CHAPTER 6

Food Supply Chains
Business Resilience, Innovation, and Adaptation

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KEY MESSAGES

- The pandemic disrupted food supply chains through government-imposed lockdowns and restrictions, affecting labor supply, input provisioning, logistics, and distribution channels, and shifting consumer demand for food.
- Impacts differed by the degree of integration and modernization of food supply chains.
- "Transitioning" supply chains were the most vulnerable – these chains are long but still poorly integrated, face infrastructure limitations, and are dominated by small and medium enterprises (SMEs) that depend heavily on hired labor.
- Traditional supply chains also suffered but less so, being generally short and relying on family labor.
- Modern, integrated supply chains were better positioned to adapt and innovate. Businesses that were able to "pivot" or innovate rapidly fared well, using either their own capacity or intermediaries to expand e-platforms for supply and delivery.
- Ongoing trends, most notably the growth of supermarket-style retail, e-commerce, and food delivery, were accelerated by the pandemic.
- Recent innovations offer opportunities for SMEs in food supply chains. E-commerce jumped by 100 percent in middle-income countries, and specialized logistics intermediaries have innovated to meet the needs of both large food businesses and developing-country SMEs and smallholder farms.

RECOMMENDATIONS

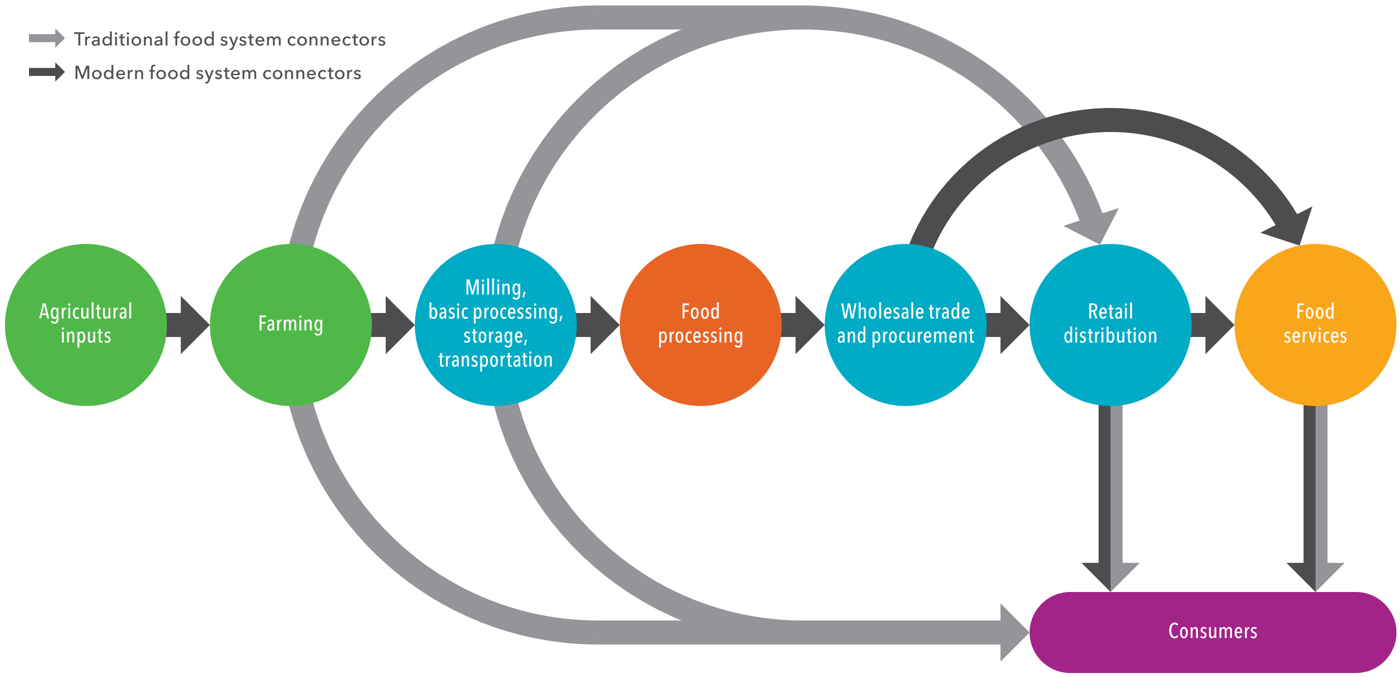
- Create a business environment that supports private sector firms in their central role in food system resilience and transformation.
- Promote food system modernization and innovations – driven by the private sector but enabled by the public sector – that enhance resilience and help generate employment and better livelihoods along food supply chains.
- Develop regulations that promote market integration and reduce transaction costs along supply chains.
- Invest in adequate basic infrastructure, ICT, and mobile networks to facilitate business and supply chain innovation and modernization, especially for SMEs.
- Focus government interventions on targeted support to improve market access and entry for SMEs.

The COVID-19 pandemic has revealed both the vulnerability and resilience of food supply chains. From farm to retail, supply chains have been disrupted, primarily by government-imposed lockdowns and other restrictions affecting labor supply, input provisioning, logistics, and distribution channels. (See Figure 1 for a simplified presentation of food supply chains.) Impacts have differed by type of commodity: Mechanized production of cereals and other staples on large farms proved less vulnerable than labor-intensive and labor-dense production of fruits and vegetables on smaller farms. Postharvest handling, packaging, and processing for many perishable foods were susceptible to outbreaks of COVID-19 among workers because of close working conditions. Disruptions and enhanced virus transmission were especially notable in the meatpacking industry.[1]

Impacts have also differed by country and degree of integration and modernization of food markets. Countries where food systems are transitioning from traditional to modern appear to have been most vulnerable to supply disruptions and restrictions on labor movements. Transitioning supply chains are long and operations often depend on hired labor, but the multiple stages between farm and retail are still poorly integrated and fragmented — characterized by, for instance, little development of temperature-controlled storage and transportation, poorly connected service and input markets, and underfinanced suppliers. These supply chains have been vulnerable to COVID-19 restrictions. Border closures and curfews have led to food losses as transport of perishables have had to take place in daytime heat instead of during cooler nights. In other cases, hired workers were unable to report to work.[2] More traditional supply chains (depicted in Figure 1) have also proven vulnerable for much the same reasons, but less so, as these chains remain short and producers and operators are mostly family owned, using little hired labor.

This chapter draws on collaborative research by the authors with A. Heiman, L. Lu, C. Nuthalapati, and D. Zilberman ("'Pivoting' by Food Industry Firms to Cope with COVID-19 in Developing Regions: E-commerce and 'Co-pivoting' Intermediaries," *Agricultural Economics* [2021, forthcoming]); the case studies published in a special issue of *Agricultural Economics* on "COVID-19 Impacts on Global Food Systems and Household Welfare," ed. J. Swinnen and R. Vos (2021, forthcoming); and the framework provided in T. Reardon and J. Swinnen, "COVID-19 and Resilience Innovations in Food Supply Chains," in *COVID-19 & Global Food Security*, ed. J. Swinnen and J. McDermott (Washington, DC: IFPRI, 2020).

FIGURE 1 Traditional and modern integrated supply chains



Modern supply chains (integrating all segments in Figure 1) have generally been the least affected, possessing greater capacity to adjust and innovate to keep supply chains running. Large-scale operators in modern supply chains benefited from a fair degree of control over input supplies and marketing channels, greater flexibility to switch between suppliers within their networks and between destination markets, and sufficient resources to innovate and "pivot" business operations. ("Pivoting" refers to fundamental shifts by businesses in strategy and practices in response to adverse shocks or to take advantage of major new opportunities.[3] Below, we introduce the term "co-pivoting" to refer to significant complementary shifts in business strategies and operations by firms upstream or downstream from pivoting businesses.[4])

Pivoting by private food businesses and intermediaries in 2020 typically leveraged digital platforms and/or new types of logistics business models that were already beginning to emerge before the pandemic. Such innovations in business operations, especially the use of e-commerce, e-logistics, e-payment, and e-procurement platforms to link to suppliers and buyers, proved effective in adjusting to the major supply and demand shocks provoked by the pandemic, and they are likely to endure. While adoption of these innovations may be challenging in some contexts, they provide important new opportunities, particularly for the many small and medium enterprises (SMEs) in developing-country food supply chains. Importantly, these innovations have been wholly market driven and introduced by private operators, though facilitated by existing, primarily publicly provided infrastructure as well as regulations for mobile communication technology and other connectivity.

PANDEMIC ADAPTATION STRATEGIES OF GLOBAL AND LOCAL FOOD BUSINESSES

Lockdown policies to contain the spread of COVID-19 provoked massive shocks to entire food supply chains, interrupting supplies and altering demand. The global recession has hurt nonfood activity the most, but business disruptions and severe employment and income losses have also spilled over to the food sector by interrupting input deliveries and dampening food demand. On the supply side, as downstream food businesses faced obstacles in sourcing agrifood products from farmers, they sought to ensure supplies either by strengthening their own vertically integrated delivery channels, in the case of large operations, or by using a range of new logistics and delivery intermediaries organized through e-platforms. On the demand side, partial or complete closure of restaurants and other food service businesses as well as restrictions on mobility meant that consumers began buying relatively more from retail distributors, especially modern stores that offer a broad variety of food products and other necessities. Social distancing measures and people's fears of infection also increased demand for home delivery, especially through e-commerce platforms.

ACCELERATING CHANGE

COVID-19 has accelerated many ongoing shifts in food supply chain operations. During the past 25 years, the agrifood sector underwent major and rapid changes, especially in developing countries. Financed by large-scale foreign or domestic investors, supply chains modernized, a process that includes restructuring of wholesale and retail distribution, logistics, processing, and input supply to provision rapidly expanding urban food markets.[5] Upstream innovations included modern farm inputs and new technologies; downstream innovations, our focus here, included expansion of supermarkets, franchised fast-food service, and packaged processed food. In developing countries, the characteristics of traditional markets — including fragmented supply chains, missing service and input markets, inadequate skills, and underfinanced suppliers — have tended to hamper adoption of these innovations.

As a result, two broad modernization modalities have emerged. Some large-scale operators have set up vertically integrated supply chains to control input and output delivery and limit transaction costs. Other large-scale supermarket chains, traders, and food processors employ an array of SMEs to support transportation, logistics, distribution, and delivery. Vertically integrated supply chains have shown greater resilience and capacity to adjust and innovate during the pandemic. Supply chains dominated by SMEs, common in many developing countries, have been more vulnerable. As mentioned, these systems have less capacity to adjust to restrictions on labor movements (when relying on hired labor, rather than family members) and greater susceptibility to disruptions in other input provisioning and transportation (especially where storage and processing capacities are inadequate).

SUPPLY: *Resilience and adaptation*

In some contexts, these modernization processes have led to strongly dualistic market structures, with modern vertically integrated supply chains serving one market segment and traditional SMEs serving another. Senegal's fresh fruit and vegetable supply chains illustrate the stark contrast in ability to adjust to the pandemic shock (Box 1). The vertically integrated, large-scale modern firms, which cater exclusively to export markets, have suffered little impact from the pandemic. These firms were able to adjust market channels and adapt business operations to circumvent labor restrictions. In contrast, small-scale farms, traders, and handlers operating in Senegal's poorly integrated domestic markets were severely affected by labor restrictions and disruptions in input supply, aggravated by a lack of adequate storage and limited capacity to manage risks.[6]

In Ethiopia, vegetable supply chains were also severely affected by disruptions in transport and in the supply of key farm inputs. In response to the pandemic, the government introduced trade restrictions to protect domestic producers from import competition. The impact on Ethiopian vegetable farmers was mixed. Those farmers who could sell into urban markets benefited from reduced local and international competition and higher prices, but those who could not trade to other parts of the country lost out.[7] However, Ethiopia's smaller vegetable farms were less affected by pandemic-related disruptions than medium-sized farms, as smaller farms rely less on hired labor.[8] This finding is consistent with the more general hypothesis that vulnerability to reduced labor availability, as resulted from pandemic restrictions, shows an inverted U-shaped relationship with farm size.[9] That is, small farms that rely on family labor have been largely unaffected by labor restrictions, but vulnerability increases among medium-sized farms with relatively high dependence on hired labor. Resilience has been much greater among agribusinesses large enough to benefit from significant economies of scale and financial capacity; these businesses managed to assure their labor supply by reorganizing labor shifts and arranging for safe transportation for workers, as was observed in Senegal's large export firms.

BOX 1 COPING WITH COVID-19 SHOCKS IN FRUIT AND VEGETABLE SUPPLY CHAINS IN SENEGAL

Senegal's large-scale fresh fruit and vegetable companies showed great resilience and were hardly affected by the pandemic, as documented in a recent study. These large companies operate vertically integrated supply chains oriented entirely to export markets. They were able to avoid labor supply disruptions due to COVID-19 infections by providing their workers with protective gear, doubling the number of shifts (and thus halving the number of laborers per shift), and investing in safer transport facilities to bring workers to and from the fields and collection centers. Vertical integration meant these companies also could rely on secure input supplies and marketing channels, as well as on their own cooled storage and transport capacity.

Small-scale, traditional fruit and vegetable enterprises catering to Senegal's domestic market, in contrast, were hit hard in the first months after social-distancing measures were imposed to contain the virus. These companies had little capacity to adjust and innovate in response to the shock and, consequently, were deeply affected by the mobility restrictions, closure of shops and wet markets, and their lack of access to credit and cold storage facilities. Senegal's traditional horticulture producers and traders generally faced lower output prices (caused in part by lower demand and quality loss) and rising input costs, which squeezed their profit margins and reflect the lack of resilience in local supply chains.

Source: Based on K. Van Hoyweghen, A. Fabry, H. Feyaerts, I. Wade, and M. Maertens, "The Resilience of Horticultural Supply Chains to the Covid-19 Pandemic: Insights from Senegal," *Agricultural Economics* (forthcoming, 2021).

DEMAND: *Modern retail and e-commerce*

Previous food and health safety crises led to increased supermarket purchases and declines in shopping at traditional wet markets; the SARS epidemic, for example, jumpstarted e-commerce in China. The COVID-19 pandemic likewise has increased modern grocery store sales at the expense of traditional stores (Figure 2 and Table A1). Albeit starting from low levels, e-commerce in food retail jumped by over 100 percent during 2020 in many middle-income countries, including Brazil, Indonesia, and South Africa, and by almost 50 percent worldwide. Although Figure 2 refers to consumer e-purchases at the retail stage only, use of e-commerce platforms in other segments of the supply chain such as logistics is growing even faster and fundamentally changing the structure of food business operations, as we detail further below.

BUSINESS INNOVATION FOR RESILIENCE: *E-commerce*

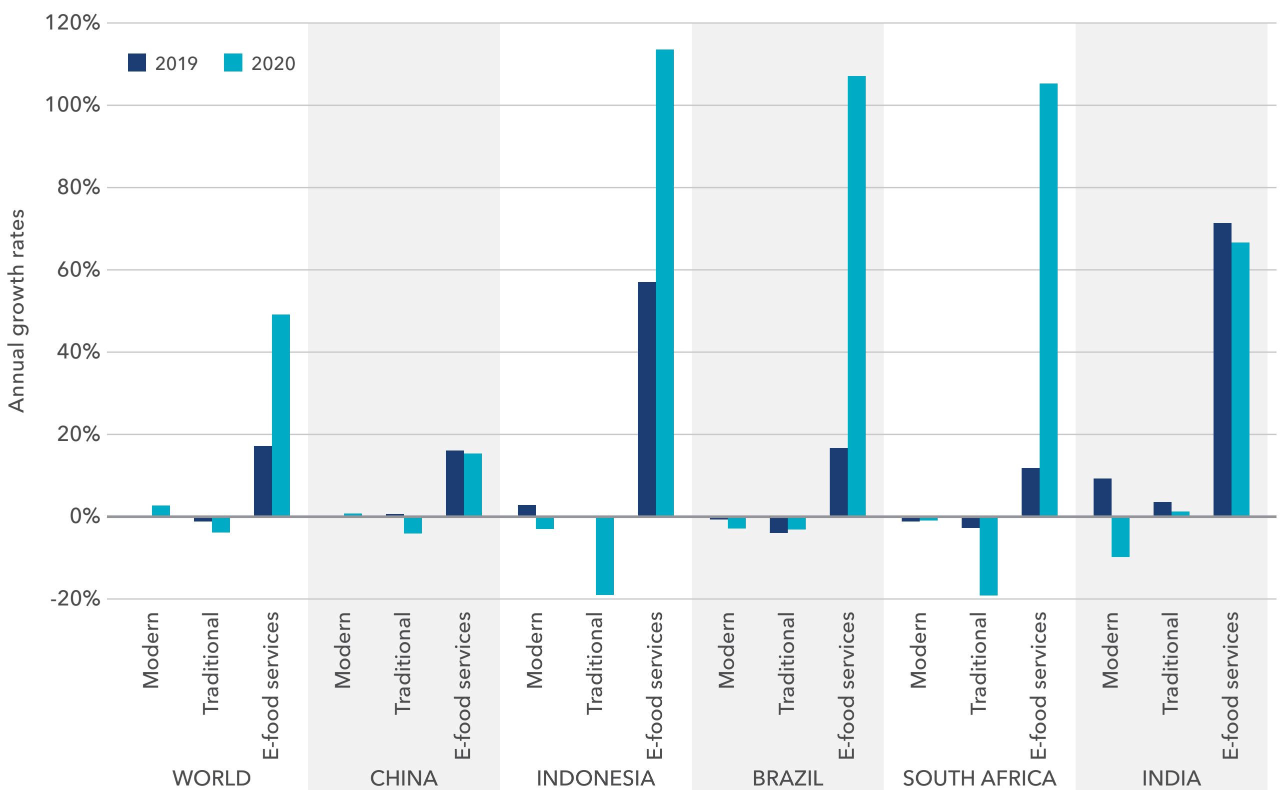
During the pandemic, many modern food businesses have been able to make innovations in their operations to cope with pandemic-related supply and demand shocks. Adjustment capacity and strategies have varied not only by type of supply chain but also within already modernized supply chains. Often, differences have their origin in pre-pandemic innovation strategies. Some modern food-industry firms pivoted by expanding e-commerce to reach consumers and, for inputs, by expanding e-procurement to reach processors and farmers. E-commerce had been growing pre-pandemic but got a big boost from COVID-19. Firms that had already introduced e-commerce and delivery services could ramp up these operations quickly. Those that had not established this digital and logistics capacity either pivoted to e-commerce by involving specialized intermediaries or were left behind. At the same time, new specialized "delivery intermediaries," such as third-party logistics service (3PLS) firms, have emerged and thrived using e-platforms, as illustrated in stylized fashion in Figure 3. These intermediaries engage with wholesale traders, processors, restaurants, and other food service providers, providing capacity to deliver and procure food products. Many of these companies already existed, but the pandemic led them to fast-track innovations to intensify and expand their operations. Intermediaries in wholesale, finance, and logistics rapidly moved to facilitate new business strategies building on e-procurement and e-commerce, as well as new logistics solutions that often required substantial investments.

Three current trends involving fundamental changes in individual business and supply-chain operations through digital technologies, described below, can be expected to continue to expand and evolve even after the pandemic ends.[10]

E-COMMERCE ENTERING FOOD VALUE CHAINS. During the 2010s, the food sector witnessed rapid growth of e-commerce firms that acquired, founded, or partnered with "brick-and-mortar" retailers. Notable examples include e-commerce firm Amazon buying the supermarket chain Whole Foods in the United States in 2017 and establishing Amazon Fresh stores in 2020, and China's JD.com (also a major e-commerce company) buying Yonghui Superstores in 2015. Conversely, Walmart-India acquired Flipkart, a large e-commerce firm, in 2018; and Reliance, another leading supermarket chain in India, founded Jiomart as a grocery e-commerce subsidiary in 2019. With the pandemic, these combinations of e-commerce and physical stores took off. Businesses unable to follow this strategy faltered, even modern large-scale operations, as exemplified by the case of Future Retail in India (Box 2).[11]

FOOD RETAILERS LEVERAGING E-COMMERCE TO INTEGRATE THEIR SUPPLY CHAINS. Downstream food retailers are either expanding their own e-based logistics or leveraging new intermediaries. Before the pandemic, supermarket chains in developing countries had begun to operate online delivery services

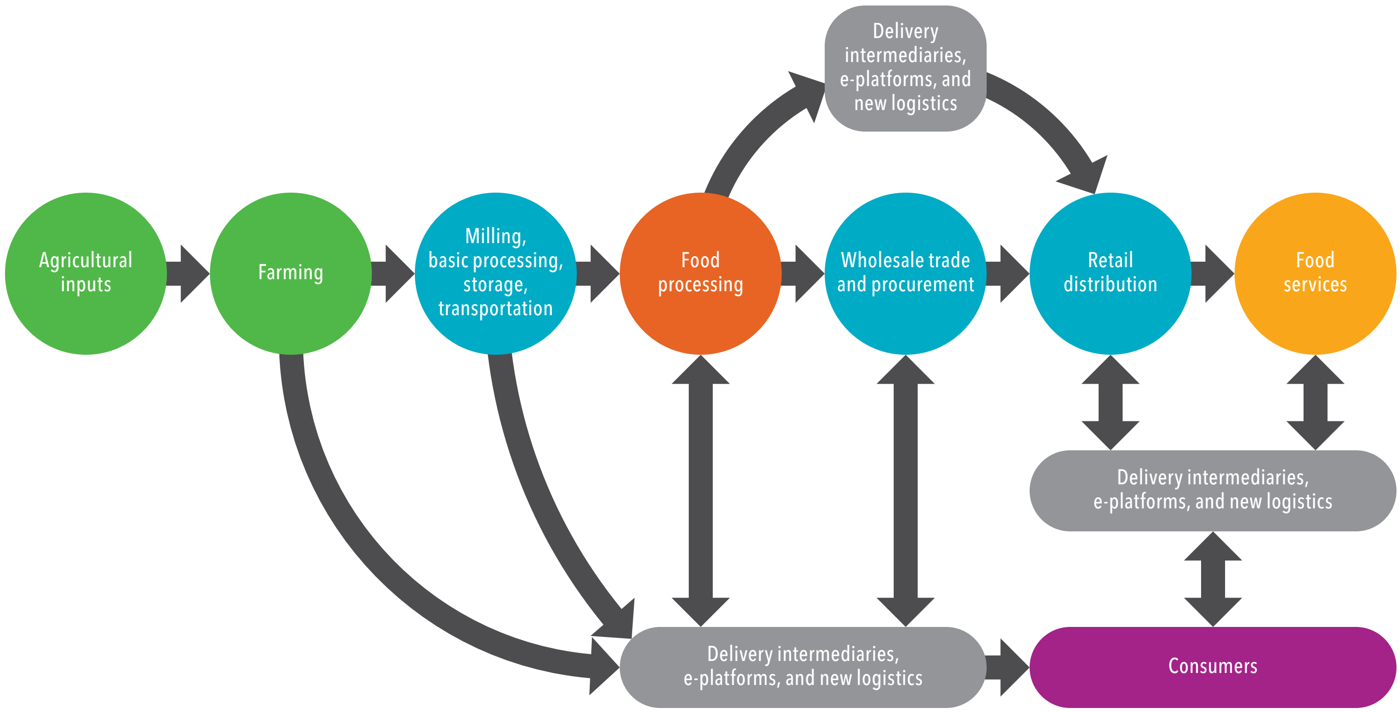
FIGURE 2 Growth rates of retail food purchases by type of provider in middle-income countries, 2019–2020



Source: Based on data from Euromonitor International, accessed January 20, 2021; for details see Table A.1.

Note: Growth rate is for real per capita food purchases at retail level. "World" data cover 103 countries. "Modern" retail stores include convenience stores, supermarkets, hypermarkets, and discounters. "Traditional" grocery retailers are those that are "non-chained," small-scale stores owned by families, and/or run on an individual basis, and do not include informal retailers in open markets or street vendors.

FIGURE 3 Pivoting with e-intermediaries in response to COVID-19 shocks



BOX 2 FALL AND RISE OF MODERN FOOD RETAILERS IN INDIA

Many brick-and-mortar retailers that did not shift to e-commerce before or early on in the COVID-19 crisis lost substantial business. Future Retail, for instance, was a leading retailer (including of food) in India, with 1,800 stores in 420 cities and wholesale and logistics divisions with trucks and distribution centers around the country. In the five years preceding the pandemic, Future Retail rapidly expanded sales locations and product assortment to compete with Reliance, Walmart-Flipkart, and other supermarket chains. Doing so left the company heavily indebted. Future Retail did not move into e-commerce, and profits plummeted when lockdown regulations and consumer fear suddenly curtailed in-store shopping. By August 2020, the company was on the verge of bankruptcy and subsequently was taken over by Reliance. By acquiring Future Retail's large network of stores and supply-chain logistics, Reliance greatly increased its market share, fortifying its combination of brick-and-mortar retail, online commerce, and logistics capacity.

The Future Retail case is an eye-opening reminder to businesses to continually update their strategies. Future Group was an early mover in supermarkets in India, and had been highly innovative in regional chain acquisitions, format diversification (such as very cheap mini-stores to penetrate poor neighborhoods), manufacturing of private-label food products, and development of logistics operations. But it failed to make the one major shift needed to make it resilient to the COVID-19 shock. As a result, the pandemic led to further consolidation of India's food retail sector, leaving just three clear market leaders, Reliance, Walmart-Flipkart, and Amazon.

Source: Based on T. Reardon, A. Heiman, L. Lu, C.S.R. Nuthalapati, R. Vos, and D. Zilberman, "'Pivoting' by Food Industry Firms to Cope with COVID-19 in Developing Regions: E-commerce and 'Co-pivoting' Intermediaries," *Agricultural Economics* (forthcoming, 2021).

alongside in-store retail as a means to expand market share and outcompete small family-owned stores and traditional markets. In response to the lockdowns and social distancing, leading retail and fast-food chains greatly expanded home delivery and curbside pickup. Some retailers did this by enhancing their own logistics platforms and those of their subsidiaries. For example, in India, Walmart-Flipkart drew on the services of its own Ekart Logistics, both to make its own deliveries and to sell logistics services to other e-commerce and brick-and-mortar retail firms.[12]

Where supermarkets and e-commerce firms relied on intermediaries for logistics services, the logistics companies have responded either by leveraging their existing e-commerce capacity or "co-pivoting" to meet the changing delivery needs of their clients. In some cases, these firms obtained investment financing from retailers to facilitate this change in business orientation. For example, India's Walmart-Flipkart invested in the logistics startup Shadowfax, an e-platform that links local logistics SMEs to e-commerce companies.[13] When India's medium and large supermarket chains suddenly needed to meet growing online demand and expand delivery capacity in 2020, Flipkart could draw on Shadowfax, while also bolstering its own logistics services. Another example of co-pivoting in India is the response of e-commerce firm BigBasket to labor constraints on delivery operations after urban drivers returned to their villages during the country's lockdown. To address this, BigBasket partnered with Uber-India and Rapido (an online bike-taxi firm) in April 2020. Uber, in turn, added food delivery to its online services, and Uber and Rapido expanded their fleets to deliver BigBasket's increased online food orders to customers.[14]

PROLIFERATION OF NEW DELIVERY INTERMEDIARIES FACILITATING E-COMMERCE IN FOOD SUPPLY CHAINS. Uber and Rapido are part of the broader trend of using intermediaries, which accelerated with the pandemic. E-intermediaries provide an app that allows consumers to select products from a list of subscribed retailers. The delivery intermediary then either fetches and delivers the product or enlists a third-party provider to do so. Rappi in Latin America and Swiggy in India are examples of large-scale food delivery services that expanded rapidly during the 2010s by adding e-commerce to their operations, initially to increase market shares, and expanded further in 2020 as a crucial adjustment to changing markets during the pandemic.[15]

In much of lower-income Asia, Africa, and Latin America, SMEs still dominate food retail and services. During the pandemic, as small shops and restaurants were severely affected by mobility restrictions and consumer fears, these businesses pivoted to deliver food products and meals using online platforms. Financial and marketing intermediary services co-pivoted to facilitate many of these changes. In Thailand, for instance, SME retailers began selling food directly to consumers via Facebook, cellphone networks, and local SME delivery apps. Also, large retailers such as Reliance in India are facilitating "local" e-commerce by SME retailers through Jiopay and Jiomart (Reliance's e-payment and e-commerce divisions). These changes started before the pandemic but rapidly accelerated in 2020, providing new opportunities for small and medium food businesses and delivery intermediaries.

WHAT POLICIES CAN DO AND WHAT THEY SHOULD NOT DO

The coronavirus has posed a major global health threat and caused a massive global economic shock. Food supply chains were not exempt from the consequences of the virus or of measures taken to contain its spread. Yet, those supply chains have shown remarkable resilience. The agrifood sector was widely declared an "essential" sector during the pandemic, which facilitated the continued flow of food supplies. Nevertheless, the sector did experience major disruptions caused by demand shocks, labor restrictions, market closures, and, in some instances, trade restrictions. Evidence from China shows that such disruptions could be limited by creating "green lanes" that exempt transport, production processes, and distribution of agricultural inputs and food products, as well as movements of food-sector workers, from lockdown measures.[16] However, such measures would naturally be less effective where supply chains are poorly integrated and where SME food businesses also faced large demand shocks.

Agrifood businesses, large and small, in modern, integrated supply chains have shown greater resilience because of their greater capacity and opportunities to adjust or pivot business operations, which in turn has accelerated ongoing food system change. Their adjustments included introduction of flexibility in labor access, in product procurement, in marketing, in technology (especially the use of e-platforms), and in financial resilience. We expect continued diffusion of these organizational innovations across food supply chains, including in developing countries. Many of the innovations, such as e-platforms for logistics, marketing, credit, and payments, were initiated by large firms. In some cases, innovations deepened the vertical integration of single food businesses at the expense of smaller players and of competition. Elsewhere, and significantly, pivoting by large companies provided new opportunities for SME intermediaries in logistics, retail, and wholesale trade, and also for SMEs in processing and farming itself. The expansion of e-commerce has helped SMEs deliver food to consumers under lockdowns and other constraints and enhanced the resilience of supply chains in developing countries. Its expansion can be expected to continue after the pandemic.

These food system innovations have foremost been market responses by private food businesses adjusting to the changing demand and purchasing behavior induced by social distancing measures, though their opportunities to adjust depended heavily on the basic infrastructure, mobile ICT networks, and regulations put in place by past public investment and policies. This type of public support is essential for market integration and lowering transaction costs along supply chains, allowing for food business operations to innovate and pivot. Governments would be ill-advised to organize supply chain integration directly, but rather should focus on their role as facilitators and provide targeted support to improve access to affordable mobile services and ease market entry for SMEs to ensure that business pivoting and changing practices do not lead to increased concentration of food markets. With this support, food supply chain modernization and innovation can contribute to decent livelihoods and employment generation along supply chains while enhancing resilience to the impacts of future shocks and disruptions, and thus contributing to the transformation of food systems.

APPENDIX

TABLE A1 Real per capita food purchases at retail level by type of provider, 2015–2020

	PER CAPITA RETAIL FOOD SALES (US$ at constant prices)						ANNUAL GROWTH RATES				
	2015	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
WORLD											
Modern	518.5	520.5	521.5	519.4	518.8	532.8	0.4%	0.2%	-0.4%	-0.1%	2.7%
Traditional	389.1	387.1	384.3	385.0	380.3	366.0	-0.5%	-0.7%	0.2%	-1.2%	-3.8%
E-food services	11.3	13.6	16.1	18.6	21.8	32.5	20.4%	18.4%	15.5%	17.2%	49.1%
CHINA											
Modern	335.6	333.9	337.1	333.3	333.2	336.0	-0.5%	1.0%	-1.1%	0.0%	0.8%
Traditional	672.0	672.2	656.1	629.9	634.2	608.0	0.0%	-2.4%	-4.0%	0.7%	-4.1%
E-food services	19.9	25.7	30.4	36.0	41.8	48.2	29.1%	18.3%	18.4%	16.1%	15.3%
INDONESIA											
Modern	66.1	69.1	70.2	72.2	74.2	72.0	4.5%	1.6%	2.8%	2.8%	-3.0%
Traditional	330.5	336.7	342.8	347.1	348.2	282.2	1.9%	1.8%	1.3%	0.3%	-19.0%
E-food services	0.2	0.4	0.9	1.4	2.2	4.7	100.0%	125.0%	55.6%	57.1%	113.6%
BRAZIL											
Modern	152.9	150.8	147.9	142.8	141.8	137.8	-1.4%	-1.9%	-3.4%	-0.7%	-2.8%
Traditional	127.5	109.2	104.6	99.6	95.7	92.7	-14.4%	-4.2%	-4.8%	-3.9%	-3.1%
E-food services	1.1	1.1	1.1	1.2	1.4	2.9	0.0%	0.0%	9.1%	16.7%	107.1%
SOUTH AFRICA											
Modern	370.5	368.8	367.5	366.0	362.1	358.7	-0.5%	-0.4%	-0.4%	-1.1%	-0.9%
Traditional	230.4	232.6	239.1	238.6	232.1	187.7	1.0%	2.8%	-0.2%	-2.7%	-19.1%
E-food services	1.3	1.4	1.5	1.7	1.9	3.9	7.7%	7.1%	13.3%	11.8%	105.3%
INDIA											
Modern	5.7	6.3	6.9	7.5	8.2	7.4	10.5%	9.5%	8.7%	9.3%	-9.8%
Traditional	248.9	257.5	270.8	280.5	290.7	294.4	3.5%	5.2%	3.6%	3.6%	1.3%
E-food services	0.2	0.4	0.5	0.7	1.2	2.0	100.0%	25.0%	40.0%	71.4%	66.7%

Source: Based on data from Euromonitor, accessed January 20, 2021.

Note: "World" data cover 103 countries. "Modern" retail stores include convenience stores, supermarkets, hypermarkets, and discounters. "Traditional" grocery retailers are those that are "non-chained," small-scale stores owned by families and/or run on an individual basis, and do not include informal retailers in open markets or street vendors.