendix

Acquisitions, Management and Efficiency in Rwanda's Coffee Industry

by **Rocco Macchiavello and Ameet Morjaria**

June 2022

A Additional Tables

List of Tables

Table A1: **CERTIFICATIONS AND LABORATORY TESTS**

Dependent Variable:	(1) Any Certification	(2) Fairtrade	(3) Rainforest Alliance	(4) 4C	(5) UTZ	(6) C.A.F.E Practice	(7) Total Cupping Points (lab)	(8) Grade A Parchment (%)
Panel A: Group ownership								
Mill belongs to a group	0.049	-0.021	0.071**	0.018	0.020	0.021	1.323**	-0.179
	(0.035)	(0.022)	(0.030)	(0.025)	(0.017)	(0.023)	(0.544)	(1.981)
Panel B: Domestic vs. Foreign groups								
Mill belongs to a foreign group	0.428***	-0.003	0.225***	0.293***	0.236***	0.349***	1.895**	2.296
	(0.063)	(0.047)	(0.054)	(0.072)	(0.055)	(0.063)	(0.729)	(2.878)
Mill belongs to a domestic group	-0.070**	-0.026	0.023	-0.069**	-0.048**	-0.082***	1.109*	-0.926
	(0.029)	(0.021)	(0.023)	(0.028)	(0.024)	(0.025)	(0.569)	(2.050)
Observations	2,009	2,009	2,009	2,009	2,009	2,009	274	999
R-squared	0.683	0.779	0.400	0.356	0.339	0.462	0.477	0.510
Mill and Year FE	Y	Y	Y	Y	Y	Y	N/A	Y
P-value [Foreign = Domestic]	0.000	0.613	0.000	0.000	0.000	0.000	0.218	0.193

Note: Standard errors are clustered at the mill-level. $***$ (**) [*] indicates significance at the 0.01 (0.05) [0.1] level. Column 1 is a dummy variable taking a value of 1 if the mill has at least one of the five standard certifications in the industry. Column 2 is a dummy variable taking a value of 1 if the mill has certification for fair trade (which is usually for cooperative mills, and thus is a placebo test for us). Column 3 is a dummy variable taking a value of 1 if the mill has certification for rain forest alliance. Column 4 is a dummy variable taking a value of 1 if the mill has certification for common conduct code for the coffee community. Column 5 is a dummy variable taking a value of 1 if the mill has certification for sustainable farming (known as UTZ). Column 6 is a dummy variable taking a value of 1 if the mill has certification for coffee and farmer equity practice (CAFE practices). Column 7 is the physical quality of the coffee produced by the mill, measured by detailed cupping tests of quality samples taken from all mills in 2017. Column 8 is the share of output (parchment) graded as A. Mill output is graded as A, B or C. The sample is 2017 mill survey for columns 1-7. We construct the panel of certification from the 2017 mill survey since we know the year in which each mill obtains the certification.

Table A2: **ROBUSTNESS TO ALTERNATIVE SAMPLES, SURVEY DATA**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A	**Dependent Variable: Conversion Ratio (ln)**						
Mill belongs to a foreign group	0.009	0.007	0.002	0.009	-0.003	0.008	0.009
	(0.026)	(0.026)	(0.029)	(0.029)	(0.029)	(0.036)	(0.030)
Mill belongs to a domestic group	-0.028*	-0.030**	-0.031*	-0.023	-0.032*	-0.026	-0.028*
	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)	(0.022)	(0.016)
Observations	901	901	867	326	367	237	422
R-squared	0.471	0.479	0.477	0.439	0.470	0.346	-
P-value [Foreign = Domestic]	0.082	0.081	0.194	0.167	0.215	0.157	-
Panel B	**Dependent Variable: Output to Labor (ln)**						
Mill belongs to a foreign group	-0.004	0.013	0.156	-0.020	0.080	0.046	-0.315**
	(0.119)	(0.119)	(0.131)	(0.131)	(0.129)	(0.144)	(0.159)
Mill belongs to a domestic group	-0.245***	-0.234***	-0.247***	-0.299***	-0.217**	-0.287**	-0.030
	(0.081)	(0.082)	(0.084)	(0.096)	(0.085)	(0.130)	(0.133)
Observations	944	944	903	349	390	259	319
R-squared	0.698	0.702	0.712	0.635	0.611	0.635	-
P-value [Foreign = Domestic]	0.059	0.050	0.002	0.041	0.022	0.012	-
Panel C	**Dependent Variable: Cost per Kg of Output (fixed + variable, ln)**						
Mill belongs to a foreign group	-0.097*	-0.095*	-0.136**	-0.050	-0.039	-0.028	-0.106*
	(0.050)	(0.050)	(0.053)	(0.052)	(0.052)	(0.065)	(0.055)
Mill belongs to a domestic group	0.036	0.038	0.037	0.054	0.055**	0.072	0.078**
	(0.028)	(0.029)	(0.029)	(0.034)	(0.027)	(0.048)	(0.032)
Observations	901	901	867	326	367	237	422
R-squared	0.567	0.573	0.575	0.597	0.593	0.628	-
P-value [Foreign = Domestic]	0.005	0.005	0.001	0.037	0.054	0.058	-
Panel D	**Dependent Variable: Cost per Kg of Output (variable, ln)**						
Mill belongs to a foreign group	-0.034	-0.034	-0.093	0.080	0.029	0.103	-0.162*
	(0.067)	(0.068)	(0.064)	(0.082)	(0.069)	(0.096)	(0.087)
Mill belongs to a domestic group	0.045	0.045	0.039	0.079	0.065	0.121	-0.005
	(0.051)	(0.052)	(0.052)	(0.066)	(0.051)	(0.086)	(0.072)
Observations	901	901	867	326	367	237	422
R-squared	0.513	0.515	0.522	0.490	0.523	0.503	-
P-value [Foreign = Domestic]	0.141	0.142	0.022	0.993	0.520	0.782	-
Sample	Baseline	Baseline	No Rented Mills	Ownership Change	Ever in Group	Acquired by Group	2WFE Alternative
Mill and Year FE	Y	Y	Y	Y	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 four main mill performance outcomes from our mill survey: the conversion ratio, measured by the ratio of output material to cherries (ln, panel A), ratio of reported output to seasonal labor (ln, panel B), manager reported total cost per kg of output (ln, panel C), calculated operational costs per kg of output (ln, panel D). Column 1 reports our baseline specification. Column 2 reports our baseline but also controls for acquired mill by one-mill firms interacted with year. Rented mills are treated as owned, in column 3 we drop rented mills from the sample. Column 4 restricts the sample to mills that have switched ownership at some point during their existence. Column 5 restricts the sample to only include mills that have belonged to a group at some point in time. Column 6 restricts the sample to only include mills that have changed ownership and whose new owner is a group. Recent literature in difference-in-difference designs (de Chaisemartin and D'Haultfœuille (2020)) notes that in 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. Column 7 runs this alternative two-way fixed effects (2WFE) estimator (*did_multiplegt*). Note this estimation code separately estimates the two treatment (foreign group and domestic group) effects.

Table A3: **ROBUSTNESS TO COUNTERFACTUAL MILLS, SURVEY DATA**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A	**Dependent Variable: Conversion Ratio (ln)**										
Mill belongs to a foreign group	0.009	-0.010	-0.030	0.008	0.006	0.012	0.022	0.037	0.003	0.012	0.012
	(0.026)	(0.044)	(0.051)	(0.047)	(0.026)	(0.031)	(0.027)	(0.031)	(0.027)	(0.027)	(0.026)
Mill belongs to a domestic group	-0.028*	-0.026	-0.043	0.008	-0.030**	-0.030*	-0.014	-0.004	-0.027*	-0.028*	-0.032**
	(0.015)	(0.029)	(0.040)	(0.032)	(0.014)	(0.017)	(0.015)	(0.018)	(0.015)	(0.015)	(0.015)
Observations	901	418	278	442	956	871	713	641	901	901	901
R-squared	0.471	0.440	0.741	0.550	0.486	0.555	0.475	0.530	0.477	0.475	0.474
P-value [Foreign = Domestic]	0.082	0.556	0.657	0.990	0.094	0.085	0.118	0.116	0.173	0.064	0.043
Panel B	**Dependent Variable: Cost per Kg of Output (fixed + variable, ln)**										
Mill belongs to a foreign group	-0.097*	-0.195***	-0.183***	-0.062	-0.129**	-0.149**	-0.093*	-0.103	-0.103**	-0.092*	-0.098*
	(0.050)	(0.070)	(0.065)	(0.072)	(0.057)	(0.065)	(0.055)	(0.065)	(0.051)	(0.053)	(0.050)
Mill belongs to a domestic group	0.036	0.004	0.116***	0.094	0.006	0.014	0.012	0.028	0.039	0.035	0.032
	(0.028)	(0.056)	(0.040)	(0.071)	(0.033)	(0.035)	(0.035)	(0.038)	(0.029)	(0.028)	(0.029)
Observations	901	418	278	442	956	871	713	641	901	901	901
R-squared	0.567	0.586	0.826	0.710	0.575	0.670	0.588	0.697	0.568	0.569	0.572
P-value [Foreign = Domestic]	0.005	0.001	0.000	0.015	0.007	0.007	0.040	0.042	0.004	0.015	0.009
Panel C	**Dependent Variable: Cost per Kg of Output (variable, ln)**										
Mill belongs to a foreign group	-0.034	0.066	-0.021	0.108	-0.018	-0.050	0.038	0.023	-0.024	-0.004	-0.026
	(0.067)	(0.125)	(0.124)	(0.122)	(0.077)	(0.084)	(0.083)	(0.092)	(0.068)	(0.069)	(0.068)
Mill belongs to a domestic group	0.045	0.012	-0.005	0.169*	0.057	0.110*	0.100	0.161**	0.044	0.042	0.032
	(0.051)	(0.112)	(0.110)	(0.096)	(0.068)	(0.061)	(0.077)	(0.069)	(0.051)	(0.052)	(0.054)
Observations	901	418	278	442	956	871	713	641	901	901	901
R-squared	0.513	0.387	0.775	0.610	0.491	0.568	0.477	0.572	0.518	0.519	0.517
P-value [Foreign = Domestic]	0.141	0.519	0.851	0.388	0.194	0.015	0.294	0.055	0.220	0.422	0.308
Panel D	**Dependent Variable: Average Price per Kg Cherries (ln)**										
Mill belongs to a foreign group	-0.024	0.010	0.023	0.033	-0.038	-0.051	-0.026	-0.038	-0.026	-0.016	-0.025
	(0.025)	(0.046)	(0.048)	(0.033)	(0.029)	(0.033)	(0.027)	(0.031)	(0.025)	(0.025)	(0.026)
Mill belongs to a domestic group	0.008	0.027	0.035	0.046	0.001	0.005	0.008	0.014	0.010	0.008	0.009
	(0.017)	(0.028)	(0.040)	(0.028)	(0.019)	(0.020)	(0.019)	(0.020)	(0.017)	(0.017)	(0.017)
Observations	901	418	278	442	956	871	713	641	901	901	901
R-squared	0.805	0.804	0.948	0.882	0.804	0.844	0.823	0.861	0.806	0.807	0.806
P-value [Foreign = Domestic]	0.162	0.627	0.709	0.716	0.132	0.063	0.175	0.069	0.132	0.287	0.170
Sample	Baseline	Potential Target Match	Potential Target Match	Failed Acquisitions	All Sourcing Mills	All Sourcing Mills	Only Relational Sourcing	Only Relational Sourcing	Baseline	Baseline	Baseline
Mill and Year FE	Y	Y	-	-	Y	-	Y	-	Y	Y	Y
Mill and Year-Pair FE	N	N	Y	-	N	-	N	-	-	-	-
Mill and Year-Acquirer FE	N	N	N	Y	N	Y	N	Y	-	-	-
Selection Criteria FE	-	-	-	-	-	-	-	-	Y	Y	Y
Selection Criteria × Year FE	-	-	-	-	-	-	-	-	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 four main mill performance outcomes from our mill survey as discussed in Table 4. Column 1 is our baseline from Table 4. Column 2 runs our baseline specification (Column 1) but the sample is now only 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 3 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. Column 4 includes from the acquirer survey the acquisitions that fell through i.e. the failed acquisitions. In column 5 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 6 includes now addition the acquirer-year fixed effects. Column 7 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). Column 8 includes now in addition acquirer-year fixed effects. Columns 9, 10, and 11 include the interactions between year-fixed effects and the predicted value for the acquisition, the group acquisition, and the foreign group acquisition based on the socio-economic characteristics of the district and mill characteristics, which we define as a acquirer's "Selection Criteria" measure. Column 9 uses the predicted value for the acquisition. Columns 10 uses the predicted value for the group acquisition conditional on being acquired. Column 11 uses the predicted value for the foreign group acquisition conditional on being acquired by group. The coefficient estimates on the socio-economic characteristics used to predict the acquisition, the group acquisition, and the foreign group acquisition are reported in Appendix Table A5. Predicted values for acquisition in columns 9, 10, and 11 in Table A3 correspond to coefficient estimates in columns 1, 2, and 3 in Appendix Table A5.

Table A4: **ACQUISITION AND PERFORMANCE**

	(1)	(2)	(3)	(4)
Panel A			**Administrative Data**	
Dependent Variable:	Operating = 1	Cherries Processed (tons, ln)	Installed Capacity (tons, ln)	Capacity Utilization (ratio)
Time Period [i,j]	[-1,1]	[-1,1]	[-1,1]	[-1,1]
Acquired by one-mill firm	0.136	0.262	-0.017	0.168
	(0.123)	(0.315)	(0.022)	(0.178)
Acquired by domestic group	0.194**	0.759***	0.164**	0.299***
	(0.080)	(0.263)	(0.079)	(0.108)
Acquired by foreign group	0.197**	1.100***	0.010	0.446***
	(0.077)	(0.214)	(0.021)	(0.109)
Observations	68	56	54	54
P-value [One-mill = Domestic]	0.694	0.218	0.051	0.527
P-value [One-mill = Foreign]	0.669	0.038	0.285	0.195
P-value [Domestic = Foreign]	0.983	0.299	0.079	0.338
Panel B			**Survey Data**	
Dependent Variable:	Conversion Ratio (ln)	Cost per Kg of Output (fixed + variable, ln)	Cost per Kg of Output (variable, ln)	Average Price per Kg Cherries (ln)
Time Period [i,j]	[-1,1]	[-1,1]	[-1,1]	[-1,1]
Acquired by one-mill firm	0.023	0.097	-0.143	0.058
	(0.038)	(0.182)	(0.224)	(0.123)
Acquired by domestic group	-0.009	-0.184*	-0.122	0.081
	(0.031)	(0.102)	(0.169)	(0.091)
Acquired by foreign group	-0.063**	-0.262***	-0.089	0.085
	(0.028)	(0.063)	(0.071)	(0.050)
Observations	23	24	24	23
P-value [One-mill = Domestic]	0.495	0.204	0.937	0.877
P-value [One-mill = Foreign]	0.083	0.075	0.825	0.846
P-value [Domestic = Foreign]	0.227	0.522	0.861	0.975

Note: Robust standard errors are estimated. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. Across all columns an OLS specification without a constant is estimated. Time period $[i, j]$ denotes the event times in which the difference in outcome variable is taken, where i is years prior to acquisition and j is post-acquisition: $[1, 1]$ denotes 1 year prior to acquisition and 1 year after the acquisition. All columns control for mill suitability score between 0-5 km from the engineering model (see Macchiavello and Morjaria (2021)) for additional details on the construction of the suitability score) and event year. Dependent variables are as defined in Table 3 and 4. The number of observations changes for two reasons: (i) recall dependent variables "Cherries Processed," "Install Capacity," and "Capacity Utilization" are conditional on mill being operational; and (ii) for columns whereby the difference is compared between a year or two after acquisition and if that acquisition took place in 2017, we would not have that mill in the sample, as our sample ends in 2017.

Table A5: **ACQUISITION SELECTION CRITERIA**

Dependent Variable:	(1) Mill Ever Acquired = 1	(2) Mill Ever Acquired by Group = 1	(3) Mill Ever Acquired by Foreign Group = 1
Score within 5 km of mill	0.020	0.015	0.133**
	(0.031)	(0.056)	(0.060)
Distance to Kigali (km, ln)	0.032	-0.027	0.056
	(0.066)	(0.104)	(0.135)
Bank Branches (per 100k, IHS)	0.001	-0.016	0.014
	(0.023)	(0.040)	(0.053)
SACCOs (per 100k, IHS)	-0.022	-0.082	0.065
	(0.063)	(0.073)	(0.137)
Year of Mill Entry	-0.026***	-0.002	0.002
	(0.007)	(0.006)	(0.005)
Installed Capacity (tons, ln)	0.075	0.303***	0.212
	(0.057)	(0.107)	(0.137)
Trust in People	0.403	0.879	0.275
	(0.416)	(0.598)	(0.879)
Poverty Head Count (%)	0.001	-0.003	-0.007
	(0.003)	(0.005)	(0.007)
Observations	310	95	70
R-squared	0.135	0.165	0.201
F-test (P-value)	0.012	0.034	0.253

Note: Robust standard errors are estimated. $***$ ($**$) [$*$] indicates significance at the 0.01 (0.05) [0.1] level. The data used in this analysis is at the mill-level. The dependent variables in all the columns denote a particular type of acquisition. In column (1) it is a dummy variable taking value of 1 for mills ever acquired and 0 otherwise; conditional on being acquired, in column (2) it is a dummy variable for mills acquired by groups and 0 otherwise; conditional on being acquired by a group, in column (3) it is a dummy variable for mills acquired by foreign groups. "Score within 5 km of mill" is a z-score denoting suitable growing conditions in the mill's catchment area accounting for geo-physical properties (appropriate density of coffee trees, proximity to road infrastructure and suitable elevation of spring water source). This measure is obtained from Macchiavello and Morjaria (2021). "Bank Branches" denotes number of bank branches per 100,000 people in the mill's district (IHS transformation). "SACCOs" denotes number of Savings and Credit Cooperatives per 100,000 people in the mill's district (IHS transformation). Both proxy for local financial development and are obtained from the Access to Finance Rwanda Annual Reports (Source: https://afr.rw/, accessed May 2020). "Year of Mill Entry" is the year in which the mill enters the industry. "Installed Capacity (tons, ln)" is the mill's installed capacity to process coffee cherries the year prior to acquisition. "Trust in People" comes from the World Value Survey (Source: https://www.worldvaluessurvey.org/WVSDocumentationWV6.jsp, accessed December 2021). Weighted average of responses in 2007 and 2012. The dummy variable equals to 0 if a respondent chooses need to be very careful with most people and 1 if a respondent chooses most people can be trusted. "Poverty Head Count" denotes the share of households under the poverty line in a district (Source: http://www.statistics.gov.rw/publication/rphc4-thematic-report-measurement-and-mapping-non-monetary-poverty. The last row reports p-values for the joint F-test of the null coefficients.

Table A6: **MILL TECHNOLOGY – PULPING MACHINES AND OTHER INFRASTRUCTURE**

Dependent Variable:	(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) Water Tank/Drying Table (ratio)
Panel A: Group ownership									
Mill belongs to a group	0.404**	0.117	-0.138*	0.022	-0.003	0.034	0.660***	0.017	0.104***
	(0.160)	(0.074)	(0.071)	(0.031)	(0.070)	(0.058)	(0.157)	(0.055)	(0.039)
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)
Observations	265	265	265	265	265	265	265	265	265
R-squared	0.280	0.205	0.240	0.105	0.311	0.160	0.336	0.155	0.216
Mill controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
P-value [Foreign = Domestic]	0.049	0.281	0.686	0.206	0.770	0.212	0.140	0.115	0.738

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 disks 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. Mill controls are age of the mill, mill type (private or cooperative) and location of mill. The sample is from the 2017 mill survey.

Table A7: **SOURCES OF WORKING CAPITAL FINANCE**

Dependent Variable:	(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)
Observations	39	39	39	39	39
R-squared	0.040	0.030	0.034	0.019	0.043
Exporter controls	Y	Y	Y	Y	Y

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 a dummy for a mill taking loans from financial institutions (e.g. banks), column 2 is a dummy for internal funds used for working capital needs, column 3 is a dummy for borrowing from farmers, column 4 is a dummy for loans from friends and partners, and column 5 is a dummy for 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 acquirer interviews.

Table A8: **MANAGERS AND FIRM PERFORMANCE**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable:	Operating = 1		Cherries Processed (tons, ln)		Installed Capacity (tons, ln)		Capacity Utilization (ratio)	
Mill belongs to a foreign group	0.128***	0.077	0.593***	0.468**	0.075*	0.017	0.226***	0.143
	(0.040)	(0.048)	(0.135)	(0.232)	(0.040)	(0.048)	(0.062)	(0.108)
Mill belongs to a domestic group	0.029	-0.006	-0.115	-0.090	0.072**	0.100**	-0.064	-0.066
	(0.028)	(0.019)	(0.091)	(0.112)	(0.035)	(0.044)	(0.042)	(0.062)
R-squared	0.338	0.240	0.678	0.723	0.863	0.906	0.573	0.594
Manager Characteristics	N	Y	N	Y	N	Y	N	Y
Mill and Year FE	Y	Y	Y	Y	Y	Y	Y	Y
P-value [Foreign = Domestic]	0.004	0.031	0.000	0.019	0.948	0.113	0.000	0.044

Note: Robust standard errors are estimated. $***$ (**) [*] indicates significance at the 0.01 (0.05) [0.1] level. Manager characteristics controls contain the experience, age, gender, education, trust, and raven's score of managers. The number of observations halves from odd columns to even columns due to the observations that do not contain the mill manager characteristics. For the observations we know the manager name, we impute the manager characteristics such as age, gender, and education attainment. We also impute the trust and raven's score of managers by taking the mean across years.

Table A9: **ORGANIZATIONAL CAPABILITIES: AUTONOMY, IT AND SALARY**

Dependent Variable:	(1) Autonomy Score	(2) Farmers Autonomy	(3) Work Collectors Autonomy	(4) Quality Autonomy	(5) CapEx Autonomy	(6) ITSYS Count	(7) Monthly Salary	(8) Incentive Pay
Panel A: Group Ownership								
Mill belongs to group	0.778*	0.285	0.319*	0.140	0.034	0.809	0.268*	-0.022
	(0.452)	(0.191)	(0.172)	(0.086)	(0.113)	(0.497)	(0.149)	(0.056)
Panel B: Foreign vs. Domestic Group Ownership								
Mill belongs to a foreign group	1.552**	0.641**	0.662***	0.248**	0.002	2.098***	0.616***	-0.049
	(0.650)	(0.255)	(0.238)	(0.122)	(0.157)	(0.703)	(0.196)	(0.090)
Mill belongs to a domestic group	0.439	0.129	0.169	0.093	0.048	0.306	0.177	-0.015
	(0.502)	(0.203)	(0.188)	(0.095)	(0.125)	(0.529)	(0.154)	(0.056)
Observations	265	265	265	265	265	262	548	551
Mill Controls	Y	Y	Y	Y	Y	Y	N	N
Mill and Year FE	N/A	N/A	N/A	N/A	N/A	N/A	Y	Y
P-value [Foreign = Domestic]	0.112	0.042	0.050	0.229	0.775	0.011	0.005	0.677

Note: Robust standard errors are estimated. $***$ (**) [*] indicates significance at the 0.01 (0.05) [0.1] level. Column 1 is the sum of all the dummy variables for the manager autonomy across all the management practices. Column 2 is the sum of 4 dummy variables for the manager autonomy over farmers: training for farmers, quality requirement, incentives for farmers, and second payments to farmers (akin to end of season bonus payments). Column 3 is the sum of 4 dummy variables for the manager autonomy over workers and collectors: replacement of key workers, incentives for workers, replacement of collectors, and incentives for collectors. Column 4 is a dummy variable for manager autonomy over coffee quality: quality checks on processing. Column 5 is the sum of 3 dummy variables for the manager autonomy over investment decision: accounting/financial software, new pulping machines, and small CapEx investment. Column 6 is the sum of 8 dummy variables for the mill's use of IT systems across various operational practices. Columns 7 and 8 are (ln) monthly salary for the manager and a dummy variable for incentive payment, respectively. Mill controls contain the mill's age, installed capacity (ln), location of mill, dummy variables for private mills and new mills. The sample is the 2017 manager survey module.

Table A10: **MINCER MANAGER SALARY**

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	Monthly Salary (ln)				
Panel A: Group Ownership					
Mill belongs to group	0.229***	0.213***	0.104	0.099	0.492*
	(0.055)	(0.059)	(0.068)	(0.072)	(0.250)
Panel B: Foreign vs. Domestic Group Ownership					
Mill belongs to a foreign group	0.587***	0.456***	0.324***	0.303***	0.730**
	(0.069)	(0.073)	(0.085)	(0.097)	(0.311)
Mill belongs to a domestic group	0.118**	0.139**	0.050	0.056	0.414
	(0.058)	(0.062)	(0.071)	(0.074)	(0.267)
Observations	635	537	537	503	350
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
Year FE	Y	Y	Y	Y	Y
Manager FE	N	N	N	N	Y
P-value [Foreign = Domestic]	0.000	0.000	0.000	0.003	0.235

Note: Robust standard errors are estimated. $***$ (**) [*] 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 variable across all columns is monthly salary (ln). Manager controls are the age, experience, whether manager attended secondary school or not, whether manager attended college/university or not, gender dummy, and z-scores of cognitive ability (raven test) and trust. 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.

Table A11: **MOTIVES FOR ACQUISITION**

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

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