SPECIAL ISSUE ARTICLE

Food supply chains during the COVID-19 pandemic

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Abstract
This paper provides an early assessment of the implications of the COVID-19 pandemic for food supply chains and supply chain resilience. The effects of demand-side shocks on food supply chains are discussed, including consumer panic buying behaviors with respect to key items, and the sudden change in consumption patterns away from the food service sector to meals prepared and consumed at home. Potential supply-side disruptions to food supply chains are assessed, including labor shortages, disruptions to transportation networks, and “thickening” of the Canada–U.S. border with respect to the movement of goods. Finally, the paper considers whether the COVID-19 pandemic will have longer-lasting effects on the nature of food supply chains, including the growth of the online grocery delivery sector, and the extent to which consumers will prioritize “local” food supply chains.

KEYWORDS
cross-border supply chains, labor, online grocery delivery, panic buying, supply chain resilience, transportation

1 | INTRODUCTION

As the COVID-19 pandemic of 2020 unfolds, considerable attention has focused on the resiliency of food supply chains in a time of crisis. Food supply chains have needed to adjust rapidly to demand-side shocks, including panic buying and changes in food purchasing patterns, as well as plan for any supply-side disruptions due to potential labor shortages and disruptions to
transportation and supply networks. This paper examines the challenges facing food supply chains in Canada (and elsewhere) during the current crisis and offers thoughts on policy and industry strategies to enhance food supply chain resilience. At the time of writing, we are currently in the midst of the pandemic. Without the benefit of a crystal ball, it is difficult to know what the future holds with respect to the scope, scale, and length of the pandemic, and, therefore, the medium- to long-term implications for food supply chains. By necessity, some of what follows is speculative in nature. Much more will be written on the implications of COVID-19 for the Canadian food and agriculture sector in the coming weeks, months, and years. This paper offers an early assessment of some potential implications for food supply chains.

2 | DEMAND-SIDE SHOCKS

A sharply visible demand-side shock evident in Canada, and in many countries, has been panic buying or hoarding behaviors by consumers. One of the more dramatic images in the early stages of the COVID-19 pandemic has been supermarket shelves emptied of key food and non-food items, including pasta, rice, canned goods, flour, frozen foods, bottled water, hand sanitizers, hand soap, and toilet paper (National Post, 2020; 680 News, 2020). Government officials and food industry representatives have been quick to emphasize that there is plenty of food in the system, but short-run panic buying behaviors became self-perpetuating. As governments around the world ramped up social distancing policies, many consumers engaged in stockpiling behaviors in anticipation of movement restrictions and fear of disruptions to food distribution systems. It is beyond the scope of the present paper to delve into the motivations behind the consumer demand response to COVID-19, and interested readers are directed to Cranfield (2020) in this special issue. Nevertheless, for a food distribution system built around just-in-time manufacturing and delivery, the sudden and unexpected spike in demand across key categories created short-run stockouts (Mussell, Bilyea, & Hedley, 2020).

The food retailing sector in Canada, and in many other western economies, is dominated by large, concentrated supermarket chains with significant buying power and an emphasis on cost efficiencies. The just-in-time approach to food retailing has been an important source of increased efficiencies in the sector, with relatively low stocks and continuous product flows. In normal times, these are efficient and responsive supply chains. Retail buyers plan for anticipated increases in consumer demand (e.g., around key holidays—Christmas, Thanksgiving, or in BBQ season), with contracts in place with key suppliers to ramp up supplies at the appropriate time. The system appears to be somewhat less nimble in responding to a widespread sudden increase in demand across regions and across product categories. Retailers eventually responded with short run rationing strategies, including the imposition of purchase limits on key items and dedicated grocery shopping hours for elderly or vulnerable customers. Another obvious response would be to use price as a rationing mechanism. Once the relevant retail price data become available, the extent to which retailers responded by increasing prices will become clearer. As supply chains rapidly adjusted to the demand signals from consumer markets with increased product flows, the short-run problem of shortages and stockouts eased.

A second reason for additional pressure on the food retailing sector has been the closure of restaurants, cafés, bars, and hotels, with many citizens working from home. It is estimated that just over one-third of food expenditures in Canada typically occurs in restaurants (Agriculture and Agri-Food Canada [AAFC], 2017). The vast majority of those food purchases have now shifted to the food retailing sector, creating additional demand pressure on the system. Supply chains geared up to supply the hotel, restaurant, institutional trade may be ill-suited to supplying the food retailing sector, for example, in terms of package size and distribution infrastructure, creating unavoidable time lags in repurposing these supply chains. To facilitate the movement of food destined for food service supply chains into the food retailing sector, the Canadian Food Inspection Agency (CFIA) has made a number of temporary changes to the regulations surrounding labeling and packaging of food. For example, it is allowing the retail sale of food products made, packaged, and labeled in Canada that were destined for food service use in Canada or the United States and has suspended standard container size requirements (Canadian Food Inspection Agency [CFIA], 2020).

For the most part, the demand spike from panic buying behaviors is likely to be a short-run problem. Longer-run demand-driven effects on food supply chains will arise from a fall in consumer incomes, with overall demand impacts as well as shifts across product categories. For example, we can expect consumers to become more price sensitive and the demand for income elastic products to decline more sharply as consumers substitute away from more expensive items. This can be expected to influence retailer buyer behavior with respect to product category management and contractual relationships with suppliers. In the event of a severe economic downturn and decline in demand, retailers may squeeze supply chains for cost efficiencies. As these are typically low-margin businesses, this will create challenges for many food processors and suppliers. Small food retailers with less bargaining power relative to the larger food retail chains may also face challenges.
In this regard, insights from previous economic downturns are insightful. Matopoulos, Didonet, Tsanasidis, and Fearne (2019) observe that many buyer–supplier relationships in highly competitive and dynamic markets, such as grocery retailing, fail to develop beyond the level of transactional exchanges given the asymmetry of market power—which the authors characterize as “relationship failure.” In contrast, collaborative supply chain relationships are long-term partnerships with suppliers that help reduce transaction costs, share risks, provide access to complementary resources and expertise, and enhance productivity (Cao & Zhang, 2011).

Analyzing buyer–supplier relationships in grocery retailing during the Greek financial crisis, Matopoulos et al. (2019) find that these relationships are placed under particular strain during an economic downturn. Nevertheless, the development of stronger relationships and commitment within buyer–supplier relationships was rewarded through reciprocal risk sharing and additional efforts to maintain strong supply networks in a time of crisis. The importance of building strong collaborative buyer–supplier relationships, even in the face of clear market power asymmetries, is a useful lesson for Canadian food supply chains. Strong relationships help build supply chain resilience. Suppliers are more likely to “go the extra mile” (e.g., priority restocking) in times of crisis for a retail buyer that has developed a collaborative, supportive relationship with its suppliers.

3 | SUPPLY-SIDE SHOCKS

Potential supply-side disruptions to food supply chains include labor shortages, disruptions to transportation networks, and “thickening” of the Canada–U.S. border with respect to the movement of goods. Labor shortages in primary agricultural sectors that rely on seasonal labor are addressed elsewhere in this special issue (Larue, 2020). The potential for labor shortages within downstream food processing and distribution networks due to worker illness, self-isolation, or movement restrictions deserves attention. Food supply chains dominated by a few large concentrated processors (e.g., meat packing) may be particularly vulnerable. The majority of food and beverage processing establishments in Canada are small operations in terms of employment size—for example, in 2016, small operations with less than 100 employees accounted for 94.1% of food and beverage processing establishments (AAFC, 2017). To the extent that these firms are more labor intensive than larger firms, they may be more vulnerable to labor disruptions. From an overall supply chain resiliency perspective, however, it is the relative importance of firms with respect to shipments that matters. Dairy, meat, and seafood processing sectors have a relatively larger percentage of medium- and large-sized operations in terms of employment size, and, more importantly, these sectors have witnessed increasing concentration in terms of market share or the value of shipments.

The effects of a large, key processing facility being temporarily removed from the supply chain have been felt before. Examples include the temporary closure of the XL Foods beef packing plant in Alberta in 2012 as a result of *E. coli O157:H7* contamination and the destruction by fire of a Tyson meat packing plant in the United States in August 2020 (Lusk, 2020). The Tyson plant accounted for 5–6% of U.S. beef processing capacity, while the XL Foods packing plant was the second-largest beef processor in Canada. Both events caused major short-run disruptions to cattle markets, a fall in fed cattle prices, and a rise in wholesale beef prices. The difference in the current situation is that those events were extremely sudden and unexpected, whereas now firms within the food supply chain have a window of opportunity in which to plan for potential labor shortages and put in place risk mitigation strategies. This may include, for example, developing contingency plans to continue operating these key businesses in the event of sudden labor shortages, as well as taking steps to ensure a safe working environment for food plant workers, with appropriate physical distancing measures.

Transportation and distribution networks are also vulnerable to disruptions due to labor shortages or movement restrictions, particularly with respect to long haul trucking. Extending the “key workers” designation to workers involved in all aspects of food supply chains can help mitigate disruptions due to movement and travel restrictions. Given the geography of Canada and its dispersed population, food supply chains tend to be long and heavily dependent on well-functioning, long-distance road and rail transportation networks.

Cross-border supply chains are critical to the Canadian food sector, with significant volumes of food and agricultural products moving across the Canadian–U.S. border daily. In 2016, the United States accounted for over 50% of the value of all Canadian agriculture and agri-food exports and around 60% of the value of Canadian food imports (AAFC, 2017). Although the United States is a net importer of Canadian beef and cattle, Canada relies heavily on seasonal imports of fresh produce from the United States and Mexico. As the pandemic lengths from weeks into months, assessments of the supply-side effects will need to consider the extent to which food categories for which Canada is a net importer are vulnerable to international trade disruptions. Efforts to maintain relatively frictionless cross-border trade in agri-food products during the COVID-19 pandemic are critical. This includes steps to mitigate any risk of inspection-related disruptions for imported fruit and vegetables from the United States and Mexico.
States and Mexico. The CFIA has indicated that it is prioritizing a number of services, including inspection services, export certification, import inspection services, food safety investigations and recalls, animal disease investigations, and emergency management (CFIA, 2020). Low-risk non-compliance activities (i.e., not related to food safety) are temporarily suspended to allow a focus on key services.

A further step to help ensure the continued smooth functioning of cross-border supply chains is ensuring that self-isolation/quarantine regulations do not impede the ability of long-haul truckers to complete cross-border deliveries. To that end, both Canada and the United States currently have exempted truck drivers carrying food or animals from the 14-day self-isolation period otherwise required for individuals entering each country (CFIA, 2020). Domestically, ensuring that long-haul truck drivers have access to sufficient facilities en route to eat, rest, and rejuvenate is a challenge, with the reported closure of most restaurants, public washrooms, and rest stops typically relied upon by these drivers (CBC, 2020).

4 | Long Run Changes

In addition to the effects of demand-side shocks and potential supply-side disruptions, it is worth considering whether the COVID-19 pandemic will have longer-lasting effects on the nature of food supply chains. Two aspects come to mind: the growth of the online grocery delivery sector and the extent to which consumers prioritize “local” food supply chains.

An element of food distribution that is undergoing significant change during the COVID-19 pandemic is the expansion of online grocery deliveries. Prior to the pandemic, the Canadian grocery sector had been slower than its counterparts in Europe and the United States to offer online grocery delivery services. Click and collect services, wherein a customer places an online food order for collection at a retail store, have been on the increase, particularly in major urban centers, but home delivery services are considerably less common. Online grocery delivery models encompass two main categories: dedicated online-only services, for example, Ocado in the UK as well as Amazon, and existing grocery retailers with an online delivery option. With governments issuing “stay at home” orders to citizens, online grocery deliveries may be particularly useful for vulnerable individuals (elderly or those with underlying health conditions) and to assist with social distancing among the population in general. Nevertheless, where online grocery delivery services are more common, these systems have struggled to cope with the sudden expansion in online orders, leaving long time lags before delivery slots are available. As more consumers comply with stay-at-home and social distancing orders, expansion of online grocery delivery services represents an opportunity for the food retailing sector to service an important community need as well as build reputational capital with consumers. Similarly, online food (meal) delivery services, such as Skip the Dishes and Uber Eats, may become more popular during the pandemic. A significant constraint, however, is the extent to which it is economically viable for restaurants to operate a delivery-only business model in the short-run (covering their variable costs) versus a short-run shut-down.

Fulfilling online orders requires appropriate investments in infrastructure (web portals), staffing, and delivery capacity. The sudden shut-down of many “non-essential” businesses has created a pool of unemployed, or underemployed, labor that could be temporarily redeployed to tasks within the food supply chain, including staffing of grocery stores, warehouses, and food delivery.

If the availability and popularity of online grocery delivery increases during the COVID-19 pandemic, what happens once the pandemic is behind us? Do consumers return to previous methods of grocery shopping or could this event prove to be a catalyst in the sustained adoption of online grocery delivery? Prior to COVID-19, a barrier to wider adoption of online grocery shopping (where available) has been consumer reticence, trust, and a lack of familiarity with how to use the service (Güsken, Janssen, & Hees, 2019). The pre-COVID-19 period represented the early stages of the innovation adoption cycle, with only early adopters utilizing online grocery delivery. During the pandemic, many consumers are utilizing online grocery delivery for the first time. As this tranche of new adopters becomes more familiar with online grocery delivery services, we move up the adoption curve much more quickly than would have been the case in the absence of the pandemic. Although some of that usage will drop off post-COVID-19, having made the shift, many consumers will continue to utilize online grocery delivery services. The extent to which 2020 becomes a watershed year in the uptake of online delivery (both for food and non-food items) will only become clear with time, but it seems likely that this element of the food distribution system will receive a sustained upward shift in adoption.

As mainstream food supply chains initially struggled to adjust to the unprecedented short-run demand shock resulting from changes in consumer purchase behavior and adapt to a radically altered business environment, there has been much discussion of the extent to which “local” food supply chains (however defined) offer a viable alternative. With widely reported stockouts at supermarkets in the early stages of the pandemic, and long queues of customers outside some stores, many consumers...
turned to smaller stores and local suppliers within their communities. In the short run, these businesses may be more nimble in their supply response (e.g., a tendency to hold more inventory as a proportion of sales). Food supply chains sourcing from local suppliers of in-season fresh produce will be less vulnerable to cross-border disruptions in imports or systemic failure at a major choke point within a larger supply chain (e.g., the shut-down of a major processing plant due to labor shortages).

The interest in “local foods” is a well-established consumer trend and previous research has shown that there are many and varied motivations for this interest, including perceptions related to economic, social, environmental, and health benefits ( Cranfield, Henson, & Blandon, 2012). Rightly or wrongly, in some regions, the COVID-19 pandemic may have shaken consumer confidence in the security and reliability of the food system. If consumers remember empty store shelves and pictures of long line-ups outside grocery stores during the initial stages of the pandemic, how will this affect their attitudes to how and where they buy their food in the future? It seems likely that interest in the “local food” movement will grow, at least in the short to medium term post-COVID-19, and that food security and a desire to support local businesses may well become more important as motivations for patronizing local food supply chains.

Although the current crisis may well give a boost to the local food movement in the short to medium term, there has been little change in the fundamental economics of the sector. Smaller scale, localized food supply chains are less cost efficient than the mainstream food system and offer less variety. Price and convenience remain strong drivers of consumers’ food purchase behavior, and mainstream food supply chains have a clear competitive advantage in this regard. Nevertheless, consumers are inherently heterogeneous in their preferences and food purchase behaviors ( Hobbs, 2019). For some consumers, the COVID-19 pandemic will solidify an existing interest in locally sourced foods, while others may be newly attracted to the sector. The extent to which the latter proves to be a long run shift remains to be seen. The speed with which mainstream food supply chains have been able to adjust to the initial demand shock and build greater supply chain resilience against potential supply-side shocks will help shape long run consumer confidence in these supply chains.

### 5 | IMPLICATIONS AND CONCLUSIONS

The COVID-19 pandemic holds a number of implications for Canadian food supply chains. The first is a need to focus on maintaining and enhancing supply chain resilience. The just-in-time supply chain model is efficient and effective under normal circumstances. Experience in the early stages of the pandemic suggests that this model may be vulnerable to short-run disruptions caused by exogenous demand and supply shocks. Nevertheless, once the initial demand shock subsides, these supply chains have shown themselves to be responsive, albeit with a lag. Supply chain responsiveness is a key dimension of resilience, and future efforts to enhance resilience through strategic inventory management plans and flexible procurement strategies will be important.

Robust and reliable supply chain relationships are central to enhancing supply chain resilience. Collaborative buyer–seller relationships build trust among supply chain partners and flexibility in responding to unexpected shifts in demand or unanticipated supply disruptions. At an individual enterprise level, risk management plans should include contingency planning to deal with labor shortages or disruptions to transportation and supply networks. Once the dust settles on the COVID-19 pandemic, Canadian food supply chain stakeholders will have an opportunity to reflect on what worked well within their supply chains during the crisis, where failures occurred, and how they can build more robust supply chain partnerships to weather future crises.

Numerous policy implications arise from the COVID-19 pandemic and much time will be devoted, in due course, to unpacking what we can learn from the crisis. At this early stage of the pandemic, a few observations with respect to food supply chains seem pertinent. Access to safe, nutritious, and affordable food is a fundamental element of food security. Ensuring that agricultural and food supply chains, and the services that support these supply chains (transportation, distribution, maintenance, etc.), are designated as “essential” businesses and the labor employed by the sector designated as “key workers” is critically important. Continued attention to keeping cross-border supply chains open and unencumbered by new regulation is also vital.

Steps to mitigate panic buying and stockpiling behavior by consumers in the event of future crises also deserve consideration. We need to better understand the motivations for these behaviors, the implications for food supply chains, and industry or policy responses to mitigate the effect of these behaviors. If retailers had moved more quickly to implement limits in purchases of key items, would this have stemmed the tide of panic buying? Do panic buying behaviors signal something more fundamental about underlying consumer trust in governments to manage the crisis, or trust in the food system as a whole? What types of communication strategies by the agri-food sector, by key supply chain stakeholders, or by government might assuage consumer panic buying behaviors?
A more troubling policy implication is the potential impact of supply chain disruptions on vulnerable populations, including low-income consumers, food banks, and remote Indigenous communities in northern Canada. The latter already grapple with precarious food supply chains, limited availability of fresh foods, and high food prices. Ensuring the continued availability of essential food and non-food items to vulnerable communities during a time of unprecedented economic disruption should be a policy priority.

Canada is a major agri-food exporter, and the agriculture and food sector is an important component of the Canadian economy. Although much has been written about the declining competitiveness of the sector and falling rates of productivity growth, the fact remains that Canadian food supply chains successfully feed millions of Canadians every day, and Canadian agri-food exports feed millions more. That fact has not changed. A common exhortation in the current pandemic has been that there is “plenty of food in the system,” and that fact also remains true. What we have learned, however, is that vulnerabilities exist, particularly with respect to logistics and distribution in the presence of unprecedented shocks to the system. As the pandemic unfolds in the coming weeks and months, much can be learned about how food supply chains respond to the crisis and about strategies to enhance supply chain resilience and retain consumer confidence.

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