Econ 325 Spring 2020 Group Project

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Group 8

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Introduction:

Coronavirus disease 2019 (COVID-19) was first discovered in Wuhan, China in December 2019. Since onset, the virus has spread internationally, infecting millions and inflicting hundreds of thousands of deaths. The virus causes a respiratory illness that manifests in telltale symptoms including fever, cough, sore throat, and shortness of breath. There is currently no vaccine for the virus and patients are treated with symptom management, prompting many countries to adopt quarantine programs. As a result, economies around the world have been damaged by these measures in order to curb the spread of COVID-19. This paper will address historial effects and responses to natural disasters, production/supply chain effects of the current pandemic, and consumer demand effects.

The natural disaster that will be covered is the Great East Japan Earthquake, also referred to as the 2011 Tohoku Earthquake and Tsunami, that occurred in March 2011 off the Tohoku region east coast. The earthquake and ensuing tsunami caused significant damage to civilians and industries, resulting in considerable economic recession. The damage was not spread equally across all industries or regions, requiring rapid response measures. However, Japan was able to restore national production levels in 4 months through government subsidies and low-interest loans, in addition to general tenacity. By analyzing history, we can understand what is happening now and predict future fluctuations.

This pandemic has severely affected international and domestic supply chains. China and the USA have both all but stopped medical equipment exports. Manufacturers of products adjacent to medical supplies have switched to producing disinfectant, masks, and respirators. Medical producers have enormously increased their production. Market distribution of goods has also come under scrutiny as inter-state competition has prevented supplies from reaching their destination. By analyzing supply chains and production, we are able to more effectively distribute needed products in the future.

This crisis has affected consumer demand significantly, but in different ways. It is important that in order to analyze consumer demand effects, we will need to study the changes to how, where, and what consumers buy. The closing of the majority of stores have shifted the focus to a few essential businesses, such grocery stores, certain warehouses, and online retailers and distributors. This course of action is not only a reflection of health and safety protocol, but also a catalyst for changing consumers' consumption patterns. These analyses will lead to a more comprehensive understanding of the COVID-19's impact on our economy and our society.

Compiling Historical evidence:

The Great East Japan Earthquake (GEJE) was a magnitude 9.0-9.1 earthquake that took place off the East coast of Japan on March 11, 2011. The damages/casualties from the earthquake and the tsunami that followed include over 27,000 lives lost, 200,000 homes and buildings destroyed, and the meltdown of a nuclear power plant, among others (Nanto). Nuclear accidents led to the evacuation of hundreds of thousands of residents, the most significant of which occurred in the Fukushima Daiichi Nuclear Power Plant complex. There, the level 7 meltdowns of at three reactors caused the explosion of reactor containment structures. Humanitarian responses were swift and Japan received aid both domestically and from the international community. However, economic recession would still inevitably follow. The flooding occurred in the less populated and less industrial Tohoku region, although due to supply chain effects and the extreme damage, the GDP of Japan still decreased by 4% in 2011 (Knowledge Note). The earthquake is still considered the costliest natural disaster in history ($360 billion) and long-term rebuilding costs were estimated to be ¥10 trillion ($122 billion). Industries affected mostly severely by these supply chain effects include technology and automobile manufacturers, essential components of Japanese production. Thus, exports dropped considerably in the following months.

Further, retail sales dropped 20% as many Japanese had either lost property or lost money in investments as the shocks from the earthquake could cause a recession. This is similar to the coronavirus pandemic, in which consumption in sectors deemed unnecessary plummeted.
Figure 1: Total production in Japan between 2006-2014 (FRED).

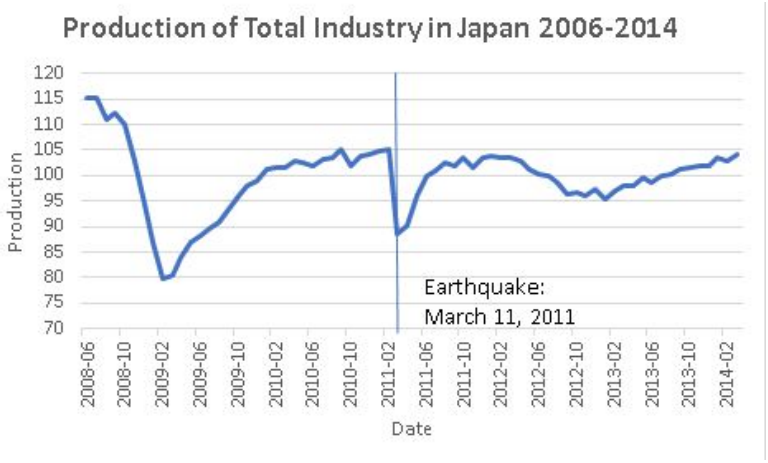
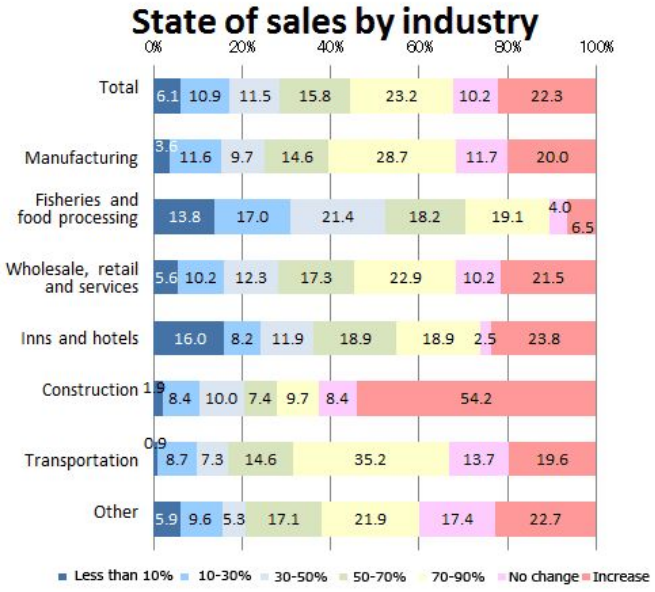


Figure 1 depicts one measure of the short-term and long-term impacts the disaster had on the Japanese economy. As described, production levels fell sharply in March 2011, however companies were eager to restore their output levels towards the end of 2011 and beyond. The totals are normalized to the level of Japan's production in 2015 (which is 100), meaning the economy was doing better than its 2015 level before the earthquake. The earthquake and tsunami destroyed thousands of homes as well as commercial and industrial buildings, so Japan's ability to manufacture some common exports such as cars and semiconductors was limited in the following months. Despite the circumstances, the production level recovered in just 4 months but was not spread evenly across all industries or regions.

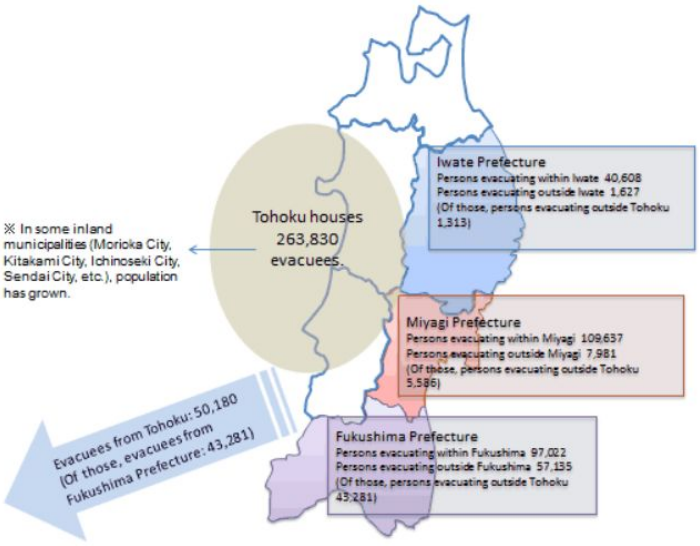
Given the massive destruction of property and factories, construction was in high demand following the disasters. As a result, 54.2% of construction companies observed an increase in sales within 1.5 months after the earthquake, seen in figure 2. In contrast, only 6.5% of fisheries and food processing companies were able to achieve an increase in sales while 89.5% failed to reach the same level of production, with 13.8% making less than 10% of their original sales. While the increase in construction can be attributed to a surge in demand, the damage to the fishing/food industry is largely due to the destruction of property due to proximity to the coast. A significant portion of inns and hotels also lost revenue, since these establishments are based almost entirely on property. As business owners struggled to replace the factories lost in the site of impact, they were not able to recuperate as rapidly, which also gave rise to regional differences in recovery rates.

Figure 2: Change in sales compared to pre-quake levels by industry (Yamada 2013). Data was collected in September 2012.



Regional differences developed based on proximity to where the disasters occurred. Specifically, the Tohoku region was the most critically damaged by the tsunami and earthquake, especially in the east coast. Though many people evacuated within their original prefectures, the vast majority left the region to move inland, numbering hundreds of thousands (figure 3), largely due to the nuclear accidents that occurred in the area. The huge loss of human capital and property caused production in Tohoku to plummet relative to Japan as a whole, and outside intervention was necessary to restore its production levels.

Figure 3: Evacuee displacement due to the disasters (Yamada 2013).

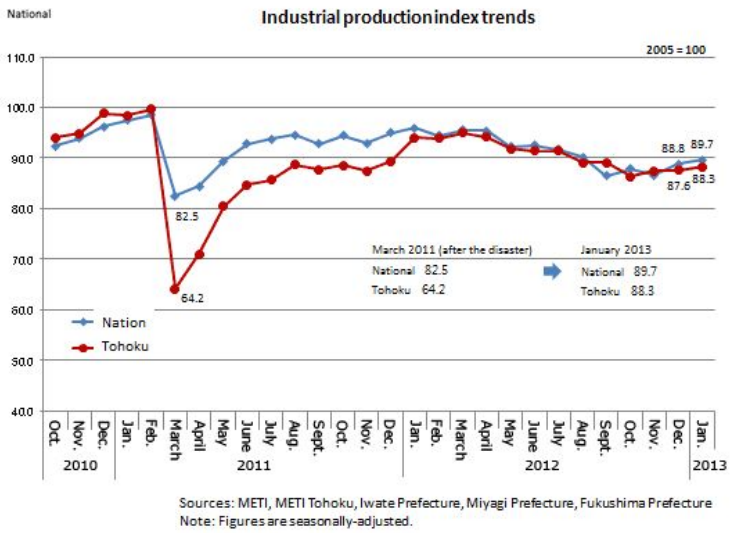


Following the disasters, the majority of SMEs (small and medium-sized enterprises) were at severe risk of bankruptcy. Owners of these companies who had recently taken out loans to start their business suddenly found themselves destitute and in debt, unable to secure "double-loans". In response, the Japanese government issued SME (small and medium-sized enterprises) Group Subsidies in order to restore production. The decision was unprecedented even after the Great Hanshin-Awaji Earthquake in 1995, at which time only low-interest loans were provided. Subsidies of any sort were not issued because private capital investment was determined to be the business of the private sector. In comparison however, the Great East Japan Earthquake was much larger in severity and scale, so the government decided otherwise in order to aid SMEs. In addition to these subsidies, the government used its disaster budget to issue loans, some even interest-free. Aside from monetary relief, the Organization for Small and Medium Enterprises and Regional Innovation also worked with small villages/towns to construct temporary facilities and buildings under free leases. These combined efforts boosted total production to near pre-quake levels only 4 months months later.

These efforts not only restored national production levels, but also production of the Tohoku region. Though redevelopment lagged relative to the rest of the country, the industrial production index of the Tohoku region was able to reach national levels within 10 months following the disaster. This was largely because economic relief provided by the government

was primarily directed towards small and medium-sized enterprises, the majority of which were based on the Tohoku region. Thus, due to government intervention and perseverance of the country as a whole, Japan was able to steadily recover from the disasters and almost return to prior production levels in a matter of months. Perhaps the U.S. should look towards adopting similar policies and focus on reconstruction of industries most afflicted by the current COVID-19 pandemic.

Figure 4: Comparison of national and Tohoku industrial production indices between 2010-2013.



Sources: METI, METI Tohoku, Iwate Prefecture, Miyagi Prefecture, Fukushima Prefecture
Note: Figures are seasonally-adjusted.

Analysis of production and supply chains effects:

COVID-19 has significantly disrupted worldwide production and supply chains. Some industries vastly increased production, others halted production, and others completely changed their typical products. The production of personal protective equipment (PPE) and other medical supplies is higher than ever before. Three major trends have emerged in this context: First, state-imposed export restrictions on these items make it difficult for them to be transported globally. Second, supply has rapidly shifted to attempt to meet demand, but firms cannot switch production quickly enough to meet this need. Third, markets appear somewhat unable to properly coordinate distribution of these medical supplies in this context.

State restrictions on exports have substantially affected supply in response to the coronavirus. The Congressional Research Service (CRS) produced a report analyzing current

medical supply chain relations between China and the rest of the world and China and the USA. Even before the coronavirus, a large percentage of US imports were medicine-related. In 2019, "U.S. imports of pharmaceuticals, medical equipment and products, and related supplies are estimated to have been approximately $20.7 billion (or 9.2% of U.S. imports)" (Congressional Research Service, 2020). As the pandemic continues, these imports become increasingly important. However, China -- heavily affected by the coronavirus -- acted to redirect supply for domestic demand.

The table below shows China's exports and imports of six key categories of medical supplies needed to fight the coronavirus. The percentage change compares the first two months of 2019 against the first two months of 2020, when the pandemic in China was rapidly spreading.

Change in China's Exports and Imports of Select Medical Products

YTD 2019 (January-February) vs YTD 2020 (January-February)

	World		**United States**	
Description	**Exports** % Change	**Imports** % Change	**Exports** % Change	**Imports** % Change
Garments, Made-Up of Fabrics of Felts and Nonwovens *[includes disposable hospital gowns and lab coats]*	-13	40,582	-21	297,288
Made-Up Textile Articles *[includes N95 and other protective masks]*	-16	2,176	-19	1,615
Surgical and Medical Gloves	4	210	-8	93
Medical Ventilators & Respiration Apparatus	-20	174	-35	209
Medical, Surgical or Laboratory Sterilizers	-34	66	-70	317
Thermometers and Pyrometers	-12	65	-16	15

China's exports to the rest of the world fell for every category except surgical and medical gloves, with a simple mean decrease of 15.2%. Exports to the USA fell in every category, with a simple mean of 28.2%. China's imports changed even more dramatically.

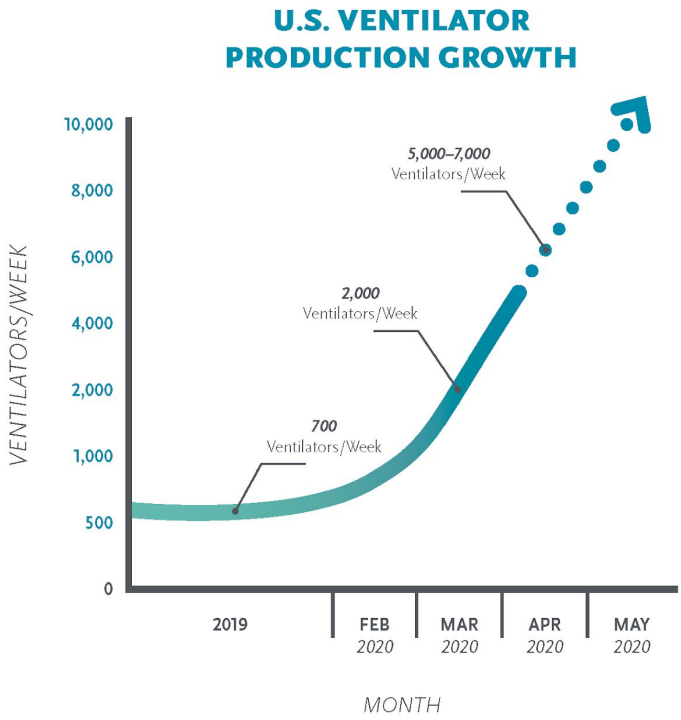
Imports from the rest of the world increased in every category. Imports increased by over 2000% in textiles (which include protective masks), by over 40,000% in garments (which include hospital gowns), and by 491% overall (simple geometric mean). Imports from the USA increased by almost 300,000% in garments and by 595% overall. Although raw numbers are not currently available, these percentages represent a clear increase of imports and decrease of exports of medical supplies.

The CRS report also discusses the role of the NDRC, China's most powerful economic planning agency, on domestic and international supply lines. The NDRC "commandeered medical manufacturing and logistics down to the factory level and has been directing the production and distribution of all medical-related production, including U.S. companies' production lines in China, for domestic use" (Congressional Research Service, 2020). The NDRC's actions almost certainly caused an interruption of existing and future international supply chains, especially considering that other countries were not yet fully aware of the severity of the pandemic. Recently, the Trump Administration invoked the Defense Production Act (DPA) to restrict exports of medical supplies (van Wagtendonk, 2020). Restrictions like these allow producer countries to keep their hospitals stocked but may harm nations that rely on medical supply imports.

Private response to the crisis has increased supply. Decreased imports and increased demand have pushed numerous large and small domestic manufacturing firms to shift production to medical supplies. For example, the US Chamber of Commerce reports that numerous distilleries have begun producing hand sanitizer. Both the small dressmaking brand Altress and the large athletic clothing brand Under Armour switched to manufacturing face masks. Many other examples of factories switching to producing medical equipment are available (U.S. Chamber Staff).

Among the most needed supplies are ventilators and masks. The diagram below from AdvaMed shows that companies significantly increased their production of ventilators from 700 per week in 2019 to 2000 per week in March 2020 (AdvaMed, 2020). Expansion of facilities and firms switching markets has allowed production to grow so significantly. This rapid increase occurred even prior to President Trump's first meaningful invocation of the Defense Production

Act (DPA) on 27 March, when he directed General Motors to produce face masks according to Health and Human Services Secretary Alex Azar's requirements. This suggests that markets were acting quickly to meet demand even prior to state intervention.



Many countries have also used state action to speed production of medical supplies. In China, the NDRC took control of the production of medical supplies related to COVID-19. In the USA, President Trump has used the Defense Production Act (DPA) to direct private companies to produce supplies that the federal government demands. At the beginning of April, the Department of Health and Human Services announced the first DPA contract with "General Motors […] for 30,000 ventilators to be delivered to the Strategic National Stockpile by the end of August 2020" (Department of Health and Human Services). Other companies that have started to make ventilators include General Electric Company, Hill-Rom Holdings, Inc., and Medtronic Public Limited Company. As a result of private and public demand, ventilator members of the Advanced Medical Technology Association or "AdvaMed" have "boosted production by more than 285 percent to meet the demands of this global crisis" (AdvaMed).

In addition to boosting supply, many countries have used state action to assist distribution of medical supplies. In China, the NDRC directly controlled where certain supplies went. In the

US, domestic supply chains have been changing as well. Certain areas of the country have been affected more than others and are in dire need of medical supplies, while other areas have excess supplies. One example of US policy is the Dynamic Ventilator Reserve (DVR), which aims to move ventilators from hospitals with excess supply to those with excess demand. The DVR is a "public-private partnership between the American Hospital Association, the White House, FEMA, and leading group purchasing organizations" that "brings together health systems from across the country to contribute a portion of their ventilator fleets to share with hospitals experiencing shortages" (AHA Data Solutions).

However, this type of partnership may be insufficiently important in directing supplies from producer to consumer. Where the federal government does not intervene, states frequently compete with each other to bid for medical supplies -- which raises the cost of supplies and encourages manufacturers to "hoard" goods before sending them (Nguyen, 2020). This suggests that the market may be unable to deal with severe shortages in the context of rapidly emerging medical crises.

Analysis of consumer demand effects:

The COVID -19 pandemic has seriously altered consumer behaviors and spending patterns, creating devastating challenges for companies and stores to efficiently and effectively allocate their resources to meet consumer demand. This is evident through the new media's widespread coverage of barren store shelves. Fear, anxiety, and concern for safety has propelled consumers to buy certain products and services as their lifestyles change drastically. From closed stores to working at home, consumers have to adapt and endure the difficulties of a evolving pandemic.

There are numerous aspects of consumer demand that should be analyzed. A fundamental change resulting from the pandemic is where and how consumers are shopping. There has been a 30% increase in foot traffic across groceries and warehouses, with frequencies of such trips decreasing by 15%. This showcases the pattern of consumers stockpiling food and other items that can last their households weeks at a time. State governments are also recommending consumers to limit travelling unless necessary; this has currently affected consumer shopping

behaviors. E-commerce, however, has seen the most significant change. Grocery deliveries and warehouse online purchases, such as those from Amazon, have surged to more than 31% from before the pandemic (Becdach). This could have long-lasting effects, as more consumers are experimenting with online grocery shopping, which can increase their confidence with the system. If online grocery shopping continues after the major pandemic months, then companies will have to adjust their resources and potentially invest more into e-commerce.

Figure 1: U.S CPG Sales % growth vs. a year ago (Nielsen 2020)

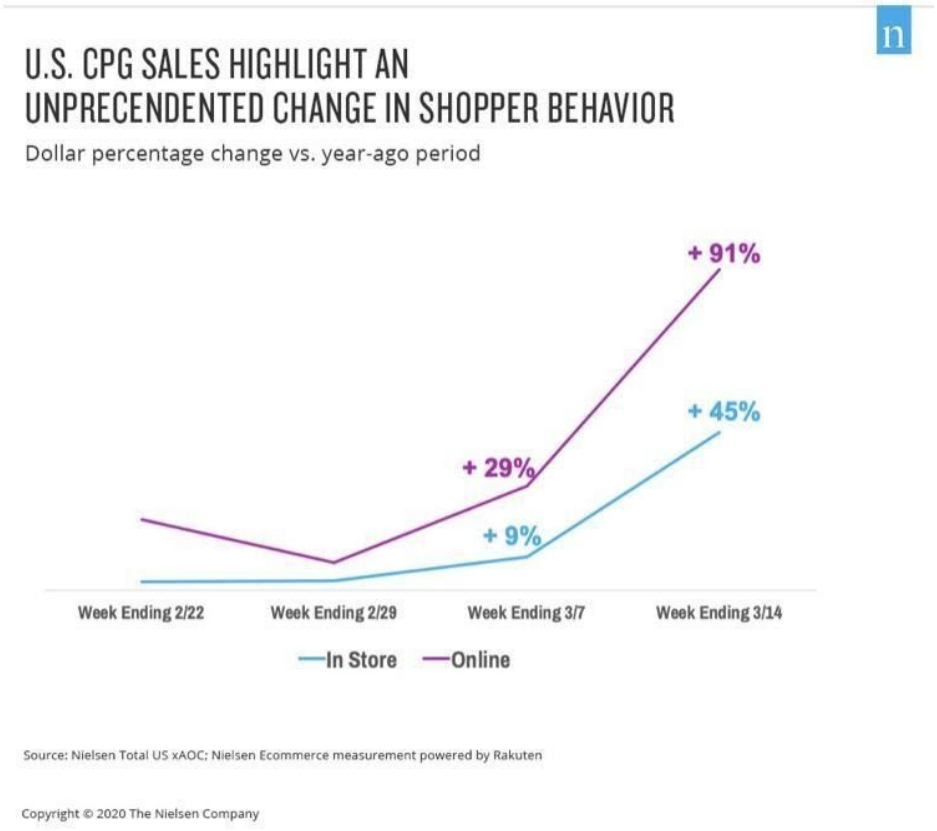


Figure 1 provides evidence for the increased prominence of online shopping. It shows the U.S. percentage change of online and in-store sales of consumer packaged goods in comparison from a year ago. Consumer packaged goods are "items used daily by average consumers that require routine replacement or replenishment, such as food, beverages, clothes, tobacco, makeup, and household products" (Bloomenthal). As media coverage increased, consumers demands for these goods increased as well, fueled by anxiety of the unknown and concern over supply.

Another significant change to analyze is what consumers are demanding more of. Demand for nondurable goods, such as food, beverages, pharmaceutical and other medical products have changed the most significantly. Two figures below, from the Nielsen Corporation, showcase the demand changes for such goods

Figure 2: U.S Sales % growth for health and safety products vs. a year ago (Nielsen 2020)

A BROADER SET OF HEALTH & SAFETY PRODUCTS SEES LIFT

U.S. sales % growth vs. year ago

Category	BEFORE COVID-19 Outbreak (Week ended Dec. 28, 2019)	AFTER first confirmed U.S. COVID-19 cases (Week ended Feb. 1, 2020)	AFTER suspected local transmission and Trump's U.S. press conference (Week ended Feb. 29, 2020)
Medical Supplies	+5.2%	+19.5%	+85.3%
Rubbing Alcohol	+6.0%	+19.6%	+65.5%
Bath & Shower Wipes	+3.7%	+13.1%	+59.6%
First Aid Kits	+9.7%	+18.6%	+52.3%
Hydrogen Peroxide	+6.4%	+12.5%	+32.2%
Multi Purpose Cleaners	+6.2%	+8.1%	+29.8%
Antiseptic	-2.5%	+9.5%	+24.1%
Cold & Flu Remedies	+10.6%	+4.0%	+18.1%
Cough Remedies	+10.8%	+4.0%	+16.9%
Antibiotics	+6.9%	+3.9%	+15.4%

Source: Nielsen Retail Measurement Services, Total U.S. All Outlets Combined (xAOC), 1-week periods vs. year-ago

Figure 3: U.S Sales % growth for common pantry (shelf-stable) products vs. a year ago (Nielsen 2020)

PEAK PANTRY LOADING AMONG AMERICANS AS COVID-19 CONCERNS RISE

U.S. sales % growth vs. year-ago

Category	BEFORE COVID-19 Outbreak (Week ended Dec. 28, 2019)	AFTER first confirmed U.S. COVID-19 cases (Week ended Feb. 1, 2020)	AFTER suspected local transmission and Trump's U.S. press conference (Week ended Feb. 29, 2020)
Powdered Milk Products	+11.8%	-3.3%	+84.4%
Dried Beans	-2.9%	-0.4%	+36.9%
Canned Meat	+15.8%	-0.7%	+31.8%
Chickpeas / Garbanzo Beans	+9.7%	+2.8%	+25.6%
Rice	+8.1%	-1.0%	+25.3%
Tuna	+2.5%	-2.3%	+24.9%
Black Beans	+7.3%	-0.1%	+20.9%
Biscuit Mix	+8.7%	-7.2%	+15.0%
Water	+7.0%	+1.4%	+11.3%
Pasta	+9.9%	-3.5%	+10.4%

Source: Nielsen Retail Measurement Services, Total U.S. All Outlets Combined (xAOC), 1-week periods vs. year-ago

Figure 2 shows U.S consumers fueling record sales of masks, antiseptics, cleaners, etc. This 85%+ increase in health & safety products demanded is not surprising; it is evident that pandemics would result in such changes.

Figure 3 shows U.S consumers initiating "pantry preparation" protocols. Shelf-stable items (beans, rice, canned meat. etc) are critical for long periods of isolation, where it allows the

consumer to avoid repetitive trips to the supermarkets if they instead bought fresh groceries that go bad within days/weeks.

Our data points to a particular question: what kinds of consumer consumption behavior are to be expected during and after the crisis?

Consumption can expand, as consumers stock up on non-durable goods due to shortage fears and health considerations. Pantry items and medical equipment, such as rice, vitamins, masks and disinfectant, are likely examples of goods that consumers will continue to stock up on during and after the crisis (Becdach). It is likely that consumer confidence will stabilize in the recovery months but at a slow rate, causing consumers to continue to rely on masks and disinfectants until they are confident to cease such precautions. However, it is possible that consumers will adopt certain practices in the future, such as wearing masks during times like the flu season; this reflects Eastern societal practices.

Consumption can be stagnant during the crisis. Individual responses to the pandemic were significant during the initial weeks. This is evident during the month of February, where the change in sales for medical products at the end of the month rose more than twice than the percentage recorded in the first week of February, from 19.5% to 85.3%. During the crisis however, consumers may limit their purchasing activity outside of the house and online, due to health considerations and budget constraints stemming from unemployment or decreased pay. This behavior can depend on what is shown on the media. Government officials reporting news updates, like infection rates and death rates, may influence increased consumption for certain products, such as more medical products, cleaning products, and food, due to increased anxiety and fear .

Consumptions can shift to other goods or to other consumptions channels during and after the crisis. Consumers have shifted demand to flour, biscuit mix, and other shelf stable items. They have also shifted to where they shop, such as shifting to online retailers that sell goods that consumers may have previously bought from in-person food service outlets.

Figure 4: Average price per dozen eggs for each week (USDA 2020)

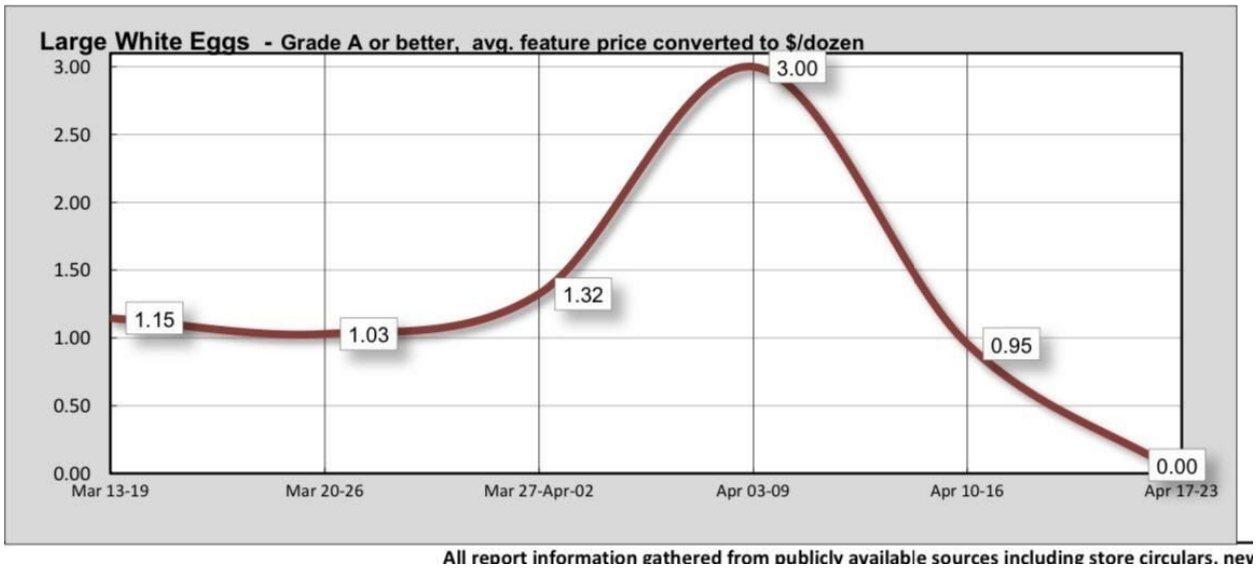
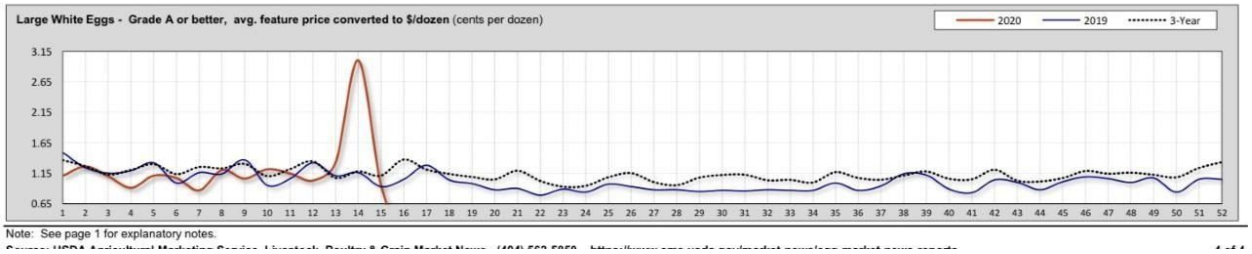


Figure 5: Average price per dozen eggs in comparison to 2019 and 3-year (USDA 2020)



Figures 4 and 5 show the dramatic increase of egg prices due to the high demand during this pandemic. Eggs are a cheap source of protein and an essential everyday food item for most families. Supply did not meet demand, therefore leading to the increase in price.

Consumption can decline for certain goods. Beauty products, clothing, and other related goods have been overshadowed by essential goods, like the non-durable items listed in the figures above. Consumer spending can decline in general, due to unemployment and decrease salaries. This negative effect of consumer budgets has affected the U.S economy, slowing growth and halting many businesses once open to the public, such as apparel stores, malls, and movie theaters. Supply shortages are also factors that can decrease consumption. When consumers find empty shelves in the stores, they may have no choice but to endure not having the goods they demanded for some time.

Conclusion:

Although pandemics are very different from natural disasters, the historical case of the Great East Japan Earthquake reveals how rapid recovery is possible after a sharp drop in production. Japan's government was critically involved in the nation's economic recovery, taking on more debt as the country helped households and businesses receive loans. This emphasizes that recovery of the economy is very achievable and depends on government policy, while recovery of individual industries and businesses may take longer than several months. A sharp decrease in exports has led to shortages in certain countries, and while supply chains have been globally disrupted, we have seen numerous countries and industries race to increase production to meet the world's demand. As companies start manufacturing PPE and medical equipment, we are slowly seeing the production start to meet the demand. Consumers have been racing to gather resources, to stock on goods that can last weeks on the shelf. Concerns over safety and health have changed the behavior of consumption in numerous ways. By analyzing how, where and what consumers buy allow us to better understand the effects on consumer demand cohesively.

All three parts of our analysis only can cover so much. The COVID-19 pandemic has affected our economy, our society, and our way of living in unprecedented ways. There are many future implications that are troublesome, but we hope with more data and analyses that we can look forward to a quick recovery with supply chains being restored to help meet consumer demand. Data that would be useful would be more accurate future predictions of COVID-19 cases, allowing us to produce and distribute the correct amount of supplies. As this world heals, we hope to continue to evaluate what has, is, and will happen in the future in order to gain wisdom, so we may prevent this from happening again.

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