13. COVID-19 and resilience innovations in food supply chains: Two years later

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Two years after the start of the COVID-19 pandemic, food value chains have undergone some remarkable adjustments, evolving to meet rapidly changing conditions. Their capacity to make these adjustments has depended on public investments in the logistics infrastructure and wholesale markets that form the structure of food systems, as well as public policies that facilitate efficient exchange and private sector innovations, the flow of food systems.

Looking back, we can see that the initial food supply chain disruptions in low- and middle-income countries (LMICs) were primarily caused by three COVID-19 responses:

- Lockdowns limited the movement of consumers who use retailer and food service outlets, logistics firms that deliver to wholesalers, wholesalers that supply food retailers and farm input retailers, and workers at firms and farms.

- Sudden demand surges occurred as consumers panicked and stocked up on staples (such as runs on maize meal in South Africa [Meyer et al. 2021]), emptying stores and straining suppliers.

- Internationally, the "roller coaster" of cargo demand surges and supply plunges disrupted exports and imports, fouling up container inventories for processed foods and farm inputs. These disruptions were exacerbated by port lockdowns and slowdowns caused by a lack of workers to load and deliver products.

In the second year of the pandemic, these factors evolved. First, disruptions associated with the lockdowns faded or became more scattered. The harbors of major trading countries were open, but mandatory quarantines and testing continued to slow the movement of goods (Fresh Plaza 2022). Moreover, to some extent, consumers continued new behaviors adopted during the lockdowns – such as relying more on food e-commerce and delivery than in pre-pandemic days, including in LMICs such as China and India (Reardon, Heiman et al. 2021). Second, demand surged as consumer incomes recovered from 2020. Third, disruptions of cargo shipping, container inventories, and ports, initially perceived as a short-term problem, continued into the medium term. This continued disruption especially affected international commerce (which constitutes some 10 percent of LMIC food economies), with a particularly large impact on major exporters of nonstaples, such as Chile. Trade of staple foods (such as grains) was less affected because these products are shipped in bulk and from ports outside of the main maritime highways.

In 2021, the supply chain changes were reinforced by powerful weather-related shocks such as La Niña, which caused droughts in South America and stronger-than-normal hurricanes in Central America and Southeast Asia. Such shocks in themselves are "business as usual" for domestic

and international food supply chains, but climate change has made them more intense and less predictable.

In the eyes of food industry operators, these waves of disruptions were sudden in their intensity and confluence — but not unusual in their nature.

Shocks that induce substantial adaptations in supply chains are not new. Supply chain actors have faced and adapted to continuous disruptions in recent decades. Before COVID-19 (SARS2), supply chains had already weathered SARS1 in 2003, as well as waves of devastating animal and plant disease epidemics in the 2000s and 2010s. They have also had to cope with many extreme weather events.

LMIC food systems are rapidly transforming, making them both more vulnerable and more innovative in the face of these shocks. Food supply chains have expanded and lengthened immensely in the past four decades to serve rapidly growing cities and to meet demand for purchased food from rural areas. This lengthening makes them more vulnerable to shocks than traditional local food economies. But their transformation has also entailed rapid development in logistics, processing, and wholesale practices, with firms of all sizes innovating in supply chains to address transaction costs and innovating in developing resilience strategies to protect their investments.

The key point is that supply chains were clearly shocked by the COVID-19 pandemic, but already had substantial experience and innovation capacity in dealing with shocks. As a consequence, they have shown a remarkable capability to adapt and innovate.

During the main lockdowns of 2020, sales of many LMIC supply chains showed a V shape, first plummeting for three to four months, and then bouncing back to normal or near normal (Belton et al. 2021; Liverpool-Tasie et al. 2022). However, many smaller and asset-poor firms operating in structurally poor business conditions, such as those with inadequate infrastructure, were unable to recover. But a growing body of evidence shows that the great majority were able to survive (Dejene et al. forthcoming).

Despite these strong signs of recovery, many studies and news reports in LMICs have focused on the bottom of the V, that is, when firms suffered from low sales, and on supply disruptions, suggesting that the pandemic has caused a crisis in our food systems. Much less attention has been given to the righthand side of the V, that is the upturn and resumption of business sales, and why and how it has occurred. We believe this may reflect insufficient understanding of the dynamics and adaptive capacity of food supply chains. Building on our previous blogs and studies, we focus on three key "pivots" that firms successfully made in sales, production, and procurement to adjust to the supply and demand shocks (Reardon, Heiman et al. 2021; Reardon and Swinnen 2020; Reardon and Vos 2021).

Sales pivot to e-commerce and delivery

Food e-commerce began developing in the 2000s and especially the 2010s, expanding most rapidly in Asia and Latin America, among developing regions, where related logistics and infrastructure were more developed, transaction costs lower, and more consumers connected online and

by smart phone. Shocks played a role in the early emergence of e-commerce in LMICs: for example, in 2003, China's Alibaba added business-to-consumer e-commerce as a response to the SARS lockdown.

COVID-19 greatly accelerated the expansion of e-commerce, and served as a key resilience strategy for retailers and food service firms in 2020 and 2021, especially in Asia and Latin America. Because of high transaction costs, the expansion before and even during the pandemic was more limited in Africa, as illustrated by the difficulties Africa's Jumia has encountered in trying to build its e-commerce business (Reardon, Belton et al. 2021.).

Adversity sparked innovation in e-commerce and delivery services, as enterprises of all sizes learned to spot opportunities and expand into them. In particular, during the past two years, e-commerce in LMICs has innovated and differentiated to enable participation by retailers of different sizes and by different strata of consumers.

- Digitally based delivery options expanded into hyper-local and hyper-rapid service. For example, Getir (started in Turkey in 2021) expanded into Western Europe and North Africa.

- E-commerce "broadened" to serve small and medium enterprises (SMEs), including wet-market stall owners; for example, Getir started Getirçarşı, a division delivering only for SME retailers. In India, Swiggy delivers for food service SMEs and Jiomart (a division of Reliance) provides e-commerce platforms for small retail shops.

- E-commerce "stretched" into social media. For example, multichannel network companies like TikTok and Kuaishou in China helped e-commerce firms promote their food products, and wholesale markets such as Xinfadi in Beijing provided venues and equipment to support this.

New ways of doing business lead to new challenges. The shift to digitalization and business in cyberspace has brought vulnerability to cyber-attacks. This became dramatically clear in 2021 when the network of JBS, the world's largest meat firm, was hacked, operations disrupted, and a ransom paid. Such attacks are a major threat to the global food system, including in LMICs, as the digitalization of food markets as well as of internal operations of firms and farms increases exponentially.

Production pivots toward technologies that save labor and increase flexibility

Production technology strategies entail choices among factors of production (for example, types of labor and capital). In 2020 and 2021, many LMIC food industry firms faced a shortage of available (healthy) workers. This challenge was exacerbated by the need for many workers to take on new tasks, such as driving delivery vehicles and staffing fast-turnover warehouses that serve e-commerce.

During the lockdowns of 2020, many local workers stayed home, rural migrant workers went back to their villages, and international migrants went back to their home countries while new migrants were denied entry. To attract workers, firms had to invest in reconfigured workspaces for social distancing

and in health protection gear. In 2021, food firms still faced severe labor shortages, but with a new twist (especially in developed countries) – despite the lifting of lockdowns, many workers did not return to work. This labor shortage will likely remain a major challenge in 2022.

Firms have been responding in two ways:

- Firms have tried to encourage labor participation with better pay and working conditions and, for migrant workers, governments have loosened visa requirements. For example, citrus packing plants in South Africa have provided incentives and training for local workers to replace migrant workers (Meyer et al. 2021).

- Firms with the financial capacity to invest in new machinery have reduced their need for labor by automating parts of their operations and supply chains. Food firms in developed countries are accelerating such investments, such as in warehousing and logistics in the United States and Western Europe. The same is occurring in LMICs. For example, China opened the world's first fully automated port in Shandong in October 2021. Brazil's pork processor Frimesa invested in automation of its plants in 2020 as did Marel with poultry processing in 2021.

This response to the labor supply shock brings societal challenges. As firms (and farms) become more capital-intensive, and need less labor, over time they will likely employ fewer nonskilled workers, despite the pressing need for jobs for the burgeoning "youth bulge" in the poorer LMICs.

Procurement pivots to increase diversification, flexibility, and redundancy of sourcing, from "just in time" to "just in case"

As food industry firms in LMICs (and developed countries) were slammed by supply chain logjams in both international and domestic markets, first in 2020 and then in 2021–2022, buyers and sellers pivoted to diversify and pursue flexibility.

The procurement of citrus products in South Africa illustrates diversification, flexibility, and the value of years of preparation for crises (Meyer et al. 2021). In 2020, citrus retailers and wholesalers in Asia switched to sourcing more from South Africa when lockdowns caused supply constraints among traditional providers. South Africa's government and its citrus industry were prepared, having already obtained market entry and certifications to sell to Asia in 2018 and 2019. When Europe locked down ports in 2020, South African citrus traders were able to redirect exports to Asia. Moreover, South African citrus supply chains were "trained" in flexibility, as they had been forced to adapt rapidly to waves of new European phytosanitary regulations over the decade preceding COVID-19. Supply-chain resilience had also been strengthened through investments in improving ports and phytosanitary protocols.

Many food industry firms have found that redundancy of suppliers and assets was crucial for pivoting as well as for absorbing shocks. When one factory or port was locked down or short on labor or materials, others in that firm's supply chain could pick up the work. This strategy is valuable before and after COVID-19. A shift is occurring away from a focus solely on tight supply chains for efficiency, such as maintaining minimal inventories (called "just in time"), toward a "just in case" strategy, which

emphasizes maintaining a degree of redundancy, flexibility, and diversification rather than strict efficiency (Masters and Edgecliffe-Johnson). Examples include:

- The Thai multinational Charoen Pokphand built a series of ports on the river they use for exports, so that if one is washed out by a hurricane another can be activated (Reardon and Zilberman 2018).

- When consumers in South Africa rushed to stock up on maize meal, they put a sudden, tremendous strain on maize mills. The industry had lamented under-utilization of capacity before 2020, but was able to easily meet the demand surge by moving to full utilization, turning the slack into an asset during the pandemic (Meyer et al. 2021).

These strategies pose a societal challenge as they are likely to accelerate food industry concentration in both LMICs and developed countries. For firms, it is expensive to make the typically substantial threshold investments necessary to maintain options for sourcing and selling, such as Charoen Pokphand's multiple ports. Large enterprises have an advantage, given their greater financial capacity and broader geographic spread of procurement and marketing. SMEs are dependent on smaller supply and marketing geographies and usually cannot afford to make investments in extra facilities or leave capacity unused.

Policy lessons: Invest in the food system's "blood and bones" to strengthen firm resilience

Governments should embrace actions to enable private sector entrepreneurs, large and small, to pivot as a resilience strategy through innovations in marketing, sourcing, and technology. To facilitate such pivots, governments need to strengthen the support system for food systems – their blood and bones.

- Investing in roads, wholesale markets, and other infrastructure (the "bones") is crucial to reducing transaction costs that firms face and thus their flexibility and ability to pivot in sourcing and marketing. Where the bones are strong, such as the South African port system, firms can pivot quickly. Where the bones are inadequate and transaction costs are high, firms are held back as noted in the African case of Jumia above.

- Facilitating logistics, wholesale sectors, and efficient exchange and innovations (the "blood") is key to the resilience of the whole system. Governments must get the enabling business environment right – facilitating business flexibility by implementing regulations designed to ease doing business, limiting concentration, setting transparent safety standards, reducing cybersecurity risks, and supporting access to finance, especially for SMEs.

These recommendations are critical to ensure resilience, innovation, and flexibility in our food supply chains as new waves of COVID-19 or new shocks arise.

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