2021

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Recommended Citation

Roe, B. E., Bender, K., & Qi, D. Y. (2021). The Impact Of Covid-19 On Consumer Food Wastejel Codes. *Applied Economic Perspectives And Policy, 43* (1), 401-411. https://doi.org/10.1002/aepp.13079

Applied Economic Perspectives and Policy (2021) volume 43, number 1, pp. 401–411.
doi:10.1002/aepp.13079

Featured Article

The Impact of COVID-19 on Consumer Food Waste

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Submitted 15 July 2020; editorial decision 12 August 2020.

Abstract *Perhaps no phenomenon has so quickly and radically altered household production parameters and daily food patterns as the onset of the COVID-19 pandemic. We contemplate the immediate and longer-term implications of this public health crisis on the amount of food wasted by consumers. We conclude that the pandemic and its aftermath may improve household skills and management practices in a manner that reduces day-to-day household food waste. However, pandemic-driven disruptions may induce larger intermittent purges of food due to changes in work patterns and food service and food retailing availability. We recommend several steps to reduce waste as the pandemic unfolds.*

Key words: Consumers, COVID-19, Food waste, Household.

JEL codes: D1, Q1.

Introduction

Perhaps no phenomenon has so quickly and radically altered household production parameters and daily food patterns in the United States as the onset of the COVID-19 pandemic. Soon after the national emergency declaration, key inputs into household production shifted massively, with the amount of time spent outside the home declining by more than 20%, consumer spending declining by more than 30%, and employment rates and earnings among low-income Americans declining by more than 35% (Chetty et al. 2020).

Food acquisition patterns were also fundamentally shifted compared to pre-COVID levels (Restrepo, Rabbit, and Gregory 2020). Consumer spending at restaurants and hotels declined by more than 60% with the onset of COVID-19 (Chetty et al. 2020). Grocery spending spiked at a 70% increase during mid-March compared to pre-COVID levels and has featured a

sustained increase of around 10% through April, May, and June of 2020 (Chetty et al. 2020). In early April of 2020, 50% of consumers reported shopping less in person than compared with the pre-COVID period, with 37% purchasing more at each visit, 16% reporting initiation of grocery delivery services, and 13% reporting an increase in the frequency of grocery deliveries (IFIC 2020a).

The content of purchases also changed after COVID-19, with consumers reporting increases in purchases of pantry items (37% reported an increase), frozen items (31%), and packaged foods (22%), and decreases in purchases of fresh produce items (15%) (IFIC 2020a). Remarkably, only 11% of consumers reported no changes in shopping habits during early April of 2020, and only 19% reported no changes in eating habits (IFIC 2020a), suggesting few American households were untouched by the turbulence of the COVID-19 pandemic. Indeed, many households have struggled to maintain food security since the onset of the pandemic (Ahn and Norwood 2020; Gundersen et al. 2020; Ziliak 2020).

The onset of the COVID-19 pandemic has drawn considerable attention to food movement through key harvest, processing and distribution pinch points, with news coverage capturing graphic incidents of upstream food waste (*e.g.*, piglet euthanasia, farm-level milk dumping, food service distribution channel waste; see Yaffe-Bellany and Corkery 2020). However, we must remember that consumers are the final and arguably most critical link in the food supply chain, as consumption of food is the *raison d'etre* for the entire food supply chain. Indeed, all effort expended to reduce upstream food supply chain waste is rendered a costly folly should the consumer then waste the food.[1] By some estimates, this is considerable: *e.g.*, 83% of food waste occurs at consumer-facing businesses (40%) and in homes (43%) according to ReFED (2016). Further, in the aggregate, this waste can create system-wide spillovers through increased prices, decreased availability of food, and increased environmental and resource pressures, all of which creates particularly harsh burdens for lower-income consumers.

In this article, we explore how the COVID-19 pandemic may affect consumer food waste in developed economies such as the United States. While not deriving an explicit model, we draw upon concepts from the household production literature and note that several authors have used such a framework to derive implications of various household production parameters for the generation of food waste (Katare et al. 2017; Lusk and Ellison 2017; Qi 2018; Hamilton and Richards 2019; Ellison et al. 2020). Comparative statics from these efforts suggest food waste may decline under circumstances stimulated by the pandemic: more time available for household production; accumulated experience and knowledge with home food provisioning and meal preparation; less income available to purchase meal inputs; and higher prices for food. However, comparative statics are insufficient to provide the entire picture, as such analyses ignore key transitional aspects of behavior that arise from rapid shocks such as those experienced during this pandemic.

We organize our article around changes in stylized facts caused by the pandemic that will perturb household production parameters and then conjecture how this will alter the amount of food waste created by consumers

[1]*See, for example, Gillman, Campbell, and Spang (2019), who calculate that the accumulated life cycle impact from wasting food at the final consumer level is so great that, for some crops, welfare is improved by allowing excess food to spoil in the field rather than enter the supply chain.*

both in the short and long run, with citations of supporting research and data if they exist. We end with some overall predictions about the net effect that the COVID-19 pandemic will have on consumer food waste and recommendations on short-term steps that could help reduce waste due to the pandemic.

Postpandemic Changes

Shifts in Home Food Provisioning

An initial and highly visible impact of the COVID-19 pandemic was that of empty grocery store shelves. While the supply chains supporting many food products endured great stress due to multiple disrupting forces (Hobbs 2020; Richards and Rickard 2020), the store shelves for many food items were empty or featured limited selection, in part due to panic buying in which fears of food shortages at an individual level led to a self-fulfilling prophecy on aggregate (Kuruppu and De Zoysa 2020). In April of 2020, WRAP (2020) reported 37% of UK adults were concerned about supermarkets running out of food during the coronavirus situation, while IFIC reported 28% of US consumers were concerned about stores running out of staple items (IFIC 2020a). Even in July of 2020, our own (along with several other colleagues) survey work with more than 500 respondents from throughout the United States suggests about 25% of US consumers feared certain items would be in short supply at grocery stores (Bender et al. 2020). Such relatively high levels of concern, though slightly lower than the ones reported in April, may be associated with several regional spikes of confirmed COVID-19 cases in July when consumers were relatively more experienced in post-COVID food sourcing compared to immediately after the onset of the pandemic in March.

A fundamental and unanswered question is whether panic-purchased foods will be wasted at greater rates than normally acquired foods. Our intuition is that this is likely. Panic purchases were in larger quantities (Chetty et al. (2020) note a 78% increase in grocery expenditures in mid-March 2020), which may lead to suboptimal storage, particularly for perishables (though we note that in April 2020, 15% of consumers reported purchasing less fresh produce according to IFIC (2020a)). However, even for nonperishable items, Wansink, Brasel, and Amjad (2000) document frequent "cabinet castaways," i.e., shelf-stable items that were never used for their intended purpose and persisted in home storage until discovered and discarded. Panic-purchased foods may also have been items that were not of the preferred size, formulation, or brand, and hence require the consumer to be flexible or creative during preparation and consumption, all of which may increase the likelihood of waste.

While panic purchasing has largely passed, other grocery purchasing patterns persist, with mixed implications for likely waste. IFIC (2020a) found that in April 2020, 50% of consumers reported shopping less in person and 37% of consumers reported buying more groceries each time they went shopping. IFIC (2020b) noted that 36% of consumers in May 2020 reported an increase in purchases of packaged foods. Larger, less frequent food shopping is likely to exacerbate waste, all else equal, as this requires better meal planning and storage practices to ensure less waste. For example, Lee (2018) found that *per capita* food waste was greater among South Korean consumers who shopped less frequently. However, increased reliance on packaged foods may reduce waste as these goods can be stored for longer periods

(nonperishables) or used with little preparation effort (perishables), both of which should decrease the risk of waste.

Online grocery shopping has also increased with 16% of consumers in the IFIC (2020a) study reporting the initiation of grocery delivery after COVID-19. Again, we see mixed implications for consumer food waste. Online shopping can largely reduce the perceived cost of taking a trip into the grocery store where social distance is more difficult to maintain. With fewer perceived costs of shopping, online grocery shopping may limit panic shopping and mitigate the necessity of food stockpiling, though many online grocery attempts immediately after the onset of the COVID-19 pandemic went unfulfilled due to service providers who were unable to adjust capacity to the spike in demand (Zumbach 2020). Online food ordering may also temper impulse purchases of food (Jilcott Pitts et al. 2018) that may seem desirable in the store but not find a use and be wasted once at home. Further, online interfaces may limit acquisition of perishable produce due to consumer hesitancy concerning quality as they no longer can choose individual produce items (Jilcott Pitts et al. 2018). On the other hand, increased reliance upon online shopping can increase a consumer's "psychological distance" to food, which has been shown to increase the tendency to waste food (Ilyuk 2018). That is, when consumers have less attachment to the food (*i.e.*, do not physically connect to items by actively choosing the item and placing it in an actual cart), it may become easier for them to waste those items.

The onset of COVID-19 in the United States also corresponded with many local growing seasons. This timing, along with consumer concern about the safety and reliability of the food supply chain, resulted in increased interest in homegrown and locally grown foods (Shilton 2020; Walljasper and Polansek 2020). In our July 2020 study of US consumers, about 30% indicated at least a portion of their food was homegrown or obtained locally from either a farmer's market or community-supported agriculture (Bender et al. 2020). However, the implications for waste are again mixed. Growing your own food or acquiring it via direct marketing channels suggests more involvement with the food, which reduces psychological distance and could reduce the amount wasted. However, perishable produce, particularly when received in bulk, may be at risk for waste. Respondents to an April 2020 study of households in the US and China reported fruits and vegetables as the most common foods thrown away during the pandemic (Dou et al. 2020). This is unsurprising given the perishable nature of fruits and vegetables combined with the reported decrease in frequency of food shopping trips.

In response to simultaneous supply chain disruptions (Hobbs 2020) and an increase in household food insecurity spurred by the COVID-19 pandemic (Ahn and Norwood 2020; Gundersen et al. 2020; Ziliak 2020), the US Department of Agriculture (USDA) introduced the Farmers to Families Food Box program that distributed more than 32 million food boxes during May and June of 2020, with additional distributions planned for the summer of 2020 (USDA 2020). Boxes contain an assortment of produce, dairy, and/or meat chosen by participating vendors and delivered to interested consumers through familiar touchpoints in the emergency food system (food banks, food pantries, churches, and other nonprofits). The launch of this program likely reduced waste at the farm and distributor levels, as the reduction in demand from food service channels yielded surpluses that may have otherwise resulted in items being discarded or used for purposes other than human nutrition (Yaffe-Bellany and Corkery 2020).

However, distribution of boxes where the assortment of foods is selected by the vendor rather than by the patron may increase waste compared to emergency food outlets that permit patrons to select their own combination of items. For example, Pruden et al. (2020) note that emergency food clients who receive fixed bundles of food (i.e., bundles chosen by the local agency) report using 12 percentage points less of the distributed food than clients who were permitted autonomy of food choice. Hence, actions by USDA and participating emergency food providers that increase the variety or customizability of these boxes to meet patron preferences may ensure fewer items are wasted in patron homes.

Other temporary measures are being taken to reduce barriers for direct-to-consumer sales and donations during COVID-induced supply chain disruptions. The US Food and Drug Administration (FDA) relaxed regulations around package labeling so that foods intended for preparation in restaurants and by food manufacturers can be sold directly to consumers instead. These packages are often larger and may lack consumer-facing labels such as nutrition labels and handling instructions. The FDA is temporarily allowing these unlabeled packages to be sold so long as the information is displayed at the point of purchase (FDA 2020). As with the Farmers to Families Food Box program, these measures will likely reduce upstream waste but could increase consumer waste. Previous research has shown that package size, ease of use, and date labeling all contribute to consumer food waste (Williams et al. 2012; Roe et al. 2018a; Roe et al. 2018b). While a lack of date labels could reduce waste (Roe et al. 2018a), larger and bulkier packages will likely lead to a net increase in consumer waste (Williams et al. 2012).

Shifts to at-Home Meal Preparation

As the COVID-19 pandemic spread and stay-at-home orders went into effect across the United States, consumer behavior changed drastically. One well-documented behavior change is the shift to at-home meal preparation and consumption, with 60% of consumers reporting cooking at home more as a result of COVID-19 (IFIC 2020c). Prior research has shown minimal plate waste when people prepare meals at home compared to meals provided in a food service setting (Roe et al. 2018b), suggesting that a greater reliance on home-prepared meals can reduce food waste created at the end of meals.

However, plate waste is only one source of food waste in homes and food service. Ongoing research by two of the authors finds that plate waste constitutes less than 40% of all waste created by a sample of US households on a daily basis, with the remaining waste created during food preparation (*e.g.*, trimming and tossing broccoli stalks) and food cleanout settings (*e.g.*, tossing out uneaten leftovers from the refrigerator), which is similar to figures documented by Quested and Murphy (2014) in the UK. We are unaware of any published research in food service settings that documents the amount of plate waste (*i.e.*, front-of-house waste) relative to preparation and storage waste (*i.e.*, back-of-house waste) in the same study. For one food service setting—K-12 cafeterias—when we compare across disparate studies, it appears that plate waste exceeds back-of-house waste on a per-meal basis. Specifically, Prescott et al. (2019) measure about 44 g of back-of-house food waste for each meal produced in several Colorado K-12 cafeterias while Bergman et al. (2004) find plate waste of 157 to 223 g/meal (Bergman et al. 2004) and Adams et al. (2005) find produce waste alone of 46 to 81 g/meal.

Though no similar data exists in other food service settings to document the relative waste between front-of-house and back-of-house sources, we note that, compared to home-prepared meals, restaurants and food service entities likely waste less food than home cooks during preparation as many food service ingredients are packaged to minimize waste (*e.g.*, pre-portioned items in quick service restaurant formats) or prepared by skilled professionals under an explicit cost-minimizing objective that seeks to maximize back-of-house efficiency (*e.g.*, reducing waste by careful preparation, meal planning, and storage practices in full-service restaurant settings).

Hence, we predict that shifting to more meals prepared at home in place of meals from food service is likely to create less plate waste but more waste during preparation and food management. The net effect of this shift on overall food waste is unknown, but in the short run (*e.g.*, March and April of 2020), a net increase in waste was likely as consumers refined their home food management and cooking skills – a topic we touch on in the section on dynamic implications of the COVID-19 pandemic.

Dynamic and Longer Run Considerations

While the changes spurred by the onset of COVID-19 occurred quickly, some effects may be long-lasting through dynamics that unfold over the months and years to follow. One change that has been hypothesized is that of consumer home production capability with respect to food. That is, with the additional reliance on home-prepared meals and, for some, additional in-home time due to fewer work and commuting hours, consumers may have increased their effectiveness as a home chef and meal planner, which could yield longer term reductions in waste (WRAP 2007; Graham-Rowe, Jessop, and Sparks 2014).

For example, in April of 2020, WRAP (2020) found that the average UK consumer reported undertaking six new food management behaviors that support reductions in food waste (*e.g.*, pre-shop planning) more often since the onset of COVID-19 lockdowns, while nearly 80% reported undertaking at least one of those behaviors more often. The authors found that at least a third of respondents to a July 2020 survey assess that their cooking skills have improved during the three-plus months since the onset of COVID-19 while even more report an improvement in their own food management skills (Bender et al. 2020).

These may be home production skills that persist and yield long-term reductions in waste, though skills learned may also be forgotten (Benkard 2000), particularly in areas where restaurant and food service facilities resumed operations rapidly after initial lockdowns. The likelihood of long-term adoption of food management practices and in-home cooking may, in fact, depend on the course of the pandemic itself; the longer stay-at-home orders are in place, or the more frequently they are reinstated over the next months and years, the more likely long-term adoption of these new habits will occur.

Another feature of the lockdown was a shift in household size and composition, with about one-fifth of Americans having relocated or knowing someone who has relocated due to COVID-19, often creating larger households in the process (Cohn 2020). This includes about 10% of adults between eighteen and twenty-nine years of age changing residences as a result of the pandemic, with many of them returning to homes of parents and relatives (Cohn 2020).

Most analyses of household food waste suggest that per-capita waste is lower in larger households as there are simply more people and hence opportunities for acquired food to be used for nutrition prior to quality decay and because package sizes often favor medium to large households over single-person households (Hebrok and Boks 2017; Schanes, Dobernig and Gozet Schanes, Dobernig, and Gözet 2018; Thyberg and Tonjes 2016).

While this may hold across established households, to our best knowledge the effect of transitions in household size on food waste are not documented. We predict that transitions, for example, where students prematurely returned home from college, may temporarily increase food waste, as items may have been left to decay at the students' school residences, while provisioning in the absorbing household may have taken several weeks to adjust appropriately with a greater chance of waste from overprovisioning or acquisition of items not favored by new and returning household members.

Just as household membership may have shifted during lockdown, so too may have household food storage capacity. We found in July 2020 that more than a quarter of respondents had increased refrigerated storage capacity and more than 10% had increased frozen storage capacity since the onset of the COVID-19 pandemic (Bender et al. 2020). These are durable investments that will likely increase long-term storage of refrigerated and frozen items. Indeed, in the same July 2020 survey, more than 40% of respondents reported an increased amount of refrigerated or frozen food in storage due to the COVID-19 pandemic, with more than a quarter reporting increases in both refrigerated and frozen food.

If consumers continue to waste refrigerated and frozen items at the same (pre-COVID) rate, then a higher carrying capacity will mean higher total waste. Put another way, consumers will have to enact improvements in their refrigerated and frozen storage efficiency to ensure total waste from refrigerated and frozen sources does not increase. Larger refrigerators and freezers can mean more territory in which items can become lost, though increased freezer capacity in particular can reduce waste if used properly.

Conclusions

Some of the household changes precipitated by the onset of the COVID-19 pandemic hold the potential to enhance the efficiency of the household food production process and reduce the overall amount of food wasted by consumers. For example, with more time available as hours worked and commuting time have decreased, many US consumers report an improvement in their cooking and food management skills (Bender et al. 2020). Decreasing employment and earnings, along with higher food prices, can heighten the incentive for tighter home management, which may include less food waste, outcomes consistent with comparative statics from household production models of food waste (Katare et al. 2017; Lusk and Ellison 2017; Qi 2018; Hamilton and Richards 2019; Ellison et al. 2020). In fact, a past review of the literature concludes that employment is generally correlated with higher levels of consumer food waste than unemployment (Schanes, Dobernig, and Gözet 2018).

Indeed, when WRAP (2020) surveyed consumers from around the UK in April of 2020 using food-waste tracking questions consistently administered over the past several years, respondents reported the waste rate for key items

such as bread, milk, chicken, and potatoes declined to 14% from a November 2019 high of 24%. Respondents were also asked if they were discarding more or less food than usual in the past month, and 36% said less than usual, with only 4% reporting more than usual. These findings are consistent with empirical work conducted by Landry and Smith (2019) using data from the late 1970s in the United States. They identified food waste as a luxury output of the household production process that was elastic to the price of food; hence the higher food prices and diminished incomes prevalent in the post-COVID United States should translate to less food waste.

While COVID-19 may provide a silver lining in terms of the everyday creation of food waste, the figures from the UK and the 1970's data used in Landry and Smith likely miss intermittent food purges, which Parizeau, von Massow, and Martin (2015) note represent large and critical elements of overall food waste figures. Also, it is unclear if the trends documented in the UK and in 1970s US homes translate to the modern US household experience.

While a survey similar to the WRAP (2020) study has not been conducted in the United States, the IFIC (2020a) study, which was also conducted in April 2020, reveals some differences between US and UK food purchasing habits, which may challenge simple translation of UK trends to the United States. For example, in the United States frozen food purchases increased by 31% while 15% reported purchasing fewer fresh fruits and vegetables. In the UK, frozen food purchases increased much less (from a 3% increase in fruit to a 19% increase in vegetables) while fresh fruit and vegetable consumption increased. If COVID-induced changes in food purchasing patterns differed between the UK and US, so too might COVID-induced changes in food waste patterns.

Our conjecture is that the multiple stresses caused by the COVID-19 pandemic have stimulated improvements in household efficiency and resulted in less food waste as part of "the new daily routine" that so many households have created in response to changes. However, the onset of COVID-19 (and the likely re-emergence of such disruptions until a vaccine is widely adopted) may induce more transitions, ranging from panic-buying at the onset of stay-at-home orders to changes in work schedules, living arrangements, food storage capacity, and food service outlet availability. These transitions likely stimulate more waste of food that may only appear during intermittent clean outs or purges of home food storage areas. For nonperishable and frozen items, these clean outs might not occur for many months or even years.

We believe several immediate opportunities exist to combat some of the consumer-level COVID-related food waste issues highlighted above. First, we recommend that local agencies devise campaigns that urge households to scan their stocks of nonperishable shelf-stable items and donate or share items purchased (or in the case of home gardening, planted) in panic but, in retrospect, do not work well for their household. Second, we would urge USDA and local emergency food agencies to work to further customize contents of food boxes to ensure a match to the preferences of patrons. This works both to reduce food waste as well as to enhance the autonomy of those who find themselves dependent upon the emergency food system. Finally, with more consumers cooking at home and limited dine-out options, educational efforts focused on food management, cooking and preservation skills may be better received and retained now more than ever.

Acknowledgements

Roe recognizes research support from the Van Buren program of Ohio State University; the Ohio Agricultural Research and Development Center (Award #OHOA1632); and the U.S. Department of Agriculture (2017-6702326268). The authors thank editor Craig Gundersen and an anonymous reviewer for suggestions to improve the manuscript. All remaining errors are those of the authors.

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