

## Mali Food Security Policy Research Program

### What Drives Food Processor Use of Local Versus Imported Inputs? Evidence from the Malian Dairy Sector

By

Ryan Vroegindewey, Veronique Theriault, Robert Richardson, Kimberly Chung



## **Food Security Policy *Research Papers***

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## Introduction

Consumer demand for dairy in West Africa has been growing for several decades and is positively correlated with both income growth and urbanization (Hollinger and Staats, 2015). In Mali, household data from 1989 and 2006 reveal that the share of household expenditures for dairy increased by 50% and by 30% in urban and rural areas, respectively (Ibid.). In Mali's capital Bamako, which accounts for more than one-fifth of the national dairy market, or 83 million of 376 million liters (L) per year, per capita dairy consumption was about 34 L/year in 2014 (author's calculations, from World Bank, 2015).<sup>1</sup>

Until now, Mali and its regional neighbors remain dependent on imported powdered milk for meeting their dairy demand.<sup>2</sup> Powdered milk accounts for about one-third of household dairy consumption for Mali as a whole (author's calculations from WB, 2015). This dependence is accentuated in urban areas (compared to rural areas), due to their higher population densities and greater distances to agricultural production zones, combined with weak overall commercial infrastructure. For example, in Bamako powdered milk accounts for 70% of dairy volumes directly consumed by households. The remaining 30% includes fluid milk and fermented products (Ibid.). Although these products are sometimes made from locally-sourced fresh milk, they are also frequently manufactured entirely from powdered milk or from some combination of fresh and powdered milk. Thus, the *actual* share of household dairy consumption represented by powdered milk most likely surpasses 70% in Bamako.

Furthermore, there are signs that competition between local and imported dairy products has been increasing in recent years. Several reports find that European dairies have been increasing their focus on West African markets, following the end of the European Union milk production quotas in 2015 and due to other factors in global milk markets.<sup>3</sup> These companies have been making large investments in processing and distribution capacity in West Africa, including in Bamako, in an effort to further increase demand for powdered milk among processors and in consumer markets (Choplin, 2016; Orasmaa et al., 2016).

In sum, foreign competition is an important feature of West African dairy markets and, in the view of many local value chain actors, a major threat to the local dairy sector (Baché, 2018, March 2; Livingstone, 2018, April 4). However, the economic literature on African dairy development is

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<sup>1</sup> In this paper, I present dried milk products in Liquid Milk Equivalents (LME) using a conversion factor recommended by Meyer and Duteurtre (1998).

<sup>2</sup> Because Mali does not manufacture powdered milk, all supply of powdered milk is imported. Also, in this paper I use the following nomenclature. "Fresh milk" refers to any fluid milk (pasteurized or unpasteurized) that is produced in Mali. "Dairy product" refers to any consumer product made from powdered and/or fresh milk. "Local dairy product" refers to any dairy product that is manufactured in Mali, regardless of the type of milk input used. I also use the terms milk "inputs" and "ingredients" interchangeably. "Firm" refers to any dairy processor.

<sup>3</sup> The European Union (EU) milk production quota system, which had regulated European markets since the 1980s, imposed a domestic production ceiling on each EU member state. Orasmaa et al. (2016) expect that the abolition of these restrictions will result in increased EU production. Given the saturation of EU consumer markets, existing trade relationships between the EU and West Africa, and growing demand for dairy in the latter region, Orasmaa et al. (2016) forecast that the EU will accelerate its exports to West Africa.

surprisingly silent on this issue and on identifying corresponding measures that can strengthen the competitiveness of processors and value chains that commercialize fresh milk.

The objective of this paper is to examine the following overarching research question: What factors drive a dairy processing firm's choice to use local fresh milk, powdered milk, or some blend of both, as an input in the manufacturing of consumer dairy products? Drawing on concepts from strategic management, industrial organization, and organizational economics, I investigate this issue by analyzing how each of the two milk input types contributes to or detracts from a processor firm's competitive advantage (Porter, 1985). I employ case study methods and examine nine Bamako firms that use fresh milk and powdered milk to varying degrees in their operations, and which (together) are representative of the Bamako dairy processing industry.

From this analysis, I am able to identify several strategic factors on which fresh milk value chains and government policy can focus to promote the use of fresh milk by processor firms. This goal is of great importance to economic development, because increased competitiveness of domestic agricultural products should contribute to job and income growth while enhancing food and nutritional security in urban areas where access to dairy products can be limited (Theriault et al., 2018; Tschirley et al., 2015).

Additionally, this paper responds to a longstanding need to apply industrial organization and agribusiness concepts to address challenges in developing agricultural markets (e.g., Bellemare and Bloem, 2018; Cook and Chaddad, 2000), particularly in the “hidden middle” segments of value chains (Reardon, 2015). These middle segments include wholesalers, transporters, and processors, who together account for a large share of added value and costs. For example, in dairy value chains, processors play the critical role of preserving liquid milk through pasteurization or fermentation and converting it into numerous other products (Jaffee, 1995). Broadening analyses beyond the farming segment is also important because, in increasingly globalized food markets, value chains compete against other value chains (Boelhje, 1999).

In the next section, I define competitive advantage and its two domains—cost and differentiation—and relate these concepts to African dairy value chains. In Section 3, I describe the case study methods that I use in this research. In Sections 4 through 6, I analyze the cases to answer three underlying questions that help me to answer the overarching research question: (1) How do firms use each type of milk input in their operations? How does the use of each input contribute to firms' competitive advantage by influencing (2) costs or (3) differentiation? In the final section, I present implications for agribusiness strategy and policy, with the aim of improving the competitiveness of local dairy value chains in Mali.

## 1 Conceptual Framework

*There are several techno-economic features of milk, milk production, and dairy processing which generate risks as well as opportunities for dairy producers and marketing enterprises and which might be expected to influence the industrial organization of dairy commodity systems in Africa (Jaffee, 1995, p. 200).*

## 1.1 Firm competitive advantage

In economic theory, a firm makes decisions in order to maximize its expected profit—or, under the principle of duality, to minimize costs—subject to constraints. However, the conventional neoclassical production model makes several strong assumptions, including the existence of perfect information, a complete set of markets, product homogeneity, competition between a large number of firms and buyers with ease of market entry and exit, and the absence of economies of scale (Kirsten et al., 2009). By relaxing these assumptions, organizational economics provide a framework for explaining the existence and behavior of different firms, as they seek to maximize profits and minimize costs in response to various market failures (Mahoney and Pandian, 1992).<sup>4</sup>

Drawing from this framework, as well as from concepts in industrial organization, strategic management theory redefines the firm's objective as the creation of competitive advantage, which is the ability of a firm to establish a profitable position in an industry, by differentiating its products from those of competitors in order to create value for its customers, while ensuring that firm costs do not exceed this value (Porter, 1985). Embedded within this definition are two domains that determine competitive advantage— cost and differentiation (Ibid.). The premise of this paper is that, by analyzing how a firm's choice of inputs influences these two domains, I can understand how different inputs contribute or detract from the firm's competitive advantage, and thus identify the critical factors that shape firm preferences for the different inputs.

## 1.2 Cost

The first domain of competitiveness is cost. For a dairy firm, costs are composed of the purchase price of milk and other inputs, the production costs associated with processing inputs into a consumer product (e.g., reconstitution, pasteurization and cooling, fermentation, packaging), the distribution costs for getting the product to the buyer (e.g., storage, transport, and promotional costs), and any associated transaction costs in these processes (e.g., gathering information on the buyer, assessing the product, contracting).<sup>5</sup>

Cost reduction contributes most to competitive advantage in the form of cost advantage, which is a firm's capability to operate at a lower per-unit average cost than its rivals, independent of scale (Waldman and Jensen, 2013; Porter, 1985). Cost advantage is rooted in superior (i.e., less costly) access to key resources such as a critical input, enhanced technology, financial capital, specialized human resources, or desirable production or distribution locations. It originates from imperfections in various capital, input, output, or labor markets, and arises when firms incur differently the

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<sup>4</sup> Organizational economics is the branch of economics that includes, among other theoretical frameworks, transaction cost theory and information economics. The shared premise in these frameworks—established by Coase (1937)—is that market failures explain not only the existence of firms, but also the strategic characteristics of firms including their size, scope, and internal organization (Mahoney and Pandian, 1992). A market failure occurs whenever a free market fails to bring about a Pareto-efficient allocation of a good or service, i.e. when there exist additional unexploited trades between two parties that could make at least one party better off without making the other worse off (Besley, 1998).

<sup>5</sup> Transaction costs are the costs incurred by two parties in using a spot market prices to transaction a good (Coase, 1937). They include the *ex ante* costs of searching for and screening trade partners and negotiating an agreement; and the *ex post* costs of monitoring and enforcing the agreement, transferring ownership of the product, and any costs associated with adapting to disturbances (Staal et al, 1997).

transaction costs resulting from these market failures. Thus, identifying the sources of transaction costs are especially important to understanding competitive advantage.

Such imperfections are a common feature of developing agricultural markets, and dairy value chains are no exception (Jaffee, 1995). In fact, as the epigraph at the beginning of this section suggests, milk has several fundamental attributes that generate significant transaction costs within the value chain. These include its high perishability and bulkiness, wide quality variability, the lumpy specialized assets required for production, and the seasonality of output (Ibid.). There is a broad literature describing the constraining presence of transaction costs in the supply and procurement of fresh milk in East Africa (e.g., Burke et al., 2015; Holloway et al., 2005; Holloway, 2004; Holloway et al., 2000). A few others studies also analyze transaction costs in processing (Jaffee, 1995). The major insight from these studies is that high transaction costs impede participation, efficiency, and supply in these dairy markets. On the other hand, there is little documentation on the procurement and processing of powdered milk, and to what extent the costs associated with this milk input differ from those generated by fresh milk.

### 1.3 Differentiation

Differentiation refers to a firm's ability to distinguish its brand on the basis of consumer preferences for some perceived product attribute, services associated with products, or costs involved in switching from one product to another (Waldman and Jensen, 2013; Porter, 1985). As a domain of competitive advantage, differentiation allows a firm to sell more products at a given price, or to raise its price relative to the prices of its rivals while still retaining customers who prefer its products (Porter, 1985; Bain, 1956). Differentiation must be valuable to buyers and relatively rare on the market in order for it to lead to competitive advantage (Porter, 1985).

In addition to generating transaction costs, the techno-economic features of milk also create opportunities for differentiation (Jaffee, 1995). One potential basis for differentiation is the input composition of a dairy product. Some consumers may have a particular preference for dairy products processed from fresh milk or, alternatively, from powdered milk, on the basis of taste, consistency, place of origin, or some other attribute that is associated with one milk type but not the other. For example, dairy firms might differentiate their products on the basis of consumers' preference for locally produced fresh milk instead of imported powdered milk as a product ingredient. Using choice experiment data collected in Bamako, Vroegindewey et al. (2019) shows that 85% of consumers have a distinct preference for 100% local fresh milk as the ingredient in pasteurized milk. Additional stated preference data suggests that similar preferences hold for other dairy products as well.

The choice of milk input might further affect competitive advantage through its influence on several other bases for differentiation. First, in general milk is amenable to processing into a very wide range of products and sub-product types. However, a firm's options for dairy product differentiation may depend on the input that is used.

Second, the taste, and safety of a dairy product depends on its chemical and biological quality, which can be highly variable and depends on an array of factors related to herd management as well as elements in processing, transport, and storage. Given the considerable differential in conditions

between dairy farming in Mali and in other exporting countries, I would expect that dairy product quality is affected by the origin of its inputs.

Third, it is costly or impossible for consumers to directly observe many of these variations in quality, which creates information asymmetry between consumers and the other actors in the value chain. Consequently, to avoid problems of adverse selection, dairy processor firms must successfully differentiate their own products from other lower-quality products through quality-signaling mechanisms, such as advertising, packaging, third-party certification, or an effective sales force (Rosenman and Wilson, 1991).<sup>6</sup>

## 2 Methods

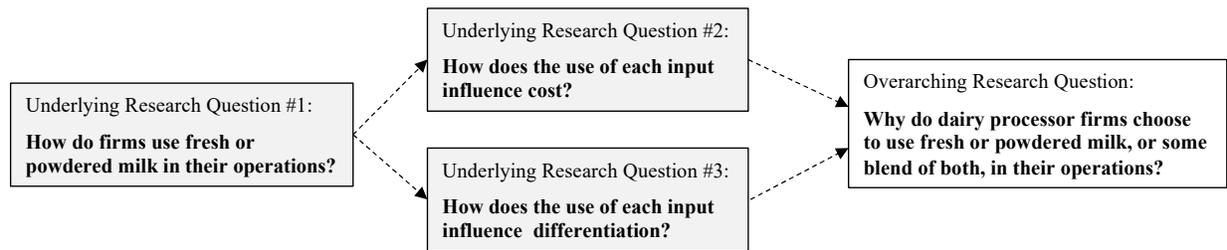
### 2.1 Case study methods and case selection

Case study methods are appropriate for this research, first, because it seeks to answer several process-type questions about firm strategy that are outlined in Figure 2.1 (Maxwell, 2013). The objective is to answer one over-arching research question: “*Why* do dairy processor firms choose to use fresh or powdered milk, or some blend of both, in their operations?” Using the conceptual framework to answer this question focuses the investigation on three underlying questions (see Figure 2.1). *How* do firms use fresh or powdered milk in their operations? *How* does the use of each input influence cost? *How* does the use of each input influence differentiation? Case study methods are an effective tool for investigating such *why* and *how*-type questions, because they allow for thick description of processes, especially through qualitative data (Yin, 2014).

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<sup>6</sup> Information asymmetry exists in a transaction when one party has more information than the other. Adverse selection is a situation of information asymmetry in which buyers must rely on market prices alone as an imperfect indicator of quality. Akerloff (1970) showed that there will be a reduction in the average quality of marketed dairy products and buyers with a preference for higher quality will eventually exit the market.

Figure 2.1: Research questions



Second, because applications of strategic management theory to developing market contexts are still rare in the scholarly literature, refinements to existing theory may be necessary. Case study methods are fit for this purpose, by building a strong understanding of firm context and by allowing the research to probe the perspectives and experiences of firm actors (Maxwell, 2013). Finally, a practical limitation of conducting agribusiness research is that there is often a limited number of large or even medium-sized processing firms (Reardon, 2015), which necessarily restricts the sample size of studies. In sum, case study methods are appropriate for this research because it analyzes multiple types of data in order to describe and explain the complex processes of firm management, of which there are fewer observations than variables of interest (Sterns et al., 1998).

Because any firm activity is a potential source of cost reduction or differentiation (Porter, 1985), I defined each case to cover four areas: procurement, production, distribution, and marketing. In the first step of case selection, I developed a preliminary list of processor firms operating in Bamako, based on secondary sources, informant interviews, and dairy product packaging that was gathered during preliminary fieldwork. I then refined this list of case candidates through initial interviews with the firms. In order to examine the relationship between the domains of competitive advantage and milk input decisions, I adopted a multiple-case design in which the primary case selection criteria was to obtain a sample of firms that varied in the extent to which they use fresh versus powdered milk in their operations (Yin, 2014).

To ensure that the research is relevant to the entire Bamako dairy processing sector, the second case selection criteria was to obtain a sample that represented the range of dairy firms operating in Bamako, in terms of three variables. The first variable is product mix, or the variety of different types of dairy products that a firm produces. The second is scale, as indicated by a firm's annual dairy output, its number of employees, and its level of capitalization. The third variable is production technology, which I break down into three groups. I define an artisanal firm as one which completes all production and packaging steps by hand, a semi-industrial firm as one which has mechanized at one part of its production operations, and an industrial firm as one which has mechanized most of its operations.

## 2.2 Data collection and analysis

I collected the case study data during three waves from July 2017 to April 2018, to obtain a seasonal understanding of dairy production and marketing activities, to build rapport with each firm,

and to facilitate a participatory process of data collection and validation. Field work focused on several types and sources of data in order to obtain in-depth coverage of each case, and to facilitate data triangulation (Yin, 2014).

As mentioned above, one objective of the first wave of data collection was case selection. During this fieldwork, I collected preliminary information on most cases through relatively short interviews with the owner of each respective firm.<sup>7</sup> These interviews focused on obtaining a broad overview of firm history and activities, including information on the shares of milk ingredients that each firm used and each firm's product mix, production technology, and scale. The case information that I gathered from the initial interviews also provided a basis for deeper inquiry in the second wave of data collection.

During the second wave, I conducted in-depth semi-structured interviews with the owner and key personnel of each firm, and a short quantitative survey. These instruments focused on obtaining a more detailed understanding of how each firm used different milk ingredients, and to explore how each ingredient affected costs and differentiation in every area of firm activity, i.e., procurement, production, distribution, and marketing. I also conducted semi-structured interviews with each firm's primary input supplier in order to gather additional data on procurement, and with a selection of buyers (i.e., the sellers, independent retailers, or wholesalers with whom the firm transacts directly) in order to gather additional data on marketing and distribution. I recorded interview data with audio recording interviews and hand-written notes, and also collected samples or photographs of packaging and other marketing artifacts (e.g., billboards, storefronts, electronic media) for each firm.

After the second wave of field work, I developed narratives of each case. These described in detail the strategic choices and processes associated with each area of firm activity and, as an analytical technique, began to organize the complexity of each case and set the stage for answering the research questions (Yin, 2014). I also summarized each case narrative into a short brief and shared it with the owner of each firm. During the final wave of field work, I invited each owner to correct any errors in the narratives and to provide any additional data or comments. In this way, the case narratives also served as a data validation tool and helped to generate a final layer of information.

Following the final wave of field work, I analyzed the case study data in three steps corresponding to each of the three research questions. First, I grouped each firm by its use of fresh milk versus powdered milk to understand how each input is used among the firms. Second, I identified the instances of cost reduction and differentiation within each group to understand the factors by which firms create competitive advantage. Finally, I analyzed the relationship between these factors and milk input choice. The results of each analysis are presented and discussed in the next three sections.

### 3 How do firms use fresh and powdered milk in their operations?

Table 3.1 presents summary information on each firm that I selected for the research, including the dairy products that the firms commercialize and whether each is made from fresh milk,

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<sup>7</sup> In the case of the largest processor, the primary firm respondent was the assistant director of operations. For convenience, I will also refer to him as "owner."

powdered milk, or some combination thereof. The production technologies, scales, and different product types in the case studies (which I describe in the following sub-section) represent the entire range of domestically-manufactured packaged dairy products that are available in Bamako.<sup>8</sup>

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<sup>8</sup> Ghee and butter are also manufactured in Bamako by some households and artisanal processors in Bamako. However, the level of commercialization of these products is very low, and no packaged version exists.

Table 3.1: Overview of firms and dairy products

Firm	Production Technology	Dairy Product Mix	Milk inputs		Scale			Year Founded	Other products
			Primary input used (1 <sup>st</sup> , 2 <sup>nd</sup> )	Share of total commercial volumes	Total commercial volumes (L./year)	Number of employees	Capitalization (FCFA)		
<b>100% VOLUMES FROM FRESH MILK</b>									
FM1	Artisanal	Pasteurized milk	FM	70%	30,000	4	3 million	2010	
		Féné	FM	30%					
<b>95% VOLUMES FROM FRESH MILK</b>									
FM2	Artisanal	Pasteurized milk	FM	95%	92,000	5	3 million	2002	
		Drinking yoghurt	PM	5%					
FM3	Artisanal	Pasteurized milk	FM	70%	60,000	7	4 million	1995	
		Féné	FM	25%					
		Drinking yoghurt	PM, FM	< 5%					
		Dégué	PM	< 5%					
<b>1% – 20% VOLUMES FROM FRESH MILK</b>									
PM4	Artisanal	Dégué	PM	85%	225,000	16	6 million	2002	
		Pasteurized milk	FM	15%					
		Féné	FM	< 5%					
PM8	Semi-Industrial	Drinking yoghurt	PM, FM	65%	1,047,000	52	284 million	1996	Juice drinks
		Strained yoghurt	PM	15%					
		Dégué	PM	15%					
		Pasteurized milk	FM, PM	< 5%					
PM9	Industrial	Pasteurized milk	PM, FM	50%	12,000,000	125	1,500 million	1969	Juice drinks
		Drinking yoghurt	PM, FM	40%					
		Strained yoghurt	PM	10%					
		Soft cheese	FM, PM	< 5%					
		Fresh cream	FM, PM	< 5%					

**0% VOLUMES FROM FRESH MILK**

<b>PM5</b>	Semi-Industrial	Pasteurized milk Drinking yoghurt	PM	> 50%	33,000	70	57 million	2004	Packaged Water
			PM	< 50%					
<b>PM6</b>	Semi-Industrial	Drinking yoghurt Dégué	PM	65%	26000	20	72 million	1999	
			PM	35%					
<b>PM7</b>	Semi-Industrial	Drinking yoghurt Strained yoghurt	PM	90%	230,000	19	125 million	1993	
			PM	10%					

Source: Authors, based on firm interviews and surveys. Dairy product mix only includes product types that the firm regularly manufactured at the time of the study. Volumes and shares are calculated from 2016 figures, except for PM4, PM5, and PM9 which are based on 2017 figures.

Capitalization refers to the reported value of all fixed investments. Year founded refers to the year in which the firm began dairy operations.

Based on the share of each firm's commercial volumes that is constituted by products manufactured from fresh milk, I classed the firms into one of four groups. One firm exclusively uses fresh milk for its volumes (100%), two firms mostly use fresh milk (for 95% of their volumes), three firms mostly use reconstituted powdered milk (for between 80% and 99% of their volumes), and two firms use 100% powdered milk. Interestingly, although many firms use some combination of fresh and powdered milk in their operations, all firms tend to depend heavily on one input or another with the dominant input accounting for 80% or more of volumes.

In this paper, I will refer to the three firms in the first two groups as “fresh milk firms,” because they mostly or exclusively use fresh milk in their operations. I refer to the six firms in the last two groups as “powdered milk firms” for the same reason. In order to respect the anonymity of the case study participants, I also refer to each individual firm by a unique identifier composed of (i) “FM” or “PM” (to indicate whether it is a fresh milk firm or powdered milk firm, respectively), followed by (ii) a number that indicates its ordinal size relative to the other firms in the study.<sup>9</sup> I measure firm size by its level of capitalization, in terms of fixed investments. Among the case studies, firm capitalization tends to increase with the age of the firm, the number of employees, and the dairy volumes manufactured. I also note that the largest dairy firms in these cases (and in Bamako generally) mostly or exclusively use powdered milk for their operations.

### 3.1 Fresh milk firms

The three fresh milk firms (FM1-FM3) are the smallest among the case studies, each with four million FCFA or less in physical capital. FM1, which exclusively uses fresh milk, is the smallest and sells about 30,000 L per year. The other two process up to about 90,000 L per year. All three firms are artisanal in their production technology, meaning that they complete all production and packaging steps by hand, utilizing rudimentary equipment (e.g., basins, cooking pots, and wood or charcoal stoves). Production takes place within the walled courtyard of the owner's residence or inside her house.

These firms use fresh milk for one or two products that make up the majority of their volumes. The primary product (making up 70% or more of commercial volumes for each firm) is pasteurized milk (*lait frais pasteurisé*), which firms manufacture by heating raw fresh milk to about 90 degrees Celsius. The second-most important product is *féné*, a traditional full-fat fermented milk that firms manufacture by leaving pasteurized milk to ferment at the ambient temperature, sometimes with a local culture.

The two larger firms in this group also have one or two additional yoghurt-based product that includes powdered milk. Each of these yoghurt-based products makes up 5% or less of each firm's total volumes. Both firms manufacture drinking yoghurt (*yaourt à boire* or *yaourt brassé*).<sup>10</sup> FM2 makes this product entirely from powdered milk, while FM3 uses fresh milk as the base ingredient, and blends in some additional powdered milk. FM3 additionally manufactures a powdered milk-based *dégué*, a traditional product consisting of millet couscous mixed with a thick yoghurt. FM1 currently

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<sup>9</sup> For example, FM1 refers to the smallest firm among the case studies, which is a FM fresh milk, while PM9 refers to the largest firm, which is a powdered milk firm.

<sup>10</sup> In Mali, the French word *lait caillé* (“soured milk”) is sometimes also used colloquially to refer to either *féné* or drinking yoghurt.

only manufactures pasteurized milk and *féné*; however, the owner has experimented with yoghurt in the past and wishes to begin regularly make this product in the near future.

Each of the fresh milk firms is a member of the Bamako Cooperative of Local Milk Resellers (CRLLB). In the 2000s, several artisanal firms (including the owners of FM2 and FM3) collaborated with a local non-governmental organization (NGO) to create CRLLB. Its purpose was to build the capacity of processors of fresh milk-based products in Bamako, and to help coordinate their procurement of fresh milk. A broader goal was to develop a viable market channel in Bamako for eighteen peri-urban farmer cooperatives that are members of the National Federation of Malian Milk Producers (FENALAIT). In 2018, CRLLB had about 90 individual members (90% of whom are women), and delivered milk to about 160 artisanal firms throughout Bamako. Field work confirmed that the number of small firms selling fresh milk in Bamako greatly exceeds this amount, although CRLLB is the largest network of these actors.

### 3.2 Powdered milk firms

The other six firms in the case studies (PM4-PM8) use powdered milk for products that make up the majority, or all, of their volumes. Among these, one firm (PM4) is an artisanal firm. Like its fresh milk firm counterparts, this firm is also a member of CRLLB and manufactures a pasteurized milk and *féné* product using fresh milk. However, *dégué* accounts for 85% of its total commercial volumes (225,000 L per year), which greatly surpasses the output of the other artisanal firms.

Another four powdered milk firms (PM5-PM8) are semi-industrial: each has a dedicated factory and has mechanized at least the packaging process of its operations (and sometimes additional steps as well). These firms have a capitalization of about 60 million to 280 million FCFA, and commercialize up to one million L of dairy products per year. Informant interviews and secondary sources suggest that these four firms are among the largest semi-industrial dairy firms in Mali.

Among these semi-industrial firms, the product accounting for the most volumes is drinking yoghurt. Additionally, two firms (PM6 and PM8) manufacture *dégué* and two firms (PM7 and PM8) manufacture strained yoghurt (*yaourt étuvé*), which is less-viscous than drinking yoghurt. The smallest and largest semi-industrial firm (PM5 and PM8) also manufacture a pasteurized milk product. All of these products are made from powdered milk, with two exceptions. For its occasional production of pasteurized milk, PM8 uses fresh milk, powdered milk, or some blend of the two, depending on the availability of fresh milk (the preferred input) at that moment. When there is leftover fresh milk from pasteurized milk production, PM8 also blends this into the drinking yoghurt formula. Finally, firms PM5 and PM8 also commercialize a product line of packaged water and fruit juices, respectively.

The industrial firm PM9 has mostly mechanized facilities and is the oldest and largest dairy processor firm in Mali. It has a capitalization of 1,500 million FCFA and an output of about twelve million L per year. This firm manufactures its best-selling products, pasteurized milk and drinking yoghurt (together accounting for at least 75% of volumes) using a blend of reconstituted powdered milk and fresh milk. While the ratio of inputs varies, it is typically dominated by powdered milk. PM9's second most popular product by volume is strained yoghurt made entirely from powdered milk. Finally, the industrial firm also manufactures a fresh milk-based soft cheese (*fromage frais*) and

fresh cream (*crème fraîche*) product manufactured from a blend of fresh milk (the base input) and powdered milk.

#### 4 How does milk input choice influence cost?

The costs of using one milk input instead of another can differ along three dimensions: the purchase price of the input itself, the transaction and coordination costs entailed in the procurement of the milk input, and idiosyncratic costs related to its use in processing and distribution.

##### 4.1 Costs of fresh milk

###### 4.1.1 Relative purchase price of fresh milk

According to one dairy industry informant, among all of the factors influencing the use of fresh milk, its purchase price was the “brake” that constrained firms the most. Indeed, each of the powdered milk firms cited the relatively high per-liter purchase price of fresh milk, compared to powdered milk, as a primary reason for its dependence on powdered milk. Even fresh milk firms complained that the purchase price, in the context of intensifying competition, are increasingly squeezing their margins. PM9 stated that the purchase price negotiated with its suppliers is the primary factor determining fresh milk purchase volumes. This negotiated price has also been a perennial source of tension between the PM9 firm and its suppliers since its privatization in 1996. The real price has risen over time—from 200 FCFA per liter in 1996 to 400 FCFA in 2018—and a few facts suggest that it is a determinant of the fresh milk price throughout Bamako. First, PM9 is the single largest market channel for the largest peri-urban dairy cooperatives, accounting for at least one quarter of the commercial volumes of these suppliers.<sup>11</sup> Second, PM9’s purchasing terms were cited by all four artisanal firms, as a variable affecting their own transaction terms with suppliers. These firms reported purchasing fresh milk (usually pasteurized) at prices ranging between 400 and 425 FCFA/L in 2018, depending on the seller. Interviews suggest that this purchase price fluctuates little throughout the year, despite significant intra-seasonal variations in supply (discussed below).

Of issue, of course, is not merely the price of fresh milk but its relative position with respect to the price of powdered milk. In Mali, most powdered milk is imported from Europe, followed by New Zealand (FAOSTAT, 2018). The per liter purchase price of these imports are cheaper in Bamako, compared to that of fresh milk, due to a combination of higher farm efficiencies and substantial policy support through the years (Choplin, 2016). An additional factor has been the market entry of filled powdered milk, in which dairy fat is substituted for a cheaper vegetable fat. Filled powdered milk first appeared on the Malian market around the year 2000, and eventually surpassed whole milk imports (in terms of volumes) around 2013 (FAOSTAT, 2018).

###### 4.1.2 Coordination costs in procuring fresh milk

In addition to the costs that are captured through purchase price, the procurement of fresh milk generates additional transaction costs associated with such challenges as finding suppliers, procuring

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<sup>11</sup> According to the three largest dairy cooperatives supplying PM9, these cooperatives delivered 1,800 L to 3,500 L of milk daily to PM9 in 2016. It is difficult to pin down PM9’s total daily procurement of fresh milk. According to company sources, it was procuring 10,000 to 15,000 per day during the 2017-2018 period; however, Corniaux (2014) reports that the daily average ranged between 2,000 L and 4,000 L.

the right quantities at the right time, and quality. Firms attempt to minimize these transaction costs through better coordination with suppliers. According to the two most experienced fresh milk firms, in the past two decades this has been greatly facilitated by several structural changes, including the expansion of cell phone coverage, increases in urban demand, and the diffusion of higher-yielding cow breeds alongside the development of dairy cooperatives.

However, coordination itself is also costly, both in terms of the fixed costs of setting up procurement arrangements and the daily costs of coordinating each individual transaction.

Broadly speaking, fresh milk firms and suppliers use several types of supply arrangements. First, each of the fresh milk firms procure inputs through relational contracting with individual dairy farmers, farmer cooperatives, or intermediary traders who work closely with farmers. PM8 uses a similar model for its occasional fresh milk purchases. Within these arrangements, firms coordinate carefully with suppliers on a daily basis, due to the perishability and bulk of fresh milk, limited cold storage capacity, and the tight production and distribution schedules that firms must keep. At minimum each day, fresh milk firms must call their suppliers to plan the next fresh milk delivery and must ensure that a capable agent is physically present to receive and inspect deliveries, to begin processing the milk, and to make any necessary adjustments for late deliveries or quantity or quality problems.

Second, all fresh milk firms also purchase a share of their volumes through the CRLLB supply cooperative, which collects 25 FCFA on every liter of fresh milk (or about 6% of the per-unit purchase price) to sustain its operations. This fee only represents a share of the daily coordination costs that firms incur for using this arrangement, given that firms must still coordinate with CRLLB (instead of directly with other suppliers) on a daily basis. Additionally, some CRLLB costs (e.g., salaries) are subsidized by external partners.

Third, the industrial firm (PM9) purchases fresh milk that is delivered to a collection center at its Bamako factory. Each week-day, it procures up to 10,000 L from a select group of forty to sixty suppliers mostly made up of cooperatives and large farmers. Suppliers must deliver unpasteurized milk before one p.m., and are paid once a month. In 2018, the second-largest firm (PM8) was also in the final stages of constructing a collection center complex next to its factory, with the aim of increasing its fresh milk procurement capacity. Funded through a public-private partnership and set to begin operations in late 2018, the center will have 8,000 L in cooling tank capacity, a training center, and a retail point for animal feed and veterinary products.

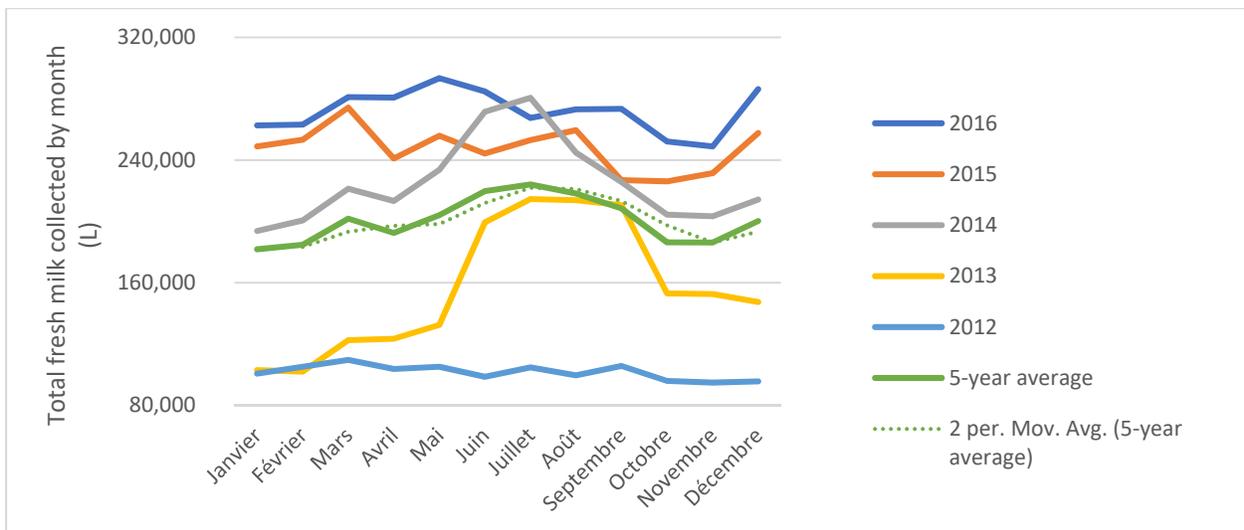
#### 4.1.3 Transaction costs in procuring fresh milk

Even with these procurement arrangements in place to coordinate daily fresh milk transactions, fresh milk firms identify two enduring problems that they must frequently manage, which drive up the transaction costs of procuring fresh milk. The first problem is the uncertainty of milk supply interannually, across seasons, and even from day to day. Four of the powdered milk firms cited supply uncertainty, especially during the hot dry season of March to May, as a key challenge that drove and/or continually constrains them from using fresh milk. PM5 (the most recent entrant in the case studies) began its dairy operations in 2017 by sourcing fresh milk, but began during the hot dry season. Within a couple months, the firm made a complete switch to powdered milk. The owner

cited the limited availability of fresh milk, in addition to its price and sensitivities in processing (see below), as the deciding factor. PM8 also stated that its choice of how much of each input to use in a given batch of pasteurized milk depends on the availability of fresh milk at that moment.

Supply uncertainty is also one of the major challenges for fresh milk processors. For example, the year-on-year changes in total volumes procured by CRLLB from 2012 to 2016 range between –29% and 24%. As an indication of seasonal variability, Figure 4.1 displays the volumes collected by the FENALAIT cooperatives in the years 2012 to 2016. While the mean trendline suggests that supply does tend to peak during the rainy seasons due to the availability of pasture for grazing (June–September), this pattern is less pronounced in certain years (e.g., 2012, 2015, and 2016) and can fluctuate significantly from month to month. These broader dynamics translate into supply uncertainty for the CRLLB members and PM9 who source from the cooperatives. For example, CRLLB records in 2016 indicate that PM4 and FM1 received all of their ordered volumes only 35% and 55% of the time, respectively. To mitigate such uncertainty associated with any given supplier, FM3, FM2, and FM1, each maintained at least two additional suppliers from whom they regularly purchased throughout the week, as backup in the event that one of their orders was not fulfilled, or to supplement their input needs when they received large special orders (e.g., for cultural ceremonies). In the words of the owner of FM2, “You cannot get what you want with only one or two suppliers.”

Figure 4.1: Monthly volumes collected by peri-urban FENALAIT dairy cooperatives, 2012-16



Source: Author, based on FENALAIT (2017)

A second enduring problem in the procurement of fresh milk is quality uncertainty, particularly spoilage that leads to losses. The three largest powdered milk firms (PM7, PM8, and PM9) cited the quality of fresh milk as a challenge. Supply cooperatives and firms usually observe some minimal

form of quality control, depending on their access to different testing instruments. PM9 and many supply cooperatives utilize a lactodensimeter (a tool for measuring milk density) and an alcohol test to assess deliveries of raw milk regarding density (e.g., to gauge whether it has been mixed with water or cream has been removed) and acidity (e.g., bacterial growth and spoilage), respectively. However, artisanal firms do not have access to these resources. Instead, they depend on any quality control procedures taken by their supplier, if any, and otherwise only apply organoleptic tests (based on sight, smell, and visual tests) when they receive deliveries (Ibid.). Under the above-described coordination mechanisms, a buyer typically holds the right to reject milk *ex ante* if it is observably bad; however, the buyer must absorb the costs of losses or quality problems that are discovered *ex post*. For example, the owner of FM1 complained that, when deliveries are slow on hot days, milk can sour before it arrives at her door. She estimated that she rejects milk deliveries about twice per week. However, sometimes she is forced to work with milk that does not pass her test, because the alternative is no product until the following day. At other times (i.e., two or three times per month), it is only once she begins working with a batch of milk that she realizes that it was souring. Processing such milk into commercial products carries risks to her customers' health and, perhaps also, to her reputation. For example, one study found that Bamako schoolchildren who regularly consume pasteurized fresh milk were four times more likely to experience diarrhea and/or vomiting in a previous two-week period (Hetzl et al., 2004).

#### 4.1.4 Additional costs in processing fresh milk

Even after procurement, the bulkiness and perishability of fresh milk make it more costly to store and process. Firms can store powdered milk in its dried form and reconstitute it into fluid milk only when they are ready to process. In contrast, firms must either process fresh milk immediately or else refrigerate it. For the semi-industrial and industrial firms—which handle large volumes—acquiring this capacity requires large lumpy investments. Indeed, four of these firms stated that one of the advantages of powdered milk is that it is “less delicate,” “less difficult,” or “easier to work with” than fresh milk. PM5 and PM6, both of which have a couple large refrigerators and use unrefrigerated delivery vehicles, stated that these resources were insufficient to process fresh milk. PM6 stated that switching from powdered to fresh milk would require new investments in a cold room, a gas pasteurizer (to heat large amounts of fresh milk quickly), and refrigerated trucks. Maintaining this expanded cold chain capacity would generate additional electricity and fuel costs as well. The only powdered milk firms that do use some fresh milk (PM8 and PM9) already have such cold chain capacity.

#### 4.2 Costs of powdered milk

According to Bamako powdered milk firms, and in contrast to fresh milk, the local powdered milk market is well integrated with international markets, due to the relatively low trade barriers in place for powdered milk and the high volumes that are imported. Most powdered milk firms reported purchasing 25-kg sacks of whole powdered milk or filled powdered milk.<sup>12</sup> Filled powdered

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<sup>12</sup> Whole powdered milk contains 100% milk fat. In contrast, manufacturers of filled powdered milk replace the milk fat with vegetable fats to maintain high fat contents ranging between 25% and 30%.

milk imports began appearing on the Malian market around the year 2000 and surpassed the imports of whole powdered milk beginning around 2013 (FAOSTAT, 2018), due to the relative affordability of this high-fat milk ingredient option. Firms reported purchasing filled powdered milk in late 2017 at prices ranging between 1,960 and 2,200 FCFA/kg, or 260 to 290 FCFA/L in liquid milk equivalents (LME).<sup>13</sup> Two artisanal firms, which purchase much smaller amounts of filled powdered milk packaged in consumer-sized packaging, reported slightly higher prices: 2,200 to 2,500 FCFA/kg (290 to 330 FCFA/L in LME) during the same period.

In contrast to fresh milk, for which spot markets are not well developed in Bamako, powdered milk is retailed from virtually every food shop in the city. The relatively well-developed state of the powdered milk market reduces the *ex ante* transaction costs involved with searching out suppliers and negotiating prices, while mitigating some uncertainty around availability. For this reason, the smallest firms (FM1-FM3, PM4-PM6) depend on the spot market to make weekly or biweekly purchases from a retailer or wholesaler.

However, firms cite three enduring problems in the powdered milk spot markets. The first is price volatility. Second, is quality uncertainty. Several firms and informants reported that powdered milk quality varies significantly across brands, does not always reflect the technical specifications printed on product packaging, and can even vary within the same brand. Informants report several potential reasons for this quality variability, including smuggling and informal trade, illicit repackaging, and counterfeit branding of powdered milk, combined with the fact that phytosanitary and food safety regulations are weakly enforced. A third problem is supply uncertainty. Most firms prefer a few select European brands that they trust, but which are not always available on the Malian market. According to firms, these problems can adversely affect the quality of their own manufactured products, result in stock-outs, or generate search costs (to identify and adjust to new brands; see Table 4.2).

In order to mitigate these problems associated with the spot market, the largest powdered milk firms (PM7-PM9) have developed two special procurement arrangements to better coordinate transactions. First, two semi-industrial firms (PM7, PM8) use ongoing relationships and repeated monthly transactions with reputed importers of high-quality powdered milk brands. These informal agreements provide some guarantees or incentives with respect to availability and/or price. However, these firms still maintain a second supplier as a backup. Second, the industrial firm (PM9) has partnerships with at least three foreign dairy companies, through which the firm imports and markets powdered milk and other products. This access, combined with the firm's strong financial and storage capacity, enables it to purchase large amounts of powdered when it is relatively favorable to do so and to maintain robust stocks. The company additionally purchases other brands of high-quality powdered milk.

Table 4.2: Costs of fresh and powdered milk in Bamako

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<sup>13</sup> This price range is calculated from data from five of the six powdered milk firms, excluding the largest industrial processor for which this data was not accessible.

Milk input	Purchase price	Other costs
<b><i>Fresh milk</i></b>		
Raw milk, delivered by various suppliers to industrial firms	400 FCFA/L	Coordination and transaction costs in procurement: <ul style="list-style-type: none"> <li>•Frequent (daily) transactions</li> <li>•Costly procurement arrangements used in every case (relational contracting, supply cooperative, maintaining collection center)</li> </ul>
Pasteurized milk, delivered by various suppliers to artisanal and semi-industrial firms	400 - 425 FCFA/L	<ul style="list-style-type: none"> <li>•High supply uncertainty (across years and seasons, and day-to-day)</li> <li>•High quality uncertainty (spoilage, variations in composition and taste)</li> </ul> Costs in processing: <ul style="list-style-type: none"> <li>•Requires large cold chain capacity and uncertainty prior to processing</li> </ul>
<b><i>Powdered milk</i></b>		
Filled or whole powdered milk, purchased from importers or other wholesalers by industrial and semi-industrial firms	1,960-2,200 FCFA/kg 260-290 FCFA/L (LME)	Coordination and transaction costs in procurement: <ul style="list-style-type: none"> <li>•Presence of spot markets, which some firms use. Others use procurement arrangements (relational contracting, partnerships).</li> <li>•Price volatility</li> <li>•Some related quality and supply uncertainty</li> </ul>
Filled or whole powdered milk, purchased from retailers by artisanal firms	2,200-2,500 FCFA/kg 290-330 FCFA/L (LME)	

Source: Authors.

Table 4.2 summarizes the relative costs for fresh and powdered milk, including the purchase prices, transaction costs in procurement, and other idiosyncratic challenges in processing and distribution for each commodity. This comparison indicates that, for every element, firms face significantly higher costs using fresh milk. Even the highest-reported price for powdered milk (purchased in consumer-sized packaging from retailers) is about 20% cheaper than fresh milk in LME terms. Although firms face some transaction costs due to the price, quality, and supply of powdered milk, the largest firms are able to successfully manage these issues through more coordinated relationships with milk importers. On the other hand, fresh milk firms face significant transaction costs related to uncertainty of quality and supply, even after putting in place costly procurement arrangements with suppliers. Additionally, the bulkiness and perishability of fresh milk make it difficult to handle in storage and distribution. Taken together, this analysis suggests that firms can reduce costs significantly by using powdered milk instead of fresh milk.

## 5 How does milk input choice influence differentiation?

The case study analysis revealed four general sources of differentiation among dairy firms operating in Bamako. First, firms physically differentiate their products by offering new product types, or more variety within a given product type. Second, they enhance or preserve some dimension of product quality through the selection of key ingredient choices. Third, they use quality-signaling mechanisms to provide information on product attributes that are otherwise difficult or costly to observe. Fourth, firms offer unique packaging features. However, fresh milk firms are less likely to exploit each of these sources of differentiation.

### 5.1 Product types and sub-types

One basic source of differentiation for all firms is to offer product types that are unique to others on the Bamako market. In Section 5, I presented the different product types that are currently available in Bamako. In recounting their beginnings, most firm owners stated that they launched their business on the back of one of these dairy products at a time that it was relatively rare on the market. For instance, PM9 was one of the first domestic firm to introduce packaged forms of several dairy products, including pasteurized milk and strained yoghurt. When all three of the largest semi-industrial firms (PM6-PM8) were launched in the mid-1990s nineties, they began with a similar flagship product, a drinking yoghurt, which at the time was uncommon in Bamako. Similarly, two artisanal firms (FM2, FM3) were among the first to begin regularly trading fresh milk in Bamako beginning in in the late 1990s. Almost simultaneously, these firms also diversified into *féné*, because of its simple manufacturing from fresh milk, and in order to offer some variety to customers.

Over time, new entrants increased the competition in these product markets. Many even closely mimicked the packaging, labeling, or brand-names of the market leaders. For example, the owner of PM8 recounted an incident in which a consumer became gravely ill from such an illicit product that mimicked her own brand. Increased competition drove some incumbent firms to offer entirely new products in order to continue differentiating their brands. PM9 introduced the first locally-manufactured soft cheese and fresh cream in the early 2000s. Around 2010, both PM8 and PM6 diversified into another product that was rare on the Bamako market—packaged *dégué*. PM5, the newest entrant among the cases, manufacturers what are now very common products (pasteurized milk and *drinking yoghurt*), but has invested in equipment and special packaging to offer a novel frozen dairy product based on powdered milk. In most cases, these firms have continued to offer the older product types as they introduce newer ones, in order to offer variety to buyers and maintain market share.

Instead of introducing new product types, PM7 differentiated by creating variety within an existing product type. This firm, like PM8 and PM6, faced growing competition in the drinking yoghurt product category. However, it responded by increasing the flavor options from the standard three (strawberry, vanilla, and natural) to eleven, which represents the most variety within any dairy product type in Bamako. The firm selected this strategy based on a consumer study that it had conducted, which showed that Malians “have a curiosity for flavors.” The owner explained that the objective was to allow each consumer to find the “flavor that was right for him or her.”

The fact that a few product types (i.e., soft cheese, and fresh cream, pasteurized milk) are made mostly from fresh milk, and one product type (i.e., *féné*) is made exclusively from fresh milk, suggests that this input has some advantage over powdered milk in the production of certain product types. For example, PM9 stated that the unique taste of its soft cheese and fresh cream products “depend on fresh milk.” The cultural familiarity that Malians have with pasteurized milk and *féné* may also play a role in preferences for fresh milk in these products. However, given that these products typically do not contain added sugar, flavoring, or other additive, there may also be less scope for further differentiating these products, compared to powdered milk-based products.

Also, the physical characteristics of Malian fresh milk may limit the use of fresh milk in certain dairy products—namely, yoghurt products (i.e., drinking yoghurt, strained yoghurt, or *dégué*). One firm specializing in yoghurt (PM7) explained that the fresh milk that is available in Bamako has a lower fat and protein content than powdered milk. To compensate and obtain the same amount of yoghurt product, this firm would have to use larger amounts of fresh milk which would effectively double milk input costs. Thus, almost all of the eight firms that manufacture any yoghurt product do so from powdered milk. One exception is FM3, which reinforces fresh milk with some powdered milk when making drinking yoghurt. Also, after the production of their fresh milk-based products, PM8 and PM9 mix any remaining fresh milk into their drinking yoghurt recipe in order to enhance the taste and consistency of this product. On one hand, there is some evidence that Bamako consumers prefer yoghurt products made from fresh milk (Vroegindewey et al., 2018). However, yoghurt products typically include other less costly ingredients (i.e., sugar, flavoring, starch, or millet) that are also intended to enhance taste or consistency. These added ingredients may reduce any marginal utility that consumers gain from the inclusion of fresh milk, compared to the utility gain from fresh milk in other dairy products that involved fewer ingredients.

## 5.2 Enhancing or preserving product quality

Within a given product type, all firms also seek to differentiate on the basis of some experiential or credence quality attribute, such as taste and consistency, shelf life, nutrition, or purity. For powdered milk-based drinks, success in quality differentiation partly depends on the careful selection of an appropriate powdered milk brand. This is aligned with Theriault et al. (2018), who found that “price premiums are paid for powdered milk manufactured in Europe and by a well-reputed multinational company, Nestlé.” For example, although PM4 was not one of the first firms to offer *dégué* on the Malian market, according to the owner it has come to distinguish itself through careful attention to quality. The owner stated that she constantly seeks to improve her product formula by tasting and studying rival products, experimenting with her own product formula and presentation, and by upgrading to higher (and more expensive) grades of powdered milk. According to the owner, this strategy—combined with the owner’s high attentiveness to customer service—has grown the firm: it now employs seventeen people, and commercialized over 200,000 L per year. It has also driven its transition from processing mostly fresh milk to powdered milk, with *dégué* accounting for 80% of these volumes. As another example, PM7 uses a powdered milk brand that is enriched with vitamins and minerals, which is highlighted on product labeling and plays into the firm’s mission to provide a nutritious food to children and elderly.

Other powdered milk firms seek quality differentiation based on the addition or omission of certain non-milk ingredients. In order to extend product shelf life, PM5 stated that it often adds the

preservative sorbate to its pasteurized milk and drinking yoghurt products, adjusting the amount depending on whether the powdered milk brand already contains this additive. PM7 also stated that it is considering adding a preservative to its products. In contrast, PM9 claims to use a particular ferment that offers better product resilience than others. Two other semi-industrial firms, PM5 and PM6, have introduced a corn or soy starch to thicken their products. Although these imported starches are expensive and sometimes unavailable, the firms report that the powders thicken the consistency of yoghurt in a way that is appealing to consumers and which allows them to reduce the amount of powdered milk by 10% to 20%, thus reducing milk input costs. PM8 also considered using a starch, but ultimately decided against it because the owner was uncomfortable using such an additive, highlighting that the omission of an ingredient can also be a way to differentiate so long as consumers value product purity.

As noted above, fresh milk products rarely contain additional non-milk ingredients, thus limiting this differentiation opportunity. Instead, quality differentiation depends to a larger degree on the quality of the procured milk ingredient. However, again, fresh milk is vulnerable to several quality issues. The three largest powdered milk firms (PM7-PM9)—together representing the most established domestic dairy brands in Bamako—all cited the quality of fresh milk as a key challenge. Overall, quality control and traceability of fresh milk is still at a very early stage in Mali. At best, firms are aware of which cooperative the milk is sourced from, but not which farm or animal. Further, firms do not have detailed or verified knowledge of herd conditions, including herd health, feed, and veterinary care. Thus, trust is an important prerequisite to doing business with a supplier.

For instance, all three of the fresh milk firms complained that CRLLB-sourced milk varied greatly in fat and other taste attributes, in comparison to milk from other supply channels. These firms and CRLLB suspected a number of possible causes, including the higher prevalence of mixed-breed dairy cows in among some cooperatives (which are popularly believed to provide milk that is less rich than the traditional breeds), feed quality, or a problem in the cooperative-level pasteurization equipment. In addition to these factors, quality in Mali also vary by season. Although CRLLB and its milk cooperative partners have co-investigated this complaint, including through a collection center inspection, have been unable to identify the source of the problem. Other quality issues that are difficult to verify are even more deleterious to long term human health. For example, interviews with government technicians and value chain actors suggest that the proper use, documentation, and monitoring of veterinary drugs such as antibiotics and vaccines are not widely respected in the Bamako peri-urban production basin.

### 5.3 Quality-signaling mechanisms

Differentiation on the basis of experiential or credence quality attributes, on their own, is difficult for consumers to observe prior to the purchase and consumption of a product. Retailers, too, must be able to verify quality attributes that are important to the consumers they serve. In order to address this information asymmetry between processors and buyers, and to avoid a situation of adverse selection, firms must couple such investments with attributes that provide information to retailers and consumers on quality attributes. In the Malian dairy sector, firms use several such quality-signaling mechanisms: sales representatives, product warranties, brand recognition, and third-party certification. I discuss a fifth mechanism, packaging, separately in Section 6.4 because it additional value in other ways.

### 5.3.1 Sales representatives

All firms use sales representatives to provide product information to existing and potential clients. In the most direct model, all four artisanal firms interface directly with consumers through forward integration into retailing. According to fresh milk vendors, the two most frequent inquiries that they receive from customers are, “Is it real?” and “Where does it come from?” By maintaining their own retail points, firm owners or employees can provide personal assurance on these questions. Additionally, the owner of FM3 explained that Malians “have the mentality to go to the houses of sellers when they wish to purchase milk,” especially when the sellers are reputed for having good quality, and because dairy products are traditionally consumed at night when markets are closed. Indeed, all four of the artisanal firms (FM1-FM3, PM4) make some sales from their homes, and two have sales windows that are connected to their household concession.<sup>14</sup>

As these artisanal firms have grown, they have acquired (through ownership or rental) retail points which they staff with family members or trusted employees. They are typically located in markets, near busy roads, or next to mosques in order to access high-traffic areas while offering convenience to customers who are commuting, shopping, or returning home from Friday prayers. One owner stated that “it is not easy to have a retail point in Bamako that works.” She explained that it had taken her years of searching and trying out new locations before she secured her external points of sale. CRLLB has provided some assistance to its members while attempting to standardize and scale up the direct retailing model. Since 2010, the cooperative has provided locally-fabricated retail kiosks to about 45 of its members. The kiosks are locally-constructed out of metal, wood, and glass, and include a sales window and signage. CRLLB has offered the kiosks (valued at about 800,000 FCFA) and new refrigerators (valued at about 450,000 FCFA) to its members on zero-interest credit.

In contrast, all semi-industrial and industrial firms outsource product distribution to external partners. Two artisanal firms (FM2, PM4) also make direct sales to retailers, which has become their primary market channel. In these cases, maintaining direct contact with consumers becomes more difficult and the relationship with the distributor becomes most important. Consequently, these firms employ commercial agents who make deliveries to their distribution partners, provide them with information, and monitor how products are stored and displayed. Individuals on motorcycles deliver products for the artisanal firms, while semi-industrial firms deploy two-person teams (a driver and sales agent) in delivery vehicles.

### 5.3.2 Warranties

As firm scale and distance to the end consumers increases, product warranties are another mechanism by which a firm provides product information and signals quality. All firms selling to retailers or other intermediary clients offer product warranties, in which they guarantee quality by replacing any defective products *ex post*. The conditions of warranties are usually vaguely defined,

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<sup>14</sup> Another advantage of maintaining a residential point of sale is that the owner can make sales throughout the day and evening without depending on an employee, while at the same time being present at home to receive milk deliveries, make and package products, and oversee any other domestic activities.

but at minimum include cases in which a client discovers a defect in the product that is clearly attributable to the firm, such as faulty packaging or spoilage that the firm can trace to faults in the product process. Several firms extend their warranties to cover some share of losses that are clearly not their own fault, such as due to power cuts or even when the causes are unknown.

### 5.3.3 Brand recognition

Building brand recognition is another signaling mechanism used by the largest firms (PM7-PM9). These firms have developed brand recognition and reputation through time, scale, and/or mass communications. First, the largest firms are also the most experienced among the case studies, with the oldest having a market presence in Mali of over twenty years. Second, each firm has a substantial distribution network consisting of 500 retailers or more, and which reaches towns outside of Bamako. Third, each firm has invested in different forms of consumer advertising, which include branded trucks, websites, social media messaging, television and radio advertising, and billboard communications. As additional measures to develop brand recognition, PM7 has opened a yoghurt parlor in the national park and PM8 had used celebrity sponsorships and social media accounts to build brand recognition among youth.

In partnership with CRLLB, fresh milk firms have also attempted to build a collective brand to signal that products are made from high-quality fresh milk. Interviews and marketing materials suggest that the CRLLB brand represents at least three principles that depend largely on CRLLB's partnership with its FENALAIT suppliers and on a system of support, standards, and quality control set up within these organizations. The first principle is purity, i.e. that all CRLLB dairy products are made 100% from local milk. The second principle is food safety. CRLLB food safety standards (e.g., proper refrigeration and a clean retailing environment) are checked weekly by marketing advisors who visit kiosks once a week. A third and related principle is traceability. Local milk is sourced from local farmers and through close relationships. Furthermore, firms have some degree of confidence that the production, collection, pasteurization, and transport of CRLLB milk is supported by an infrastructure of FENALAIT veterinary care, standards, and quality control. The cooperative's forty-five retail kiosks, placed throughout the city, play a role in building recognition for this brand. These kiosks are identically painted blue and white, with the cooperative name and tagline ("milk from our cows") written in Bambara in bold letters across the tops. On the sides are images of dairy farming and the phrase, "I love my local milk." CRLLB has also made available to its members branded product labels with similar colors, images and messages.

However, the effectiveness of the CRLLB brand faces several challenges. None of the interviewed members cited this common brand as a primary advantage to cooperative membership. Not all members have access to a kiosk, and others have additional unbranded retail points. Many members do not use branded labels because they are expensive for them to print and possibly also vulnerable to counterfeiting. CRLLB does not have the resources to advertise outside the kiosk signs. Feeble use of the CRLLB brand may also be due to weak implementation of its standards. First, many members sell products that are based on powdered milk alongside local milk products, sometimes in the CRLLB-branded kiosk. Second, traceability is weakened by the fact that firms source milk from outside CRLLB and the FENALAIT network. Firms often are not aware of the source of this milk, let alone the standards by which it was produced and handled.

#### 5.3.4 Third-party certification

A final potential mechanism to signal product quality is through third-party quality certification. According to government regulation, all food firms must obtain for each of their products a certification that is issued by l'Agence Nationale de la Sécurité Sanitaire des Aliments (ANSSA) (Government of Mali, 2006). The ANSSA seal, which should be printed on product packaging, indicates to consumers that the product has met product-specific norms and standards that the Government has adapted from CODEX. However, few, if any, imported or domestic dairy products carried the seal at the time of fieldwork. Among the cases, only PM5 had obtained an ANSSA certification, and in this case for its water product.

One reason for this low certification compliance may be weak recognition of the seal by consumers and even retailers. In a 2018 survey of Bamako consumers, only 20% of respondents recognized the ANSSA seal and most of these stated that they did not have a good idea of its meaning (Vroegindewey, 2018). Another reason for low compliance may be the complexity and costs of obtaining ANSSA certification. Among the required steps, a company must provide proof of necessary business registrations and tax payments, provide satisfactory results from lab tests of their products, and pass a factory inspection. PM5 estimated that obtaining certification for its water products took two years and cost about two million FCFA. Finally, low compliance might also be explained by the historically weak government enforcement of noncompliance. However, some of these trends could be changing: before its water carried the ANSSA seal, PM5 had been fined 250,000 FCFA by the Ministry of Commerce. To avoid similar sanctions and disruptions to its dairy and juice business, the firm was in the process of certifying these other product lines as well. Among the firm cases, at least two other powdered milk firms (PM7, PM9) had also initiated the certification application process.

#### 5.4 Packaging

The use of distinct packaging features is the fourth source of differentiation in the Bamako dairy market. In the same context, Theriault et al. (2018) found price premiums to be associated with powdered milk products that were packaged in metal tins or cartons, as opposed to plastic pouches which could potentially be manufactured in Bamako. Packaging can potentially create value for retailers and consumers in three ways. First, packaging protects product contents from the external environment, which can extend shelf-life and facilitate wider distribution. The fresh milk firms that primarily distribute through their own retail points (FM1, FM3) package all or most of their products by double-bagging them in thin transparent plastic bags that they hand-tie to close. The two larger artisanal firms (FM2, PM4), all of which distribute most of their volumes through independent retailers, have upgraded to use thicker plastic bags that they heat-seal with a hot iron and, occasionally, locally-purchased plastic bottles. The powdered milk firms, all of which outsource their distribution to external partners, use even sturdier packaging: opaque plastic pouches (for drinking yoghurt and *dégué*), plastic bottles (for drinking yoghurt), or durable plastic cups (for strained yoghurt and *dégué*).

Second, packaging is another means of communicating information about quality. In addition to exposing products to more shocks and longer lead times between production and consumption, a longer marketing chain also increased the potential for information asymmetry between a firm and consumers. To mitigate this and avoid problems of adverse selection, expensive packaging can signal to consumers that quality contents are superior to products with less sophisticated packaging. Among the cases, five of the seven firms (all powdered milk firms) with longer marketing channels use packaging that they either custom-manufacture in their factories or import directly. Package labeling can also explicitly convey information on product attributes. For example, PM7 packaging indicates that yoghurt is made with “enriched milk,” a reference to the enrichment of the powdered milk they use.

Despite its low cost and the minimal protection that it provides, informants claimed that many consumers draw a strong cultural connection between the very familiar appearance of hand-tied plastic bag packaging and quality fresh milk. The bags themselves are locally manufactured and ubiquitously used by Malian vendors in traditional markets, and their transparency allows Malians to visually examine the milk contents (e.g., color and consistency, and any debris). The owner of FM3 explained that, traditionally, milk was sold out of calabashes, which allowed buyers to verify the quality *ex ante* by sight, smell, or taste.

Even when fresh milk firms upgrade to thicker plastic bags that are better suited for longer marketing chains, they maintain the transparency of their packaging. As distance between the firm and retail point of a product increases, labeling also becomes more important. One fresh milk firm does not even use labels for products sold from her home, because of the personal contact that she has with these consumers. Similar to their choice of packaging materials, fresh milk firms use simple labeling that evokes associations with traditional milk marketing. Most labels are locally-printed in monochromatic colors; feature icons of cows or traditional milk marketing; include a brand name that utilizes words from a local language and/or the personal name of the firm; and provide contact information on the firm.

For instance, FM2’s label features a simple drawing of a Fulani woman selling milk from a bowl on her head, under the company name in Fulani, which translates as “milk from our cows.” The owner, who is herself Fulani, explained that “everyone knows that it is the Peuhl who sell and know milk.” To further underline (and help to protect) the product quality, “Fresh pasteurized milk 90 degrees” and “conserve at 7 degrees” are printed vertically in large font up either side of the package. However, the owner of FM3 believed that there were limits on how much she should innovate on traditional packaging, because sophisticated packages have a “pharmaceutical” appearance that many Malians associate with the industrial processing of powdered milk. Indeed, all nicely-packaged yoghurts that are sold in Bamako are made from powdered milk.

Finally, packaging form and size can improve the convenience and affordability of a product, especially for consumers with limited resources for purchasing, storing, and consuming dairy products. Across the cases, the firms indicated/stated that their most popular packaging formats are those that are smallest. The per-liter consumer prices of PM9’s pasteurized milk and drinking yoghurt are among the highest on the Bamako market. However, the firm packages these products in 200 ml pouches in order to offer a relatively low price-point to consumers. Consequently, this packaging has become the format preferred by wholesale distributors in Bamako and is an essential element for maximizing a brand’s breadth of distribution. PM5, PM8, and the two other industrial dairies in Bamako have each introduced a similar packaging for their milk and drinking yoghurt

products, and PM7 has purchased new packaging equipment to do the same. Additionally, pouches and plastic bottles are convenient for more viscous products (pasteurized milk, drinking yoghurt, *fèné*) because consumers can drink from them directly, while plastic cups are preferred for products that are consumed by a spoon (e.g., strained yoghurt). Some firms also offer bottles and cups with re-closable tops as an additional enhancement.

## 6. Conclusion

This paper examines the competitiveness of local fresh milk—versus imported powdered milk—as an input for dairy processor firms in Bamako. To do this, I conduct case studies of nine dairy firms, analyzing the relationship between their use of each input and the creation of competitive advantage through cost advantage and/or product differentiation.

Regarding cost, I find that the use of fresh milk is more costly than use of powdered milk. The purchase price of fresh milk is at least 20% higher than the liquid equivalent of powdered milk. Additionally, in contrast to powdered milk for which spot markets already exist in Bamako, all firms that procure fresh milk must carefully coordinate their transactions with suppliers. Yet, even with special procurement arrangements in place, these firms still face transaction cost problems related to quality and supply uncertainty.

I also find four sources of differentiation that dairy firms use to distinguish their brands from competitors. First, firms offer unique products, such as a new type of yoghurt. Later, as rivals adopt similar products and competition increases, firms enhance the product or create variety by introducing new ingredients, such as flavors or additives. Second, within each product type firms seek to preserve or enhance quality. Third, firms adopt quality-signaling mechanisms to convince consumers that unobservable product attributes of their brand are superior to those of competitors. Mechanisms include the use of sales representatives, enhanced packaging and labeling, warranties, investments to improve brand recognition, and third-party certification. Finally, firms offer unique packaging features (e.g., different forms or materials) that create customer value by protecting contents, signaling quality, improving convenience, or increasing affordability.

However, I find that fresh milk firms face unique difficulties exploiting these differentiation opportunities, compared to firms of powdered milk. For example, these firms have adopted variations of three signaling mechanisms to communicate product information to consumers that have a preference for fresh milk, but each has significant disadvantages. One mechanism is to sell through small specialized retail points that are costly to scale up. Another is to use traditional packaging that poorly protects product contents and has limited appeal to many consumers. These firms also attempt to use collective branding that requires more coordination in order to work effectively.

In order to improve the competitiveness of local dairy value chains, milk farmers and processors should work with the Malian government to bring down the costs of procuring and processing fresh milk. Measures that improve milk producers' access to productive breeds, feed, and veterinary care should help to reduce the price of fresh milk, while improving quality and stabilizing supply. The government should also address problems in the business environment that drive up transaction

costs in dairy procurement and marketing, especially the high costs of electricity, poor roads, and limited agricultural financing.

Even with these measures, it is unlikely that the costs of fresh milk will drop below those of powdered milk in the near term. The competitiveness of local dairy value chains, therefore, will also depend on their ability to stimulate and exploit demand for products made from fresh milk through differentiation. One possibility is the development and commercialization of products that are well-suited for local fresh milk and difficult to imitate using powdered milk. Because milk ingredient type is a product attribute that is difficult for consumers to observe, investments in more effective quality-signaling mechanisms will also be critical. One option is the development of innovative packaging that maintains traditional features while offering better protection and convenience. Government can also strengthen the enforcement of an existing certification system—which, technically, has a special designation for local fresh milk—as a tool to help local value chains differentiate their products.

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