

Analysis of Economic Impact Caused by COVID-19 Pandemic and Comparisons to that Caused by Past Public Crises

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Abstract—In December 2019, Dr Zhang Jixian from Wuhan, China reported cases of pneumonia with unidentified causes. The number of such reports rose rapidly in the city of Wuhan shortly thereafter. Experts and researchers from Chinese Center for Disease Control and Prevention (China CDC) immediately launched an investigation, later determined that a previously undiscovered coronavirus was the cause of the outbreak of the pneumonia in Wuhan. The World Health Organization, after that, named the disease caused by this novel coronavirus “COVID-19”.

Public health is a crucial and essential component of people’s welfare. As the COVID-19 pandemic unfolds, governments across the globe have been taking forceful, drastic and rapid measures to stop the spread of the disease. While such decisions are prudent, they are affecting every respect of people’s life – from cancelling in-person classes to putting our beloved NBA on hold; from ordering the closure of non-essential businesses to putting restrictions on international travels. Government actions are affecting the way in which the economy ran.

In this research, the team will investigate at in which aspects the COVID-19 impacts the economy, how the economic impact of COVID-19 differs from that of other causes (e.g. asset price bubbles), and which tools people often use to boost the economy can help Canada recover from this pandemic.

Index Terms—COVID-19, Economic Impact, Data Visualization.

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I. INTRODUCTION

We never expected to start the 3rd decade in the twenty-first century with a war against a novel coronavirus. Adjustments were so forceful, drastic and rapid. On April 6, the International Monetary Fund (IMF) released a World Economic Outlook Report, in which it projected that the output by advanced economies in 2020 would be 6.1% lower than in 2019, lowering this expectation from 1.9% growth. On June 24, 2020, the IMF was projecting a deeper recession in 2020 and a slower recovery in 2021. It lowered its projected global real GDP growth, again, from -3.0% to -4.9% [1].

We saw an unprecedented drop in the gross domestic product, the most rapid drop in the stock market, and the worst labour market condition. Almost every economic outlook is predicting slow and difficult recovery after the pandemic. In comparison, we see countries in east Asia successfully contained the pandemic, but Canadian and the US’s economies are still in the trough.

In this research, we will investigate the magnitude of the impacts of COVID-19 pandemic on different countries from

- The real economy,
- The financial market,
- The labour market, and
- Supply chain,

using statistical methods.

II. IMPACTS ON THE REAL ECONOMY

Since the start of the pandemic, the Government of Canada has been taking actions to contain of the spread of the virus.

Many, may unavoidably lead to impact on the real economy. Canada's economy shrank at almost 40% annual pace in 3 months between April and June. [2]. In this section, we will analyse COVID-19's impact on some industries in Canada.

A. Impacts on Arts, Media & Entertainment Industry

COVID-19 has changed people's lifestyle and media consumption model significantly. Within the Media & Entertainment (M&E) industry, films and events, which rely heavily on social gatherings, have the most significant impact; followed by TV and radio sector, affected by reduced monetization opportunities through advertisements. Companies that deploy an e-delivery model, such as OTT, online gaming and animation, remain resilient through the crisis. According to the industry assessment report by KPMG, production shutdown in Canada will reduce production volume by \$2.5 billion and have an impact on up to 172,000 jobs across the country [3]. Based on March labour force survey by Statistics Canada, 61.7% of companies in Arts, Entertainment and Recreation Sector reported laying off more than 80% of their workforce [4]. Canadian government has pledged \$88.8 million to The Canadian Media Fund and \$27 million to Telefilm; as well as \$500 million to COVID-19 Emergency Support Fund for Cultural, Heritage and Sport Organizations. However, factors such as limited cash flow, lack of supply, and social distancing protocols, still make it a challenging time period for companies in the M&E industry [3].

1) Increased demand for online contents, but challenges with shortage of supply and limited monetization opportunities: As stay-at-home measure continues to be enforced, data shows that media consumption and screen time experiences continuously increase. According to Nielsen Digital Content Ratings, residents in U.S. has spent 215% more time on mobile devices in March 2020 compared to March 2019 [5]. Similar trend is also evident across all continents, particularly in geographic locations with lock-down and stay-home instructions.

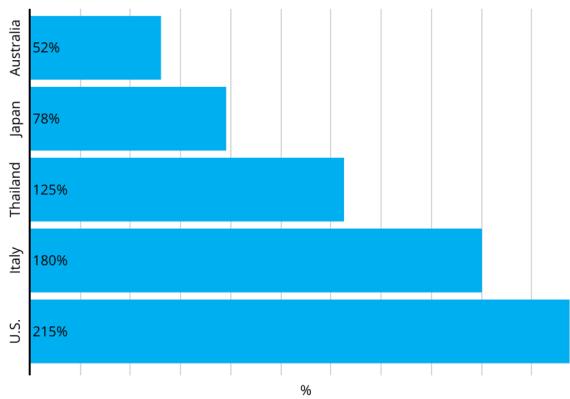


Fig. 1. Percentage difference of time spent online on mobile devices accessing current events and global news, March 2019 vs. March 2020 [5]

Prior to COVID-19, the film and television production industry in Canada has experienced an all-time high in pro-

duction volume of \$9.32 billion in 2019 and generated \$12.8 billion in GDP for the Canadian economy [6]. New series launched since the start of COVID-19 were all completed prior to production sets shutting down. Analysis from Deloitte in April suggested that if production remains halted, there may be limited new content to launch in September [7].

Apart from supply chain shortages, online media contents producer faces challenges with fulfilling advertising spots and reduced monetization opportunities. According to IAB US survey in April, 70% of the 400 buy-side decision-makers sampled have already adjusted or paused their planned advertisement spend. Digital ad spend has decreased by 33%, while traditional media takes a bigger hit of 39%. [8] The trend continues even after the easing of COVID-related restrictions. The latest survey in July suggests that over 85% of agency sample are still negatively impacted; among which 39% reduced spend, 32% delayed spend and 16% temporarily paused advertisement spend. The main reasons behind such cutbacks originate from concerns with cash flow (68%) and redirection of budget to other more essential causes (39%). Considering the impact from both supply and monetization of contents, the value creation chain of M&E industry, in particular the film, TV and radio sector, is certainly disrupted [9].

2) Disruptions on in-person events and entertainment; slow recovery observed since reopening: Since the stay-home instruction is issued by Prime Minister Justin Trudeau in March, all in-person events and live entertainment have been postponed or cancelled. Global entertainment giant Cirque du Soleil, based in Montreal, was forced to lay off about 95% of its workforce and shut down shows worldwide since March. In June, the company struggled to keep its business running amid coronavirus restrictions and filed for bankruptcy. Cirque du Soleil is only one example of entertainment companies that fails to paddle through the crisis. According to the database of the Office of the Superintendent of Bankruptcy Canada, 10 companies began CCAA (Companies' Creditors Arrange Act) proceedings in May; followed by a record of 12 companies in June [10].

Companies seeking creditor protection surges to record

May and June were the two biggest months for CCAA filings in years.

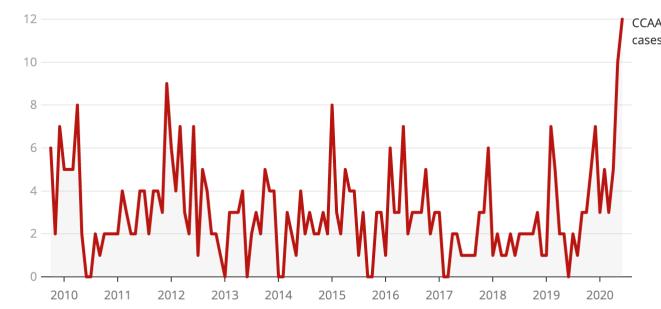


Chart: Pete Evans/CBC • Source: Bankruptcy Canada

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Fig. 2. Number of companies seeking creditor protection (from 2010 to 2020) [11]

Other companies that were able to survive through the peak of the crisis face other problems since reopening of economy, including increased cost due to health and safety protocols and lack of COVID-19 insurance coverage [6]. Independent film producers have reported to be facing the issue of uncovered insurance as well. They are not able to endure the cost of having to halt production due to illness of crew members. Movie theatres face reduced capacity, extended turnaround time between shows and enhanced cleaning process [12].

From a consumer perspective, the mental impact from COVID-19 crisis is long-lasting. According to survey conducted by Performance Research and Full Circle Research Co. in May, 70% of people would choose to stream movies at home even when cinema reopens [13]. Such attitude may lead to a long-term change in consumer behaviour and preference; more than one-third of respondents claimed that they will go to movie theatres less often in the future, while 10% refuses to go again. Similar consumer attitude is observed beyond moviegoers. The recent survey result released on August 31 by Morning Consult suggests that less than one-fifth of U.S. population feel safe to go to an amusement park or a concert.

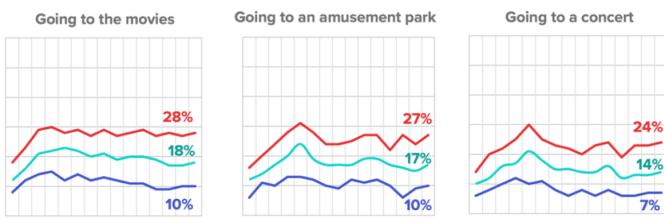


Fig. 3. Percentage Feel Comfortable Participating in Leisure Activities [12]

Such factors further contribute to the slow recovery within the M&E industry. Reopening foot traffic data needs to be tracked to further conclude whether changes in consumer behaviour will force the M&E industry to further shift into a virtual delivery method.

3) Growth of M&E industry in the near-term is restricted due to drastic fall in capital expenditure and investments; outlook optimistic in the long run: According to PwC Global Entertainment & Media Outlook 2019-2023 prior to the crisis, total revenue from industry is expected to continue its growth at around 4% per year; with an increasing weighting of digital revenue [14].



Fig. 4. PwC M&E Industry Outlook (2014-2023) [14]

Nonetheless, due to distancing measures and immediate counter-reaction of COVID-19, the growth of M&E industry in the near-term will be negatively affected. As discussed earlier and evident through decreased ad spend, companies will shift its focus towards paddling through the crisis and cash conservation, rather than on aggressive investments catalyzing future growth. Granados, executive director of Pepperdine's Institute for Entertainment, Media, Sports, and Culture (IEMSC), predicted that there will be a minimum of an 18% contraction of the entertainment industry for 2020 [15].

In the long run, leaders remain positive in the strength and resilience of the industry. Major shift is expected in the structure of the industry, with reduced focus on print media and accelerated migration towards social media and online/live streaming capabilities. In the future, digital channels, video games and social media within the sector will continue to drive industry growth.

B. Impacts on Educational Services.

Because of the pandemic, we have observed a 50% in monthly gross domestic product (GDP) from coming educational services in Canada. Education is one of the industries that strongly impacted by the COVID-19. In this sub-section, we will analyze the factors contributing to the drop in production.

1) International Travel Restriction has led to cancellation of International Exchange Programme: In March 2020, the government of Canada has temporarily suspended of Temporary Resident Visas (TRVs) as well as non-essential travels to Canada [16]. International Exchange programme was not on the list of exemptions, and consequently, cancelled accordingly. While the purpose of international exchange programme is not intended for profit, international exchange programmes have other impacts.

On one hand, such programmes help promote the education in Canada. There is no better way than directly experience the Canadian education to learn what studying in Canada is like. Inbound exchange provides visiting scholars with an opportunity to communicate research, and work with Canadian educators and researchers, helping to attract more international scholars to come to Canada. Data shows that more international students are coming to Canada for their study.

A report released by Immigration Refugee and Citizenship Canada shows that between 2014 and 2018, the number of international students in Canada increased by 68%. In 2018, a total of 721,205 international students at all levels studied in Canada—the largest number ever [17]. The cancellation of international exchange programmes may as a consequence, affecting the promotion of Canadian education services in the short term.

On the other hand, international exchange programmes have economic impacts. Industries such as hotel service, retail service, tourism, transportation etc. will benefit from these short-term exchange programmes and the programmes increases the demand for their services.

2) Fewer students are going to be studying in Canada physically: In 2018, international students in Canada contributed an estimated \$21.6 billion to Canada's GDP and supported almost 170,000 jobs for Canada's middle class [17]. The current travel restrictions are restricting prospective international student from entering Canada, and current international university/college students are provided with an option to study completely online for the 2020 — 2021 educational year. Higher tuition fee is collected from the international students, but because of the pandemic situation, the demands for accommodation, groceries, medical services, transportation, and many others essentials go down dramatically. With available public data, we are not able to estimate the loss of GDP and jobs associated to this drop in demand, but given the size of the population being 721,205, this impact may be huge [17]. Also, the study permit applications being received this year is significantly smaller than last year's. We may expect a smaller number of international students in Canada in the coming year.

3) Online learning tools now became popular: The sudden shift from in-person classes to online only was not smooth. We have seen courses removing sections from the syllabus, courses cancelling final assessments, and some courses cancelling all remaining classes and assessments. While almost all universities in Canada has announced cancellation of in-person classes, universities are researching on how to deliver the classes remotely and effectively. The online instructing tools such as video conferencing, online learning tools are having an increasing demand.

The transition to online courses has also brought in marketing opportunities for online learning platforms. These online learning tools are seizing this opportunity to increase their market share. Let's take Coursera, an online learning platform as an example. Coursera has decided to offer free access for University Students is available to current undergraduate and graduate students with a verified college or university email address [18]. Another example is Byju's online learning platform. Since announcing free live classes on its Think and Learn app, BYJU's has seen a 200% increase in the number of new students using its product, according to Mrinal Mohit, the company's Chief Operating Officer [19].

4) Remote learning has increased the demand for upgrades of IT infrastructure: As online learning requires quick and stable internet connection, and a significant number of students

who are not able to come to Canada have to access the university's system remotely, the universities in Canada began looking at solutions to enable fast and reliable access from overseas. Institutions like University of Toronto and University of Waterloo have purchased service from Alibaba Cloud Enterprise Network which is located in China, to allow fast, reliable and consistent connection to the university's learning tools.

C. Impact on the Accommodation and Food Services

The direct impact of pandemic to the accommodation and food service can be seen on the labor force market. From Feb to Mar, the labor force market of accommodation and food service industry experienced a plummet of 24% while the total number of cases rocketing to 569 times higher ([20]).

One of the sectors that faced a big recession is the hotel industry – the commercial building. Not to mention the panic that is caused by pandemic which certainly cuts down the desire for travelling across cities, the measure for the travel restriction already act as an absolute prohibition for leisure tourism, business travel and some exchange program. This status can easily be substantiated by data of occupation which should be approximately 73.7% normally according to the data in 2019, the statistics during pandemic, however, shows a dramatic decrease to 10% in March and an upswing to 38.8% in August after the alleviation of cases and release of measure [21].

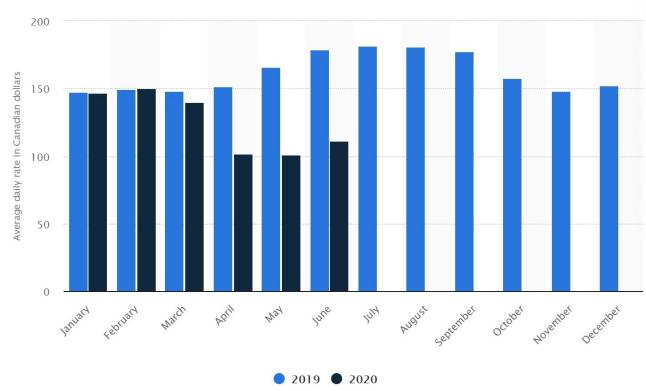


Fig. 5. Monthly occupancy rate of hotels in Canada from 2019 to 2020. [22]

Especially for the small, median size hotel businesses-owned by single family-which occupy 87% of the whole hotel industry in Canada, it is facing a lock down and will instantly bankrupt due to lack of liquidity of cash flow. Even for the large company with adequate cash flow, it cannot get rid of the situation that the pandemic will induce to the lack of confidence from their insurance company and refuse to provide next year's insurance under this circumstance due to large uncertainty of future profit. It is definitely not realistic and circumspect to continuously run a company without commercial insurance [23].

Notwithstanding the pandemic situation is gradually controlled, the influence to the hotel industry is long-term since the supply chain of the hotel industry is destroyed caused by the reduction of customers in the short term. It is a formidable task to recover it to normal status.

As we turned our sight to residential building, the price of residential building slumps as a result of the change of demand. The statistics indicated a 29% reduction in 2020-Q2 on the residential sales activity compared to the same period of time in 2019 mainly caused by unemployment and indoor restrictions that reduces this relatively unnecessary expenditure. However, as the propulsion of stage of Canada's policy to this propulsion, it presents a completely inconsistent feedback with hotel industry. The residential housing market returns an immediate reaction that the residential sales activity surprisingly has a 36% increase in July relative to 2019, which is even a larger proportion if contrasted to its pullback, explained by retaliatory consumption [24].



Fig. 6. National Residential Statistics I. [24]

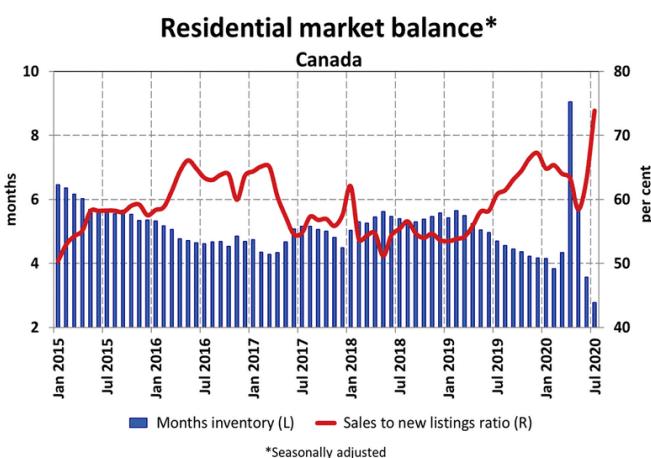


Fig. 7. National Residential Statistics II. [24]

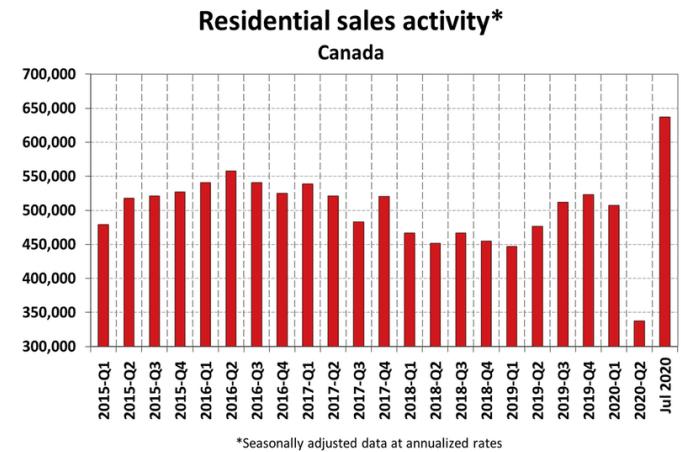


Fig. 8. National Residential Statistics III. [24]

The recession of accommodation market is definitely affected by demand side of the market while the food service market shows a worsening situation on supply side during pandemic. Food service, as a necessity of daily life, is unlikely to face a loss of demand in spite of the pandemic. But during this special circumstance, the life style of people change to stay at home and order food deliveries instead of dining in restaurant and bars. Except for the rental expenditure that is consistent as before, the labour force and transportation expenditure for delivery is extra needed which decrease their profit even if their revenue remains unchanged. The lack of experience on this kind of pattern gives rise to lower quality and efficiency with same amount of demand. This will force those companies to provide promotion in order to maintain their competitiveness. All these compulsory changes will further worsen their profit affected by cut-down of income and surge of expenditure.

III. IMPACTS ON THE FINANCIAL MARKET

The financial market, as an indicator of a country or a part of world's financial and economic situation, is a "must-examine" component when conducting analysis on the economic impact of COVID-19. This section of the report will analyze how the financial market is impacted by COVID-19 from three perspectives: the empirical changes in the financial markets that are directly observable from indices, the potential effects of government policies against COVID-19 on the financial markets, and how the variations in the investors' sentiments during the pandemic affect the financial markets.

A. Stock Market Impact

During COVID-19's outbreak across the world, stock markets have various responses. Some are very immediate affects where we can see rapid changes in the price, while others are more influential to the whole stock market in long run. First, we made a Tableau visualization pack to overview the impact of COVID-19 on stock market by country. An overview is



Fig. 9. North America: United States, S&P (Source:Yahoo Finance)

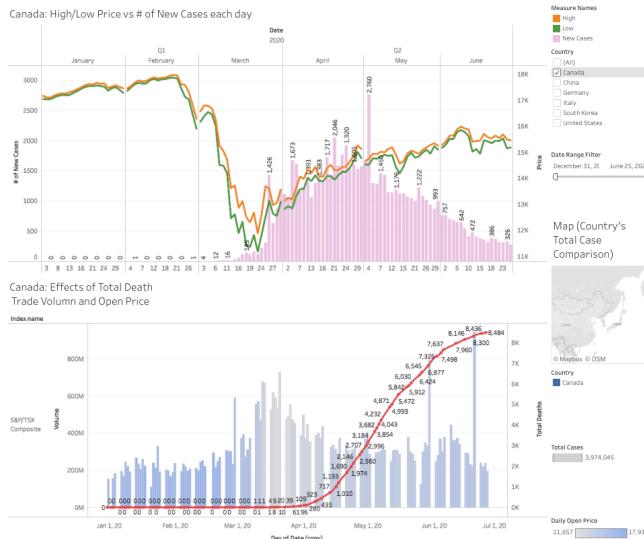


Fig. 10. North America: Canada, S&P/TSX Composite (Source: Yahoo Finance)

available in following graphs by countries on the following page.

We pick the most representative stock index for each country and observe the changes in price through the pandemic time. One of the common observations is that the stock index price tends to decrease by a large amount at the beginning of the outbreak. This could be caused by the sudden changes in the government policy like lockdown. Because of these reasons, lots of business faced unexpected difficulties, causing the rapid decline in the stock market.

For example, US faced several challenging times in March when the trading curb frequently occurs. A more detailed visualization on NASDAQ Index is available here(Source:Yahoo Finance). Similar situations happened in Canada and South



Fig. 11. Asia: China, CSI300 (Source: Huibo Terminal)

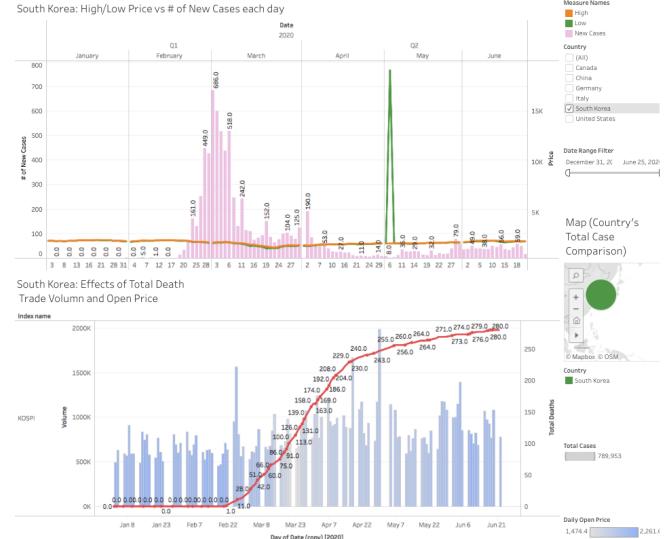


Fig. 12. Asia: South Korea, KOSPI (Source: Yahoo Finance)

Korea—a huge decline in stock values when the first few cases appeared, but then a slow recover in the following few months. However, China encountered the rapid decline twice, in January and March, although China was under good control of stopping the COVID-19 spread. Since there are lots of imports and exports in China, the decline in March may be caused by closed trading with other countries. A more detailed analysis in the stock market performance in China is available by investigating the HUSHEN300 index.

In China, the stock market performance in financial crisis 2008 is still the worst in past two decades. We can see the implication from both volatility and price changes. In another perspective, this also shows strict government control can help mitigate the hit and simulate financial recovery.

Furthermore, countries like Italy are suffering significant

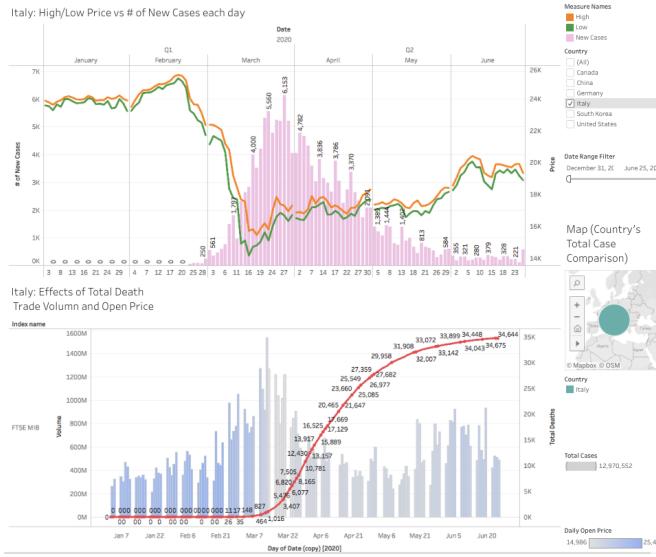


Fig. 13. Europe: Italy, FTSE MIB (Source: Yahoo Finance)

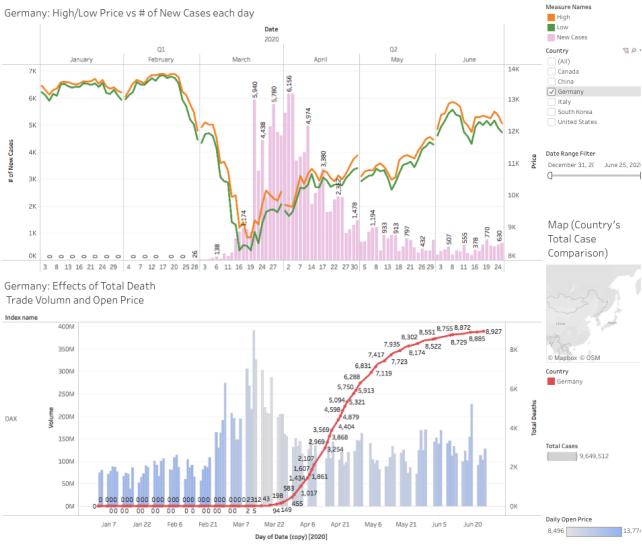


Fig. 14. Europe: Germany, DAX (Source: Yahoo Finance)

economic losses. We can see that even after the peaks of increasing cases, its market value is still low in May and June compared to the situation before COVID-19. Some politics reasons may also affect Italy's financial recovery.

We have never met such powerful financial strike caused by infectious diseases in last centuries. Some studies like [25] point out that this COVID-19 pandemic is different than previous disease outbreaks including Spanish Flu, SARS, and Ebola.

“Government restrictions on commercial activity in response to COVID-19 are more stringent, broader in scope, more widespread, and lengthier in duration than policy responses to the Spanish Flu and completely unlike the governmental response to the 1957–1958 and 1968 influenza

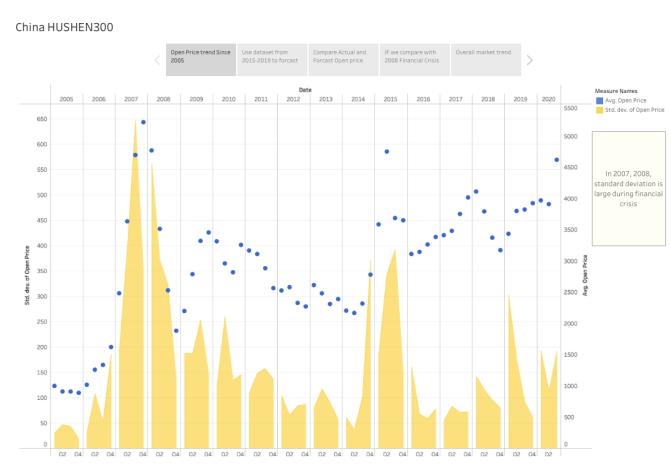


Fig. 15. China HUSHEN300: Overview from past 15 years. High volatility usually reflects the market situation

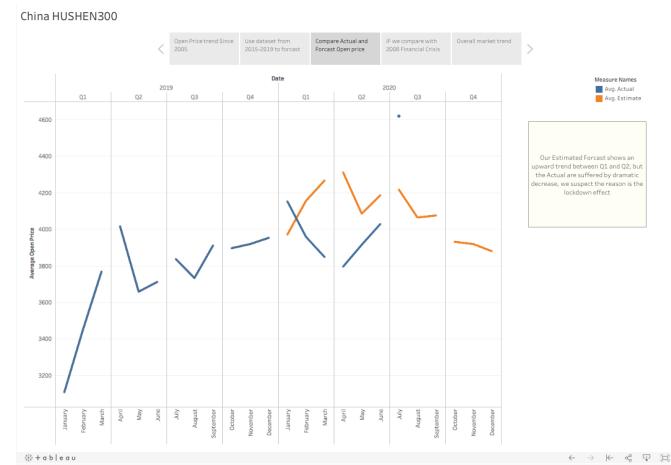


Fig. 16. As showed in the picture, using prediction method, the orange line gives us positive price trends in early 2020. However, due to COVID-19, the actual index value is much lower than expected.

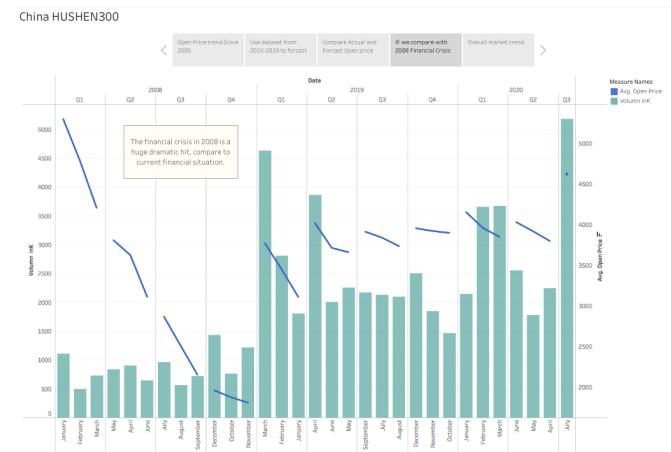


Fig. 17. 2020 Compare to 2008

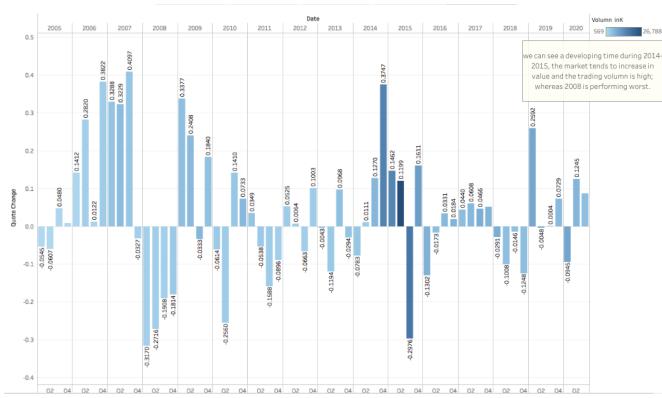
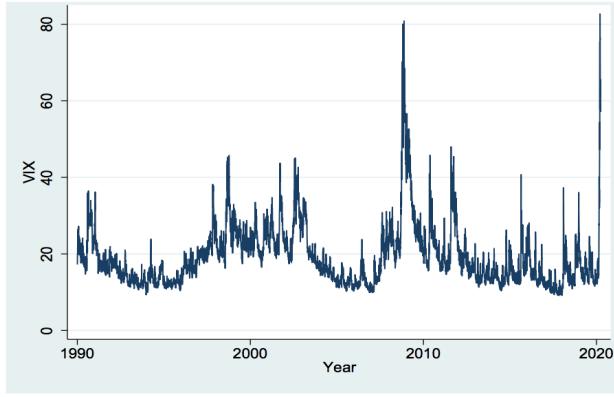


Fig. 18. Daily Quote Change

Figure 1: VIX, Implied Stock Returns Volatility, Daily Since 1990



Notes: Daily implied volatility (over the next month) on the S&P500 index from the Chicago Board of Options Exchange, expressed in annualized units. We plot data from 2 January 1990 to 31 March 2020. Values downloaded from: <https://fred.stlouisfed.org/series/VIXCLS>

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Fig. 19. Source: [27]

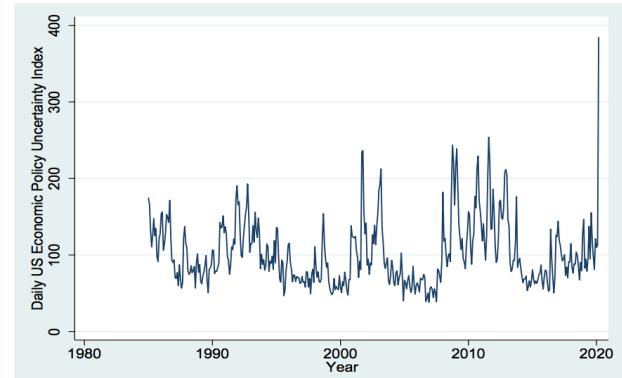
pandemics.”

However, it does not necessarily mean the COVID-19 pandemic only has negative impact on stock market. There are some positive aspects about stock market index. According to [26], by using regression and hypothesis testing, Elasticity of stock market responds to cumulative confirmed COVID-19 cases is approximately -0.028. since the elasticity is less than 1, it means the stock market performance is relatively inelastic. And they proved statistically that the estimated elasticity does not depends on the choice of model. This indicates that current pandemic may have adverse effects on stock market, and it will likely recover in the near future. Investors should not be too panic about current “financial crisis”.

Meanwhile, we should also consider the (economic) uncertainty of stock market in this unexpected situation. We will analysis this by observing the volatility changes through the pandemic.

According to Baker et.al (2020), We saw a significant peak of volatility index (VIX) in 2020, even in a higher fluctuation

Figure 2: U.S. Economic Policy Uncertainty Index, Monthly Averages of Daily Index Values, January 1985 to March 2020



Notes: Daily index values downloaded from www.policyuncertainty.com/media/All_Daily_Policy_Data.csv. See Baker, Bloom and Davis (2016) for details of index construction. We plot data from 1 January 1985 to 31 March 2020.

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Fig. 20. Source: [27]

level than 2008’s financial crisis [27] . The COVID-19 pandemic affected VIX to be increased about 500% from January to March. Similar observation shows in U.S. Economic Policy Uncertainty index, there is an extreme increase in 2020, from 100 in January to 400 in March. This increase is the first time in the history, in such big scale and also in such short period. These two graphs reflect how quick and tremendous COVID-shock induces financial uncertainty and volatility.

Some people argue that such powerful stock market effects are due to the large scale of spread of disease, since we haven’t encounter serious challenge in public health for decades. This is definitely part of the reason that caused such losses, however, Baker et.al (2020) [25] points out that the disease itself is not a complete answer:

“The excess mortality rate in the United States during the Spanish Flu pandemic was 14 times as large as the excess mortality rate to date (as of June 23, 2020) during the COVID-19 pandemic. Nevertheless, the Spanish Flu triggered not a single daily stock market move of 2.5% or more, while developments related to COVID-19 triggered two dozen such jumps.”

Beside health aspect, Baker et.al (2020) [25] explained part of the reason is due to the flow of goods and rapid information spread. The style of modern economy is in a sense of global village. Comparing to a century ago, now our trading is all connected, country by country, we are heavily dependent on transportation like airlines. However, current pandemic largely affected the normal operations of transportation industry. Many countries implemented strict travel policies. If we relate this to the timeline of government travel policy, we indeed saw that stock market were under big hit when restrictions were in force. Stock trading partially reply on the information asymmetry. Since we are living in a data driven world where people can easily access to large amount of information, but back in the time of Spanish flu, or even more recent in

SARS (2003), we don't have such immediate communication speed. This barrier at that time actually help us mitigate the stock market volatility. Now in 2020, we saw that COVID-19 triggered high volatility and frequent daily jumps.

B. Government Interventions

The financial crisis caused by COVID-19, unlike other usual crises, requires more complicated and careful regulation from the government due to its broad impact on virtually all aspects of the public life – social, economic and political activities. This section of the report will focus on analyzing the government interventions during COVID-19 crisis from three aspects – government support, social distancing measures, and healthcare policies, together with their potential effects on the financial markets [28].

1) *Government Support:* On March 15, 2020, the Federal Reserve announced that they would inject around 70 billion U.S. dollars into the economy by a policy known as “quantitative easing (QE)”, a common and typical type of government support during a financial crisis to stimulate market activities. The cash flow injection is usually achieved by government debt bonds and securities purchases [29]. Under this policy, consumer spending is encouraged and firms and companies are encouraged to operate and make investment decisions as usual or even with an ease. Although it appears that the stimulating government policies can, in all ways, energize the firms and market during the pandemic, the actual effect of this economic support is more subtle and complicated to observe.

Unlike the financial crisis in 2008, the financial crisis caused by COVID-19 should be categorized as one caused by natural disasters, which requires a period of “self-recovery”. A metaphor for this is when a person catches flu, the medicine from a doctor could only treat the symptoms but the person needs to endure several days to recover by him/herself. That means investors expect a period of time, usually one to two years for a pandemic, in which suspension or hibernation of the economy is inevitable no matter what government measures are taken. Thus, during this “self-recovery” period, the government support will not have significant short-term effect as the investors automatically assume government support and discount the support against the objectively difficult financial present. The current stock market already reflects, at least partially if not completely, government support even before the exact measures are announced. This opinion is supported by the research findings from Gormsen and Koijen [30]. In their research, it is shown that news about government support programs raised long-term company growth expectations but had little stimulating effect in improving short-term growth expectations. However, the government help should not be undermined because it indeed protects the market by decreasing risk aversion and reassuring investor by fulfilling their expectations of government support, but the exact extent to which the protection takes effect is hard to determine.

2) *Social Distancing Measures:* Unlike government support's effect, social distancing measures have been uniformly shown by researchers to have a direct negative effect on stock

market returns. Ashraf [28] produced a model which includes a stringency index to describe social distancing measures information—a higher stringency index implies more strict measures. The model results indicate that corporate returns on average decline when social distancing measures increase. Similar results are derived by Eleftheriou and Patsoulis [31] when they investigate the impact of governments' social distancing measures using forty five major stock market indices. Hence, it is very clear that a negative relationship exists between enforcing social distancing measures and negative stock returns, which also strengthens as the measure stringency increases. However, it is also found that the negative returns in the stock market are also strongly correlated with COVID-19 outbreaks in Ashraf's research [28]. Hence, as one of the most effective ways to control outbreaks, social distancing measures are necessary to return the economy to normal as soon as possible, even though it brings about inevitable financial sacrifices.

3) *Healthcare Policies:* Apart from social distancing measures, governments also implemented healthcare policies to facilitate the detection, precaution, and treatment of COVID-19 infections. These may include public campaign to raise awareness, testing services policies, and public contact tracing information [28]. Among them, contact tracing is identified as the most effective stimulus for the stock market [32]. The belief that contact tracing together with self-isolation can effectively control the COVID-19 quickly injected optimism into the stock market which contributes to a quicker market revival. However, one complication is that it is hard to disentangle the overall effect and ascribe positive or negative part solely to individual policies because the stock market represents the overall expectations from investors, and policies usually work together—for example, healthcare policies are used together with social distancing measures. Whether or not the financial market is actually positively or negatively impacted depends largely on investors' beliefs. Hence, besides simply announcing new policies that experts believe will be beneficial to the economy and the market, campaigning for the policy and convincing the public of its effectiveness is also a necessary step for the government to take to protect the market in full effect.

C. Investor Sentiments

It is for certain that COVID-19 has had great impacts on people's wealth and investment, ranging from affecting investors' income, investor sentiments to the whole investment industry. This section of the report will focus on summarizing the main findings of researchers who have been trying to identify the impacts of COVID-19 on people's wealth and investment.

1) *People's Income and Financial Status:* A recent survey conducted by Betterment [33] in April 2020, focused on 5400 American investors, states that COVID-19 has had an immediate impact on investors' financial security and confidence. More than half (54%) of all respondents had their income directly impacted by COVID-19 and three-quarters mentioned

that they are at least somewhat more stressed due to COVID-19 in terms of their financial position and status. 34% of them said that they did not have sufficient saving or emergency fund when COVID-19 began (i.e. three to six months of expenses in savings built up). Betterment, and most of other financial advisors, recommend having at least three months' of expenses saved in case any emergency takes place. A good deal of unease around the pandemic stems from the unknown, and the inability to plan for the next. Most investors reported some form of increased uncertainty in their financial situation: more than half (52%) of respondents believed they would need to tap into their long-term savings in a year or less, and 43% believed it would take six months or longer to recover their finances from the financial impacts brought about by the pandemic. As a direct result of COVID-19, 18% of respondents have stopped saving and 21% have withdrawn from their savings accounts to cover regular expenses. Overall, the report published by Betterment is consistent with some other sources, asserting that COVID-19 does have a strong impact on people's income and financial status.

2) Investor's Behaviour: Different investors have different aims and thoughts. Focusing on the same report published by Betterment [33], among people they interviewed, 20% took money out of the market in mid-March to mid-April. Among those people, 48% said that they would only reinvest when the market either was fully corrected or began to correct while 39% said that they would reinvest when they were financially secure again. As investors seek to diversify their risks, many are moving towards assets that are perceived as safer, such as US Treasuries and gold. Gold is often turned to in periods of economic instability. Amid the current crisis, demand has gone up to levels last seen in the months immediately following the financial crash of 2008. Although governments and central banks have put in efforts to simulate the stock market, investors' attitudes are still, understandably, being influenced by the risks caused by COVID-19. However, for some investors and traders, they seek to profit in the volatile markets. This point is supported by the surging need of opening new accounts. As new and existing investors both looking to make the most out of the volatile markets, they are trading at unprecedented rates. Some platforms have been unable to keep up with that demand. [FROM HERE] A well-known example is that Robinhood suffered several days of outages in early March which saw furious customers demanding compensation as they missed out on making trades [34]. Thus, no clear conclusion has been derived regarding how general investor sentiments changed during COVID-19 since there are always different types of investors in the market.

3) Effect on Investment Management Industry: The whole industry also faces some challenges as well as changes due to COVID-19. For example, some brokers still send paper order forms for share sales or purchases, while many fund and pension providers use paper forms to process fund transfers. As remote working becomes the norm, those investment firms are unable to deal with these bits of paper. Security protocols

Age Group	January 2020 Labour Force	Number of unique CERB Applications	Percentage of Labour Force Applied for CERB (%)
15 – 24	2,822,500	1,568,250	55.56244464
25 – 55	13,049,300	5,242,300	40.1730361
55 –	4,205,600	1,843,980	43.84582461

TABLE I
CANADIAN LABOUR FORCE IN JAN. 2020 AND NUMBER OF UNIQUE CERB APPLICATIONS AS OF AUG. 23, 2020.

do not allow them to be sent to an employee's house. Even if they did, employees may not want to handle large volumes of correspondence that others have touched. In addition, many negotiations between advisors and clients were held face to face. However, due to COVID-19, everything turned online. Clients who need advice will not be happy with a phone call unless it is with their personal advisor, something that individual advisors' lack of capacity makes highly unlikely [34]. Due to those challenges, firms are seeking ways to adapt to the situation. For example, developing more efficient and convenient online systems to store important documents is one of the potential changes, which may be retained by the firm even after COVID-19.

IV. IMPACTS ON THE LABOUR MARKET

13.7%, the Canadian unemployment rate reached a number that had never seen since labour statics became available in 1976. The total unemployment grew by 1,285,000 (+113.3%) from February to April, among which 97% of the newly unemployed were on temporary layoff. The scale of drop in employment was almost 3 millions in March and April. Among those who were still employed, there were over 2.5 million who were working $\leq 50\%$ of regular working hours due to COVID-19 from February and April.

The government of Canada has launched an Canada Emergency Response Benefit to support those who have involuntarily stopped working because of reasons related to COVID-19 or are eligible for Employment Insurance regular or sickness benefits or have exhausted their Employment Insurance regular benefits or Employment Insurance fishing benefits between December 29, 2019 and October 3, 2020. [35] According to Canada Revenue Agency, the Government of Canada has received 24.43 million applications from 8.66 million unique applicants. [36] This number suggests that at least 8.66 million of the labour force, at one point, involuntarily stopped working because of COVID-19, which represents approximately 43% of the labour force.

These figures are suggesting that COVID-19 has a huge impact on the labour market.

A. Decrease in Labour Force

Health is the top concern for the people. The spread of SARS-CoV-2 is threatening public health. Until the end of August, we are still seeing many new cases being reported by public health agencies in Canada. The public understands that continuing working may not be safe, and the numbers speak

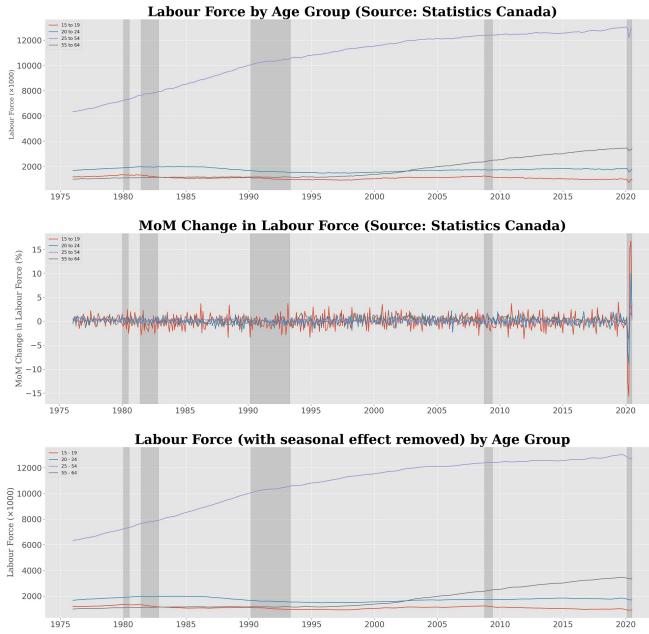


Fig. 21. From top to bottom: Labour force for different age groups in Canada; Month-over-Month change in labour force for different age groups in Canada; labour force for different age groups in Canada (With seasonal effect removed). Source: Statistics Canada. The five shaded periods are respectively for the 1980 Recessions, 1981/1982 Recessions, 1990/1992 Recessions, 2008/2009 Recessions, and the COVID-19 pandemic.

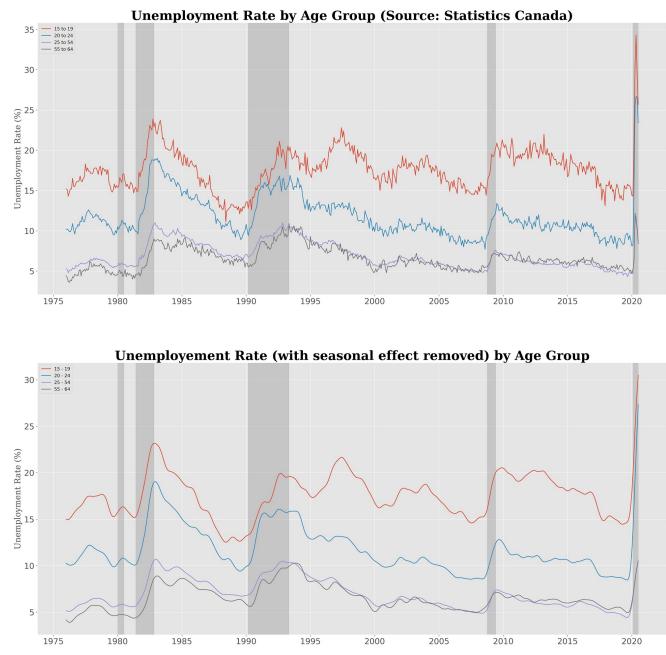


Fig. 23. From top to bottom: Unemployment rate for different age groups in Canada; Unemployment Rate for different age groups in Canada (With seasonal effect removed). Source: Statistics Canada. The five shaded periods are respectively for the 1980 Recessions, 1981/1982 Recessions, 1990/1992 Recessions, 2008/2009 Recessions, and the COVID-19 pandemic.

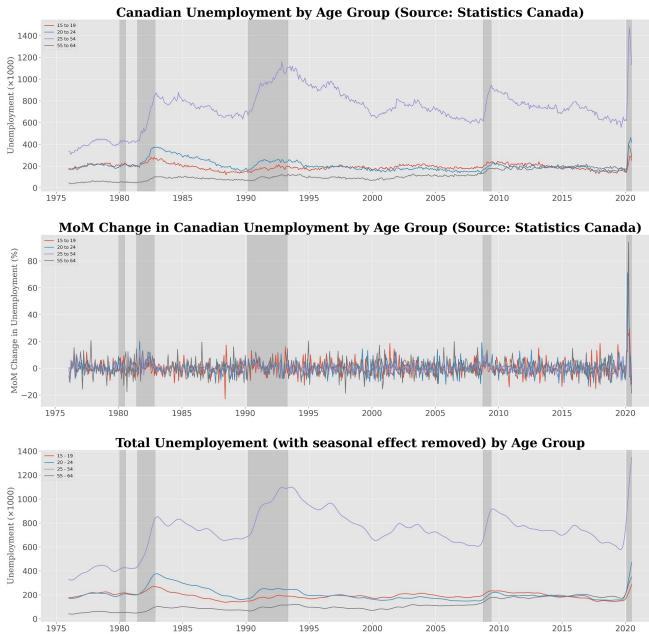


Fig. 22. From top to bottom: Total Unemployment for different age groups in Canada; Month-over-Month change in unemployment for different age groups in Canada; Unemployment for different age groups in Canada (With seasonal effect removed). Source: Statistics Canada. The five shaded periods are respectively for the 1980 Recessions, 1981/1982 Recessions, 1990/1992 Recessions, 2008/2009 Recessions, and the COVID-19 pandemic.

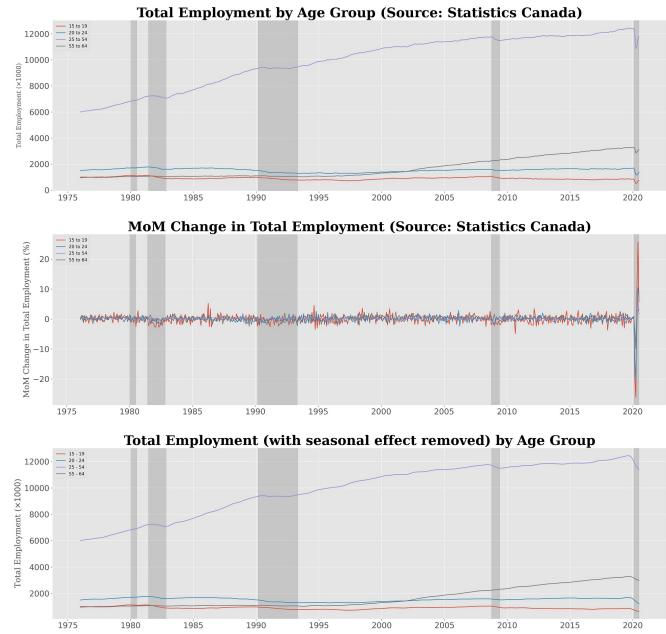


Fig. 24. From top to bottom: Number of employments for different age groups in Canada; Month-over-Month change in employment for different age groups in Canada; Number of employments for different age groups in Canada (With seasonal effect removed). Source: Statistics Canada. The five shaded periods are respectively for the 1980 Recessions, 1981/1982 Recessions, 1990/1992 Recessions, 2008/2009 Recessions, and the COVID-19 pandemic.

for people's concern. As reflected in Figure 21, the labour force, which consists of employment and unemployment¹, decreased by 8.4% (1,720,000) in March and April compared to the labour force in February 2020. During the week of April 12, 1.1 million people were not in the labour force but had worked recently (in March or April) and wanted to work. They were not counted as unemployed but were counted as not in the labour force because they did not look for work, presumably due to ongoing business closures and very limited opportunities to find new work. [37] Although we observed continuous growth in the labour force from May, such recovery pace is slow.

Data from the Canadian Perspective Survey Series indicates that close to 4 in 10 Canadians who had shifted to working from home or were absent from work during the week of June 9 did not feel safe in returning to their usual workplace. [38] A more recent study conducted by KPMG revealed that 72% of Canadians believe there will be a second wave in fall or winter 2020. Moreover, 94% of Canadians think that COVID-19 is far from over. [39] For this reason, many who aim for a long-term full-time job still hesitate to join the labour force. Additionally, financial relief programmes provided by financial institutions, some policies carried out by the government such as Rent Deferral and Forgiveness Policy, as well as CERB payments with \$2,000 every four weeks, are providing ways for people to receive some income and live at a lower cost. These factors are contributing to the slow recovery of the labour force.

Canadian immigration slowed after travel restrictions came into effect. Immigration is an integral part of the Canadian labour force. In Toronto, Canada's financial hub, a census conducted by Statistics Canada in 2016 shows that new immigrants constitute 46.1% of its population, 13.2% of which are new immigrants. [40] With travel restrictions in place, many potential newcomers upended their plan for temporary work, study as an international student, or immigrate to Canada. The landing immigrants in Canada is 34,000 in the second quarter of 2020, with a year-over-year (YoY) decline of 67%. The study permit being processed was just over 10,000, down from 107,000 a year before. [41] This may also be a contributing factor to the slow recovery of the labour force.

Number of Applications ($\times 1,000$)	2019	2020
January	21.1	30.5
February	17.8	25.9
March	21.2	18.6
April	33.2	3.8
May	34.7	3.4
June	39.2	3.3

TABLE II

NUMBER OF NEW STUDY PERMIT APPLICATION BEING PROCESSED.
(SOURCE: IMMIGRATION, REFUGEE AND CITIZENSHIP CANADA; RBC ECONOMICS)

Many other government policies are impacting the participation in the labour force as well. A study by the Royal Bank

¹Unemployment refers to people who do have a paid job and have looked for one in the past four weeks.

of Canada found that COVID-19 contributed to the lowest participation in labour forces in the past three decades. All public schools in Canada have been shut down to control the spread of the virus. A high degree of uncertainty regarding structure of school reopening is impacting people's decision on whether to join the labour force. Employment among women with toddlers, or school-aged children fell 7% between February and May compared to a decline of 4% among fathers of children the same age. Single mothers were even more significantly impacted, with employment among this cohort (with a toddler or school-aged child) down 12% from February to June (compared to a 7% decline among single fathers) [42].

B. Decline in Employment, and Increase in Unemployment

As a measure to control the spread of the disease, the government ordered the closure of non-essential businesses following guidance from public health administrations. The closure of many businesses implicates decrease in the demand for labour, in particular part-time employment, and consequently, a drop in employment. As shown in Table III, 45.2% of the Canadian business have reported layoffs to staff and laid off 80% or more of their work forces according to March labour force survey by Statistics Canada. A layoff tracker by *The Logic* shows that at least 156,417 workers with 171 employers have lost their job due to their employer's layoff plan.

Industry	%
All sectors	45.2
Agriculture, forestry, fishing and hunting	23.6
Mining, quarrying, and oil and gas extraction	26.9
Utilities	26.7
Construction	41.6
Manufacturing	29.4
Wholesale trade	24.6
Retail trade	51.2
Transportation and warehousing	19.3
Information and cultural industries	19.2
Finance and insurance	12.4
Real estate and rental and leasing	19.3
Professional, scientific and technical services	24.6
Management of companies and enterprises	21.9
Administrative and support, waste management and remediation services	18.6
Educational services	46.4
Health care and social assistance	64.2
Arts, entertainment and recreation	61.7
Accommodation and food services	69.0
Other services (except public administration)	46.3
Public administration	16.6

TABLE III
PERCENTAGE OF BUSINESSES THAT REPORTED LAYOFFS TO STAFF AND LAID OFF 80% OR MORE OF THEIR WORKFORCE, BY SECTOR, CANADA, MARCH 2020 (SOURCE: STATISTICS CANADA)

According to Statistics Canada, in May 2020, more than one-third (34.8%) of the potential labour force was fully or partially underutilized, down slightly from 36.6% in April, but considerably higher than the 11.9% observed in February. The underutilization rate in May 2020 was 51.8% for youth aged 15 to 24; 31.3% for people in the core working ages of



Fig. 25. The number of full-time and part-time employments over the past 24 months in Canada. Until July 2020, the labour market is still running under the “normal curve”. (Source: Statistics Canada)

25 to 54; and 35.0% for people aged 55 and older. [43] The underutilization rate went down notably to 26.9% in June and 22.2% in July [38], [44], although it is substantially higher than the level before the pandemic. The “labour underutilization rate” combines those who were unemployed; those who were not in the labour force but who wanted a job and did not look for one; and those who were employed but worked less than half of their usual hours. While this is an indication that labour recovering is occurring, the fact is that the average working hours being far from usual is alerting.

The concern of having a second wave of COVID-19 cases in fall or winter has also impacted demand for long-term full-time employment. Statistics, as shown in Figure 25, shows that Canadian jobs’ recovery has been led by part-time work. The increase in full-time employment in Canada from June to July is 0.5%, which is significantly lower than that in part-time employment which is 11.3%. In July 2020, 29.7% of those working less than 30 hours per week would have preferred full-time work (not seasonally adjusted). This level is 7.6 percentage higher than July 2019 [44]. This result indicates that the many in the labour market are employed with reduced working hours, which as a result, leads to a drop in personal income, and agrees with the lower demand for labour work.

C. Impacts On Youth (Age 15 to 24)

As an increasing number of researches suggest the existence of the long-term and substantial effect of initial labour market conditions on the college/university graduates, Oreopoulos et al researched to examine the consequences of graduating in a recession sometime during the 1980s and 1990s. In which, they discovered that in the first year after graduation, earnings were about 10 – 15 percent less, on average, than peers who graduated when unemployment rates were 3 – 4 percentage points lower [45].

As Figure 24 suggests, the decline in employment since February 2020 exceeds any observed declines in previous labour market downturns (–15.7%). The employment for youth in particular, declined by 873,000 from February 2020 level of 2,553,000, which is a 34.2% plunge over 2 months. The unemployment rate increased to 31.7% among students aged 15 to 24 in April. And so far, we have not seen a

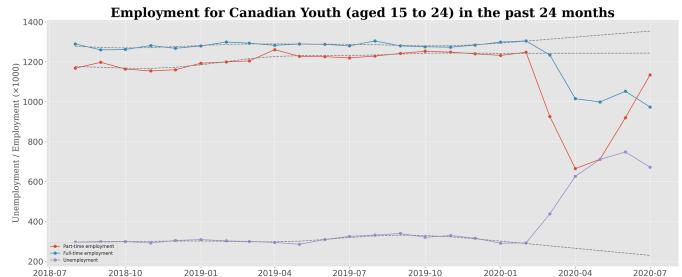


Fig. 26. The number of full-time and part-time employments for youth (aged 15 to 24) over the past 24 months in Canada. Youth employment grows in July but remains far below pre-COVID levels. (Source: Statistics Canada)

upward trend in full-time employment for youth. “There’s no sugar-coating that many will be unable to find full-time work after finishing high school or completing a postsecondary program”, mentioned Professor Phillip Oreopoulos, Professor of Economics at the University of Toronto, in his letter to this year’s university graduates [46]. The magnitude and speed of such decline were unprecedented. And shockingly, the number of unemployed youth increased by 155.9% between February and June, 2020.

From Table I, the number of CERB applicants from 15 – 24 age group is 1,568,250 as of Aug. 23, 2020, which is equivalent to the 55.56% of the labour force between 15 – 24 years of age in January 2020. This percentage is significantly higher than that of the other age groups. The Government of Canada is also providing financial support to post-secondary students, and recent post-secondary and high school graduates who are unable to find work due to COVID-19 through its Canada Emergency Student Benefit. This implicates that the number of people from youth group being impacted by COVID-19 is greater than what we mentioned above. The Government of Canada has not published the statistics for CESB yet, but a supplementary questions added to the June Labour Force Survey indicate that 12.7% of youth aged 18 to 24 had received payments for the Canada Emergency Student Benefit (CESB) [38].

While we have found studies to predict effects of initial labour market conditions of college/university graduates, the current labour market conditions are significantly worse than those used to estimate past effects.

D. Statistics Show that the Impact on Different Industries are Different

As reflected in Figure 27,

- Forestry, fishing, mining, quarrying, oil and Gas;
- Agriculture; and
- Utilities

industries had minimal from goods producing sector, as well as

- Public administration;
- Finance, insurance, real estate, rental and leasing; and
- Professional, scientific and technical services

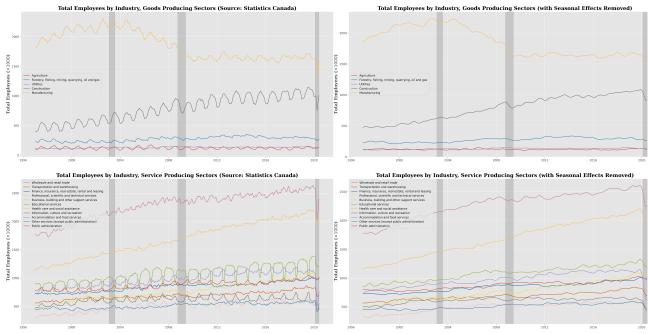


Fig. 27. The number of employees by industry. (Source: Statistics Canada)

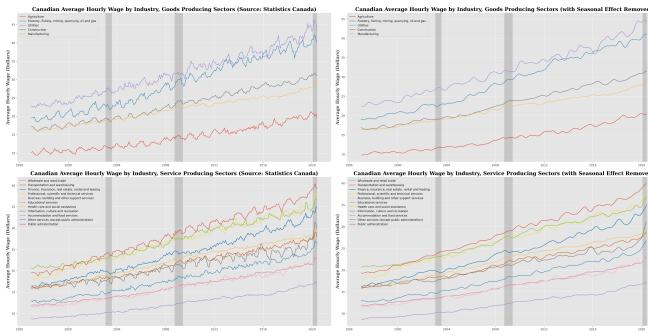


Fig. 28. The average hourly wage by industry. (Source: Statistics Canada)

from service producing sectors had minimal impact by COVID-19. It is not hard to see that the aforementioned six industries, in general, are considered as “essential” businesses or easy to transit to remote working environment.

Take agriculture as an example. The agriculture industry produces foods people consume everyday. The product produced by this industry have an inelastic demand.

Temporary Foreign Works ($\times 1000$)	2019	2020
January	3.7	3.7
February	3.5	3.3
March	5.9	3.1
April	12.1	11.5
May	7.2	6.9
June	8	7.3

TABLE IV
NUMBER OF FOREIGN WORKERS IN THE AGRICULTURE INDUSTRY.
(SOURCE: IMMIGRATION, REFUGEE AND CITIZENSHIP CANADA; RBC ECONOMICS)

As shown in Table IV, a large Year-over-Year decrease in temporary workers in March 2020 shows that the international travel restrictions affected seasonal labour when they were first implemented. With changes to some exemptions being introduced [47], and new measures being put in place for employers who seek to bring in workers through the temporary foreign worker programme, we saw that the flow of workers quickly turned back to the 2019 level, even though there are measures to safeguard the national health were still in place, causing inconvenience to workers.

As the domestic restrictions are easing, we are seeing industries from goods producing sectors having employments close to January 2020 level such as manufacturing and construction. Although with seasonal effect being removed, such number of employments is still smaller than normal. However, the industries from the service producing sectors are facing a much slower recovery. Industries that are either driven by tourism or have reduced capacity due to social distancing such as

- Wholesale and Retail Trade; and
- Accommodation and Food Services

are finding themselves particularly tough in recovery. The social distancing policy and international travel restrictions may not be fully lifted in the short-term. And with the high unemployment and lower-than-normal working hours, we can expect that demand for such leisure may take longer time to come back to pre-pandemic level.

E. Impact on Global Labour Market

1) *The Federative Republic of Brazil:* According to data from the Oxford Economics, Brazil's unemployment rate between March and May was 12.9 percent, which increased from 11.6 percent in the previous quarter [48]. According to the Brazilian Institute of Economics [49], the total number of Brazilian workers in May was 83.4 million, and 93.5 million for the same period in 2019, fell by 10.7 percent in one year. In May, Brazil's informal and formal employment decreased by 15.1 and 6.7 percent, respectively. Brazil experienced a recession from 2014 to 2016, when the informal labour market absorbed some of the unemployed workers in the formal labour market. Due to social isolation and shutdowns during this epidemic, the current informal labour market cannot absorb more unemployed people.

At the end of March, the Brazilian Government introduced an emergency subsidy scheme to provide 600 Brazilian reals per month for low-income families, informal workers and unemployed persons.

2) *The People's Republic of China:* Since the outbreak of the pandemic in March, China's employment has suffered some shocks. According to Statistic China [50], there were 2.29 million new jobs in cities and towns across the country from January to March. The number decreased by 0.95 million compare to last year. The data in March showed a slower trend of decrease. In March, the urban unemployment rate was 5.9 percent, dropped slightly from a month earlier. At the end of the first quarter, the registered unemployment rate in cities and towns was 3.66 percent, and the employment situation was more difficult than in previous years.

To recover the impact of unemployment, Chinese Premier Li encouraged and lead a wave of “Stall business.” Many cities started allowing people to set up roadside booths or food stalls on the street. For example, the cultural-ethical civilization committee office of Changchun, capital of Jilin province, announced that it would encourage and support the opening of night markets and temporarily lift a ban on roadside markets on May 30 [51]. Before then, the vendors had been banned in order to keep the public environment clean. From

this policy, the earnings could help to increase people's income and revive local economies.

In addition to this, unemployment insurance could be claimed online since April. The Chinese government also offered grants to small and medium business to recruit more new graduates.

3) *The Federal Republic of Germany*: Germany's 2020 unemployment rate increases by 0.66 percent from 2019. Germany applied short-time duty(Kurzarbeit) to save the economy every time they face an economic downturn or seasonal production swings. This time they used it during the coronavirus pandemic. According to Carolynn from Bloomberg [52], 470,000 companies applied for Kurzarbeit in March in 2020, suggesting that around 9 million employees, or 20 percent of the German workforce, were affected by the program so far. Compare that to 2019, when an average of 1,300 companies applied for support each month. She mentioned big companies including Volkswagen, BMW, Daimler, sports-apparel maker Puma and airline Lufthansa have said they plan to use the program. According to the data released by Germany's Federal Employment Agency [53], after the seasonal adjustment, the German labour market unemployment fell by 9000 people in August to 2.915 million. The German economy is in the recovery channel as of August, but the pandemic's impact on the country's labour market is still huge. Besides, the number of employees engaged in Kurzarbeit continued to decrease. The latest figures show that the number of German workers in short-term jobs in June was 5.36 million, down 460,000 from the previous month. More than 12 million applied for Kurzarbeit during the most severe financial crisis in 2009, only 3.3 million Germany workers used from March to June.

4) *The Republic of India*: India has a wide gap between the rich and the poor. The vast majority of the population is engaged in low-paid low-end jobs. The poor, who have little savings, have more burden on living and need to resume work. While the pandemic was not fully controlled, the risk to continue work maintained high. Before June 2020, India's daily new confirmed cases increased continuously over the days, reaching the highest among all countries. To avoid the pandemic's spread, India started lock-down on March 25, 2020, which increased the unemployment rate to nearly 30 percent. The economy began to recover in June, and the unemployment rate in June decreased from 23.5 percent to 11 percent.

5) *The Italian Republic*: Italy announced that Italy would enter a six-month state of emergency on January 31st to respond to the epidemic and started lock-down from March 10 to May 3.

According to Italian National Institute of Statistics [54], from February to May, the number of labour force decreased by about 0.5 million. As the Italian government began to loosen control of the pandemic from May 3, the unemployment fell to 84 thousand. The number of people who were actively seeking jobs increased by 0.3 million. Among the 0.3 million, 0.23 million are female.

While the epidemic has led to an increase in unemployment, Italy's agricultural sector is short of at least 350,000 workers in the picking season. The Italian government considers allowing about 600,000 illegal immigrants living in Italy to enter the labour market for agriculture and fishing. Italy's agriculture minister, Bellanova, said that the move would not only address the immediate needs of the agricultural sector but also help improve the living conditions of these migrants and control the epidemic.

6) *The Russian Federation*: On May 12, Russia ended its six-week national holiday shutdown. Russia's official registered unemployment was 1.4 million in May, double that of early April. While lifting the ban, Putin also stressed that the country's current priority is to reduce unemployment. The unemployment kept relatively constant compare to the other countries.

7) *The United Kingdom*.: As more companies laying off workers, employment in the UK dropped by nearly 650,000 (2.2 percent) since the outbreak of the pandemic in March, facing a larger wave of unemployment. According to a survey of 7400 companies, 29 percent of the companies claimed that they would continue to cut down more employees. From March to June, the UK saw its most significant drop in employment since 2009. The number of self-employed people has fallen sharply since the outbreak, while the number of employees has risen. According to the UK's Office for National Statistics, part of the reason is that workers reclassified themselves as employees [55]. According to HM Treasury's anticipation, the UK's unemployment rate would reach 12 percent before Christmas. In addition to the sharp increase in unemployment, British wages are also shrinking. The wages decreased by around 1.2 percent, achieving the highest in ten years.

As the pandemic outbreak in March, the UK government introduced "Corona-virus Job Retention Schem" to 75 million workers, which was a grant worth 80 percent of their average monthly profit to help them cope with the pandemic's financial impact [56]. The British government has also set £5 billion on infrastructure as start-up funds to recover the epidemic's mass unemployment and economic downturn.

8) *The United States of America*: In June, the number of permanent unemployed in the United States was close to 2.9 million, increased from 0.58 million in May, reaching a peak since early 2009. This reality fully reflects the systemic impact on the U.S. job market caused by the epidemic. 14 percent of the small businesses cut down all its employees, and 22 percent gave employees a paid leave.

According to the U.S. Economic Analysis Bureau, the per capita savings rate was only 7.6 percent at the end of 2018 [57]. In the past decade, the American people's savings rate has hovered between 3 and 9 percent, less than half of the world's per capita savings rate. During the epidemic, most of the residents' economic resistance was relatively weak.

At the end of March, the U.S. government implemented the "CAREs Act", which covered up to 2.2 trillion dollars to recover the U.S. economy [58]. In addition to the checks, the

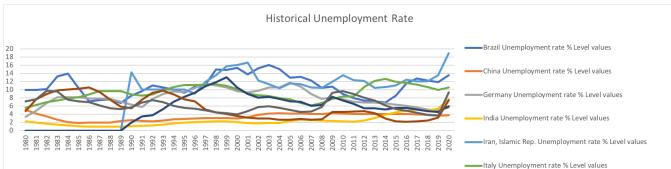


Fig. 29. Historical Unemployment Rate by Country (Source: Oxford Economics)

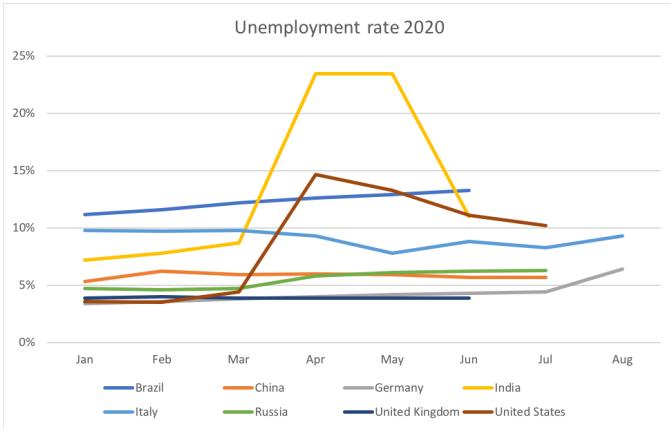


Fig. 30. 2020 Monthly Unemployment Rate by Country (Source: Trading Economics)

eligible citizens could receive unemployment compensation of 600 dollars every week. 68 percent of the unemployment beneficiaries received more money from the government than actual work before the epidemic. More than 35 million Americans have filed for unemployment benefits as records showed in the past few months. The U.S. government stopped giving away this benefit from July 31st.

V. IMPACTS ON THE SUPPLY CHAIN

COVID-19 has shifted the demand dramatically to various products, such as agriculture products and medical devices. Supply chain, being the link between the producers and the consumers, plays an important role during this special time period: it has to be managed well to make sure that vital supplies get into the hands of people who need them on time.

From the study on the bull whip effect, changes in demands due to a financial or health crisis can cause a larger change in order quantity upstream in the supply chain [59]. This can eventually bring disruptions to the supply chain at each stage, that is being said by Sam White, ‘ripple effects turn into a massive wave’ [60]. Attention and analysis are needed on the supply chain problems, because if any link in the chain is broken, the whole process will fail and influence people’s daily life. It has been proved that some of the major famine in the past years are caused by the disruptions in the agriculture supply chain instead of lack of productions in the food [61]. Further understanding of how the supply chain is affected

by public crises can help supply chain managers make wiser decisions in the future.

There are four essential aspects in the supply chain analysis, which are production, processing, retailing and consumer. Production can be largely affected by the global travel restriction if the factories have a large proportion of migrant workers [61]. The inventory and efficiency of the production firms are largely depended on the status of the processing firms: if the manufacturers downstream suspend their businesses due to the pandemic, it is likely to cause an overfill of the inventory, hence leading to inefficiencies, and vice versa. The processing businesses are affected by the change in order quantities from the retailers. The retailer businesses are largely limited by the government restrictions, while for industries such as medical products, the retailers are facing the conflict between the increase in demands from the public and the decrease in the supply from the manufacturers due to their business suspensions. Lastly, as discussed before, the demand from the consumers changes by the pandemic.

In order to securitise the supply chain problems, if any, from a quantitative perspective, data such as order value, inventory level, value of unfilled orders as well as ratio of inventories to shipments and unfilled orders will be analyzed by the team. Three countries, Canada, the US and China, are taken as examples to show the changes in relevant metrics caused by the pandemic. Comparisons between the consequences by COVID-19 and SARS, if applicable, will be made, as well as any impact on the supply chain by the financial crisis in 2008.

A. Canada

Canada, being the 10th largest economy in the world [62], has been largely influenced by the pandemic. The team will focus on Canada for analysis of the impact of supply chain. The data for new orders of the total manufacturing is shown in the Figure 31 below. It is clear that the value of new orders changed dramatically during these days (shown in grey on the right), as well as during the period of the global financial crisis (shown in yellow). The reason that the number of new orders decreased during the global financial crisis is that the whole economy was facing the Great Recession, hence the demand for all products decreased. The following subsections will focus on the impact of health crises on products manufactured in Canada. Areas such as medical products, food, and sanitary paper products are in the scope of the project.

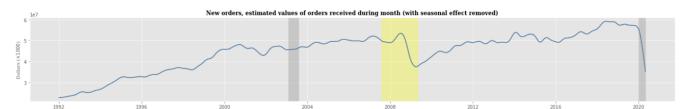


Fig. 31. New orders, estimated values of orders received during month (with seasonal effect removed) – Total Manufacturing [63]

1) Medical Products.: As appeared in the news all these days, COVID-19 increased the demand for medical products such as masks and ventilators, which are under the category of

medical equipment and supplies in North American Industry Classification System (NAICS). The team performed data analysis on the data available from the Statistics Canada. As shown in Figure 32 below, the new orders during the periods of SARS in 2003 showed an increasing trend, and the similar trend occurred for the past few months as the pandemic reached Canada. The seasonal effect was removed from the data. The rise in new orders was caused by the increase in the demand from the consumers as explained above.



Fig. 32. New orders, estimated values of orders received during month (with seasonal effect removed) – Medical products [63]

It is expected that the orders may not be filled when the order quantity increases. It is apparent from the news that the medical products have been at shortage since the pandemic, and the data, shown in Figure 33, is consistent with the phenomenon. However, the data for values of the unfilled orders during the SARS period in 2002 showed a relatively small increase. This can be contributed the fact that there were less than 10,000 positive cases for SARS, as compared to the worldwide total confirmed number of COVID-19 around 19,500,000 by August 8, 2020 [64]. Although it is stated by Healthline that the severity of SARS is higher than that of COVID-19, the pandemicity of COVID-19 is higher due to the easy transmission [65]. The demand of medical products has increased much more rapidly these days as compared to the past, by the fact that people are more aware of the serious situation thanks to the Internet development, as well as that COVID-19 seems to transmit more easily [65].



Fig. 33. Unfilled orders, estimated values of orders at end of month (with seasonal effect removed) – Medical products [63]

In order to find out the impact of government policy, if any, on the supply chain in Canada, the team took a close look at the data after March 2020. The Trudeau government had an announcement on March 20 that it would ‘redirect money to businesses that make medical supplies’ [66], the team believes that this policy has been well implemented and achieved its goal from the data on the Statistics Canada. The value of raw materials and work in process (WIP) increased from March to April, as seen in Table V below. It is also found that the number of finished goods didn’t increase, and it might due to the time needed to allocate resources and produce.

	March 2020	April 2020
Raw materials	301975.96738862	308283.37676011
WIP	74192.81187012	77306.27017463
Finished goods	128868.78978743	128674.66756305

TABLE V

ESTIMATED VALUES OF RAW MATERIALS, WORK IN PROCESS (WIP) AND FINISHED GOODS AT END OF MONTH (WITH SEASONAL EFFECT REMOVED)

2) *Food Products*.: Another product that the team is interested in is Food product. The data analyzed comprises productions of both food for human and animal consumptions, including subsectors such as grain and oil-seed milling, fruit and vegetable preserving, dairy product, meat product, seafood product and bakeries and tortilla manufacturing [67]. In general, it is expected that demand for food may increase because of the measure that asks individuals to limit non-essential travels, and people may store food at home to avoid potential shortage in the near future. However, in reality, there was a drop in the new orders for food products since COVID-19 was identified in Canada, as shown in Figure 34 below. As the demand decreased, there should be more products kept in stock, as proved from the change in the ratio of total inventory to sales in Figure 35. Similar increasing trend appeared in the corresponding ratio during the SARS period, but it is worth noticing that the ratio of total inventory to sales was larger than 1 these months, which indicates that there were more products in the inventory as compared to the number of sales. It is a signal of potential supply chain break down, because the inventory cost, consisting of 20 – 30 percent of total cost [68], can largely impact the liquidity of the company’s capital, and the efficiency of the production / manufacturing process.



Fig. 34. New orders, estimated values of orders received during month (with seasonal effect removed) – Food products [63]



Fig. 35. Ratio of total inventory to sales (with seasonal effect removed) – Food products [63]

The situation can be much worse if the food products, such as daily products, are perishable. Nowadays, schools, which are large consumers for milk, are closed, hence the team expects the demand for milk to decrease largely. The short-term impact is that there will be an overproduction of milk in the current market situation, hence likely to cause a stall in milk prices. In addition, as milk is perishable,

farmers/producers are forced to dump extra milk that is not sold as we commonly see in the news [69], and it can be considered as a huge waste. By taking a deep look at the data available (Figure 36 and 37 below), the team finds that there was a steep decrease in the dollar value of the sales of goods manufactured, and a similar downward trend appeared for the values of finished goods manufactured. While unexpectedly, the number of new orders for the dairy products was actually increasing these days, shown in Figure 38, probably due to the increasing needs for nutrition supplements. Although the team cannot make the conclusion on whether the demand for the dairy products has indeed increased or decreased in general, we still see the value of supply chain management in this case. To either avoid the waste if there is a surplus, or make sure the increase in demand is timely transmitted upstream in the supply chain, the supply chain manager should integrate the information of the demand by all means, and help plan customers' orders and delivery of the products.



Fig. 36. Finished goods manufactured, estimated values at end of month (with seasonal effect removed) – Dairy products [63]

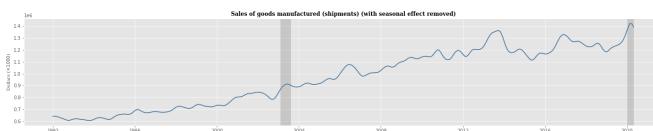


Fig. 37. Sales of goods manufactured (shipments) (with seasonal effect removed) – Dairy products [63]



Fig. 38. New orders, estimated values of orders received during month (with seasonal effect removed) – Dairy products [63]

During the period of SARS, there was an increase in the demand for and number manufactured of dairy products. As shown in Figure 39, there were almost no unfilled orders in 2003. It might be because the scale of production of dairy products is smaller than the current one, hence it was easier for the supplier to make reactions to the change in the demand at that time.



Fig. 39. Unfilled orders, estimated values of orders at end of month (with seasonal effect removed) – Dairy products [63]

3) Sanitary Paper Product.: The team is also interested in sanitary paper product, which is a necessity in people's daily life. The team anticipates there should be an increase in the number of new orders, and hence the number of unfilled orders may rise, especially under the situation when the supply chain is almost shut down. However, the data (Figure 40) showed a almost constant, even decreasing trend during the COVID-19 period, in the value of new orders for sanitary paper products during the periods of the two health crises. Similarly, there was almost no change in the values of unfilled orders, as indicated in Figure 41. However, the team does see a decrease in the value of total inventory and an increase in the sales (Figure 42 and 43) after the spread of the pandemic, which may indicate that some of the orders were fulfilled by the inventory. It is an early sign of the break in the supply chain, and if the suppliers don't have buffer inventory in hand, they may face the situation where they will eventually get out of stock. The worst situation is that some companies may have Just-In-Time (JIT) production control, which means the production is a reaction to the present demand, and when there is a huge change in demand, the companies may not be able to meet the requirements.



Fig. 40. New orders, estimated values of orders received during month (with seasonal effect removed) – Sanitary paper products [63]



Fig. 41. Unfilled orders, estimated values of orders at end of month (with seasonal effect removed) – Sanitary paper products [63]

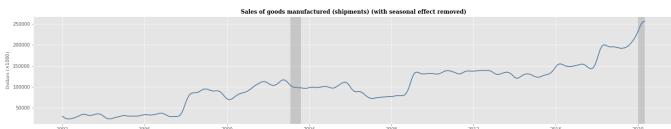


Fig. 42. Sales of goods manufactured (shipments) (with seasonal effect removed) – Sanitary paper products [63]



Fig. 43. Total inventory, estimated values of total inventory at end of the month (with seasonal effect removed) – Sanitary paper products [63]

B. The United States of America

Having almost 5 million people infected as of August 8, 2020 [64], another economy that is highly impacted by the pandemic is the US. Being the second leading country in the world on manufacturing outputs, the US supply chain is largely affected by the closing economies. Similar to the analysis done for the statistics of Canada, the team takes a look at the data from the United States Census Bureau [70]. The composition of industry categories used by the US Census Bureau is the same as that of the Statistics Canada, which is NAICS, making the two data sets more comparable to each other. The data on total manufacturing can be used to show a general trend in the change in the supply chain, as shown in Figure 44 below, the value of sales of goods manufactured slumped during the global financial crisis (shown in yellow) and these days due to the COVID-19 pandemic (shown in grey on the right).



Fig. 44. Sales of goods manufactured (shipments) (with seasonal effect removed) – Total Manufacturing [70]

It is interesting to see, similar to the case of Canada, that the financial crisis in 2008 caused a huge decrease in the total value of shipments. Online data showed that the largest decrease was in transportation equipment, with 42.3% drop in customer orders from 2008 to 2009 [71]. As demand changed dramatically during that period, the unforeseen drop in the number of new orders across numerous industries can cause severe consequences in supply chain. Seeing common phenomenon in Canada and the US, the team suspects that the financial crisis can indeed bring firms difficult time if they don't have a swift and decisive reactions in their supply chain management.

Similar products, which are pharmaceutical and medicine products, and food, are analyzed in order to compare the situations of the Canada and the US.

1) Medical Products.: There was no data available for medical equipment on the United States Census Bureau website. However, the news in the past few months have proven the shortage of medical equipment caused by the steep rise in the demand in response to the pandemic [72]. It was mentioned on Quartz that US ‘gets much of its mask supply from China’ [73], and hence the products available in the country highly depend on the supply from China. The available data indicates that the number of imports of masks from China to US plunged in March. Although the graph below (Figure 45) does not include the number of medical masks imported via air, this would still indicate that there was a shortage in masks in the US.

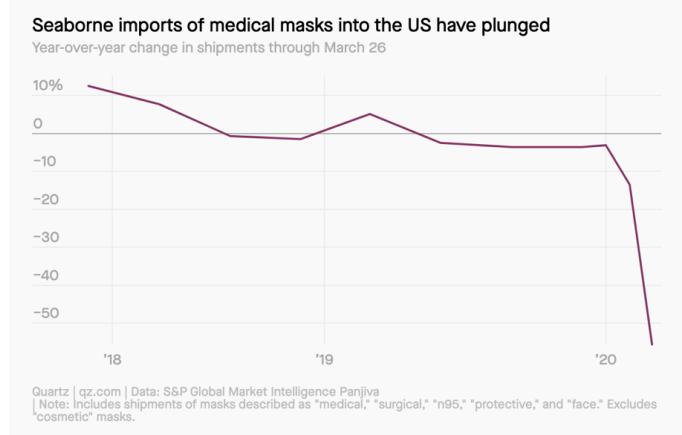


Fig. 45. Year-over-year Change in Shipment of Medical Masks into the US [73]

In order to fulfill the demand from both the healthcare workers and the general public, the US government has made various policies to encourage productions of the medical equipment and drugs. Back to March, the federal government promised to ‘buy all excess coronavirus masks’ [74]. As a medical equipment importer, there is a large uncertainty in the number of medical products available in the US. The US government realized this problem these days, and is working on bringing the pharmaceutical and medical supply chains back to home [75]. Over-reliance on other countries for supply of essential products can be dangerous, extremely in the situation of global crisis as it is now, and this is a good lesson learned from this pandemic regarding supply chain management.

The data for pharmaceutical and medicine manufacturing is available on the website. As it was mentioned in the news, Kodak was given a \$765 million loan from the federal government for drug productions in the US as a treatment to COVID-19 [76]. As the latest data available is for June, 2020, the impact of the federal government decisions on the loans was not reflected in the graph, but there was a consistent

increasing trend in the value of shipments in the medicine products. If there is no buffer inventory in store, the large increase in the number of orders may cause shortage and hence a disruption in the supply chain.

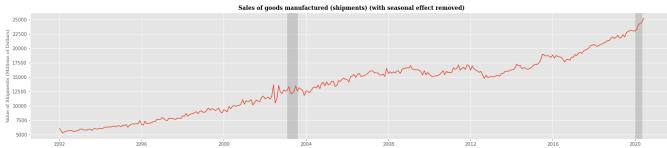


Fig. 46. Sales of goods manufactured (shipments) (with seasonal effect removed) –Pharmaceutical and medicine products

2) Food Products.: Food is a necessity in people's daily life. Therefore, the team expects there would be an increase in the demand, and hence shipments of the food products, in response to the quarantine rules. However, as shown in Figure 47, there was no conspicuous rise in the value of sales during the COVID-19 period, neither during the SARS period, which is consistent with the trend of Canada's statistic. Hence, it can be concluded that there is almost no change in food demand caused by the health crises.

Ratios between the inventory and shipments during the period from 1992 to present are shown in Figure 48. It shows very different patterns as compared to the data of Canada (See Figure 5 above). In the opposite to what was happened in Canada in 2002, the inventories to shipments ratio decreased in the US, meaning that some inventories were used to fulfill the new orders/shipments. The ratio fluctuated for the past few months, which indicates the distortion in the supply chain management. It is also notice that the inventories to shipments ratio never exceeds 1 for the US data since 1992, which represents a style of supply chain management that tries to avoid buffer inventory in hand.

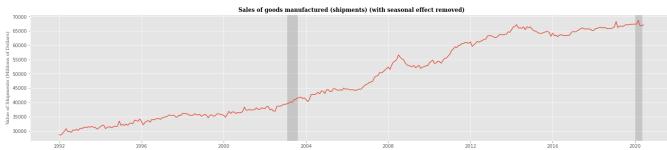


Fig. 47. Sales of goods manufactured (shipments) (with seasonal effect removed) – Food Product

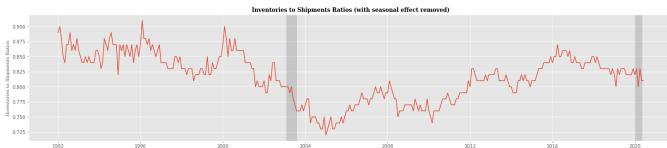


Fig. 48. Inventories to Shipments Ratios (with seasonal effect removed) – Food Product

Similar to the analysis for Canada, the data on perishable goods, such as dairy products, is analyzed by the team. There

was no remarkable change in the value of shipments during the periods of public health crises, while there was a conspicuous and long-lasting decrease in the shipments during the financial crisis in 2008 (shown in yellow in Figure 49). Though the data on the number of new orders is not available online, the decrease in shipment during 2008-2009 was less likely to be caused by the decrease in the demand than the bankruptcy of many companies during that period, causing the drop in supply. Therefore, the team suspects that in the case of a financial crisis, the supply chain is likely to be affected by the business condition of the manufacturers, hence highly depended on the supply side; while when it comes to a health crisis, it is more likely that demand from the public is the one that changes. The number of workers available in the factories will also affect supply of goods.

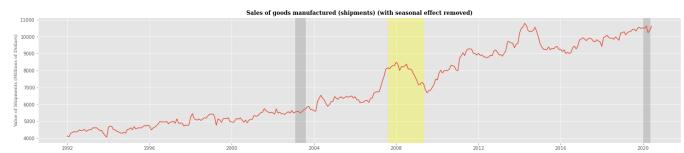


Fig. 49. Sales of goods manufactured (shipments) (with seasonal effect removed) – Dairy Product

C. China

China is the first country where the coronavirus was discovered. In other words, it is the first economy that is highly impacted by the pandemic. Luckily, China has recovered from the disruptions in a few months, having almost no cases on a daily basis. Although the team does not have access to data of the individual category of products, the data of China's manufacturing PMI of the whole manufacturing industry is available on the website of National Bureau of Statistics of China [77]. As shown in Figure 50, there were a V-shape recovery in February 2020 with a slump in the economic situation in manufacturing and a recovery in March 2020 after the control of the pandemic.

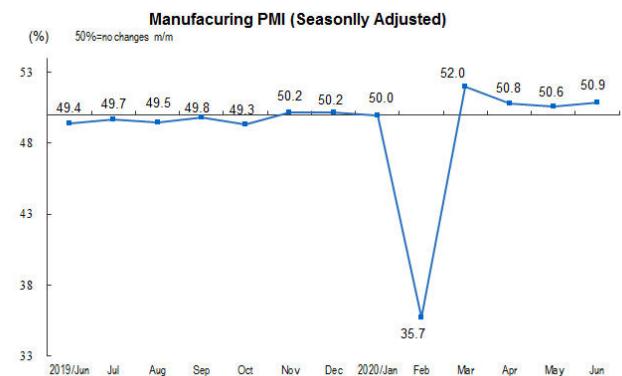


Fig. 50. Manufacturing PMI (with seasonal effect removed) [77]

Sub-indices that compose PMI showed a similar shape, such as the new orders index (Figure 51). The nadir in the graph was probably caused by the decrease in the manufacturing market demand due to the COVID-19 pandemic in China in February. Unfilled orders index, as one of the non-manufacturing PMI, can be a good indicator of the performance of the manufacturing factories. There is no surprise to see that the unfilled orders index also showed a V-shape (Figure 52), as a smaller number of new orders are easier to fill given that the capacity of manufacturing is rather static.

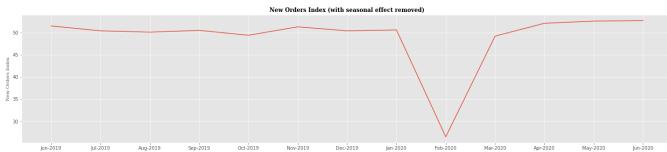


Fig. 51. New Orders Index (with seasonal effect removed)



Fig. 52. Unfilled Orders Index (with seasonal effect removed)

As the world's largest exporter [78], the data on foreign new orders may represent the demand from foreign countries. With the lowest point in February 2020, it is shown from the Figure 53 that the demand level from foreign countries has not yet been fully recovered to the original level up to June 2020, which was consistent with the data of Canada and the US as discussed before.



Fig. 53. Foreign New Orders Index (with seasonal effect removed)

The manufacturing PMI data for the SARS period and the 2008 financial crisis is not available on the website, but there is no doubt to believe that both events brought disruptions to China's supply chain management.

To summarize, data from the three countries indicates that both a public health crisis and a financial crisis can distort the supply chain, either from downstream (consumer demand) or upstream (manufacturing). The extent and direction of the consequence depend on the consumption style of the local residents, the inventory management style of the manufacturers and suppliers, and the local government policies.

There are some lessons learned from the analysis that can help companies better cope with similar situations in the future. The first one is that it is important to understand the change in demand and the effects of the change. As previously mentioned, there is bull whip effect when there is a change downstream. Therefore, the manufactures upstream should always understand the true demand, identify the change in consumer's demand from reliable sources, and estimate the corresponding change in their order. The second one is that for those countries that rely on foreign imports, it is better to avoid over-reliance on foreign supplies because the performance of foreign manufacturers and the transportation process is out of control. The third lesson from the past crisis is that the supply chain management style should fit the local market. So, if there are constant fluctuations in the consumer demands, it is more reasonable to have buffer inventory to avoid stock-out. On the other hand, if the demand is stable and the cost of holding the goods in hand is high, the manufacturers may prefer a JIT production control style, which might cause some problems in the scenarios of an unpredictable crisis.

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