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"Pivoting" by food industry firms to cope with COVID-19 in developing regions: E-commerce and "copivoting" delivery intermediaries

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Abstract

Coronavirus disease 2019 and related lockdown policies in 2020 shocked food industry firms' supply chains in developing regions. Firms "pivoted" to e-commerce to reach consumers and e-procurement to reach processors and farmers. "Delivery intermediaries" copivoted with food firms to help them deliver and procure. This was crucial to the ability of the food firms to pivot. The pandemic was a "crucible" that induced this set of fast-tracking innovations, accelerating the diffusion of e-commerce and delivery intermediaries, and enabling food industry firms to redesign, at least temporarily, and perhaps for the long term, their supply chains to be more resilient, and to weather the pandemic, supply consumers, and contribute to food security. We present a theoretical model to explain these firm strategies, and then apply the framework to classify firms' practical strategies. We focus on cases in Asia and Latin America. Enabling policy and infrastructural conditions allowed firms to pivot and copivot fluidly.

KEYWORDS
COVID-19, delivery intermediaries, developing region food supply chains, e-commerce, pivoting

JEL CLASSIFICATION
M31, O13, Q13

1 | INTRODUCTION

Coronavirus disease 2019 (COVID-19) has induced developing-country governments to put in place policies to constrain consumer movement, food industry firm activity, logistics, and worker mobility to limit the spread of the pandemic. The resulting immobility was compounded by consumers' staying away from crowded retail stores and restaurants. These shocks have presented major challenges for food industry firms (in retail, food service or restaurants, and food processing) in supplying consumers, and sourcing inputs of labor and materials. Examples of what appear to be typical policies and their impacts during COVID-19 are found in Nigeria (Liverpool-Tasie, Reardon, & Belton, 2020) and India (Biswas, 2020).

The shocks induced food industry firms to make major changes in their strategies and practices. Adaptations by firms to changing market and other context conditions

(such as climate shocks) can be continuous or discrete, marginal, or major. We are interested in major, discrete adaptation that substantially alters supply chains, via changes in market channels, technologies, and commercial organization. Such fundamental shifts by businesses in practices and strategy are called "pivoting" in the business community and in the business management literature (see, e.g., Winston, 2014).[1] In this paper, we examine two forms of pivoting in developing country food supply chains. Reardon and Swinnen (2020) introduced the idea of the duality of pivoting and copivoting by firms in different segments of a supply chain, citing as an illustration the pivoting to e-commerce of food industry firms and the copivoting by delivery intermediaries. The present paper builds on Reardon and Swinnen (2020) with a conceptual framework and detailed case-study evidence.

First, we examine the pivoting of food industry firms primarily in their output marketing channels (shifting from or adding on to in-store or in-restaurant sales to e-commerce) and their technologies (shifting from labor-using to capital-using technologies). This pivoting constituted a substantial acceleration of retail transformation into the incorporation of e-commerce (either in competition with supermarket chains or as an adjunct to those chains) that was already emerging in developing regions in the 2010s before COVID-19 as a follow-on to food e-commerce's emergence in the United States and Western Europe in the 2000s (Lu & Reardon, 2018). As we discuss further below, food e-commerce had emerged earliest and developed fastest in China (Zeng, Jia, Wan, & Guo, 2017) but had been only nascent in most of the other developing countries. The pivoting we analyze below also included a broadening of segments undertaking e-commerce as some processors adopted it, and a broadening of scale, as some small- and medium-sized enterprises (SMEs) did.

Second, we examine "copivoting" of firms in the wholesale and logistics midstream segments to facilitate the pivoting by food industry firms and thus take advantage of major new opportunities. This involved major adjustments in business strategies and operations of wholesale and logistics providers copivoting with food industry firms in response to lockdown regulations related to COVID-19. Many wholesale or logistics firms shifted their service mix to become "delivery intermediaries" necessary to the downstream and processing firms' rapid implementation of e-commerce. Delivery intermediaries (such as Instacart)

had already developed rapidly during the 2010s in the United States and Western Europe, but only emerged in Asia and Latin America (and very nascent in Africa) in the past 5 years. Again, COVID-19 induced a substantial jump in their proliferation both with growth of the pre-COVID-19 start-up firms but also in the conversion or pivoting of logistics firms into the delivery intermediary category, as we discuss below.

Two sets of prior agriculture and food sector-related literature inspire our analysis of pivoting cum copivoting during COVID-19. First, there has been a strand of the literature on farms' adapting to shocks such as drought with pivots in crop composition and a shift to irrigation. The latter induced copivoting in the irrigation equipment and services firms to handle a much larger and more heterogeneous clientele (Zilberman et al., 2002). Second, there has been a strand of the literature relating the modernization of food systems over the past several decades, and the pivoting by large food industry firms to adjust to market challenges.

On the one hand, there has been a rapid growth of large food processing firms. They have needed to pivot their supply chains to adjust to fundamental changes in quality and safety needs of consumers and standards of supermarkets. This required the copivoting of farmers to supply those traits, involving abrupt and substantial change in their technologies. From the farm point of view, they wanted to pivot to take advantage of a new marketing opportunity, but they faced imperfect capital markets. In that situation, processors copivoted to offer farmers resource provision contracts to finance adoption of the new technologies implied by the new standards (Swinnen & Kuijpers, 2019).

On the other hand, there has been a "supermarket revolution" in developing countries (Reardon, Timmer, Barrett, & Berdegué, 2003); large domestic and international supermarket chains have pivoted to adjust to developing country markets. Relative to the situation in their developed-country home markets, these chains face large shocks to procurement supply chain conditions when entering developing country markets. While in their home markets, they could source directly from a relatively small number of high-capacity suppliers who could all meet their private standards, they faced high transaction costs in developing-country markets, where the supplier base consisted mainly of many heterogenous small-scale firms and farms with relatively low product quality or consistency. The chains' pivoting required a shift from direct sourcing to sourcing via intermediaries that would act as agents who would collect and sort and pack and impose standards on suppliers. However, traditional wholesalers did not perform those services nor have the warehouses and equipment to do so. Shifting to those services and making those

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[1] The term pivoting is also often used in the business innovation literature (Blank, 2013; Morgan, Anokhin, Ofstein, & Friske, 2020; Ries, 2011), organizational science literature (McDonald & Gao, 2019), research-technology management literature (Garcia-Gutierrez & Martinez Borreguero, 2016); and, more popularly, in the "trade press" or practitioner newsletters and reports (White, 2020).

threshold investments represented fundamental copivoting for wholesalers; a subset of them copivoted with the entering supermarket chains to help them to "fast-track" modernized procurement systems (Reardon, Henson, & Berdegué, 2007).

To date there has been a dearth of studies of pivoting by food industry firms, especially regarding organizational shifts to e-commerce (or substantial acceleration in e-commerce where the firms had already embarked on it before COVID-19), as well as in business operations in response to major health shocks affecting both output demand and labor supply. Also, there is still scant evidence on and analysis of copivoting by intermediation segments, especially by delivery intermediaries to facilitate the shift to e-commerce in developing countries.

To address this knowledge gap, in Section 2, we present a simple conceptual framework, building on the recent literature on value chain design (Lu & Reardon, 2018; Zilberman et al., 2019). The framework identifies conditions under which a shock may lead to Schumpeterian structural change when firms fully or partially pivot from current strategies to alternative ones. We further analyze how irreversibility and risk considerations as well as credit constraints affect adjustments to shocks. Section 3 presents an overall contextualization of e-commerce in developing regions, and its acceleration during COVID-19, as a backdrop for the detailed discussion of pivoting in Sections 4–6, covering the downstream, midstream, and upstream supply chain segments. In the latter sections, we present a taxonomy of the pivots and copivots made by food industry firms and farms, and copivoting by intermediaries, in the ways discussed above. We illustrate them with case-study evidence from developing regions, mainly in Asia and Latin America as the regions where e-commerce and delivery intermediaries have emerged earlier and developed much more than in Africa so far.[2] The pandemic is recent, and at the time of writing still rampaging in most countries. Lockdown policies are thus also recent, and in some countries ongoing or being revived. Hence, we are not able to draw on substantial surveys of businesses, let alone panel data. Thus, we rely on case study evidence to indicate and classify emerging patterns. We conclude with implications for policies to facilitate supply chain adjustments in the face of shocks to maximize resilience and a research agenda.

2 | CONCEPTUAL FRAMEWORK

At each stage of the supply chain, agents choose how much input to obtain from potential sources and how much output to sell to potential buyers, and under what arrangements. For example, intermediaries such as processors must determine how much agricultural produce they should source from the spot market, contracted farms, or farms under their own management. After processing the product, the processor must determine how much to sell directly to consumers, wholesalers, retailers, and exporters.

We develop a simple static model of an intermediary making acquisition and distribution decisions. Some of the implications of including dynamic risk and credit considerations are discussed at the end of this section.

For both decisions, there is an option of a traditional or a modern marketing channel, denoted by $i = 1$ and $i = 2$, respectively. Each marketing channel is associated with a technological specification. In the model, "pivoting" (as defined in the Introduction) in the sense of, for instance, creating a new marketing channel, is identified as a technological change. Examples in Section 4 include retailers who pivot from selling in a store to receiving orders online and shipping by a delivery intermediary, and in Section 5, processors at first only selling to retailers pivoting to sell directly to consumers using a delivery intermediary. Such pivoting is illustrated in Figure 1.

Each marketing channel has a revenue function and variable processing costs, such as labor and energy. A firm pivoting to a new marketing channel incurs fixed (sunk) costs (Just & Zilberman, 1983). In our case, these refer to costs of machinery, learning, and marketing. Both revenues and variable costs will be affected by systemic shocks. The shocks to the system that we consider have both a demand and a supply component. Shocks like COVID-19 may have a differential impact. They may adversely affect the traditional supply chain, while the modern supply chain may gain. For instance, the COVID-19 containment measures reduced the demand for restaurant and hotel food services, while increasing demand for food delivery. Policies related to COVID-19 restricted labor mobility, and thus, may have increased the variable cost of the traditional, labor-intensive marketing channel, as well as production costs. The fixed costs of the modern marketing channel may represent the costs of establishing the use of a new technology, for example, app-based sales systems that allow direct delivery to consumers.

Let $R_1(y_1, \varepsilon)$ be the revenue from the tradition channel and a function of the output of the traditional channel when it is the only channel, and a random shock ε to the system. The revenue from the new market channel is denoted by $R_2(y_2, \varepsilon)$, where y_2 is the output of the

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[2] However, Africa did see the start-up of several e-commerce firms during the 2010s. One notable example is Jumia, based in Nigeria, which initially expanded rapidly including by investing in other African markets, but then declined as high transaction costs and limited demand substantially slowed its operations. Jumia's sales surged again, perhaps temporary, during COVID-19 in 2020 (Kazeem, 2020).
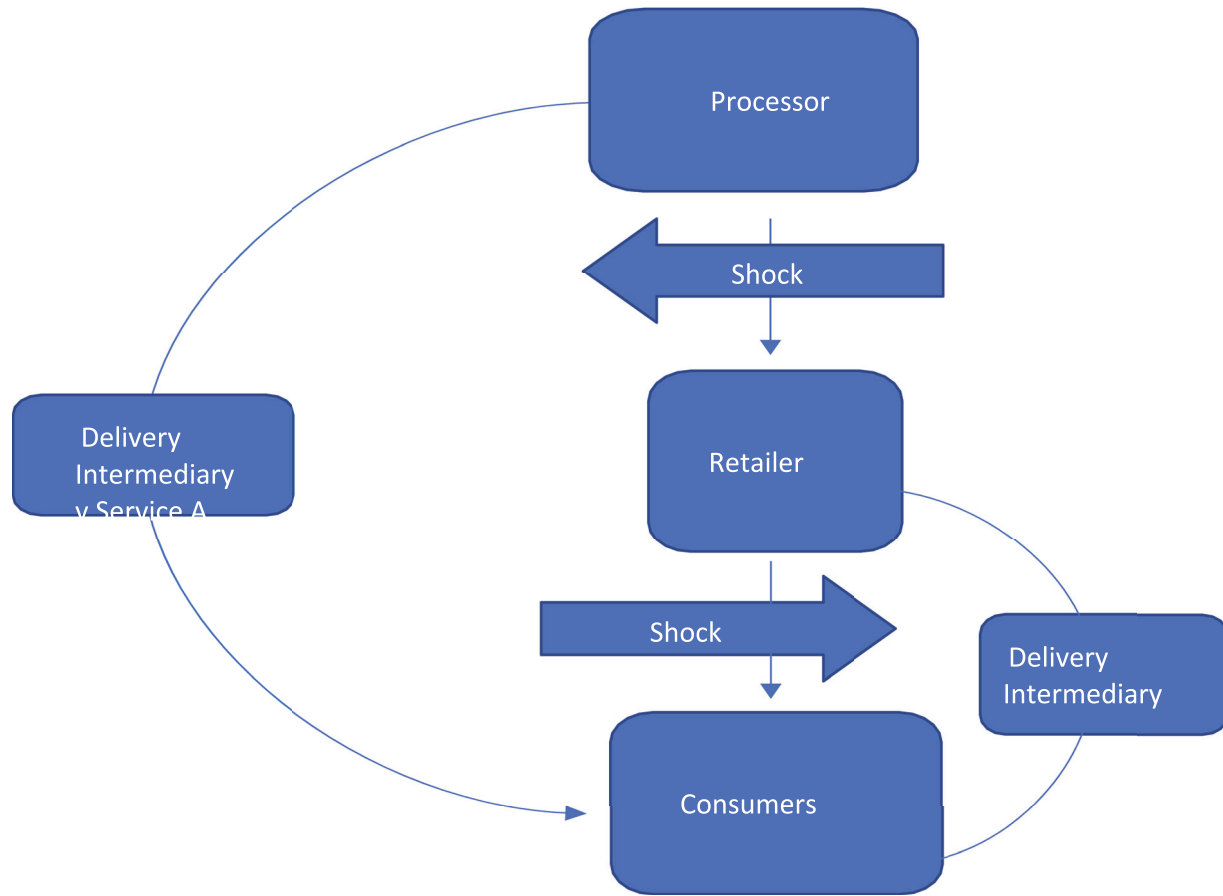
FIGURE 1 Pivoting by processors and retailers and copivoting by delivery intermediaries [Color figure can be viewed at wileyonlinelibrary.com]

second channel. The vector of variable costs of processing and retailing (such as labor, intermediate inputs, materials such as packaging, transport costs, and energy) for each channel is denoted by $PS_i(y_i, \varepsilon)$. We assume regular properties of the revenue and variable cost functions with respect to output. Revenues are concave in output, and variable costs are convex in output. Furthermore, we assume that the shock reduces both revenue and marginal revenue under the traditional marketing channel and increases both under the modern marketing channel. It also increases variable costs of the traditional marketing channel, while the variable costs of the modern marketing channel are unaffected.

The variable reflecting fixed costs such as machines, buildings, and learning for each channel is denoted by K_i. For simplicity, we assume $K_1 = 0$ and $K_1 >> 0$. Assuming, also for simplicity, that the quantities of the final output and the intermediate input are the same, the cost to the processor of buying the intermediate input is $C(y, \varepsilon)$ where C is increasing and convex in y and increasing in ε. The magnitude of the shock ε is from 0 to 1. When the shock is at its highest level, it eliminates demand for the traditional marketing channel and increase demand for the modern channel. Total food marketed by both channels is $y = y_1 + y_2$. Both channels may be in operation only after the modern channel is adopted and the firm is diversifying its marketing chains. If only the traditional channel is being used, profit per period is

$$\pi^T(\varepsilon) = \max_{y_{1T}} [R_1(y_{1T}, \varepsilon) - PS_1(y_{1T}, \varepsilon) - C(y_{1T}, \varepsilon)]. \quad (1)$$

If both channels are used, the profit per period will be

$$\pi^M(\varepsilon) = \max_{y_{1M}, y_2} [R_2(y_2, \varepsilon) + R_1(y_{1M}, \varepsilon)$$
$$- PS_2(y_2, \varepsilon) - PS_1(y_1, \varepsilon) - C(y_{1M} + y_2, \varepsilon) - K_2], \quad (2)$$

where y_{1T} is the output marketed through the traditional channel when only this channel is available, while y_{1M} is the output through the traditional channel when both channels are available, and y_2 is the output marketed through the modern channel. We also require output to be nonnegative in both channels. Assuming concave revenue functions and convex cost functions in output, the optimal

y_{1T} where only the traditional channel is used is denoted as y_{1T}^*. This optimal value occurs where the marginal revenue, MR_i, is equal to marginal processing costs, MPS_i, plus marginal production costs, MC.

$$MR_1 \left(y_{1T}^*, \varepsilon \right) = MPS_1 \left(y_{1T}^* \right) + MC \left(y_{1T}, \varepsilon \right). \quad (3)$$

If the firm invests in the modern marketing channel and both channels are used, the optimal levels, y_2^* and y_{1M}^*, satisfy:

$$MR_1(y_{1M}^*, \varepsilon) = MPS_1 \left(y_{1M}^* \right) + MC \left(y_{1M}^* + y_2^*, \varepsilon \right), \quad (4)$$

$$MR_2(y_2^*, \varepsilon) = MPS_2 \left(y_2^* \right) + MC \left(y_{1M}^* + y_2^*, \varepsilon \right). \quad (5)$$

In both channels, marginal revenue equals marginal processing costs plus marginal intermediate input purchasing costs. It may be possible that after investing in the modern marketing channel, the firm will specialize in that channel. This will occur if any positive level of output marketed through the traditional channel reduces profits. Based on our assumptions, it is easy to show that if marginal costs of purchasing intermediate input are not affected by the shock, a stronger shock will reduce the amount of output sold through the traditional channel under both arrangements and increase sales through the modern channel. Thus, larger shocks are associated with an increase in the relative profitability of the modern marketing channel. If the shock increases the marginal cost of purchasing intermediate input, it may reduce total output of the processor, but the relative profitability of the modern channel will increase.

By solving for the optimal output under both scenarios, the firm decides to pivot toward the new marketing channel if this will increase profits.

$$\pi^2 \left(\varepsilon \right) - \pi^1 \left(\varepsilon \right) \geq 0. \quad (6)$$

Variable profits are revenues minus processing and intermediate input purchasing costs. $\Delta VP(\varepsilon)$ is the net gain in variable profits if the modern marketing channel is introduced.

$$\Delta VP \left(\varepsilon \right) \geq K_2. \quad (7)$$

Thus, pivoting is optimal if this net gain is greater than the fixed costs of the new channel, K_2. Since the shock negatively affects the profitability of the traditional marketing channel and improves the profitability of the modern channel, the gains from pivoting are strictly increasing in the magnitude of the shock ε.

Thus far, we have analyzed the behavior of an individual firm. Since firms are heterogeneous, some firms that may have low transaction costs and a relative advantage in terms of adoption of technologies associated with a new marketing channel, may pivot to the new channel even before any shock occurs, when $\varepsilon = 0$. Other firms may pivot once the magnitude of the shock exceeds a certain level. Some of the firms with high learning and transaction costs associated with pivoting will go out of business if the shock exceeds a certain threshold, ε_b. At this threshold, $\pi^T(\varepsilon_b) = 0$ and $\pi^m(\varepsilon_b) \leq 0$.

When there are heterogeneous firms, each will have a threshold at which it will exit the market or adopt the new channel. Thus, our analysis suggests that shocks may change the composition of the processing or retail sector, leading some firms with high variable costs and low demand to exit, and others to pivot to the modern channel and increase market share. We may also expect new entrants to emerge that have a relative advantage in the modern marketing channel.

Our analysis can apply to multiple situations. Supermarkets' "traditional channel" is retailing to consumers who come to the stores. With digitalization, supermarkets may also retail by e-commerce, perhaps assisted by a delivery intermediary (as in Figure 1). The transaction cost of pivoting to e-commerce is high, but if a pandemic reduces consumer demand for buying food at the supermarket and increase the demand for getting food at home, one would observe this pivoting by some retailers, as indeed we illustrate in Section 4. Similarly, some restaurants already established take home service (as an alternative channel), but others may completely pivot to delivery service with the pandemic shock. However, a restaurant with high fixed costs of conversion and insufficient demand may go out of business.

Following the spirit of the model, we can envision a food processor (as in Figure 1) whose "traditional" marketing channel is to retail stores, but, with the pandemic, it may face higher costs to deliver to stores or believe that the demand for its product at stores will drop, and the processor may pivot to e-commerce directly to consumers, taking advantage of new technologies of shipment and packaging, and using delivery intermediaries to facilitate the pivot; we discuss cases of that in Section 5.

Another example is when labor constraints, such as those caused by worker mobility regulations under COVID-19, put firms with a high labor–capital ratio at a serious disadvantage. If they can, they will pivot technologically by increasing the capital–labor ratio substituting machines for labor, such as in a processing plant. We will provide a case illustration of this in Section 5. Similar reasoning can explain the copivoting by logistics firms to become delivery intermediaries facilitating e-commerce.

For example, reflecting a case we discuss below, a passenger transport firm like Uber may find few clients during lockdown and switch to or add on a product-delivery service linked to the e-commerce pivoting of retailers and food service.

Our simple analysis can be extended in several directions. First, the analysis could incorporate dynamics. Pivoting to a new marketing channel can require significant investments in new technology that have to be repaid over multiple periods from returns that may or may not materialize. One could expand our model to a dynamic investment model à la Dixit and Pindyck (1994) that accounts for this uncertainty and for the irreversibility of the fixed sunk costs. This model suggests that the timing of the investment decision, when there are random shocks, depends on the magnitude of the shock, and thus, every firm has a critical level of shock that will cause it to undertake investment. Thus, when a given shock affects multiple firms, some will modify their activities, and larger shocks will lead a greater share of firms to pivot.

A key implication of these considerations of risk and dynamic irreversibility is that once a firm pivots in response to a shock, it will persist with the new strategy after the shock. This suggests that the reliance on e-commerce strategies in the food sector will continue. There is precedent for this. For example, there is evidence that food safety incidents and other shocks lead to changes in food standards that induce firms to pivot to new technologies and strategies (Swinnen, 2016); the sunk costs will lead firms to persist in their new choices (Swinnen, 2017).

Second, the analysis could incorporate risk aversion. At least *ex ante*, we might assume that a modern channel has higher uncertainty in costs and revenues, thus preventing risk-adverse firms from pivoting. However, shocks may reduce the relative uncertainty of the modern marketing channel, in which case risk aversion makes firms more sensitive to shocks when deciding whether to pivot. For example, if the traditional channel is a sit-down restaurant, demand uncertainty likely increased as the COVID-19 pandemic emerged, but demand uncertainty for takeout services relative to sit-down services likely decreased.

Third, the analysis could incorporate credit constraints. Firms need access to credit or available savings to pivot to the modern marketing channel, and credit constraints may prevent pivoting. With the traditional marketing channel, output will decline, which may decrease food security. Interventions that ease credit constraints in the face of shocks can thus play an important role. In some cases, when the modern channel of linking producers or intermediaries with consumers requires investment in third-party vehicles, the producers or intermediaries with greater credit access may finance this investment.

In the context of acceleration of diffusion of e-commerce with COVID-19, our model predicts several potential patterns of outcomes. In the subsequent sections, we provide empirical illustrations for each of the following five cases:

(1) When e-commerce demand increases and the demand for in-store purchases declines, our model predicts a retailer's either pivoting to (or increase in prior) e-commerce as both MRP_2 increases and ΔVP increases.

(2) When economies of scale and scope reduce marginal costs of e-commerce (lowering MPS_2), e-commerce supply will increase.

(3) When a retail firm considers developing e-commerce capacity and realizes that it has a comparative advantage in building that capacity internally rather than relying on third-party partners (that is, $MPS_2 < MPS_1$, and $\Delta VP > K_2$), it will invest in building this capacity, given credit and other constraints, and rely on third parties (such as delivery intermediaries) on the margin, for some deliveries or to augment the volume of clientele.

(4) When a third party such as a delivery intermediary has a comparative advantage in facilitating the food industry firms' adjustment to e-commerce (for that company, $MPS_2 < MPS_1$), our analysis predicts either copivoting by the third party to facilitate the food industry firm's pivot to e-commerce or a set of third parties copivot, such as a combination of delivery intermediaries plus pure logistics firms.

(5) When a processor faces higher costs of accessing labor, if it can, it substitutes machines for labor.

3 | ACCELERATED DIFFUSION OF E-COMMERCE WITH COVID-19

3.1 | Increased e-commerce during COVID-19

As with food safety crises that induced jumps in shopping at supermarkets and declines in shopping at wet-markets, and as with SARS influencing the start of e-commerce in China, so COVID-19 induced a sharp rise in consumer demand for and retail supply of e-commerce in a number of developing countries. Vardhan (2020) presents Euromonitor survey data showing e-commerce upticks in yearly growth rates in various countries, comparing 2019 with 2020: Indonesia, 60% versus 120%, South Africa, 20% versus 100%; Brazil, 15% versus 100%; Mexico, 15% versus 80%; India, 30% versus 70%; Nigeria, 20% versus 50%; China, 10% versus 20%.

Rees (2020) presents other Euromonitor data for Asia (using India, Indonesia, Malaysia, Philippines, Thailand,

and Vietnam), Central and Eastern Europe (using Bulgaria, Hungary, Poland, Romania, Russia, and Ukraine); Latin America (using Argentina, Brazil, Chile, Colombia, Mexico, and Peru); and the Middle East and Africa (using Egypt, Morocco, Nigeria, Saudi Arabia, South Africa, and United Arab Emirates), and Turkey. The data showed that e-commerce is still only emerging in this set of countries, with food e-commerce at about USD 50 billion versus modern retail store sales at about USD 1.5 trillion, and traditional grocers' sales at about USD 600 billion. The value and growth in e-commerce of snacks plus dairy over 2015–2020 grew from USD 7.5 billion in 2015 to USD 22 billion in 2020, with year-on-year growth at 15% in 2015 versus 50% in 2020.

Region-specific surveys confirmed this rise, such as in Asia,[3] where Kuijpers et al. (2020,) showed, based on a McKinsey survey, that the frequency and share of online food purchase increased between 16% and 70% with the pandemic. Consumers indicated that they plan to continue to use food e-commerce at that rate.

On the supply side, when the COVID-19 pandemic lockdown measures took hold in many countries in March 2020, it was a shock to an e-commerce supply chain that had already developed rapidly and whose main structure and actor strategies were already mainly in place. With the lockdowns inducing declines in sales of retail and food service, there was a sharp increase in supply by the large incumbent e-commerce firms. By early 2020 (pre-COVID-19), the latter comprised pure e-commerce firms as well as "mixed firms" of e-commerce and brick and mortar retail. For example, in China, e-commerce was accelerated by COVID-19 (Chou & So, 2020). Online grocery shopping orders in general increased 400% compared with the first trimester in 2019 (Meituan Research Institute, 2020). Yonghui Online reported an increase of 600% compared with sales in the same period in 2019. During the last week of January, MissFresh (Mei Ri You Xian) reported a 465% increase in sales, compared to the same period from previous year (Li, 2020). By June, MissFresh reported delivering 1 million orders of fresh grocery in Beijing per day (Sina News, 2020).

In India, Flipkart–Walmart, already growing rapidly before COVID, sharply accelerated with the pandemic. With the apparent recovery in May 2020, Flipkart and Amazon acquired a large amount of warehouse space as they expected the accelerated e-commerce trend to continue (The Economic Times, 2020c). India's "unicorn" (billion-dollar) firm, BigBasket, reported a 500% surge in March–April, as did their rival GROFERS, reporting having serviced a million homes in three weeks (Sharma, 2019; Singh, 2020b).

3.2 | Drivers versus constraints to e-commerce during COVID-19

Early in the lockdowns, delivery e-bikes and motorbikes were stopped, harassed, had to deal with changing regulations, or had to go through slow procedures to leave a package or call a customer down to the street. Transaction costs of consumers increased with lockdown and mobility restrictions, reducing the ease or even possibility of going out to a store or restaurant. Consumers feared going to crowded retail and restaurant venues even if mobility rules allowed it. Food safety scares have often been about a particular "tainted food," such as e-coli on melons or spinach, but COVID-19 created a fear of "tainted places" and dense gatherings, such as in stores, markets, or restaurants. Occasionally also, even if consumers reached a store, they risked finding it closed, as retailers that faced shortages of workers and products closed early or shut permanently. The constraints on delivery vehicles in the early lockdown phase also limited e-commerce for several months.

When logistics restrictions started to relax after several weeks or months of the pandemic in a number of countries, contactless delivery and payment spread, and delivery became easier. As the fears of the consumers to go to stores and restaurants remained, there was a sharp upturn in the demand for e-commerce. Thus, ease of access combined with demand for access of e-commerce and its use burgeoned. Even with relaxation of lockdowns in some countries, many consumers kept a fear of going to restaurants and stores and thus have continued to use e-commerce and delivery.

The practical difficulties combined with fear were a shock to long-held shopping habits. Shocks push consumers above a threshold or inflection point and behavior adapts and changes. Once the new behavior is in place after the shock, the consumer learns and maximizes in the new behavior (Zilberman et al., 2012). During COVID-19, consumers had to stay at home and simply were forced to rely on delivery; they could phone local shops but often those faced restrictions too. Consumers got used to use mobile phone apps to order food from a local restaurant via Meituan or Swiggy, or via Bykea in Pakistan to get rice and oil from a local shop or supermarket, or buy processed and fresh foods from Alibaba's Hema chain.

While demand and sales surged, e-commerce and delivery intermediary firms faced constraints in the early period of COVID-19 when mobility restrictions were most severe. At times, such constraints were ambiguous and changing. They also showed great variation across countries and across states or provinces within countries. For example, China allowed food logistics to move freely but

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[3] Australia, China, India, Indonesia, Japan, South Korea, and Thailand.

at first required delivery persons to leave the food outside the residence and the customer had to come out to get it and pay. After that, the system evolved to most transactions being contactless using e-payment. Pakistan stopped delivery vehicles in March and April but then relaxed mobility constraints in late April. Malaysia let all delivery vehicles pass.

Moreover, even when formal regulations allowed delivery vehicles to move, the actual implementation was fraught with risk and informal stoppages. For example, in India, most e-platforms found it difficult to deliver during March, with it easing only when regulations were adjusted. To reduce interstate deliveries, Flipkart had to invest in many more warehouses to allow local storage and delivery (Pham, 2020). Delivery intermediary leaders Zomato and Swiggy let go of 1600 workers in March/April and scaled down their "cloud kitchen" programs with local SMEs for food preparation (FirstPost, 2020).

The combination of the surge in e-commerce demand coupled with the initial constraints to supply propelled a flurry of innovations involving pivoting and copivoting that we predicted in the theoretical model and below illustrate with cases.

4 | DOWNSTREAM FIRMS' PIVOTING DURING COVID-19

4.1 | Retailers pivot to e-commerce plus "bricks and mortar"

The 2010s saw rapid pivoting of e-commerce firms that acquired, founded, or partnered with bricks-and-mortar retailers and vice versa. This pivoting was important for grocery (especially fresh grocery) e-commerce; brick-and-mortar stores are a base for local delivery and for consumer curb-side pickup, while the addition to bricks and mortar stores of e-commerce permitted greater reach and convenience (eTail, 2019). Before COVID-19, this strategy was followed in the following examples: (1) In 2017, Amazon bought Whole Foods in the United States and founded Amazon Fresh stores in 2020; (2) in 2015, Alibaba founded HeMa XianSheng in 2015 in China (https://www.freshhema.com; Wu & Gereffi, 2018); (3) in 2015, JD.com (a major e-commerce company in China) bought part of Yonghui Superstores (https://www.yonghui.com.cn); (4) in 2018, Walmart-India bought Flipkart, a large e-commerce firm started in 2007; and (5) in 2019, Reliance (which became India's leading supermarket chain in September 2020) founded Jiomart as a grocery e-commerce subsidiary (Pham, 2020).

The e-commerce of these amalgams of e-commerce and brick-and-mortar stores formed crucial "inherited strategies" once COVID-19 struck. In-person store visits fell and e-commerce rose from March 2020 on, such as in the mentioned Indian and Chinese cases. Brick-and-mortar stores in those amalgams copivoted and served as fulfillment points for e-commerce orders, such as in the cases of Reliance stores that dedicated a part of their store space to fulfillment logistics for Reliance's e-commerce operations, and of Yonghui that continued as a brick-and-mortar store with hygienic and distancing measures taken but that also served as an e-commerce warehouse, packing, and dispatching facility.

A recent event shows the dangers to brick-and-mortar retailers that did not adopt the strategy of pivoting into e-commerce before or early on in the COVID-19 crisis. Until August 2020, Future Retail was a leading food retailer in India, with 1800 brick-and-mortar stores in 420 cities and wholesale and logistics divisions with trucks and distribution centers around India. To compete with Reliance, Walmart/Flipkart and various other supermarket chains, Future Retail had expanded its operations rapidly since the late 2010s, but it did not pivot into e-commerce. The expansion left the firm heavily indebted, forcing a series of asset sales and making it vulnerable to the rapid drop of consumer in-store shopping during COVID-19. In August 2020, Reliance bought Future Retail, acquiring a massive set of stores and supply-chain logistics to both leverage its brick-and-mortar retail operations and vastly expand its the logistics capacity for Jiomart, Reliance's e-commerce arm (Jagganath, 2020; Tandon, 2020). A similar example can be found in China where Alibaba recently purchased RT-Mart. Owned by Taiwan-based Sun Art Retail (a joint venture of RT-Mart and Auchan), RT-Mart is the largest grocery/hypermarket chain retail store in China with a market share of 14.1% in China (Xie & Otto, 2020). In October 2020, Alibaba obtained a controlling stake of Sun Art Retail, which is seen as a strategic move in digitizing brick-and-mortar grocery retail.

The cases of Future Retail in India and RT-Mart in China illustrate the need for continuous revision of strategy and pivoting. Future Group had been an early mover on supermarkets in India. It opened Big Bazaar in 2001 after having been the leading clothing retailer in large-format stores for 15 years. The Group had already been highly innovative in regional chain acquisitions, format diversification (such as very cheap tiny-scale stores to penetrate poor neighborhoods), manufacture of food private label products, and formation of logistics operations (Reardon & Minten, 2011). However, it failed to make the one additional pivot needed to mitigate its vulnerability to the COVID-19 shock. As a result, COVID-19 further

consolidated India's food retail sector with three leaders (Reliance, Walmart/Flipkart, and Amazon) and a few second-tier retailers (such as Spencer's) dominating the market.

4.2 | Retailers pivoting to use of own-delivery services

Before COVID-19, leading supermarket chains, especially in Asia and Latin America, had pivoted from just in-store retail to also supply through online orders and local delivery. The objective was to compete with the local incumbents (small shops and wet markets) that had the advantage of proximity to consumers. The pivoting strategy also aimed to capture demand from consumers wanting to avoid traffic congestion in cities to get to supermarkets, to serve those without cars, and to compete with local deliveries by family-owned mom-and-pop stores (reminiscent of the motives for supermarkets delivering to homes in the United States in the 1940s/1950s). Examples in Chile are retailers Jumbo (www.jumbo.cl) and Walmart's Lider (www.lider.cl), and, in Brazil, fast-food chain Giraffas (www.giraffas.com.br) (Popkin & Reardon, 2018).

During COVID-19, leading retail and fast-food chains deepened the pivot to home delivery and curbside pickup using their own logistics platforms and subsidiaries. In India, Walmart–Flipkart drew on the services of its own Ekart Logistics (www.ekartlogistics.com), which had started as Flipkart Logistics before Walmart acquired Flipkart. Flipkart rebranded it as Ekart. With the change it not only used the brand for its own deliveries, but also to sell logistic services to other e-commerce and brick-and-mortar retail firms (Gooptu & Shrivastava, 2020). The latter might seem odd, but it has been observed in situations where there is an underdeveloped market for third-party logistics services, as in the case, for example, Future Group's formation of Future Logistics Solutions in 2007. In this case, it consolidated the procurement system of Future Retail chains as well as for selling logistics services to Nestlé India, a main supplier of Future Retail (Business Standard, 2009), and even to competing retailers in India, making it an important profit center for Future Group (Foodbizdaily, 2009). In China, Metro Cash and Carry (a global wholesale cash and carry and retail firm based in Germany) was acquired by the Chinese supermarket chain Wumei in 2020. After the acquisition, Wumei's deliveries to food service businesses (restaurants and hotels), already comprising 40% of its business, increased further with the end of lockdown. Also, its home deliveries had rapidly increased during lockdown in the first half of 2020 (Edge by Ascential, 2020a).

4.3 | Logistics firms retooled to increase capacity and services to retailers

As a first trend, pure logistics firms copivoted with the delivery needs of online commerce of both supermarkets and e-commerce firms in the cases where these firms relied on logistics firms (unlike, for example, Amazon in the United States that shifted from third-party logistics to its own fleet in 2020). Sometimes, this copivoting involved the logistics firm receiving investment funding from the retailer to facilitate the co-pivoting. As the pandemic emerged suddenly, the retailers who had facilitated the growth of incumbent logistics firms were able to rapidly increase the retailer's supply of e-commerce and curbside pickup service as they drew on the relation with the logistics quasi-partner.

For example, in India, Walmart/Flipkart invested in the logistics start-up Shadowfax, an e-platform that matches local logistics SMEs to e-commerce companies (such as Flipkart and Amazon, as well as for delivery intermediaries such as Swiggy, discussed below) (Shrivastava, 2020). Flipkart pivoted to launch "hyperlocal delivery services" during COVID-19, as medium-sized supermarket chains suddenly needed a combination of online capacity and logistics for delivery. It did so by drawing on its partnership with Shadowfax as well as by bolstering its logistics capacity (Singh, 2020d).

Medium-sized and large domestic firms also partnered with logistics firms to copivot during COVID-19. In India, the e-commerce firm BigBasket faced delivery worker constraints as urban drivers returned to their villages during lockdown. BigBasket then partnered with Uber and Rapido (an online bike-taxi firm) in April 2020. Uber copivoted by adding product delivery and Uber-India and Rapido expanded their fleets to meet BigBasket's increased demand (Nandy, 2020; Singh, 2020b).

In a second trend, logistics and ride-share firms repurposed during COVID-19 to partner with retailers and food service firms. Bykea (www.bykea.com) is an example in Pakistan. Founded in 2017, Bykea is Pakistan's leading on-demand personal transportation (ride-hailing), product logistics, and cash-on-delivery service. It is a competitor of Uber. Bykea is one of the seven portfolio companies of Sarmayacar, a venture capital fund supporting technology start-ups in Pakistan. Bykea's services are packaged into one "app" that leverages Slack, Google Docs, Sheets, and Google-Hangouts. The physical side is a network of motorcycles. There are 17 million motorbikes in the country, three times more than cars. They move more quickly than a car can in congested streets and narrow alleyways of cities. Bykea's headquarters are in Karachi but it has sites (franchises) in major cities around the country. Bykea does not

own the motorcycles but is just a "matchmaker" platform for 30,000 drivers in 2020. The driver uses smartphones and engages as "partners." Bykea has 500,000 motorcycles registered on its on-demand logistics service that registers Bykea Partners who are paid by the number of bookings.

Because of COVID-19 restrictions, Bykea had to suspend rides (their main business before COVID) and their emerging delivery services in March/April 2020. With the easing of the lockdown, deliveries resumed although the ride service remained suspended. As a consequence, deliveries of goods turned into a major business for them; thus, Bykea transitioned from mostly ride hailing to a B2C e-commerce business from local retailers to consumers. However, the latter was constrained by many retailers being suspended limiting even the delivery service. To remain in business and keep their drivers employed, Bykea began to deliver food rations and other essentials on behalf of humanitarian organizations, as well the government, often at cost. In June/July 2020 with the reopening of the economy, the firm resumed ride hailing and B2C e-commerce delivery. Postopening, e-commerce is a much larger share of their business than before and seems set to continue that way as consumers have become accustomed to the service.[4]

4.4 | Rise of "delivery intermediaries" that copivot to help retailers

The "delivery intermediary" is an important type of e-intermediary that had already emerged before COVID-19, but copivoted and grew rapidly to help both large-scale and SME downstream firms (Koontz, O'Leary, & Gwyther, 2020). These intermediaries combine logistics services (or outsource these to specialized logistics firms) with other transactional services (directly to consumers or through other input or service providers like warehouse firms), and provide an app for consumers and retailers. For example, Instacart customers use an app to select products they wish to purchase from a retailer from a list of subscribed providers. The delivery intermediary then either fetches and delivers the product or enlists a pure logistics firm to do that. The latter could be with firms such as Ekart or Shadowfax in India or a ride hailing service such as Uber in India or Bykea in Pakistan that copivoted with delivery intermediaries and others to enter the market for product delivery. The delivery intermediary typically processes the payment, either with its own e-pay platform or in partnership with a third party such as Paytm in India. The delivery intermediaries compete with the own-delivery platforms of firms like Amazon in some countries, although in others

they may supply services to these firms before or instead of those firms' setting up their own delivery e-platform and operations.

The leading "delivery intermediary" is Instacart (started in 2012) in the United States and Canada. Other examples are Rappi in Latin America and Swiggy in India. These firms developed very rapidly in the 2010s. We examine several key examples and show how the delivery intermediaries copivoted with their clients. First, Rappi was founded in 2015 in Colombia and is now present in Argentina, Brazil, Chile, Costa Rica, Ecuador, Mexico, Peru, and Uruguay, with 10 million users monthly. Rappi partners with both food service firms and supermarket chains. It provides the e-platform for online orders and also the logistics of delivery via gig (independent) drivers who buy and deliver the product or just deliver the product. An example of a close partnership is that of Rappi with Carrefour in Brazil. Rappi maintains "dark store" areas in the Carrefour stores (areas dedicated to the logistics of stocking and dispatching goods for delivery). Rappi grew rapidly during COVID-19 lockdowns; it began contactless delivery and has been testing robot deliveries in Colombia for contactless delivery (Edge by Ascential, 2020b; Koontz et al., 2020).

Second, in India, the delivery intermediary Swiggy works mainly with SME food service firms such as independent restaurants. Swiggy was constrained in the early lockdown period: it had to let go a portion of its staff and also had difficulty retaining drivers who wanted to go back to their villages. But as lockdown waned and expectations of a recovery started, Swiggy "copivoted" with its 40,000 restaurant partners that were pivoting their service arrangements and hygiene practices. Swiggy implemented a "jumpstart" program that had three prongs: (1) Swiggy Capital Assist Program for loans to SMEs endeavoring to restart; (2) safety and hygiene training and sales of packaging and cleaning kits; and (3) advertising to potential customers the hygiene upgrades of its restaurant clients on the app so as to bring back customers (Indiaretailing.com, 2020). Large e-firms emulated Swiggy such as Amazon's starting in June 2020 delivery services for independent restaurants, competing with incumbents Zomato and Twiggy (Firstpost, 2020).

4.5 | Competition among big firms to outfit retail SMEs with e-commerce

In most of developing Asia and Africa and part of Latin America, SMEs still dominate the retail and food service markets. Increasingly, large retailers/wholesalers and e-commerce firms have treated SMEs not only as competitors but also as clients. Of course, this has long been the

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[4] Personal communication, Anwar Naseem of Rutgers University, based in Pakistan.

case for large "cash and carry" wholesale firms like Metro Cash and Carry (a global chain based in Germany) that had as their primary clientele in developing countries SME retailers and food service firms, with a secondary clientele the consumers going to them as retailers. But during COVID-19, small shops and restaurants were particularly affected by mobility restrictions and consumer fears, and the SMEs (that managed to survive) pivoted to address that constraint. A primary pivot was to deliver food products and meals, and a subset of the firms doing delivery implemented it online, as e-commerce, in several ways.

On the one hand, even before COVID-19, mobile network, mobile finance, and Internet-based bookkeeping apps were proliferating among SME retailers and food service firms in many countries. The SMEs were adopting the use of Facebook and Whatsapp for e-commerce transactions and payments. Facebook and competitors like Google with GooglePlay intensively invested in developing regions. There are local competitors, such as Khatabook in India for bookkeeping (Shrivastava, 2020). In Thailand, during COVID-19, SME retailers began selling food directly to consumers via Facebook and cellphone networks and local (SME) delivery apps (Leesa-Nguansuk, 2020).

On the other hand, large retailers such as Reliance in India facilitated "local" e-commerce by SME retailers with: (1) Jiopay (Reliance's e-payment division), (2) Jiomart (Reliance's e-commerce division) facilitating the small shop's creating a "virtual storefront," (3) inclusion of the small shop in Jiomart's own e-commerce as a fulfillment or pickup point, (4) allowing the small shop to order from Reliance via Jiomart as a mobile form of a cash and carry, (5) supplying small shops with hand terminals from Jio to manage inventory, and (6) accelerated development of "hyperlocal delivery" services for SME suppliers, small shops, and small supermarket chains like Vishal Mega Mart, as Walmart–Flipkart did in India (The Economic Times, 2020a), while Reliance did the same for its Jiomart program with small shops that had declined 4% in total sales in the March trimester (The Economic Times, 2020b). These types of changes in business operations had already emerged before COVID-19, but accelerated rapidly during COVID-19 as "copivoting" strategies to facilitate the pivoting by SMEs (Pham, 2020; Shrivastava, 2020; Singh, 2020a).

In a further trend, foodservice delivery platforms helped SME restaurants pivot during COVID-19. In China, Meituan, the largest foodservice delivery intermediary started in 2010 with two-core businesses. One is in advertisement for users, similar to Groupon's service (www.groupon.com), a subscriber service connecting consumers to a set of retailers. The other is a Yelp-style online restaurant review platform. Meituan expanded into other types of services such as travel and hotel booking and food deliv-ery. During COVID-19, Meituan pivoted its delivery service and started "contactless delivery." Moreover, since restaurant service plays an important role in the value-added provided to the consumers (Tian et al., 2021) and the restaurant service is being replaced by delivery service during COVID-19, it is important to know whether consumer satisfaction/dissatisfaction comes from the restaurant or the delivery service. To deal with this issue, in November 2020, Meituan added a new feature on its review platform allowing delivery workers to leave reviews about the restaurants they delivery for, thereby helping "copivoters" to provide better information to consumers dining options.

Lastly, TikTok is an example of a "social network" e-commerce that started in China (Wang, 2021). TikTok pivoted into e-commerce through their live-streaming portal where sellers directly sell through TikTok's mobile platform. The company's comparative advantage is in capturing the demand for online shopping through social networking. Initially, TikTok lacked two critical types of infrastructure. It did not have a system for digital payment, as this required approval by the Chinese government. It further lacked logistics infrastructure as this requires significant (indivisible) investment making it prohibitive to set up on its own logistics during the COVID-19 lockdown. Instead, TikTok made use of third-party payment systems, such as AliPay or WeChat Pay, and third-party logistics firms to copivot its transition to online sales.

4.6 | B2B e-commerce firms helping big and small retailers in procurement

In India, COVID-19 accelerated the development of e-platforms for B2B, helping both large companies and, especially, SME retailers to address logistics and search-cost constraints of sourcing from farmers and first-stage processors. This included B2B divisions formed by large companies, such as Walmart/Flipkart and Reliance, as well as the German wholesale/retail multinational Metro Cash and Carry. It also involved the participation of domestic large- and medium-sized start-up ecommerce firms, such as ShopKirana and Jumbotail (e-wholesale firms connecting small shops to both regular wholesalers and food suppliers), and OfBusiness (an SME finance firm), as well as firms such as Udaan and NinjaCart. Just like delivery intermediaries working with retailers and processors to sell directly to consumers, these B2B firms offer a mix of services to SME retailers and suppliers, typically including logistics, SaaS (software as a service), e-payment, and marketing.

Udaan is an example of an online marketplace with about half of its sales in food. It started in 2016 and became a fast-growing "unicorn" (a billion dollar company). For its

food sales, it focused on small towns, linking staples processors and farmers to SME retailers to source fresh produce. It received initial funding from well-known Internet start-up financiers, including Lightspeed Venture Partners (California), DST Global, and Tencent (Sharma, 2019). As with other intermediaries, its sales and work force sharply dropped during the early COVID-19 lockdown period, but returned to 80% of its pre-COVID sales by June as demand by SME processors and retailers recovered after overcoming sourcing constraints they faced early on during the pandemic (Shrivastava, 2020).

Ninjacart (www.ninjacart.in) started in 2015 (with Qualcomm and Accel as investors) and presents itself as the largest app-based formal-sector fresh produce supply chain company in India, operating in seven major cities. It runs a supply chain from farmers to collection centers to fulfillment centers to distribution centers to SME retailers and foodservice, as well as to apartment complexes. Ninjacart also started working with large-scale wholesalers and retailers in early 2020. Just two months before COVID, Walmart–Flipkart acquired part of Ninjacart to develop its sourcing from farms for the grocery e-commerce of Flipkart and for Walmart's "India's Best Price" B2B cash and carry stores (Vankipuram & Nandy, 2020). In a strategy widely implemented by e-commerce firms in several countries during COVID-19, Flipkart started rapid "hyperlocal" service in July 2020 and used Ninjacart's supply chain to implement that and help Flipkart compete with Amazon Fresh, BigBasket, and Grofers (Velayanikal, 2020).

5 | MIDSTREAM FIRMS PIVOTING STRATEGIES DURING COVID-19

5.1 | Processors selling direct to consumers via e-commerce and delivery intermediaries

Large food processing firms also forged novel partnerships and networks. They partnered with delivery intermediaries. In India, Marico Ltd. set up a partnership with Swiggy and Zomato to deliver oats and edible oil directly to households in April 2020 (Tandon, 2020). Marico's competitor, ITC, also started selling basic staples to housing complexes and communities via Swiggy and Zomato and community apps such as Apna Complex, Mygate, and NoBroker. A third major processor, Godrej Consumer Products, partnered with Zomato, Zoomcar, and Dunzo to sell directly to consumers, but also undertook B2B with small shops (The Economic Times, 2020d).

At the same time, various SME food processors started (or increased) direct food sales to consumers in response to mobility restrictions on consumers during COVID-19.

For example, in Thailand, SMEs are selling food directly to consumers via Facebook and cell networks and local (SME) delivery apps, sometimes in competition with foreign e-commerce firms (such as Alibaba via its subsidiary Lazada) that SMEs are said to perceive as charging higher commissions (Leesa-Nguansuk, 2020).

5.2 | Wholesalers pivoting to e-commerce and use of delivery intermediaries

Some wholesalers who had started as delivery intermediaries for retailers moved into e-commerce themselves establishing forward linkages by retailing directly to consumers during COVID-19. An example is Glovo, a wholesale company that started retailing directly to consumers in Spain. This is not a new trend, as for decades wholesale cash-and-carry chains, such as Metro, added direct consumer retail to their original wholesale-to-retail business. With COVID-19, however, the former trend transitioned into including e-commerce retail.

Moreover, intermediaries other than delivery intermediaries also started making increasing use of e-platforms during COVID-19. In Myanmar, for example, constrained by lockdown policies, wholesalers in two major bean and pulses wholesale markets initiated an e-platform on Facebook to link domestic suppliers and processors and exporters.[5] The Monywa Commodity Exchange is the main wholesale market in the main bean and pulses production zone, the Dry Zone. The government announced a stay-at-home rule in the second half of April. For small-lot transactions, the traders at the Exchange created a Facebook/Messenger group for its members, accessed by mobile phone. The traders posted their proposed prices. They merely posted photos of products such as pigeon peas that have lower quality differentiation. While the Exchange moved back to normal trading as restrictions eased in June/July 2020, the e-platform continues to service long-distance exchanges with China.

5.3 | Processors pivoting technology and work organization

Food industry firms as well as delivery intermediaries in various developing countries faced severe constraints in accessing labor during COVID-19 due to regulations limiting worker commuting. Firms entering the pandemic period with a higher machine/worker ratio were less affected by the labor shortages, such as in the large-scale

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[5] Personal communication from Curtis Slover, UNOPS, Myanmar.

food processing industry in India. Some large processors increased capital/labor ratios during the pandemic. For instance, In Brazil, the two largest meat processors, Marfrig (Rochas, 2020b), and JBS (Rochas, 2020a) increased daily worker shifts and ran machines for longer hours, reducing labor use per shift to comply with social distancing guidelines. Machine use per labor hour increased. Tyson Foods' meat packing plants in the United States increased the usage of robots after many workers were infected by COVID-19 in a labor-dense working environment (Bunge & Newman, 2020). It is likely that automation in food processing will increase post-COVID to avoid labor shortages in the future (for the Indian case, see Yadav, 2020).

5.4 | B2B e-commerce firms helping processors to procure from farmers

In India, Godrej (discussed above) partnered with several start-up B2B firms to source intermediate inputs. These start-ups were funded by Godrej's own venture capital fund (Omnivore, with additional funding from U.S. firm Sequoia Capital) started in 2010. Two illustrative start-ups are DeHaat (meaning marketplace in Hindi) and Stellaps. These start-ups functioned like Ninjacart and source crops and dairy, respectively, for Godrej, as well as for retailers, such as Reliance Fresh, and other delivery intermediaries, such as Zomato and Udaan (Mitter, 2020; Singh, 2020c). Britannia, another large processing firm, used the B2B Agribazaar, as well as various local logistics firms during COVID-19 to avoid the overcrowded, and hence, unsafe regular wholesale markets (Mathew, 2020). Moreover, ITC (discussed above) used its digital advisory application "e-choupal" more intensively during the pandemic. E-choupal provided information to farmers about prices via a mobile platform (Anand, 2020) and transport of crops from farms to their train network and coastal container shipments to ensure uninterrupted movement of grain and soy inputs during and right after the lockdown period (Kurmanath, 2020).

6 | FARMERS SELLING TO CONSUMERS VIA E-COMMERCE

First, large e-commerce firms have partially supplanted the traditional intermediation between farmers and consumers consisting of field brokers, wholesalers, and brick-and-mortar retailers with the establishment of a linkage from the farmer through the e-commerce firm directly to the consumer. In China, for example, before COVID-19, Pinduoduo (the second-ranked Chinese e-commerce after

Alibaba in terms of number of customers) expanded business during COVID-19, leveraging its existing e-platform. This platform aggregates produce over farmers "teams" and arranges pickup and delivery to consumers. Pinduoduo also advertises its platform through "livestreaming" farmers group videos to consumers (Pinduoduo, 2020).

In Indonesia, some farmer groups worked with Pinduoduo's rival Alibaba. The Rumah Sayur Group, a vegetable farm coop with 2500 farmers, sold to supermarkets, wet-markets, and food-service businesses in Jakarta before the pandemic. The coop suffered a 60% drop in orders with COVID-19. However, it managed to partially recuperate sales by forming a partnership with Alibaba to sell vegetables directly to consumers. In Malaysia, Alibaba's Lazada connected a Malaysian SME flower supplier to online florists to gain a new customer base after COVID-19 restrictions stopped its earlier marketing system (Harper, 2020).

Second, SME e-commerce and delivery intermediary firms have facilitated farmers' sales. In Malaysia, flowers and fish delivery intermediary MyFishman.com helped the fish SMEs sell through fresh-seafood subscriptions and delivery services, thereby avoiding having to sell on wet markets or directly to consumers. Third, in some countries, governments have facilitated farmers selling directly to consumers during COVID-19. In Israel, four e-commerce trade hubs were designed and promoted by the government before COVID-19. This initiative facilitated the emergence of private B2B e-commerce platforms that allowed individual farmers and farmers' cooperatives to sell directly to SME retailers, skipping wholesale markets. COVID-19 induced two of the four e-commerce firms (avenews-gt.com, g-ex.org, www.tendermarket.co.il) to add B2C e-commerce sites.

Fourth, in several countries, "social-network" e-commerce of food has emerged. This involves sales direct from farms to consumers. In Israel, for instance, social networks of volunteers aid farmers to sell directly to consumers in urban neighborhoods (Libsker, 2020). These networks had already emerged before COVID as part of the development of the innovative bicycle network in Tel Aviv, Shokeat. With COVID-19, these networks expanded rapidly, evolving into e-commerce or "Shocoo," which sells via Facebook groups. E-banking and payment applications facilitated this growth, allowing mobile person-to-person transfers of cash (Wisberg, 2020). These produce sales networks endured after the easing of COVID lockdowns, and may well become an important alternative to food purchases in supermarkets and green groceries, as consumers have become accustomed to the higher quality (Bar-On, 2020). The ministry of agriculture reported that currently, 29% of farmers sell directly to consumers (Moses, 2020a). Networks like Shokeat expanded from 1 to 25 logistics

centers in Tel Aviv operated as franchisees (Kadosh, 2019). The boom in online direct F2C sales is inducing many more farmers to sell directly to consumers. To recover the additional cost, some food producers request consumers to place large volume orders, while others charge delivery fees (Moses, 2020b). While some farm-to-consumer arrangements aided by e-commerce may, like the Israel case, endure and develop after the pandemic, it is possible that traditional relations with aggregators and wholesalers will resume. It may be that the economies of scale enjoyed by wholesalers will make the direct sales approach noncompetitive except in special cases.

7 | CONCLUSIONS

Food industry firms have transformed food supply chains in developing countries over the past three decades by endogenously designing their supply chains to market product and procure intermediate inputs to overcome the constraints faced in traditional market settings, such as high transaction costs and climatic and agroecological risks and shocks. The firms often developed "fast-tracking" strategies by forming symbiotic relationships with firms in their "complementary clusters," such as intermediaries who innovated to help the food industry firms adapt their supply chains.

COVID-19 and the set of lockdown policies accompanying it emerged in early 2020 as a massive shock to these firms' supply chains. Suddenly, consumers had to stay at home, so firms had to deliver their products to them rather than serve them in their restaurants and stores. Suddenly, there were heightened obstacles to sourcing intermediate inputs from farmers and first-stage processors such as flour mills. A number of food industry firms "pivoted" by turning at least partially to e-commerce to reach consumers, and e-procurement to reach processors and farmers. Some food industry firms went into the COVID-19 period already specializing in e-commerce or having it as part of their portfolio; some did not. Some were ready to ramp up their own e-commerce and delivery, but many were not ready to do all of that themselves, and many had no capacity to do it.

It was then, in the middle of the pandemic, that a category of firm—delivery intermediaries—copivoted with food-industry firms to fill the gap in the capacity to deliver and procure. Many of these intermediaries already existed, but the pandemic led them to intensify and expand their operations. This was crucial to the ability of the food-industry firms to pivot. The pandemic acted as a "crucible" that induced this new set of fast-tracking innovations, and thus accelerated their diffusion in devel-oping regions. This was also a factor in food industry firms being able to redesign, at least temporarily, and perhaps for the long term, their supply chains to be more resilient. This appeared to have helped a number to weather the pandemic, to supply consumers, and thus to reduce the bleeding in the domain of food security during the pandemic.

This paper presented a theoretical model to explain these firm strategies and developed relationships that can be quantitively simulated and estimated once more data become available. We then presented a taxonomy of the practical strategies undertaken by firms, mainly using emerging market country cases. Our intention was to conceptualize and taxonomize, but also to show the fascination of the dynamic innovations that firms undertook in pivoting and copivoting in their complementary clusters, along food supply chains. We used case studies because it was too soon to have systematic survey databases to see how many consumers and farmers and food industry firms used these strategies and with what impacts.

The case-study findings point to an obvious need by these firms to enjoy enabling policy and infrastructural conditions that allow them to pivot and copivot. This became clear when the lockdown diminished and the symbiosis intensified and flourished, at least in our study regions. Those study areas, mainly in Asia and Latin America, had sufficient infrastructure such as mobile networks and good roads to facilitate a certain fluidity in the pivoting. Certainly, in areas where there are more transaction costs such as in Africa and policy rigidities, the adaption is more difficult.

Our conceptual model and taxonomy and illustrations provide an initial framework for further research including quantification of the behavior and evolution of agri-food supply chains in response to shocks. Quantitative understanding of these dynamic patterns and statistical testing, as well as business management explorations of alternative hypotheses, require quantitative data collection and case studies covering all segments of the food supply chain. These empirical extensions can explore strategic food industry responses, not only to face outbreaks of human-disease pandemics, but also to face shocks related to the spread of livestock disease, food-safety crises, climate change, and conflict. There will be a particular need to study immediate versus longer term responses, hence persistence of pivoting, as well as the impacts of these responses on farmers, SMEs, employment, and consumers. Finally, there will be a need to further explore the pivoting to e-commerce and delivery intermediation in developing countries postpandemic, and other behavioral changes of firms such as in substitution of labor with capital in the form of an intensification of automation.

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