EXAMINING THE FACTORS LEADING TO RISING UNEMPLOYMENT RATE DURING THE COVID-19 PANDEMIC

BY

CHOO ZHAN JING

CHUA XIAO WOON

OOI YEE CHERN

WONG SUET YEE

BACHELOR OF ECONOMICS (HONOURS) FINANCIAL ECONOMICS

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF BUSINESS AND FINANCE

DEPARTMENT OF ECONOMICS

APRIL 2021

DECLARATION

We hereby declare that:

1. This undergraduate research project is the end of result of our own work and that due acknowledgement has been given in the reference to ALL sources of information be they printed, electronic, or personal.
2. No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.
3. Equal contribution has been made by each group member in completing the final year project.
4. The word count of this research report is 15,338 words.

Name of Student	Student ID	Signature
Choo Zhan Jing	1702973	
Chua Xiao Woon	1704655	
Ooi Yee Chern	1704123	
Wong Suet Yee	1702558	

Date: 21 April 2021

ACKNOWLEDGEMENT

First and foremost, we would like to express our sincere appreciation to our university, Universiti Tunku Abdul Rahman (UTAR) for providing us adequate resources to accomplish and polish the research.

Besides, we would like to extend a heartfelt gratitude to our supervisor, Dr. Wong Chin Yoong for guiding us in the whole process of accomplishing the research. We truly appreciate the time and efforts that he spent in providing us professional advice on research. Since this topic is the latest global issue, there is very few research discussing about it. Therefore, we have to start from scrap and eventually, after getting useful advice from Dr. Wong, we manage to draw to a perfect ending.

In addition, we would also like to appreciate our examiner, Ms. Kalaivani a/p Kalimuthu for devoting her time to provide us useful recommendations on our research which allow us to further brush up our research.

We would also like to show appreciation to each of the group members for committing their time and efforts in contributing to the research. Throughout the process, every member gives their best effort to accomplish the research. At this moment, all the hard work is finally paid off. Ultimately, we would like to appreciate our family member for supporting us to complete the research.

TABLE OF CONTENT

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ABBREVIATIONS

COVID-19	Coronavirus disease
FEM	Fixed effect model
GDP	Gross domestic product
H7N9	Avian influenza A
ILO	International Labour Organization
OECD	Organization for Economic Co-operation and Development
POLS	Pooled ordinary least square model
REM	Random effect model
SARS	Severe acute respiratory syndrome
SGD	Singapore dollar
WHO	World Health Organization

LIST OF APPENDICES

Page

ABSTRACT

A study on factors leading to rising unemployment rate during the COVID-19 pandemic. To examine the overall effect of the COVID-19 outbreak on the unemployment rate, policymakers' decision in suppressing the rising unemployment rate and effects of economic activity to the unemployment rate. We used Pooled ordinary least square model (POLS), fixed effect model (FEM) and random effect model (REM) to examine our empirical models. There are 14 countries which are Australia, Brazil, Canada, Denmark, Finland, Germany, Ireland, Italy, Japan, Malaysia, Russia, Switzerland, the United Kingdom and the United States, have been adopted as our sample size with the time period of 10 months, from 1st February 2020 until 31st November 2020.

In the study, we analyse how the impacts of independent variables which are economic activity, fiscal policy, COVID-19, internet accessibility and stock market return to the unemployment rate in 14 countries. Our major findings showed workplace mobility and government spending bring negative impacts to unemployment rate, while number of COVID-19 cases, stock market return, internet accessibility and residential mobility reflect positive impacts to unemployment rate. This study serves as a lesson for the future on what is the right thing to be done in order to soften the impact of the pandemic towards the unemployment rate.

Keywords: COVID-19, unemployment rate, economic activity, fiscal policy, internet accessibility, stock market return

Chapter 1: Introduction

1.1 Research Background

According to the WHO, COVID-19 is a contagious disease which is caused by a new strain of coronavirus. Some of the common symptoms that are associated with COVID-19 are fever, fatigue, and dry cough. There are also other symptoms that might be experienced which are sore throat, loss of smell and taste, headache, diarrhoea, and skin rashes (Lauren, 2021). This disease is more vulnerable towards elderly people especially those age 60 and above, as well as those who have a history of health problems such as diabetes, high blood pressure, and heart and lung problems. The method of transmission for the virus is through droplets of fluids in the air when we cough or sneeze, infected surfaces and close contact with an infected person. Hence, the reason why this disease is widely feared is because it can cause respiratory failure and acute respiratory distress symptoms (ARDS) which can eventually lead to death if no immediate treatment is given (Coronavirus disease (COVID-19), 2020).

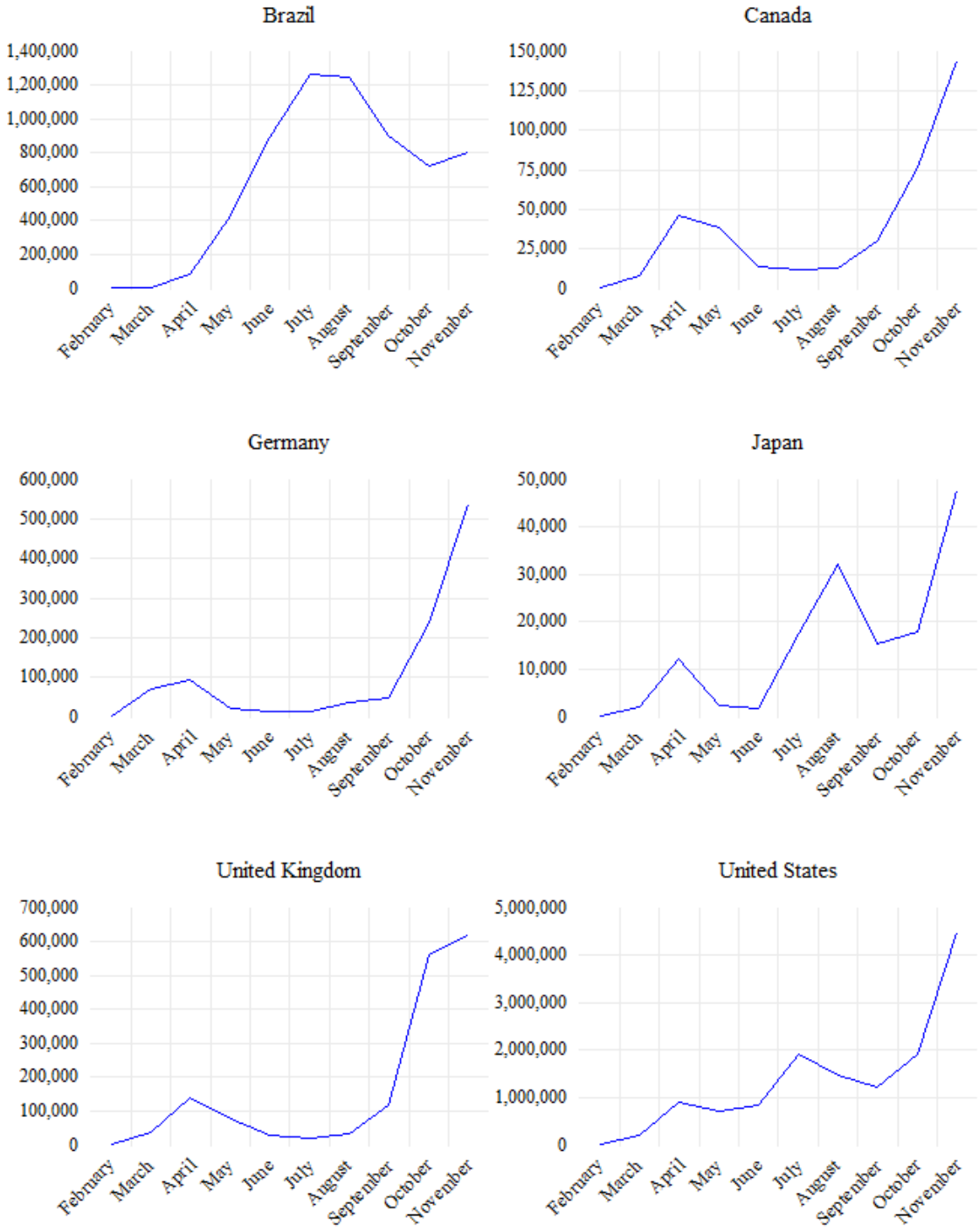
The world was first exposed to the COVID-19 virus back in December 2019 when the first case was discovered in Wuhan, China. It was first thought of as some unusual cases of pneumonia which triggered the China government to notify the issue to the World Health Organization (WHO). From then, the virus had spread from Wuhan city to the Hubei province and then further caused an outbreak to the other parts of China. In terms of case wise, although Hubei suffered an outbreak, the COVID-19 cases in Hubei is much lesser compared to Wuhan due to the implementation of mobility restriction.

In January 2020, the first COVID-19 case that was confirmed outside of China occured in Thailand which involved a tourist from Wuhan. After that, similar situations happened in the United States, South Korea, and Malaysia whereby each country reported cases of COVID-19 due to the Wuhan tourists. Only after the virus started to spread to other countries, that it is clear that this problem is not limited to China only, but it has now turned into a global issue.

The main reason as to why this COVID-19 virus is turning into such a serious pandemic is due to the different response of the countries.

Some countries are assuming the COVID-19 to be similar to the past flu pandemic such as SARS and H7N9. Indeed, SARS and H7N9 are less dangerous as it only affects a few countries, but COVID-19 is on a whole new level as now more than 200 countries are affected. Their belittling thoughts on the danger of the COVID-19 have caused them to be reluctant to impose the mobility restriction within the country. There were also some countries that sensed the immense threat that the virus could cause to the economy and swiftly took immediate precautions to impose the mobility restriction.

Although the outbreak first started in the East Asia countries, when the virus spread to Western countries, their cases per capita are apparently far worse than those in the Eastern countries. As can be seen in Figure 1.1, from the six countries below, only Japan is an East Asia country while Brazil, Canada, Germany, the United Kingdom and the United States are Western countries. However, the COVID-19 cases in Japan was far much less than its Western counterpart. Therefore, this is a perplexing matter as to why most of the Western countries are badly affected but East Asia countries are doing well in containing the virus.

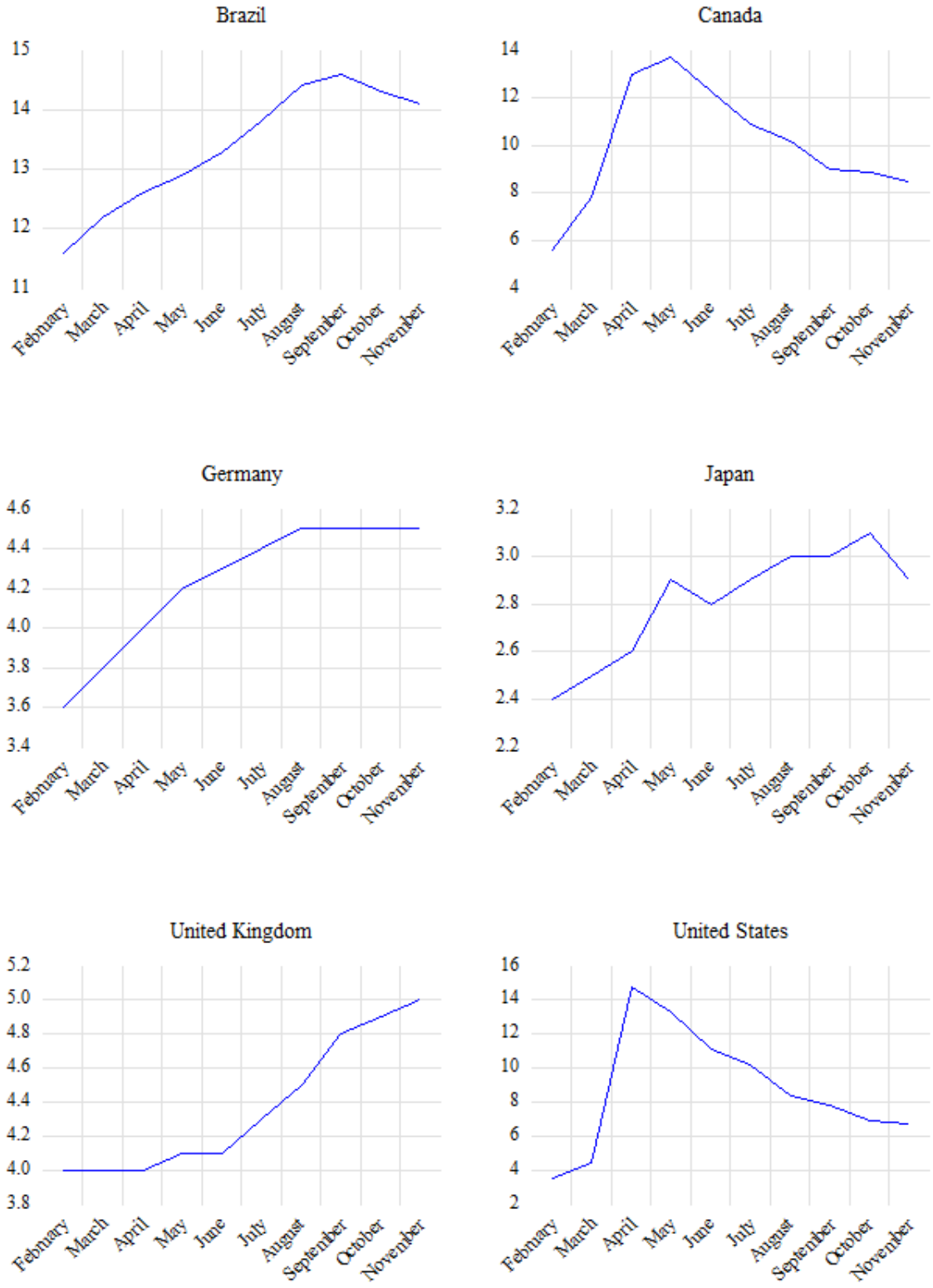


Notes: Y-axis: Monthly confirmed COVID-19 cases
Source: Our World in Data
Figure 1.1 Monthly confirmed COVID-19 Cases

Even though the cases vary across different countries and different regions; however, one similarity is that the COVID-19 pandemic has indeed badly affected their economies. Many economic problems have emerged and one pronounced issue that will be discussed in this research is unemployment. Due to the COVID-19 outbreak, many countries have opted to

impose mobility restriction in the form of lockdown in order to prevent the further spread of the virus. While this may be necessary to curb further infections, it has caused a trade-off for economic activities. Thus, this leads to an economic slowdown for all the countries worldwide. Many companies have opted to lay off their workers in order to sustain their operation. Not to mention, SMEs and self-employed are also going out of business as they are not able to earn any income to cover their operating cost.

Therefore, this all leads to an increment in the unemployment rate worldwide as countries struggle to cope with the sudden halt in economic activity. Figure 1.2 below plots the unemployment rate of the previous six countries in a time span from February 2020 until November 2020. Hence, when we compare Figure 1.1 and Figure 1.2, we are able to observe that an upward trend in the monthly confirmed COVID-19 cases does not necessarily reflect an increase in the unemployment rate for all the countries.



Notes: Y-axis: unemployment rate (%)
Source: Trading Economics
Figure 1.2 Unemployment Rate

Therefore, this raised some questions whereby based on Figure 1.1, Canada and the United States had a high number of COVID-19 cases, but in relation to their unemployment rate, it started to decrease after the peak in April and May 2020. However, a different scenario can be seen for Brazil, Germany, Japan and the United Kingdom. Their increasing cases of COVID-19 were reflected by a rise in the unemployment rate. It also makes sense that a high number of COVID-19 cases would bring an adverse effect to the labour industry as now many economic activities are disrupted. Hence, the positive relationship between COVID-19 cases and the unemployment rate that was viewed in Brazil, the United Kingdom, Japan and Germany does seem plausible. However, why is the unemployment rate for Canada and the United States decreasing while their COVID-19 cases are soaring?

Therefore, we would now look into government actions that were implemented in those countries. The governments have been introducing various policies in order to prevent further increment in the unemployment rate. This means that the type of policies introduced plays a crucial role in determining the unemployment rate of the country. This is because different countries have their own distinct government policies to reduce the unemployment rate and based on their actions it can be observed that the countries each yield different results in the unemployment rate. Most of the policymakers would focus on monetary policy, fiscal policy and health system policy. This is because it is important to support the communities during the pandemic period to ensure that the country is ready for an economic rebound when it reopens its economy later.

However, there is one policy that most countries have similarly implemented together which is the lockdown policy. The lockdown policy is important because it serves as a temporary security measure to control the further spread of the virus. As different countries are governed by different policymakers; therefore, the lockdown policy implemented in each country may not be necessarily similar.

For the case of Brazil and the United States, although they were faced with a high number of COVID-19 cases, they refused to impose strict lockdown on the country. Instead, their lockdown regulations are very lenient and they choose to ease their lockdown before the cases are stabilized. For Canada, the country went into a very strict lockdown and when the cases declined the lockdown was then eased. For Japan, the country opted for a very special approach whereby the lockdown policy is only adopted for a few certain states that are more affected by the COVID-19 but never imposed a full country lockdown. This is to prevent

Japan's economy from being affected by the lockdown measures. Hence, we are able to see the different impacts of the lockdown regulations on the unemployment rate of the countries.

Moreover, due to the implementation of the lockdown policy, it has caused the mobility of the citizens to be affected in certain areas. Therefore, two main indicators that would be used to measure the change in the mobility of the citizens are the residential percent change from baseline and the workplace percent change from baseline. These two indicators are chosen because during the lockdown period, citizens would spend more time in their residential area rather than at the workplace. These two indicators are also able to indicate the severity and strictness of the lockdown regulations as well as the behaviour of the citizens in obeying the lockdown policy.

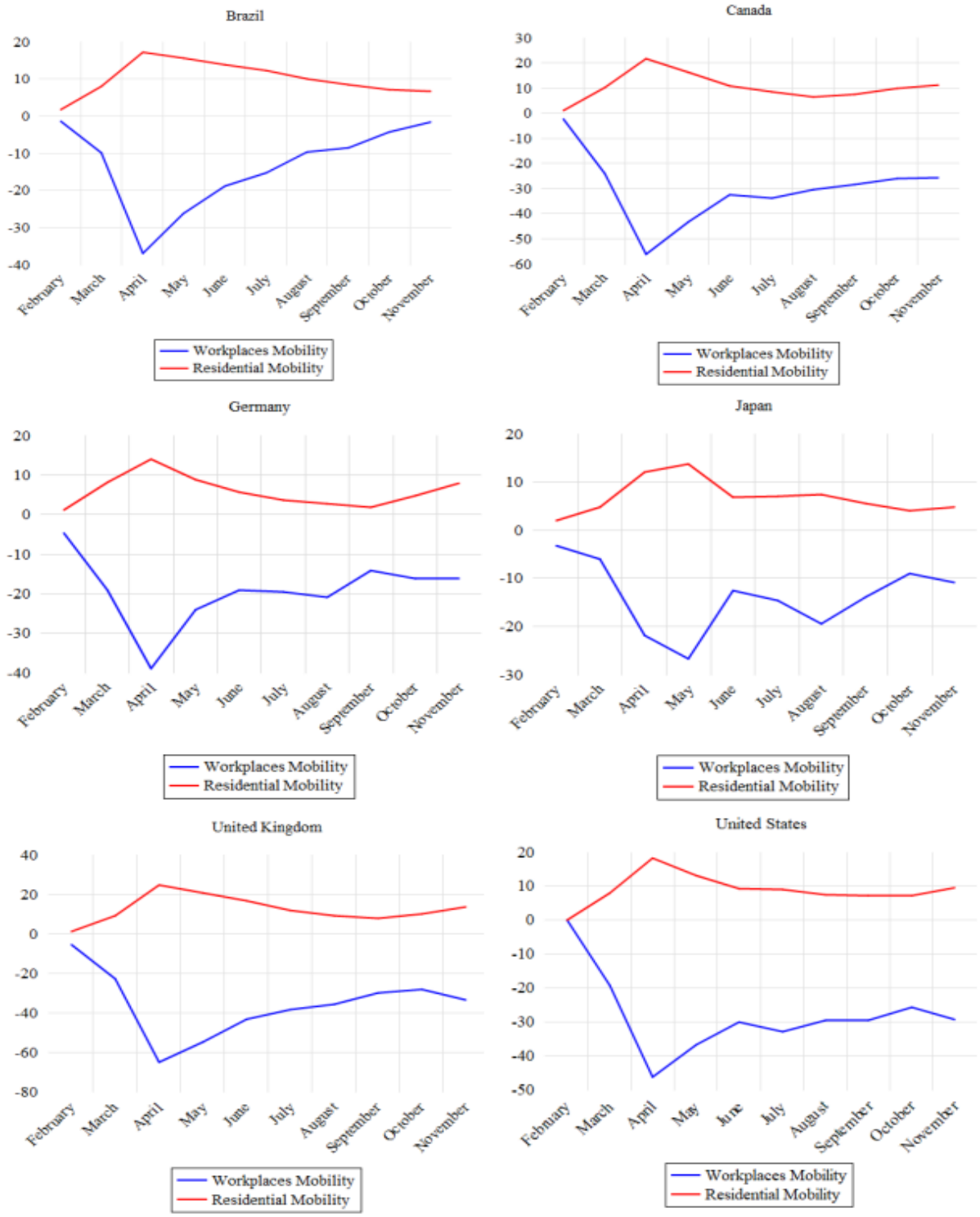
Based on Figure 1.3, it shows the graph combination for residential percent change from baseline and workplace percent change from baseline for the previous six countries. These two indicators are closely related to each other whereby there is an inverse relationship between them. A decrease in the workplace percent change from baseline would be reflected by an increase in the residential percent change from baseline. Hence, with reference to Figure 1.3, we can observe that in March there is a huge decline in the workplace percent change from baseline indicators for Brazil, Canada, Germany, the United Kingdom and the United States. For Japan, this happened in April which is a month later than the other 5 countries.

The decline in the workplace percent change from baseline can be associated with the period in which the countries started to implement the lockdown. As during lockdown, business activities are restricted and the people are ordered to stay at home, hence, this will lead to an increase in the residential percent change from baseline. For Brazil, Canada, Germany, the United Kingdom and the United States, the highest residential percent change from baseline is in March which is within the range of 17% to 28%. While, the highest residential percent change from baseline for Japan is in April, and it is approximately 16%. This showed that the strictness of lockdown in Eastern countries is lower than the strictness of lockdown in Western countries.

However, people seem to be returning back to work in the month of May, as can be seen that the residential percent change from baseline is decreasing while the workplace percent change from baseline is improving. This indicates a loosening in the lockdown regulations as people start to be mobile again and return to their normal routine. Thus, from Figure 1.3 it is observed that the six countries implemented the lockdown policy approximately together, and

also eased the lockdown regulations more or less at the same time. However, why is there such a stark difference in the unemployment rate and the number of COVID-19 cases across the countries? Since they have similar lockdown periods, it only makes sense for them to exhibit a similar pattern in the unemployment rate.

Does the key element lie in the strictness of the lockdown policy? As previously mentioned, Brazil and the United States only imposed lenient lockdown regulations as the governments do not want the lockdown to bring the economy to a sudden halt. Hence, is lenient lockdown regulations the main reason that causes the number of COVID-19 cases to escalate into such an uncontrolled situation?



Notes: Y-axis: Percent change from baseline for residential and workplaces

Residential percent change measures change in mobility or movement of people in residential areas from the baseline. The baseline refers to the median for the period of 3 January 2020 to 6 February 2020. Workplaces percent change measures the change of people movement and mobility in the working area from the baseline. The baseline refers to the median for the period of 3 January 2020 to 6 February 2020.

Source: Google Mobility Report

Figure 1.3 Residential and Workplaces Percent Change from Baseline

1.2 Problem Statement

From the previous section, we know that the unemployment rate differs among countries. Why do some countries have high unemployment rates while some are able to suppress the unemployment rate from rising? This is indeed a very confusing matter and further research is needed to understand what causes the differences in the unemployment rate in the countries. Hence, some observations that were identified are listed below.

Inconsistent Effect of COVID-19 Cases on Unemployment Rate in Different Countries

Based on the statistics, it is observed that the COVID-19 cases and unemployment rate exhibited a positive relationship in Brazil, Japan, Germany and the United Kingdom. While for Canada and the United States, a different scenario can be observed whereby the COVID-19 cases and the unemployment rate shows a different relationship. Here we can clearly see two different effects of the COVID-19 cases on the unemployment rate.

For the case of Brazil, Japan, Germany and the United Kingdom, a study by Beland, Brodeur, and Wright (2020) supported the positive relationship found as their study reported that the unemployment rate escalates during COVID-19 pandemic. This is also proven by Chetty, Friedman, Hendren and Stepner (2020) whereby from their studies, they found that COVID-19 dampens consumption and then decreases employment. On the other hand, the study by Rojas, Jiang, Montenovo, Simon, Weinberg and Wing (2020) shows that unemployment claims are higher in the states that have a high number of COVID-19 cases.

When examining the case of Canada and the United States, the COVID-19 cases statistics of these two countries seem to go against what is stated in the literature as even with a high number of COVID-19 cases, the unemployment rate in the countries decreases. Therefore, this is a very confusing matter and represents the first problem that we would like to research in detail.

Whether Unemployment Will Recover Under the Implementation of Government Policies

Due to the COVID-19, many people had suffered from being unemployed as employers laid off their workers in order to sustain their business. According to Ozili and Arun (2020), governments try to cope with the pandemic crisis by introducing different policies to support the economy. Policymakers played an important role to curb the rise of the unemployment rate to prevent the country's economy from entering into a recession due to the sudden economic slowdown. Hence, a good policymaker will ensure that the implemented policies were effective in combating the rise in the unemployment rate.

According to Ozili and Arun (2020), the government of the United Kingdom and United States approved a large stimulus package to help those affected sectors and industries. One of the policies included in the stimulus package is the wage subsidy scheme. The purpose of this policy is to enable the employers to have the ability to pay wages to their employees. However, the results of the stimulus package on the unemployment rate for two of the countries are very different. The United Kingdom had an increasing unemployment rate, but for the United States, it showed an uptrend pattern of unemployment rate from February 2020 and peaked at April 2020. After that, the unemployment in the United States started to decrease. Thus, it can be concluded that even with the same policy, the outcome yield may not be necessarily similar. It is very complicated to predict the response of a certain policy. Hence, we would like to know if there is a certain policy that would provide similar results to all countries that adopt it.

Effectiveness of Lockdown Policy Towards the Unemployment Rate

Mobility was not the main concern before the COVID-19 pandemic took place. After the outbreak of COVID-19, when mobility restriction or the lockdown was imposed, this brought great impact to the businesses and the people. Many people were caught off guard by the sudden outbreak and the lockdown policy. Each country had its own way of implementing the lockdown policy that resulted in different unemployment rates.

Japan, which is the representative of the Eastern countries shows the highest residential percent change from baseline with only 16% in April which is lower than the Western countries in the discussion. Japan only adopted the lockdown policy for several states rather than a whole

country lockdown which was applied by other Western countries. By comparing the data on the unemployment rate, it shows that the unemployment rate is unaffected by the state lockdown as there is no country lockdown yet.

For the case of Canada and the United States, both are having a 17% to 23% residential percent change from baseline in March respectively and they reflect different results when compared to Japan. Based on Figure 1.2, it shows significant changes in the unemployment rate starting from February to April 2020. The unemployment rate of Canada jumped approximately 8% and the United States had the most serious unemployment as it shoots up to more than 10% in two months time. According to Baek, McCrory, Messer & Mui (2020), more than half of the United States population was under the Stay-at-Home directive by 24 March 2020. The result of the study shows the United States unemployment claims rise by 1.9% during the increase of one-week Stay-at-Home orders.

The United Kingdom, which is also a Western country; however, did not follow the path of Canada and the United States. According to the research of Goes & Gallo (2020), the lockdown can directly reduce the infection of COVID-19 but it will cause a higher unemployment rate. Nevertheless, the United Kingdom shows that unemployment is not affected by the lockdown. So, further study is needed to understand the actual reason why the same lockdown policy has different effects on the unemployment rate.

1.3 Research Objectives

1.3.1 General Objective

The aim of our research is to study how the number of COVID-19 cases, level of economic activities, and the government policies affect the unemployment rate of the country during the COVID-19 pandemic period.

1.3.2 Specific Objectives

To better examine the general purpose of the research, the objective is segregated into three specific research objectives. Hence, to be more specific, we would like to:

1. To examine the overall effect of COVID-19 outbreak on the unemployment rate.
2. To analyse the role of policymakers in helping to overcome the rising unemployment rate problem.
3. To investigate how economic activity is affecting the unemployment rate.

1.4 Research Questions

Based on the research objectives, several research questions are formulated that serves as a guide to achieve the objectives of the study. The research questions that would be emphasized throughout this research are:

1. What is the overall effect of the COVID-19 outbreak on the unemployment rate?
2. Do policymakers play a significant role in suppressing the rising unemployment rate?
3. How does the economic activity affect the unemployment rate?

1.5 Significance of Study

This research would serve as a reference for the policymakers as well as the governments on what should be done in case of another pandemic outbreak in the future. The last time such a serious global pandemic had hit our world was during the Spanish Flu in 1918. Then till now, there is a 100 year gap. Thus, it would not be possible to refer to the journals written back then as now our world is constantly evolving. It would only be sensible to research about the current pandemic and record the lessons we can learn from it.

Besides, there are only several times that our world has been hit with a pandemic, indicating a lack of journals available regarding how unemployment is affected by the pandemic. Therefore, this research would be able to contribute to the existing knowledge in the area studied. Through this research, the underlying factors that cause the increasing unemployment rate would be studied and we would be able to better understand the linkage between all the factors that cause them to be locked in a vicious cycle. Unemployment is a very vital issue that will determine the well-function of the country as a country that has a small labour force would mean that it would not be able to perform its economic activities efficiently.

Most importantly, this is surely not the last time that a pandemic will hit our world. Thus, this research would serve as a lesson for the future on what is the right thing to be done in order to soften the impact of the pandemic towards the unemployment rate.

1.6 Scope of Study

This study aims to investigate the relationship between the number of COVID-19 cases, level of economic activities, government policies, and the unemployment rate in 14 countries. These 14 countries are Australia, Brazil, Canada, Denmark, Finland, Germany, Ireland, Italy, Japan, Malaysia, Russia, Switzerland, the United Kingdom and the United States. The scope of this study is set among these 14 countries because we have found that the Western countries' cases per capita are apparently far worse than those in the Eastern countries. Hence, from the 14 countries, it can be categorized into 2 groups of countries which is Western countries and Eastern countries. The Western countries are Australia, Brazil, Canada, Denmark, Finland, Germany, Ireland, Italy, Russia, Switzerland, the United Kingdom and the United States. For the Eastern countries, they are Japan and Malaysia.

The selected time frame is from 1st February 2020 until 31st November 2020. This is because most of the countries are affected by the COVID-19 after February 2020. In our study, we used a time period of 10 months to examine the impact of COVID-19 on the unemployment rate as these 10 months is the serious outbreak period of the virus. Hence, within these 10 months, we would be able to examine the true impact of COVID-19 on the unemployment rate and how different government actions bring different results to the unemployment rate. Thus, the data used in this study is panel data as it gives more accuracy to our research.

Therefore, a few significant factors are chosen in order to study how those variables affect the unemployment rate in each of the 14 countries. The factors are the number of COVID-19 cases, level of economic activities, and government policies. As each country has different unemployment rates, thus those countries that are affected by the COVID 19 will face different outbreak periods, peak periods and stabilization periods in the number of COVID 19 cases. With this, the actions taken by the government can be critically analysed to study the effects on the unemployment rate.

1.7 Organization of Study

This study is broken down into five chapters. Starting off with Chapter 1, it gives a brief overview of the chronological events of the COVID-19 outbreak and explains how the pandemic leads to many economic problems, specifically the unemployment rate. Moving on, Chapter 2 would discuss the literature associated with the unemployment rate, COVID-19, and the governmental actions during the pandemic period. Proceeding to Chapter 3, the theoretical and empirical model would be laid out, and a further explanation on the variables are given regarding the source of data and their proxy. The various types of methodology used in the research are also explained in this chapter. Chapter 4 would focus on our model estimation, and their results and findings. The last chapter would be Chapter 5 which provides a summary of our finding, the limitation and also recommendation for our study.

Chapter 2: Literature Review

2.1 Description of COVID-19

COVID-19 has been the greatest challenge for humankind in the year 2020. COVID-19 is a recently discovered virus which is a contagious disease (Coronavirus, 2020). Many people have suffered from the disease especially for those who are at an old age. There are around 63.4 million of total confirmed cases worldwide and it causes more than 1.47 million people to perish due to the disease as at 30 November 2020 (Our World in Data, 2020). Based on the study by Kucharski, Russell, Diamond, Liu, Edmunds, Funk, Eggo, Sun, Jit & Munday (2020), China which was heavily impacted by COVID-19 pandemic has succeeded in limiting the spread of the virus by strictly restricting the mobility of their residents. According to Coates, Cowgill, Chen & Mackey (2020), there is a possibility that 20% of people will be unemployed due to the COVID-19 policy response. In fact, numerous opinions have surfaced on whether people's freedom in mobility should be prioritized or preventing the spread of the virus is more important. There is no superior opinion as it depends on which perspective we are viewing this situation from. As a policymaker, lowering the infection rate is the top priority, but as a normal person, resuming our normal lives and earning an income would be our ideal scenario. Therefore, let us look back to the history of past pandemic crises to learn the lessons and impacts from them.

2.2 History of Past Pandemic Crisis

2.2.1 1918 Influenza Pandemic (Spanish Flu)

In 1918, the Spanish flu occurred and it had spread to all around the world. According to Parmet and Rothstein (2018), the total population in 1918 is about 1.8 billion only but the disease killed more than 50 million people. There were a few reasons that caused the high

morbidity and mortality of this influenza pandemic. According to Jester, Uyeki, Patel, Koonin & Jernigan (2018), the lack of specific drugs and vaccines, as well as the slow development of diagnostic for research and pharmaceuticals was the reason for the high mortality rate during that period.

When the Spanish Flu happened, it was also during the time the world was having World War I. Hence, in the United States, the government remained silent about the pandemic as it was a struggle for the government to juggle both problems at once. If the government chose to inform its people about the virus, it would risk disclosing to the enemy the current situation of the country. The Spanish Flu brought a slowdown to the affected countries' economy, but it had taught us the importance of medicine development. Parmet and Rothstein (2018) also stated that a mixture of social distancing and biomedical interventions is important to counter the next pandemic. Hence, better preparation in the health sector would help to minimize the risk of the virus infection.

2.2.2 Swine Flu Pandemic (H1N1)

According to Chan (2009), H1N1 was detected in the United States in April 2009 and the World Health Organization (WHO) declared it as a global pandemic in June later that year. Based on the WHO, the H1N1 came from the Influenza A virus that originated from co-infected pigs that later spread to humans. The virus normally spreads through infected surfaces, or inhalation of the virus through sneezing and coughing. Frequent hand wash and the use of disinfectants were highly recommended by the mass media as the H1N1 is a highly infectious virus.

During this period, governments and health organizations have responded to stop the further spread of the virus. Some of the measures taken include incoming international flights which carried China's passengers need to be screened to check for the symptoms of the flu. If any passengers are suspected of contracting the flu, they would be sent to quarantine. Due to the shortage of the vaccine supply in mid-September 2009, high-risk groups like the health care provider were prioritized in getting the vaccine first. Then, when there was enough supply of vaccines in December 2009, it was later given to the public and this led to a reduction in H1N1 cases in January 2010.

Based on the Centers for Disease Control and Prevention (CDC) (2010), even though the cases of H1N1 had a significant decrease as compared with October 2009, there were still hospitalizations and deaths happening until February 2010. The seriousness of the pandemic has caused a toll on bank loans and shrunken the economy of the affected countries. According to Gong, Jiang & Lu (2020), the cost of bank loans had risen during the pandemic and the volume of bank lending had also been restricted. The lesson from the Spanish Flu pandemic had been learnt, as the development of the vaccine had successfully decreased the infection and mortality rate caused by the H1N1 virus.

2.2.3 SARS Pandemic

SARS was first discovered in Guangdong Province, China in November 2002. It was believed that the virus originated from palm civets and later transmitted to humans. However, this virus only started to spread outside of China in February 2003. It first spread to Hong Kong, and then to Vietnam and Singapore (Cherry, 2004). In Hong Kong, the outbreak in one of its residential areas, Amoy Gardens proved to be very serious as it contributed to a total of 321 cases out of the total SARS cases in Hong Kong. The rapid transmission in that area was mainly caused by the flaw in the sewage system (Lee, 2003). Singapore was one of the most affected countries that time with 238 cases as of 3 August 2003 (Summary table of SARS cases by country, 2003). The Singaporean government then decided to conduct contact tracing widely to detect the possible infected people, so that they can be quarantined to avoid further infection. Centralisation of treatment centres was also implemented to control the virus. At that time, Tan Tock Seng Hospital became the only hospital to treat SARS patients (Pan, Pan & Devadoss, 2005).

As people tried to avoid social contact with others due to the fear of being infected, the tourism-related industry was badly affected at that time. During the SARS pandemic, the unemployment problem was particularly severe in the tourism industry in Hong Kong. This was because of the drastic decline in the number of tourists visiting Hong Kong during the pandemic. Thus, this had caused the hotel industry employment rate to drop by 2.4% in April 2003. The problem continued to deteriorate until August 2003 as the employment rate in the hotel industry plunged by 7.1%. Due to the hotel's management decision, the percentage of hotels' employees who were required to go for unpaid leave rose from 79.3% to 83% within a

month. However, the hotel employees were willing to do so in order to keep their jobs (Warner & Lee, 2005). Besides, the affected industries were also given an option to either dismiss their employees or allow the employees to stay with a work-sharing scheme (Siu & Wong, 2004). Therefore, with these job retention policies, the unemployment problem was able to be solved that time as the employees were given an option besides being laid off.

In Singapore, the unemployment rate rose to 4.7% in 2003 which was the highest in 17 years. Singapore faced the same problem with Hong Kong as the number of tourists were also reduced greatly. This resulted in the low hotel occupancy rate and the low room rental which led to a drop in revenue. The whole industry suffered a loss of SGD 23 million per week. For Singapore, the hotels and tourism-related industry opted to lay off their workers and freeze their recruitment in order to sustain their operations (Warner & Lee, 2007). In China, the hotel and airline industry also suffered as people are afraid of getting infected. Small and medium enterprises in the catering and social service sectors were forced to shut down after being affected by the pandemic, which then led to a sharp decline in labour demand (Warner & Lee, 2007).

2.2.4 Lesson Learnt from the Past Pandemics

Studies found that when a country is going through a pandemic, it will lead to an increase of mortality and bring an adverse impact to the economy. According to Jester, Uyeki, Patel, Koonin & Jernigan (2018), the World Health Organization suggests every country to develop a response plan in order to countermeasure the negative effects caused by the pandemic. So, policymakers need to take actions to reduce and prevent the spread of the virus when it arises. From the past pandemic, we can see the importance of the healthcare sector in combating the pandemic. Therefore, many countries have put in effort in improving their healthcare infrastructure. Besides, the creation of the vaccine is also very essential in overcoming the pandemic. With the vaccine, the infection rate would be able to be controlled and this would enable the countries' economies to slowly recover.

2.3 Unemployment Benefits and Policies

2.3.1 Unemployment and Unemployment Benefits during COVID-19 Pandemic

At the early period of the COVID-19 pandemic, many countries had implemented lockdown as a preventive measure to control the transmission of the virus. When the cases started to stabilize due to the effects of the lockdown, the government took the initiative to gradually reopen the economy in order to avoid any long term depressing impact on the country's economic activities. This is because the unemployment rate in many countries had been rising during the lockdown period.

In the United States, there were around 25 million people who applied for unemployment benefits in mid of March 2020 (Petrosky-Nadeau & Valletta, 2020). In California, there are a total of 13.9 million claims on unemployment benefits from 15 March 2020 to 28 November 2020 (Bell, Hedin, Schnorr & Wachter, 2020). According to Coibion, Gorodnichenko and Weber (2020), the employment-to-population ratio shrinks from 60% to 52.2% in the United States which is approximately equal to 20 million unemployed individuals. This might be caused by temporary layoff due to the lockdown. Jobless claims were also reported to have significantly increased in the areas where COVID-19 cases were high (Gibson & Sun, 2020). Furthermore, Hedin, Schnorr and Wachter (2020) found that the spike in unemployment insurance claims is more obvious in urban areas in the United States. However, according to Altonji, Contractor, Finamor, Haygood, Lindenlaub, Meghir, O'Dea, Scott and Wang (2020), they have found that an increment in the generosity of unemployment insurance does not bring up the unemployment rate.

During the early stage of COVID-19 pandemic, stay at home order or lockdown had been imposed to stop the virus from spreading. The catering, leisure and tourism industries are heavily affected due to the restriction of the lockdown policy. This leads to massive unemployment (Ceylan & Ozkan, 2020). This is proven by Beland, Brodeur, and Wright (2020). Their studies found that unemployment surged when COVID-19 pandemic spread around the world.

In addition, Fang, Nie and Xie (2020) mentioned that employees have low incentive to work when they face a high risk of being infected. The job seekers also put in less effort when seeking a job during times of high COVID-19 infection. From the firms' perspective, they are less willing to recruit new employees as they worry that there is a greater chance for the new

employees to suffer from the virus. Therefore, in sectors which involve close contact, the job vacancy advertisement was brought close to 0 after the lockdown was implemented. This further increases the unemployment rate in those sectors. This can be observed from the vacancy available in the job market. The weekly job posts are almost halved from the mid of March 2020 to the end of April, dropping from 815 thousand to 460 thousand. This indicates that the demand for labour had dropped significantly (Forsythe, Kahn, Lange & Wiczer, 2020). In Norway, a 27% plunge could be observed in the number of job vacancies from February 2020 to June 2020 as compared to year 2019 (Holgerson, Jia & Svenkerud, 2020).

2.3.2 Does Government Policy Benefit the Unemployment Rate?

Government policy toward COVID-19 has many different types such as restriction policy, wages subsidy policy and medical enhancement policy. The main purposes of government policy are reducing the spread of viruses in the country and reopening the economy in the shortest period. Due to the different booming time of COVID-19 cases, some countries followed others who had succeeded in controlling the COVID-19 by adopting similar government policy. However, the issue arises as the impacts of government policy in each country are different and it may cause the unemployment rate to become worse. So, we found that intervention of government policy is important in terms of timing, types and size of the policy.

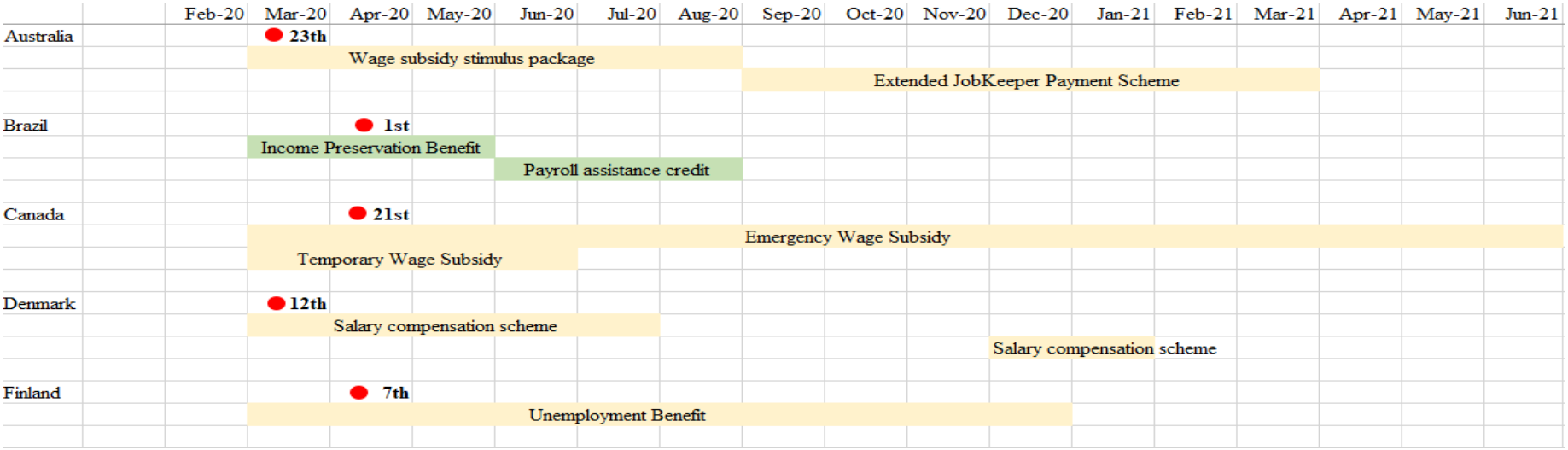
Due to different degrees of sensitivity to the outbreak, medical level and timing of adoption policy between those countries, impacts of government policy will be different to the countries (Sebhatu, Wennberg, Jonsson, & Lindberg, 2020). The appropriate adoption policy timing depends on the countries' condition and the impacts of the unemployment rate on the countries. The adoption of policy at a booming period or the start of an outbreak will lead to different impacts on the countries. If the governments adopt the policy at an appropriate timing, they can have better control of the spread of COVID-19 and the unemployment rate.

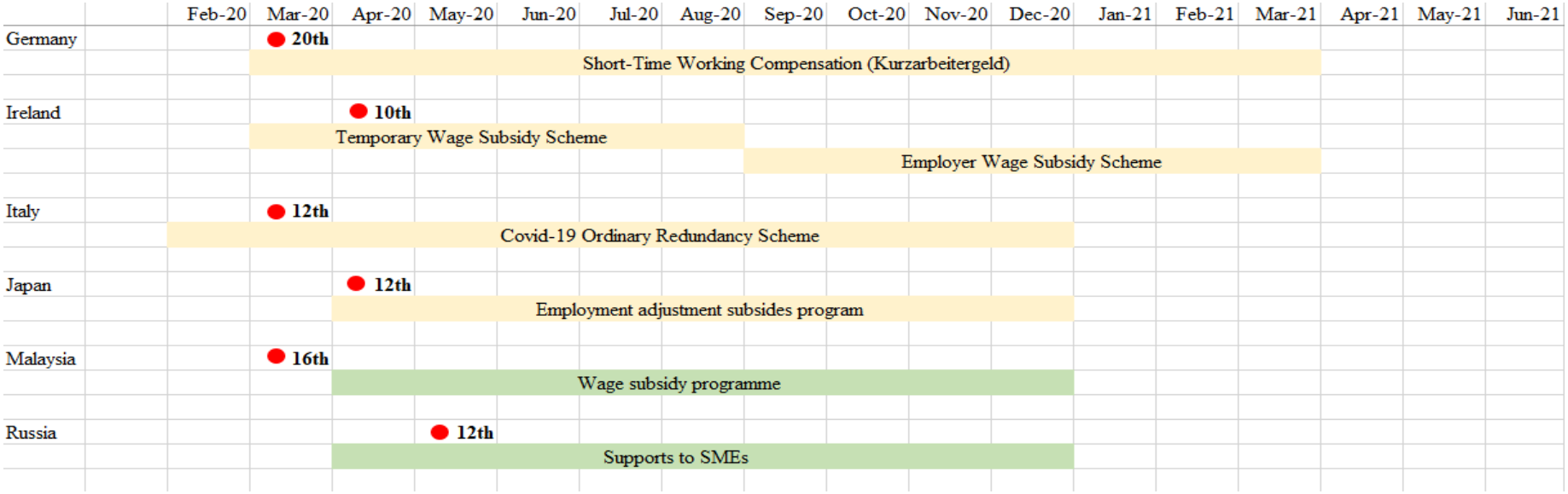
For this case, our study will focus on lockdown policy and wages subsidy policy. This is because lockdown policy can be used to control the spread of COVID-19 and indicate the movement of people. In lockdown policy, Brazil and the United States is a good example of this. Both of the countries faced high unemployment problems in their countries because of inappropriate timing for government policy intervention. This is because they eased the

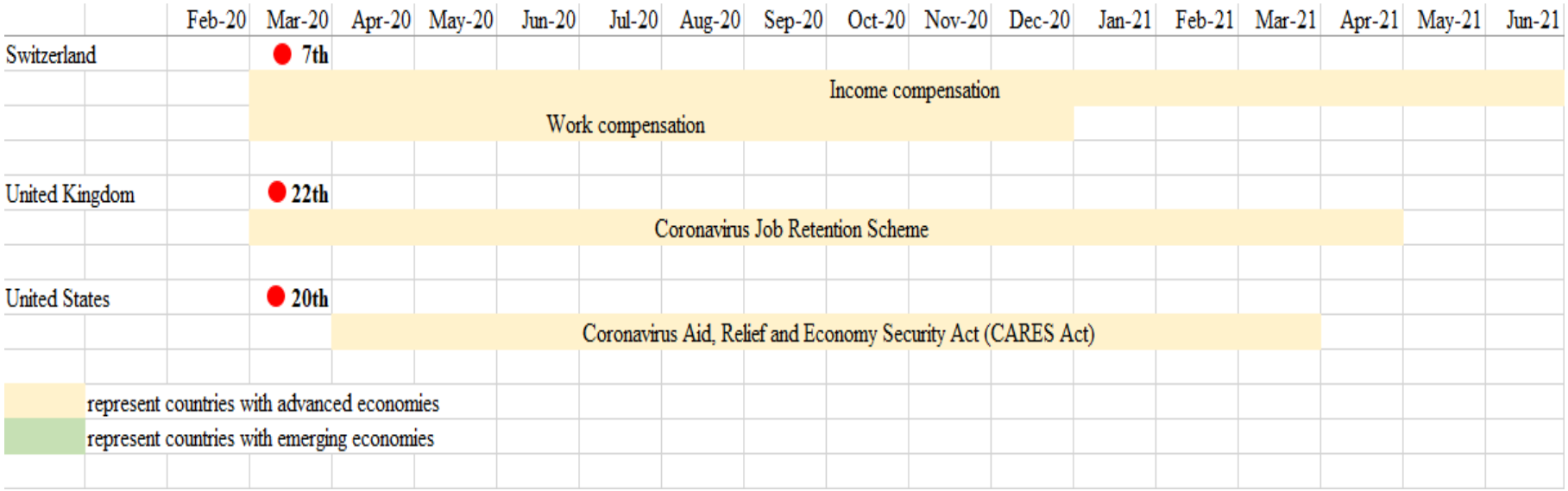
lockdown too early which leads to a surge in the number of COVID-19 cases. High unemployment also happens due to the inappropriate timing of government policy which includes the nations receiving financial support in unnecessary time. This then causes the usage of government policy fails to reach an utilized condition. The impact of the inappropriate timing of government policy in the United States is clearly seen in its wage subsidy. Many nations of the United States applied for wage subsidies during the pandemic crisis, but there was a delay in the distribution of the wage subsidy.

Coming to the wages subsidy policy, it plays a significant role in cushioning the impacts of increasing unemployment rate in the countries. The wages subsidy policy is used to provide financial support to the business in order to prevent the companies from laying off their employees for the sake of cutting down the operation costs. By looking at Figure 2.1, it shows the timeline for the 14 countries which depicts their individual booming time of the COVID-19 cases and the period of adoption for wage subsidy policy. It is clear that all 14 countries adopted their wage subsidy at different periods in relation to their booming time of COVID-19 cases. These 14 countries can be categorised into 2 categories which are countries with advanced economies and countries with emerging economies. For countries with advanced economies, there are Australia, Canada, Denmark, Finland, Germany, Ireland, Italy, Japan, Switzerland, the United Kingdom and the United States. For countries with emerging countries, there are Brazil, Malaysia and Russia.

Now, we would look at the responses of the government adopting wages subsidy policy, and timing of policy adoption. Advanced economies and emerging economies countries adopted the wage subsidy policy when COVID-19 cases were skyrocketing. Based on Figure 2.1, it is observed that countries with advanced economies would normally come out with a response action during the booming of COVID-19 cases as the immediate response is able to reduce the adverse impacts of the pandemic towards unemployment rates. For countries with emerging economies, they might have difficulties in adapting to this pandemic crisis compared to advanced economies; hence, they would normally earlier their response action to reduce the pandemic impacts to their economic growth.


Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Australia
23th
Wage subsidy stimulus package
Extended JobKeeper Payment Scheme
Brazil
1st
Income Preservation Benefit
Payroll assistance credit
Canada
21st
Emergency Wage Subsidy
Temporary Wage Subsidy
Denmark
12th
Salary compensation scheme
Salary compensation scheme
Finland
7th
Unemployment Benefit


Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Germany
20th
Short-Time Working Compensation (Kurzarbeitergeld)
Ireland
10th
Temporary Wage Subsidy Scheme
Employer Wage Subsidy Scheme
Italy
12th
Covid-19 Ordinary Redundancy Scheme
Japan
12th
Employment adjustment subsides program
Malaysia
16th
Wage subsidy programme
Russia
12th
Supports to SMEs



Notes: indicates the booming date of COVID-19 cases in those countries.
In default, the starting date of the policy is the first day of the month and ending date of the policy is the last day of the month.
Figure 2.1 Timeline of Wages Subsidy Policies

Besides, the effectiveness of government policy to control the spread of viruses and reduce unemployment rate problems can be improved by tailoring the policy to each country. Taking a deeper consideration, the affected countries would like to initiate the most effective government policy which incurs the lowest economic costs to them. According to Chen and Qiu (2020), the most effective and lowest economic cost government policy is the centralised quarantine, followed by lockdown and school closure. This is because centralised quarantine is able to reduce the spread of viruses as the quarantine centres are located at central locations rather than at home. The longer the period used in controlling the spread of viruses, it would cause the country to bear higher economic cost. Especially for poorly developed countries, they may face financial difficulty to adapt to this pandemic crisis which may cause a huge economic impact on their future. The temporary workers will fall into unemployment because the economy halts during the pandemic. In short, leaders of each country should be careful when choosing the types of government policy to replace ineffective government policy in order to minimise the economic costs of their countries. Hence, it is stated that centralised quarantine is the most cost effective policy but does it make it the most effective government policy to control high unemployment rate problems?

After looking at the different timing of adoption policy and the types of government policy, the focus would now be placed on how intervention of government policy reduces the economic impacts of unemployment. Due to the existence of COVID-19, economic growth of countries have been affected seriously which can be compared to the economic impacts of the Great Depression. So, the government would like to reduce the unemployment problem and reboot their economy through government fiscal policy. This is because government fiscal policy can bring direct impacts in a short period to the economy and reduce the adverse impact of the unemployment rate.

According to Shaha, Safria, Noordinc, Rahmand, Sekawie, Iderisf and Sultana (2020), the government of Malaysia announced the PRIHATIN package to alleviate the economic impacts and the financial burden to the nations. They offered grants, subsidies and loans through fiscal policy to encourage those eligible nations to spend which can improve the economic growth of the country. When the nations spend, it will create job opportunities in the market and solve the unemployment problem in the future. Not only Malaysia, other countries had also initiated many fiscal policies to reduce the economic impacts on unemployment.

Based on Table 2.1, it illustrates the fiscal policies of the 14 countries by measuring the total amount of government spending against their gross domestic product (GDP). We would like to analyse the efficiency of fiscal policies in response to the COVID-19 pandemic and their impacts towards the unemployment rate. Fiscal policies can be categorised into 3 categories which are the above the line measures, below the line measures and contingent liabilities. For above the line measures, it included government's additional spendings and forgone revenue during the COVID-19 pandemic, while below the line measures included the transactions in extra-budgetary funds such as loans, assets purchases, equity injections and debt assumptions. For the case of contingent liabilities, it is focused on guarantees and quasi-fiscal operations. The currency for all countries is standardized by the US dollar which converts from local currency to US dollar, which is based on exchange rate in January 2021. The percentage of GDP is measured by the GDP of the countries in 2020.

For the government spending on fiscal policies in proportion to total GDP(%), Germany is placed first as it allocates 39.1% of its total GDP in fiscal policies. The other countries that follows are Italy with 37.9%, Japan with 35%, United Kingdom with 25.8%, Canada with 16.8%, Denmark with 14.9%, Brazil with 14.6%, United States with 14.3%, Australia with 13.5%, Switzerland with 11.2%, Finland with 9.6%, Malaysia with 7.9%, Ireland with 7.6%, and lastly Russia with 3.4%. Since the amount of fiscal policies are measured in USD dollars, a statistical comparison can be made between the countries in terms of the amounts spent in fiscal policies and percentage of GDP perspectives. With this, the total amount of government support towards economic growth is able to be determined.

Referring to Figure 2.1 and Table 2.1, we had found that the timelines of wage subsidy policies and the percentage of total government spending against each country's GDP were not interlinked to each other. For example, Italy adopted its fiscal policies during the booming time of COVID-19 and the government had contributed 37.9% of its total GDP towards fiscal policy. Russia also adopted its wage subsidies at the booming time of COVID-19 and contributed 3.4% of its total GDP towards fiscal policy. Although both countries had adopted their fiscal policies during the booming time of COVID-19, the amount of money used in the total government spending is very different in both countries. So, the timing of adoption of government policy, size of government spending and types of government policy are linked together. They need to perform together and tailor to the condition of countries to maximize their efficiency.

Table 2.1 Fiscal Policies of 14 Countries

Country	Amount (USD billion)	% of GDP
Australia	242	13.5
Brazil	206	14.6
Canada	306	16.8
Denmark	20.9	14.9
Finland	26.5	9.6
Germany	1472	39.1
Ireland	28.6	7.6
Italy	790	37.9
Japan	2210	35
Malaysia	27.1	7.9
Russia	64	3.4
Switzerland	84.4	11.2
United Kingdom	878	25.8
United States	4013	14.3

Notes: The fiscal policies focused on in above the line measures, below the line measures and contingent liabilities.
Source: International Monetary Fund (IMF)

In short, the previous literature review showed that centralised quarantine is the most effective government policy to reduce the spread of COVID-19. The timing of policy adoption and size of government policy spending will become a key feature to the success of government policy. This is because they can impact the economy directly and reduce the impacts of COVID-19 to unemployment. Thus, the appropriate timing of adoption of government policy, size of government spending and types of government policy should tailor to the condition of countries.

2.4 Consideration on Lockdown between Countries

2.4.1 Is Social Distancing and Lockdown Necessary?

In the midst of the COVID-19 pandemic crisis, it seems that the majority of the countries have opted to implement social distancing and lockdown on countries as one of the measures to combat the further spread of the virus. According to Goes and Gallo (2020), it is said that a lockdown is able to lower the infection rate effectively. However, at the same there are also arguments that commented on the lockdown causing the unemployment rate to rise (Baek, McCrory, Messer & Mui, 2020; Faber, Ghisletta, & Schmidheiny, 2020; Beland, Brodeur, & Wright, 2020).

According to Estrada (2020), it is concluded that developed countries have a higher frequency of COVID-19 cases while for underdeveloped countries, their COVID-19 vulnerability rate is typically higher than in other countries. Therefore, if the COVID-19 virus is not contained in those countries, it will lead to a massive outbreak of COVID-19 cases. For the developed countries, the COVID-19 cases will skyrocket just as observed as in the United States. While for underdeveloped countries they will have a shortage of medical equipment due to not being able to afford it. Ornelas (2020) also mentioned that the cost bear by the developing countries would be much higher than developed countries in terms of health and economic cost.

Hence, social distancing and lockdown are indeed necessary to prevent the pandemic from becoming worse. However, it is important to be able to weigh the benefits and cost of the lockdown, because if the government failed to detect the changes, the prolonged lockdown would cause the unemployment rate to be even higher and the country's economy to suffer. It is also notable to acknowledge the harm that can be caused by extensive mobility restriction. Therefore, the role of the government is crucial to help soften the impact of the pandemic on the communities.

2.4.2 What is the Optimal Period for Lockdown?

Lockdown, stay-at-home orders (SAH), movement control order, and circuit breakers are some of the terms that are used by different countries when imposing mobility restrictions during the COVID-19 pandemic period. The lockdown had limited all forms of close

interaction. Therefore, normal routines such as eating out, shopping, sports activities, and special ceremonies had all been banned. Businesses are unable to operate normally and all non-essential businesses have been ordered to shut down. Of course, this causes an uproar among many communities as the mobility restriction has disrupted their daily norm.

The lockdown is indeed very important to help curb the further infection of the COVID-19 virus (Goes & Gallo, 2020), but how long should the lockdown be imposed? In reality, lockdown and social distancing have both pros and cons. According to Ornelas (2020), the economic benefit of the lockdown helps in preventing the further spread of the virus and the overcrowding in the hospitals. For the economic cost, of course, it is the increasing unemployment rate. Ornelas (2020) mentioned that the economic benefit and cost of the lockdown is not fixed as it changes throughout the lockdown period. At the start of the lockdown, the benefit is greater than the cost, but as the health situation turns to be more controllable the cost will then exceed the benefits.

As the lockdown is extended further, the economic cost increases more. This is because businesses would not be able to sustain their business and eventually go bankrupt due to absence of inflow of revenue. This will then cause the workers to be laid off as business could not afford to pay their wages. A loss in income for individuals would result in a decrease in aggregate consumption, thus impacting the economy of the country. This can later be proven by Ozili and Arun (2020), whereby a negative and significant relationship is found between the lockdown period and the level of economic activities.

Hence, the optimal length of the lockdown should depend on how well the country is able to cope in combating the COVID-19 pandemic. This is because the longer a country stays in lockdown the more harm it will cause to the economy. Ornelas (2020) then suggested that an intermediate lockdown would be the best policy whereby the lockdown should not be lifted as long as the pandemic is still a threat and there is no vaccine available yet. However, the rules of the lockdown could be relaxed after the initial period to enable the country to resume its economic activities and prevent the unemployment rate from increasing further.

2.5 Literature Gap

Looking at past literature, most of the journals focused on studying the relationship between the variables independently. For example, Goes and Gallo (2020); Couch, Fairlie and Xu (2020) studied the relationship between COVID-19 and unemployment while Chen and Qiu (2020) examined the relationship for government policy and the unemployment rate. Baek, McCory, Messer, and Mui (2020) on the other hand, research on the relation of the level of economic activity and unemployment rate. By far, there is no journal that combines all three variables together into one journal.

The effects of the rising unemployment rate during the COVID-19 pandemic period is not a result of one variable only as it could be caused by the combined effect of a few variables. Therefore, our research is capturing these three important variables which are the COVID-19, government policy and the level of economic activity within the same framework. Our research is going to study the effects of COVID-19, government policy and the level of economic activity towards the unemployment rate.

Chapter 3: Methodology

3.1 Theoretical Model

In our empirical study, we use Okun's law as our supporting theory as it examines the relationship between the unemployment rate and economic activity. Okun's law stated that there is a negative relationship between the unemployment rate and economic activity (Okun, 1962). Negative relationship means that when the unemployment rate increases, economic activity will decrease, vice versa. Hence, there is an inverse effect between the unemployment rate and economic activity.

In Okun's law, there are many different versions along with different properties and specifications. For example, gap version, dynamic version and difference version. For our study, we had chosen to use Okun's law in the gap version as our theoretical model. This is because it can examine the relationship of the unemployment gap, $(U_{it} - U_{it}^{*})$ and economic activity gap, $(Y_{it} - Y_{it}^{*})$. So, we will transform the original Okun's law to match with our empirical study. Equation 3.1 stated below is the original model of Okun's law:

$$U_{it} - U_{it}^{*} = \beta_1 (Y_{it} - Y_{it}^{*}) \tag{3.1}$$

where U_{it} refers to the unemployment rate, U_{it}^{*} refers to the natural rate of unemployment, β_1 refers to the coefficient of Okun's law, $\beta_1 < 0$, Y_{it} refers to economic activity and Y_{it}^{*} refers to potential economic activity. All the variables in Equation 3.1 are measured in the long-run levels. The assumption of the equation is that β_1 lesser than 0 ($\beta_1 < 0$), which means that the sign would be negative. Hence, this indicates that there is a negative linear relationship between the unemployment rate and economic activity which matched the theory of Okun's law. This equation is adapted from Akram, Hussain, Raza & Masood, (2014) which aims to illustrate the impacts of economic activity on the unemployment rate. Therefore, in order to specify the changes in the unemployment rate, we had then converted Equation 3.1 to Equation 3.2.

$$U_{it} = \beta_0 + \beta_1 Y_{it}^{c} \tag{3.2}$$

where β_0 equals to the natural rate of unemployment, U_{it}^* and Y_{it}^c refers to economic activity gap, $(Y_{it} - Y_{it}^*)$.

Equation 3.2 represents a more simplified version that we had transformed from Equation 3.1. The new equation is able to display the relationship between economic activity and unemployment rate more accurately. Furthermore, there are also other important variables that will affect the unemployment rate which will be included in the extension model.

3.2 Empirical Model

3.2.1 Econometric Model

Aside from economic activity, there are other variables which show significant impact on the unemployment rate during the COVID-19 pandemic. Hence, we had extended our model by adding in new variables like the COVID-19 cases. This is because the unemployment rate during the COVID-19 period is elevated by the number of COVID-19 cases (Patrick, Fernando & Alvin Sanjaya, 2020). Lockdown is also another factor which significantly increases the unemployment rate (Auray & Eyquem, 2020).

Thus, mobility is used as the proxy for economic activity. Mobility is measured by workplace percent change from baseline, and residential percent change from baseline. We use the mobility of people instead of GDP as a proxy of economic activity. This is because the COVID-19 only occurs for almost 1 year, so GDP which is only available on yearly basis is less appropriate. Therefore, mobility is more applicable to be used because it is a high frequency data which is available on a daily basis. Mobility can help to measure economic activity because when more people are at the workplace, it means that people are working and this will increase the productivity of the economy. Hence, economic activity will rise. On the other hand, the proxy for COVID-19 is the number of COVID-19 cases. Therefore, when we include all of these new variable we are able to derive Equation 3.3:

$$U_{it} = \beta_0 + \beta_1(M_{it}) + \beta_2 \, log\,(C_{it}) + \mu_{it} \tag{3.3}$$

where $\beta_0 = U_{it}^*$, U refers to the unemployment rate, M refers to economic activity gap (mobility) and C refers to the number of COVID-19 cases.

We then convert the number of COVID-19 variables in units of natural logarithm as the value of the variable is relatively large compared to the unemployment rate. This is done in order to standardize the unit measurement and to ensure that our equation estimation is more accurate.

3.3 Data Collection Method

For our research, we have chosen to use panel data as the means to conduct our research. Our data spans from the time frame of February 2020 until November 2020 and consists of a total of 14 countries. Those countries are Australia, Brazil, Canada, Denmark, Finland, Germany, Ireland, Italy, Japan, Malaysia, Russia, Switzerland, the United Kingdom and the United States. These countries were specifically chosen as they contained both Western and East Asia countries, hence we would be able to clearly examine the differences in the impact of unemployment in both countries.

For our dependent variable, we are utilizing the monthly unemployment rates of the 14 countries. As only 10 months of data is to be used, this leads to a limitation of data. Therefore, in order to make up for our data limitation we had added more countries into our research. The method of our research is the secondary research which utilizes secondary data. As our aim is to analyse the impact of COVID-19 towards the unemployment rate, we would need professional opinions and findings to ensure that our research is accurate and reliable.

In order to study the impact of COVID-19 towards the unemployment rate, we have chosen three variables to explain the relationship. First of all, the unemployment rate data which is the dependent variable is obtained from Trading Economics and is measured in percentage (%). For the independent variables, firstly is economic activity and mobility would be used as the proxy. Next, the size of government spending would be used as the proxy for government policy. Besides, to measure the impact of COVID-19 we would like to use the monthly confirmed COVID-19 cases. Furthermore, internet accessibility would be used to measure the number of individuals using the Internet. Lastly, stock market index return would be used as the proxy for stock market return. Table 3.1 below shows the summary of the independent variables, their proxy, unit of measurement and the source of data.

Table 3.1: Source of Data

Variables	Proxy	Unit Measurement	Source
Unemployment Rate (Dependent variable)	Unemployment Rate	Percentage (%)	Trading Economics
Economic Activity	Mobility	Percentage (%)	Google Mobility Report
Fiscal policy	Size of Government Spending	Percentage (%)	IMF
COVID-19	Number of COVID-19 cases	Numbers	Our World in Data
Internet Accessibility	Individuals using the Internet	Percentage (%)	World Bank Data
Stock Market Return	Stock Market Index Return	Percentage (%)	Investing

3.3.1 Independent and Dependent Variable

Unemployment Rate

Unemployment rate serves as the dependent variable in our study. According to the OECD, in a normal situation, a person is categorized as unemployed when they do not have a job, do not receive any salary from their employer, are actively looking for a job and the period of absence on the job is more than three months or not specified. However, during the period of COVID-19, the definition of unemployed was modified slightly. For Canada and the United States, workers who are temporarily laid off are classified as unemployed (BLS, 2020). However, that is not the case for Europe. Those who were temporarily laid off due to the COVID-19 were counted as employed in Europe with adherence to the ILO Guidelines (Eurostat, 2016). In general, during the COVID-19 period, a person is only counted as unemployed when he or she does not receive half or more of the wage subsidy from the employer and does not have any confirmation on returning to their work in three month time.

Mobility

Mobility is used as a proxy for economic activity gap. Based on the definition from the Cambridge Dictionary, mobility represents the capability to move freely or easily. Throughout the COVID-19 pandemic period, Google has utilized its Google Maps into tracking the movement of people around the world. This information is later compiled and categorized according to geographic locations, such as countries, regions, workplace, residential and other places to make up the Community Mobility Reports or Google Mobility Reports. Hence, two indicators from the Google Mobility Reports would be used in this research which are the residential percent change from baseline and the workplace percent change from baseline.

The residential percent change from baseline represents the change in the movement of people in the residential areas as compared to the baseline. The baseline refers to the median of the people in residential areas for the period of 3 January 2020 to 6 February 2020 (Ritchie, 2020). As this period is before the outbreak of the COVID-19 to the whole world, hence this period would serve as an unbiased and accurate baseline. Therefore, this indicator would be used to indicate the degree of lockdown imposed on the country. A strict lockdown would imply that the people are not allowed to go out of their residential areas, hence increasing the time that they would spend at home. Therefore, a high value in the residential percent change from baseline would mean that the country is under strict lockdown.

The second indicator is the workplace percent change from baseline. It is defined as the change in the movement of the people in the workplace areas as compared to the baseline. The baseline refers to the median of the people at the workplace for period 3 January 2020 to 6 February 2020 (Ritchie, 2020). We would use this indicator to represent the economic activity of the country. As during lockdown, people are not allowed to work and businesses are forced to closed, therefore, the longer the period of lockdown, it would cause a decreased in the economic activity and leads to a slowdown in the country's economy (Brodeur, Gray, Islam, & Bhuiyan, 2020). Hence, a negative value in the workplace percent change from baseline would mean that the people are still under lockdown and prolonged period of these values would suggest that the country is facing an economic slowdown.

Number of COVID-19 Cases

The number of COVID-19 cases is used to reflect the impact of the COVID-19 towards the unemployment rate. The number of COVID-19 cases is in the form of monthly confirmed cases so that the monthly increment in the cases can be examined. It is said that an increase in the number of COVID-19 cases would lead to an increment in the unemployment rate. This is proven by Couch, Fairlie, and Xu (2020), which states the COVID-19 and unemployment rate has a significant and positive relationship.

As the COVID-19 cases keep rising, the government would implement strict lockdown to prevent the further spread of the infection (Couch, Fairlie, & Xu, 2020). Although the strict lockdown is effective in flattening the COVID-19 curve, it has caused a toll on the unemployment rate as many workers were laid off and businesses were forced to close down (Goes & Gallo, 2020). In fact, certain groups of workers were more vulnerable to being unemployed. Blustein, Duffy, Ferreira, Scali, Cinamon, and Allan (2020) found out that unemployment among youths is higher and has a positive relationship with COVID-19. This is because youths generally have a hard time to find employment due to the harsh employment standards of the society, but with the COVID-19, employers are taking this opportunity to first lay off the youths in means of keeping the more experienced and talented employees.

In addition, the lower-skilled workers are also more vulnerable towards being unemployed. According to Couch, Fairlie, and Xu (2020), it is said that the lower-skilled workers contribute to a higher unemployment rate when the COVID-19 cases are increasing. This indicates that most of the lower-skilled workers are being laid off during the lockdown period. Hence, COVID-19 is expected to positively influence the unemployment rate.

Size of Government Spending

In order to measure the differences in governmental policies implemented across the 14 countries, we would use the size of the government spending as the proxy. In our research, we had decided to utilize the fiscal policy data to determine the size of government spending. As most of the policies implemented by the government during the pandemic comprises under fiscal policy, hence, it would serve as a suitable estimator in examining the effects of different governmental policies on the unemployment rate. Basically, a high government spending on fiscal policy would mean that there would be greater support for the businesses and employees.

With this, employees do not need to worry about if they will be furloughed or forced to reduce their working hours, as they would not completely lose their source of income.

According to Ozili and Arun (2020), they reported that the size of fiscal policy spending has a positive and significant impact on the level of economic activity. Hence, this means that a rise in the government spending on fiscal policy would be able to improve the economy's condition. This is due to rising consumer confidence in spending and consumption. In the earlier period of COVID-19, people have opted to save more as a means of precautionary saving. However, as the COVID-19 becomes more under control, people start to spend and consume again. Therefore, when the level of economic activity increases due to an increase in consumption, the country would slowly recover and this will lead to a decline in the unemployment rate. Hence, the expected relationship between the size of government spending and the unemployment rate is negative.

Internet Accessibility

In addition, internet accessibility would be another independent variable in our research. The proxy for this variable is taken from the World Bank Data under the indicator individuals using the internet (% of population). As we are studying about the changes in mobility due to lockdown policy, hence, this variable serves as a link to better understand the relationship between mobility and unemployment rate. This is because during lockdown, many employees are forced to stay at home or work from home. Hence, we would like to investigate if with the availability of the internet, would it be able to reduce the unemployment rate as people are still able to work from home. Another view by Jayakar and Par (2013) stated that with the availability of the internet, it can increase the chances of people who are out of job to find employment.

Stock Market Return

Stock market return is used to analyse the impact of the stock market towards the unemployment rate. According to Gonzalo and Taamouti (2017) it is reported that there is a positive relationship between stock market return and unemployment rate. Besides, Hui (2007) also reported that stock market returns have a positive effect on the future unemployment rate. This is because when the market expects the unemployment rate to increase, the stock market

return will increase because the government will implement monetary policy to mediate the negative impact of the unemployment rate. Hence, this will cause the interest rate to increase and increase the stock market return.

3.4 Model Estimation

Since we are using panel data for our research, three panel regression models would be used to analyze our model. From it, we would then estimate and decide on the most suitable model to be used for our analysis. The three panel regression models that would be discussed are Pooled ordinary least square model (POLS), fixed effect model (FEM) and random effect model (REM).

3.4.1 Pooled Ordinary Least Square Model (POLS)

There are several assumptions in POLS that must be met before applying the model. The assumptions include slopes are constant, intercepts are constant and time invariant. POLS assumes that there is no time effect. POLS also suppose the error term is independent. To make the hypothesis testing result valid, it must be normally distributed. When every assumption is met, the estimator is Best Linear Unbiased Estimate (BLUE). The POLS estimator (Equation 3.4) will be:

$$U_t = \beta_0 + \beta_1(M_t) + \beta_2(C_t) + \mu_t \quad (3.4)$$

Where t = 1, 2, ... , T, $\beta_0 = U_{it}^*$, *U* refers to the unemployment rate, *M* refers to the economic activity gap, *C* refers to COVID-19 cases and μ refers to the error term.

Some limitations of POLS will occur when heterogeneity exists. The value of the estimated parameter will become inconsistent, biased and inefficient over some periods.

3.4.2 Fixed Effect Model (FEM)

FEM is a model that uses ordinary least square (OLS) principle. The model assumed the independent variables are constant and only the changes of independent variables will affect the dependent variable. It also assumed there is no time effect, having constant slopes and different intercepts. The equation will be as (3.5):

$$U_{it} = \beta_0 + \alpha_i + \beta_1(M_{it}) + \beta_2(C_{it}) + \mu_{it} \quad (3.5)$$

where i = 1, 2, … , N , t = 1, 2, ... , T, $\beta_0 = U_{it}^*$, *U* refers to the unemployment rate, *M* refers to the economic activity, *C* refers to COVID-19 cases, α refers to the inconstant or random individual-specific incorrect component and μ refers to the incorrect component that combines time series and cross section. The limitations of FEM are limited duration, inaccurate P-values and biased coefficients.

3.4.3 Random Effect Model (REM)

REM is different from two of the models above as it uses generalized least square (GLS) principle rather than the OLS principle to achieve BLUE estimation. REM assumes the intercept of the individual unit is a random pick from large population data with consistent mean value. Then, the consistent mean value can become the deviation of the intercept. REM is preferable to utilize when every cross-sectional unit for the intercept is not correlated with the regressors. The intercept can be interpreted as (3.6):

$$U_{it} = \beta_0 + \beta_1(M_{it}) + \beta_2(C_{it}) + \varepsilon_i + \mu_{it} \quad (3.6)$$

Where i = 1, 2, … , N , t = 1, 2, ... , T, $\beta_0 = U_{it}^*$, *U* refers to the unemployment rate, *M* refers to the economic activity, *C* refers to COVID-19 cases, ε refers to the cross-section error component is inconstant or random and μ refers to the mix of cross-sectional and time series error component.

The assumption of REM is no time effect, slopes are the same and intercepts are different. The benefit of utilizing REM is it has lesser unknown parameters. Besides, the chance of facing a multicollinearity problem will be lesser as the model reduced the number of independent variables.

Chapter 4: Data Analysis

4.1 Introduction

In Chapter 4, we would like to analyse the impacts of residential mobility and workplace mobility towards the unemployment rate. Firstly, we had regressed our basic model with the three panel regression model which is POLS, FEM and REM. After the basic model estimation, we further ran the hypothesis testing to determine which panel regression model is the most suitable for our model regression. The best fit model would then be used to study our extension model for the purpose of analyzing the impact of other variables towards the unemployment rate of the 14 countries.

4.1.1 Expectation on Variables

Before proceeding to our model estimation, we first laid out the theoretical expected relationship of each variable. In our research, mobility acts as the proxy for our economic activity gap variable. Hence, the two types of mobility used are workplace mobility and residential mobility. The workplace mobility is expected to contribute negative impacts to the unemployment rate while residential mobility is expected to contribute positive impacts to the unemployment rate. This is because, when people engage in the workplace, they will increase the employment rate and decrease the unemployment rate. For residential mobility, the unemployment rate will increase when people stay at home and are not engaged in the workplace.

On the other hands, the size of government spending acts as the proxy for fiscal policy. We expected it to contribute negative impacts to the unemployment rate. This is due to government spending will reduce the unemployment rate through subsidies, grants and other policies. In order to analyse the impacts of government spending, we have interacted it with other variables and examined if the interaction will change the expected relationship of

interacted variables. For the internet accessibility variable, we expected it to have a negative relationship with the unemployment rate. This is because, people are able to work from home with the internet accessibility and this leads to a decrease in the unemployment rate.

Another variable is the number of COVID-19 cases. We expected it to contribute a positive impact to the unemployment rate. As the number of COVID-19 cases increases, there are many people who will be affected as the lockdown is imposed and they are unable to go to work. Although some people are able to work from home, but, some jobs are still required to work at the office such as the finance department of companies. Thus, the number of COVID-19 cases will contribute a positive impact to the unemployment rate. The last variable that will affect the unemployment rate is stock market return. The expected relationship of stock market return has a positive effect on the unemployment rate. This is due to the profitable stock market return that will attract more people to become trading investors and indirectly contribute to the unemployment rate.

Table 4.1: Expected Relationship of all the Independent Variables against the Dependent Variable

Variables	Proxy	Expected relationship
Economic Activity	Residential Mobility Workplace Mobility	Positive (+) Negative (-)
Fiscal policy	Size of Government Spending	Negative (-)
Internet Accessibility	Individuals using the Internet	Negative (-)
COVID-19	Number of COVID-19 cases	Positive (+)
Stock Market Return	Stock Market Index Return	Positive (+)

4.2 Basic Model Estimation

We would first begin our model analysis by estimating the basic model of the three panel regression model which is the POLS, FEM and REM. The basic model is focused on studying the impacts of mobility towards the unemployment rate. There are two types of mobility that

are used to estimate its impacts towards the unemployment rate which are workplace mobility and residential mobility. Table 4.2 below shows the regression results of the basic model for the POLS, FEM and REM model.

Table 4.2: Basic Model Results

	POLS	FEM	REM
C	5.9942 *** (0.5177)	5.6028*** (0.2327)	5.614*** (0.8711)
RM	0.0732 (0.0631)	-0.0556 (0.0362)	-0.0513 (0.0359)
WM	0.0033 (0.0295)	-0.0602*** (0.0166)	-0.0582*** (0.0165)
Adjusted R-Squared	0.0051	0.8382	0.1186
F-Statistics	1.3577	48.994	10.3543
Durbin-Watson Statistics	0.1447	1.014	0.9211
Jarque-Bera Stat	19.127	151.9625	32.1845

Notes: Number in the parenthesis indicates the Standard Error
*,**,*** denotes the significance level at 10%, 5%, 1% respectively
RM refers to residential mobility; *WM* refers to the workplace mobility.

Based on Table 4.2, both mobility variables reflect negative impacts to the unemployment rate for the FEM and REM model. This result works similar to Okun's Law which is the underlying theory of our basic model. The theory illustrates that economic activity and unemployment rate have a negative relationship. For the POLS model both mobility variables showed a positive relationship but, they are insignificant to the model.

Looking from the residential mobility perspectives, it brings negative impacts to the unemployment rate. This indicates that people who tend to move their residences will decrease the unemployment rate. This is because they move their residence to a better place which has a high employment opportunity and low unemployment rate. Thus, increasing residential mobility will lead to decline in unemployment rate. Although residential mobility will affect the unemployment rate, the results showed residential mobility contributed insignificant effect to the unemployment rate. According to Langella & Manning (2019), they found that residential mobility brings a significant negative impact to the unemployment rate, but it

becomes insignificant after taking individual fixed effects as consideration. To determine whether residential mobility will have an actual impact toward the unemployment rate, we further extended our research in Section 4.3 to define it.

For workplace mobility, when the workplace mobility increases, it will decrease the unemployment rate because the rising workplace mobility indicates that people are engaged in the labour force. This simply means that lockdown regulations are being relaxed and employees are now returning back to work. Hence, workplace mobility plays a significant role to estimate impacts on the unemployment rate with 1% of significance level as it is able to indicate the strictness of lockdown policy by policymakers. According to Faisal, Ansari, Hussnain & Abbas (2019), they found that there is a negative correlation between workplace mobility and unemployment rate through correlation analysis.

4.3 Decision on Best Fit Model

To determine which model is the best fit model for our further research, we had run three types of hypothesis testing. The results of the hypothesis test are as stated in Table 4.3.

Table 4.3: Results of Hypothesis Testing

	Poolability test	Hausman Test	Breusch Pagan Lagrange Multiplier
Test Statistic	59.8389**	0.9562**	420.1749***
Results	FEM is preferable	REM is preferable	REM is preferable

Notes: *,**,*** denotes the significance level at 10%, 5%, 1% respectively

First, the result of the Poolability test showed the F-statistic is larger than the critical value. The rejection of H_0 happens when the F-statistic is larger than the critical value. Rejecting H_0 means that we can conclude that a Fixed Effect Model is more preferable than Pooled OLS.

Second, we did a Hausman test to determine whether the Random Effect Model or Fixed Effect Model is more suitable for our data. As the test statistic is smaller than the critical

value, we do not reject H_0. Thus, we have sufficient evidence to conclude that Random Effect Model is more preferable as we do not reject H_0.

Lastly, Breusch and Pagan Lagrange Multiplier test also shows the test statistic greater than the critical value which represents Random Effect Model is more preferable than Pooled OLS.

4.3.1 Extended Model Estimation

Based on the results of the hypothesis testing, we have chosen to use the REM model for our model estimation. To start off, we would first regress the basic model as shown in Model 1 in Table 4.4. The basic model is based on Okun's Law as we are interested in examining the relationship between economic activity gap (mobilities) and unemployment rate. From Table 4.4, we are able to see the negative correlation between the residential mobility and workplace mobility towards the unemployment rate.

We then add in another independent variable which is *LnC* (refer to Table 4.4 column 3). The results show that the expected sign is hypothesized which is a positive relationship and the variable is highly significant to our model at 1% significance level. In addition, the adjusted R-squared which indicated the goodness of fit of the model also increases as compared to the basic model. The *LnC* interprets that when the COVID-19 cases increase by 1%, the unemployment rate for the countries in our study will increase by 0.1476 percentage point. It shows that residential mobility and workplace mobility which represent our economic activity gap were not the main cause of affecting the unemployment rate.

Table 4.4: Extended Model

Model	1	2
C	5.6140*** (0.8711)	4.6187*** (0.8822)
RM	-0.0513 (0.0359)	-0.0547 (0.0347)
WM	-0.0582*** (0.0165)	-0.0433** (0.0166)
LnC		0.1476*** (0.0448)
Adjusted R-Squared	0.1186	0.1955
F-Statistics	10.3543	11.0138
Durbin-Watson Statistics	0.9211	1.0288
Jarque-Bera Stat	32.1845	24.4623

Notes: Number in the parenthesis indicates the Standard Error
*,**,*** denotes the significance level at 10%, 5%, 1% respectively
RM refers to the residential mobility, *WM* refers to the workplace mobility and
LnC refers to the natural logarithm of COVID-19 cases

4.3.2 Interaction of Mobilities, Government Spending and Internet towards Unemployment Rate

In this section, we would like to investigate how the independent variables interact with each other and whether the interaction relationship would change its effect towards the unemployment rate. Hence, we had introduced 3 new equations in this section. The equations are shown in Equation 4.1, Equation 4.2 and Equation 4.3. Table 4.4 represents the regression result of the equation.

Looking at Table 4.5 column 2, we had added an interaction term to the model which is *RMxWM* . The equation of the interaction term is shown in Equation 4.1. The purpose of the interaction term is to study the effects towards unemployment rate when workplace mobility interacts with residential mobility. From variable individual impacts, workplace mobility contributed negative impacts to the unemployment rate, while residential mobility contributed positive impacts to the unemployment rate. We would like to analyse the overall impacts of mobility regardless workplace or residential mobility to the unemployment rate. By looking at interaction term impact, we can analyse which types of mobility contributed a larger impact to

the unemployment rate. From Table 4.5 column 2, we can clearly see that there is a positive relationship between *RMxWM* and the unemployment rate, indicating that when more people stay at home, the unemployment rate increases. Moreover, the residential mobility variable has a positive relationship in Table 4.5 column 2. However, the presence of this interaction term increases the insignificancy of the residential mobility factor.

$$U_{it} = \beta_0 + \beta_1(RM_{it}) + \beta_2(WM_{it}) + \beta_3(RMxWM) + \mu_{it} \quad (4.1)$$

Table 4.5 Interaction Variables

Model	1	2	3
C	5.2695*** (0.7467)	4.6602*** (0.9263)	4.6721*** (0.7565)
RM	0.0203 (0.0508)	-0.0514 (0.0588)	-0.3767 (0.2325)
WM	-0.0669*** (0.0171)	-0.0635** (0.0291)	
LnC		0.1458*** (0.0449)	0.1849*** (0.0433)
RMxWM	0.0017* (0.0009)		
GSxRM		-0.0005 (0.0027)	
GSxWM		0.0011 (0.0013)	
IxRM			0.0046* (0.0027)
Adjusted R-Squared	0.1478	0.1823	0.1509
F-Statistics	7.8639	7.1967	9.2352
Durbin-Watson Statistics	0.9580	1.0311	0.9536
Jarque-Bera Stat	31.3317	28.6999	19.4741

Notes: Number in the parenthesis indicates the Standard Error
*,**,*** denotes the significance level at 10%,5%,1% respectively
RM refers to the residential mobility, *WM* refers to the workplace mobility, *LnC* refers to natural logarithms of COVID-19 cases, *SMR* refers to stock market return, *IxRM* refers to the interaction term of internet accessibility and residential mobility, *GSxRM* refers to the interaction term of government spending and residential mobility, *GSxWM* refers to the interaction term of government spending and workplace mobility and *RMxWM* refers to the interaction term of residential mobility and workplace mobility.

We then added the government spending variable into Table 4.5 Column 3. The equation of the interaction term is shown at Equation 4.2. We had government spending interact with the mobility variables to study if with the aid of the government, how it affects mobility and ultimately the unemployment rate. This is because we have multiple expectations towards government spending. The unemployment rate will increase when people stay at home, while the existence of government spending will decrease the impacts of staying at home and change the impacts to the unemployment rate. Two additional interaction term, *GSxRM* and *GSxWM* were regressed into the model (Table 4.5 Column 3). The results showed that the expected relationship for *GSxRM* and *GSxWM* are as we hypothesized, but the p-value indicates that both interaction terms are insignificant to the model. It means even if the government increases the subsidy in the workplace and residential, it does not assist the unemployment rate.

$$U_{it} = \beta_0 + \beta_1(RM_{it}) + \beta_2(WM_{it}) + \beta_3(LnC_{it}) + \beta_4(GSxRM) + \beta_5(GSxWM) + \mu_{it} \quad (4.2)$$

Therefore, we are now interested in studying how internet accessibility affects residential mobility. As during the lockdown many employees had to work from home, hence how does internet accessibility affect their work performance and how does the unemployment rate have been improved by the internet accessibility. Hence by looking at Table 4.5 Column 4, we had regressed unemployment rate with residential mobility and *IxRM* which is the interaction term between internet accessibility and residential mobility. The equation of the interaction term is shown at Equation 4.3. The findings shows that *IxRM* has a positive relationship with the unemployment rate and it is significant at 10% significance level. It indicates that the increase of internet access will increase residential mobility. When employees have internet access in their residence, they are able to access the server of the company and continue their work at home. Work from home culture will be more common after the spread of COVID-19 virus.

$$U_{it} = \beta_0 + \beta_1(RM_{it}) + \beta_2(LnC_{it}) + \beta_3(IxRM) + \mu_{it} \quad (4.3)$$

4.4 How Stock Market Return Affect Unemployment Rate

Now, we are concerned that during the COVID-19 period when there is limited mobility, how will the performance of the stock market return be impacted. Besides, we also try to study what is the relationship between the stock market return and unemployment rate, whether the stock market performance was better than before. Thus, we had regressed the *SMR* into column 2 to see the relationship with the unemployment rate (refer to Table 4.6). The equation of the interaction term is shown in Equation 4.4. The stock market return had a positive relationship with the unemployment rate and it is significant at 5% significance level. It is possible that employees feel the stock market return may gain more money than working under a corporation, so they focus more on investing or speculating in the stock market. The low working efficiency in a company because they invest in the stock market during the stay from home period, it leads to the companies fire more employees. The firing of low efficiency employees may reduce the labour cost of the company.

$$U_{it} = \beta_0 + \beta_1(RM_{it}) + \beta_2(WM_{it}) + \beta_3(LnC_{it}) + \beta_4(SMR_{it}) + \mu_{it} \quad (4.4)$$

As we have proved that internet accessibility plays an important role in affecting the residential mobility, we would add the *IxRM* interaction term to Table 4.6 Column 3 to investigate when there is internet access and most of the people stay at home, how will it change the stock market. The equation of the interaction term is shown in Equation 4.5. The results show that the *IxRM* and the *SMR* has a positive relationship with the unemployment rate and all the variables are significant to the model at 10% significance level.

$$U_{it} = \beta_0 + \beta_1(RM_{it}) + \beta_2(WM_{it}) + \beta_3(LnC_{it}) + \beta_4(SMR_{it}) + \beta_5(IxRM) + \mu_{it} \quad (4.5)$$

Since the lockdown policy was implemented by most of the government during the pandemic period, it forced the people to stay at home. With the internet accessibility, people can access the stock broker platform. This increases the convenience to invest their money in the stock market. There were more people investing or speculating in the stock market when they stayed at home. Thus, the stock market return increased during that period and the unemployment rate increased due to more people being attracted by the higher return in the stock market.

Table 4.6 Extension on Stock Market Return

Model	1	2
C	4.9585*** (0.9146)	4.9544*** (0.7817)
RM	-0.0547 (0.0343)	-0.4313* (0.2259)
WM	-0.0369** (0.0167)	-0.0313* (0.0165)
LnC	0.1250*** (0.0456)	0.1321*** (0.0447)
SMR	0.0278** (0.0138)	0.02997** (0.0136)
IxRM		0.0045* (0.0027)
Adjusted R-Squared	0.1969	0.2013
F-Statistics	9.5187	8.0051
Durbin-Watson Statistics	1.0107	0.9646
Jarque-Bera Stat	24.2791	25.9940

Notes: Number in the parenthesis indicates the Standard Error
*,**,*** denotes the significance level at 10%, 5%, 1% respectively
RM refers to the residential mobility, *WM* refers to the workplace mobility, *LnC* refers to natural logarithms of COVID-19 cases, *SMR* refers to stock market return, *IxRM* refers to the interaction term of internet accessibility and residential mobility.

Chapter 5: Discussion, Limitation, Recommendation and Conclusion

5.1 Introduction

This chapter will discuss the findings and summarize the result of chapter 4. Moreover, we will compare the expected relationship with the result output to determine whether we meet the objectives of our research. We will also discuss the limitations of our research and give some recommendations if any of the researchers want to do some further study. Finally, we will give a brief conclusion for the research of the unemployment rate during the COVID-19 pandemic.

5.2 Major Findings

The first motivation for us to do this research is that we intend to find out the consequences of COVID-19 pandemic towards the unemployment rate. During that time, COVID-19 pandemic was an often discussed current issue, but there was only little research done on it. Since it is a global issue which has brought most of the economy in the world to a halt, we are interested to study how it affects the unemployment rate. The research we have done is able to find out our research objectives. We are able to study the effects of COVID-19 from Chapter 4. We are also able to analyse the effects of the role played by policymakers in monetary policy in Chapter 4. Since we use mobility as the proxy for economic activity gap, mobility is also studied by us for their effects towards unemployment in Chapter 4. Therefore, we are able to attain our research objectives which stated in Chapter 1.

After constructing our basic model, we further construct model 2 in Table 4.3 to investigate how COVID-19 affects unemployment rate. The expected sign of COVID-19 cases is positive and the results shown in the model 2 in Table 4.3 have met our expectation. COVID-19 cases have also been proved to be significant in affecting the unemployment rate.

For the second objective, the result is shown in model 2 in Table 4.4. The relationship between both interaction terms of government spending and mobilities with unemployment is the same as what we expect. However, they are insignificant. The reason might be the government spending is an interaction term with mobility and not an individual term in the model.

We also find out that mobility affects the unemployment rate which is shown in model 1 in table 4.4. The relationship of residential mobility and workplace mobility with the unemployment rate is as we expected. The insignificance of residential mobility might be due to its irrelevance with stay at home. This is because people going out from home and back to home will also be considered as residential mobility. The interaction term of residential mobility and workplace mobility showed us the overall effect of mobility is positive towards the unemployment rate. However, the positive effect is comparatively small.

5.3 Limitation

Although our research achieved and met research objectives successfully, there are some of the limitations that we found in this research. These limitations should be improved and used for further study in future. The first limitation that we faced is the short time frame and it leads to insufficient databases. In order to increase our database, we should add in more countries to analyse their unemployment impacts. Since we add in more countries to our database, we are unable to analyse the effects of each country. Our research output analyses the overall effects of all countries, not the individual effects to each country. Researchers are suggested to focus on individual country to analyse one country's action.

On the other hand, the period of collected data as our independent variables are restricted in monthly data because of the short time frame. Due to the short time frame, collected data are restricted to many countries and monthly data. This will limit the independent variables that can be used in our research, while most of the independent variables are annually data. We are unable to adopt annual data as our independent variables, but most of the data are measured in annual such as gross domestic product (GDP) and inflation rate. The restriction filtered out most of the independent variables we can use in our research.

Lastly, non-disclosure of information is also one of the limitations to our research. This is due to some of the countries not disclosing their information to the public will restrict us to analyse our study on those countries. In our research, we are unable to access China's COVID-

19 cases data, and this will limit us to analyse pandemic impacts to unemployment rate in China. The purpose is that we are concerned about the pandemic impacts in China because it is the country which discovered coronavirus in the earliest time.

Due to these limitations, we learnt how to solve these problems in our future research, while it provided a clear direction for further study. These limitations act as a lesson to researchers and enhance their studies in future. We provide some recommendations and hopefully they can help researchers in future research.

5.4 Recommendations

To overcome the limitations, the suggestion provided by us is to extend the time frame of studies so that adequate data can be acquired. By lengthening the time frame, less countries will be required to obtain adequate databases because there are more time series data. Therefore, a deeper analysis can be done on a particular country as less countries are involved in the studies.

Besides, extending the time frame will also alleviate the data restriction problem. This is because a longer time frame is able to achieve sufficient databases with less countries involved. In order to prevent data restriction, researchers may also include data on other basis like daily and yearly as interaction terms. Researchers may also be more cautious when they choose the proxy for their studies in the future to avoid such problems.

Lastly, to overcome the non-disclosure information problem, future researchers may avoid studying those countries which did not disclose their information. This is to prevent the accuracy of the analysis to be affected by missing data due to non-disclosure information.

5.5 Conclusion

To summarize the research, we found out that restricting residential mobility will not impact the unemployment rate that showed insignificant results in chapter 4. But workplace mobility shows the confidence level of 99%. The result can be interpreted as the reduction of people going to the office to work; the unemployment rate will directly increase. We also confirmed that there was a negative impact of the COVID-19 pandemic on the unemployment rate. The research met our objectives as we found out the several variables that impact the unemployment rate during the COVID-19 pandemic.

References

Altonji, J., Contractor, Z., Finamor, L., Haygood, R., Lindenlaub, I., Meghir , C., O'Dea, C., Scott, D., Wang, L. (2020). Employment effects of unemployment insurance generosity during the pandemic. Tobin Center for Economic Policy Yale University. Retrieved from https://tobin.yale.edu/sites/default/files/files/C-19%20Articles/CARES-UI_identification_vF(1).pdf

Akram, M., Hussain, S., Raza, S.H., & Masood, S., (2014)."An Empirical Estimation of Okun'S Law in Context of Pakistan." *Journal of Finance and Economics 2.5* (2014): 173-177.

An, B.Y., & Tang, S. (2020), Lessons from Covid-19 responses in East Asia: institutional infrastructure and enduring policy instruments. *American Review of Public Administration 2020, 50(6-7),* 790–800. https://doi.org/10.1177/0275074020943707

Auray., S & Eyquem, A. (2020). The macroeconomic effects of lockdown policies. *Journal of Public Economics.* https://doi.org/10.1016/j.jpubeco.2020.104260

Baek, C.W., McCrory, P.B., Messer, T. and Mui, P. (2020). Unemployment effects of stay-at-home orders: Evidence from high frequency claims data. *IRLE Working Paper*, 101-20. https://irle.berkeley.edu/files/2020/07/Unemployment-Effects-of-Stay-at-Home-Orders.pdf

Ball, L., Leigh, D., & Loungani, P. (2012). Okun's Law: Fit at 50? International Monetary Fund Washington. 13, 8-9. Retrieved from https://www.imf.org/external/np/res/seminars/2012/arc/pdf/BLL.pdf?fbclid=IwAR0_L4Q_9YDJAcoZ1wgicoIhIGOZcjEuC6Qkw-Ha7n8xtgEpaYMRROa9OoU

Beland, L.P., Brodeur, A., and Wright, T. (2020). COVID-19, stay-at-home orders and employment: Evidence from CPS data. *Discussion Paper Series*. IZA Institute of Labor Economics. Retrieved from http://ftp.iza.org/dp13282.pdf

Bell, A., Hedin, T.J., Schnorr, G., & Wachter, T.V. (2020). *An analysis of unemployment insurance claims in California during the COVID-19 pandemic*. Retrieved from https://www.capolicylab.org/wp-content/uploads/2021/02/Dec-21st-Analysis-of-CA-UI-Claims-during-the-COVID-19-Pandemic.pdf

BLS (April 3, 2020). US Bureau of Labor Statistics. Retrieved from https://www.bls.gov/cps/employment-situation-covid19-faq-march-2020.pdf

Blustein, D., Duffy, R., Ferreira, J., Scali, V., Cinamon, R., & Allan, B. (2020). Unemployment in the time of COVID-19: A research agenda. *Journal of Vocational Behaviour 119*. doi: 10.1016/j.jvb.2020.103436

Brodeur, A., Gray, D., Islam, A., & Bhuiyan, S.J. (2020). A literature review of the economics of COVID-19. Discussion Paper Series. IZA Institute of Labor Economics. Retrieved from http://ftp.iza.org/dp13411.pdf

CDC (2010). The 2009 H1N1 pandemic: summary highlights, April 2009 – April 2010. *Centers for Disease Control and Prevention*. Retrieved from https://www.cdc.gov/h1n1flu/cdcresponse.htm

Ceylan, R. F., & Ozkan, B. (2020). The economic effects of epidemics: From SARS and MERS to COVID-19. *Research Journal in Advanced Humanities*, 1(2), 21-29.

Chan, M. (2009). World now at the start of 2009 influenza pandemic. *World Health Organization*. Retrieved from https://www.who.int/mediacentre/news/statements/2009/h1n1_pandemic_phase6_20090611/en/

Chen, X and Z Qiu (2020), "Scenario analysis of non-pharmaceutical interventions on global COVID-19 transmissions", *Covid Economics: Vetted and Real-Time Papers*, 7, 46-67. Retrieved from https://cepr.org/sites/default/files/news/CovidEconomics7.pdf

Cherry, J.D. (2004). The chronology of the 2002–2003 SARS mini pandemic. *Paediatric Respiratory Reviews,5*(4), 262-269.

Chetty, R., Friedman, J.N., Hendren, N., & Stepner, M. (2020). How did covid-19 and stabilization policies affect spending and employment? *A new real-time economic tracker based on private sector data*. Retrieved from https://iepecdg.com.br/wp-content/uploads/2020/06/tracker_paper.pdf

Coates, B., Cowgill, M., Chen, T. & Mackey, W. (2020). Shutdown: estimating the COVID 19 employment shock. *Grattan Institute*. Retrieved from https://grattan.edu.au/wp-content/uploads/2020/04/Shutdown-estimating-the-COVID-19-employment-shock-Grattan-Institute.pdf

Coibion, O., Gorodnichenko, Y., & Weber, M. (2020). Labor markets during the Covid-19 crisis: A preliminary view. *CESifo Working Paper, No. 8238*, Center for Economic Studies and ifo Institute (CESifo), Munich

Coronavirus (2020). World Health Organization. Retrieved from https://www.who.int/health-topics/coronavirus#tab=tab_1

Coronavirus disease (COVID-19). (2020). World Health Organizations. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19#:~:text=symptoms

Dias, M.C., Joyce, R., Vinay, F.P., & Xu, X. (2020). The Challenges for Labour Market Policy during the COVID-19 Pandemic. *Fiscal Studies*, *41*(2), 371–382.

Estrada, M. A. R. (2020). From inemployment to unemployment worldwide: Post Covid-19. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.3612663

EU labour force survey: Explanatory notes (2016). Eurostat. Retrieved from https://ec.europa.eu/eurostat/documents/1978984/6037342/EU-LFS-explanatory-notes-from-2016-onwards.pdf

Faber, M.,Ghisletta, A. and Schmidheiny, K. (2020). A lockdown index to assess the distributional impact of the coronavirus. *Swiss J Econ Stat*, *156*(1), 11. doi: 10.1186/s41937-020-00056-8

Fang, L., Nie, J., & Xie, Z. (2020). Unemployment insurance during a pandemic. *Federal Reserve Bank of Atlanta Working Paper Series*. Retrieved from https://www.frbatlanta.org/-/media/documents/research/publications/wp/2020/07/31/13-unemployment-insurance-during-a-pandemic.pdf

Forsythe, E., Kahn, L.B., Lange, F. & Wiczer, D. (2020). Labor demand in the time of COVID-19: Evidence from vacancy postings and UI claims. *Journal of Public Economics*. https://doi.org/10.1016/j.jpubeco.2020.104238

Gibson, J., & Sun, X. (2020). Understanding the economic impact of COVID-19 stay-at home orders: A synthetic control analysis. http://dx.doi.org/10.2139/ssrn.3601108

Goes, M.C.B. & Gallo, E., (2020). A predator-prey model of unemployment and w-shaped recession in the Covid-19 pandemic. *Working Paper. The New School for Social Research*. doi: 10.13140/RG.2.2.11492.60805

Gong, D., Jiang, T. & Lu, L. (2020). Pandemic and bank lending: evidence from the 2009 H1N1 pandemic. *Finance Research Letters.* https://doi.org/10.1016/j.frl.2020.101627

Gonzalo, J. & Taamouti, A. (2017). The reaction of stock market returns to unemployment. Studies in Nonlinear Dynamics and Econometrics, 21(4). DOI: 10.1515/snde-2015-0078

Hedin, T.J., Schnorr, G., & Wachter, T.V. (2020). An analysis of unemployment insurance claims in california during the covid-19 pandemic. California Policy Lab. Retrieved from https://www.capolicylab.org/wp-content/uploads/2020/05/An-Analysis-of-Unemployment-Insurance-Claims-in-California-during-the-COVID-19-Pandemic-1.pdf

Holgerson, H., Jia, Z., & Svenkerud, S. (2020). Labor demand during the Covid-19 crisis in Norway. https://dx.doi.org/10.2139/ssrn.3663479

Hui. G. (2007). Stock market dispersion and unemployment. Economic synopses. Retrieved from https://files.stlouisfed.org/files/htdocs/publications/es/07/ES0705.pdf

Jayakar, K. & Park, E. A. (2013). Broadband availability and employment: An analysis of county-level data from the national broadband map. *Journal of Information Policy*, 3, 181-300.

Jester, B.J., Uyeki, T.M., Petal, A., Koonin, L., Jernigan, D.B. (2018). 100 years of medical countermeasures and pandemic influenza preparedness. *American Journal of Public Health, 108*(11), 1469–1472.

Kucharski, A.J., Russell, T.W., Diamond, C., Liu, Y., Edmunds, J., Funk, S., Eggo, R.M., Sun, F., Jit, M. & Munday, J.D. (2020). Early dynamics of transmission and control of COVID-19: a mathematical modelling study. Doi: https://doi.org/10.1016/ S1473-3099(20)30144-4

Lauren, M. S. (2021). What is coronavirus. Johns Hopkins Medicine. Retrieved from https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus

Lee, S.H. (2003). The SARS epidemic in Hong Kong: what lessons have we learned? *Journal of The Royal Society of Medicine*, *96*(8), 374-378.

OECD short-term labour market statistics. (June 2020). OECD. Retrieved from oecd.org/sdd/labour-stats/OECD-employment-and-unemployment-statistics-during-the-COVID-19-crisis.pdf

Okun, A. M. (1962). Potential GNP: Its measurement and significance. Proceedings of Business and Economics Statistics Section, *American Statistical Association*, 331-356.

Our World in Data. (2020). Coronavirus (COVID-19 cases). Retrieved from https://ourworldindata.org/covid-cases?country=IND~USA~GBR~CAN~DEU~FRA

Ornelas, E. (2020). Lockdown 101: Managing economic lockdowns in an epidemic. *CESifo Working Paper No. 8455*. Retrieved from https://ssrn.com/abstract=3671240

Ozili, P. & Arun, T. (2020). Spillover of COVID-19: Impact on the global economy. SSRN Electronic Journal. doi: 10.2139/ssrn.3562570

Pan, S.L., Pan, G., & Devadoss, P.R. (2005). E-Government capabilities and crisis management: Lessons from combating SARS in Singapore. *MIS Quarterly Executive 4*, (4), 385-397.

Parmet & Rothstein (2018). The 1918 influenza pandemic: Lessons learned and not – introduction to the special section. *American Journal of Public Health*, *108*(11), 1435-1436.

Patrick, J., Fernando, J., & Sanjaya, A. (2020). The influence of Covid-19 on unemployment in Indonesia. DOI: 10.17605/OSF.IO/TA398

Petrosky-Nadeau, N., & Valletta, R. G. (2020). An Unemployment Crisis after the Onset of COVID-19. *FRBSF Economic Letter*, 1-5.

Policy response to the Coronavirus pandemic. Our World in Data. Retrieved from https://ourworldindata.org/policy-responses-covid

Ritchie, H. Google Mobility trends: How has the pandemic changed the movement of people around the world?. Our World in Data. Retrieved from https://ourworldindata.org/covid-mobility-trends

Rojas, F.L., Jiang, X., Montenovo, L., Simon, K.I., Weinberg, B.A., & Wing, C. (2020). Is the cure worse than the problem itself? Immediate labor market effects of Covid-19 case rates and school closures in the U.S. *NBER Working Paper No. 27127*. Retrieved from http://www.nber.org/papers/w27127

Sebhatu, A., Wennberg, K., Jonsson, S.A., & Lindberg, S.I. (2020). FOLLOW-MY-LEADER. *Public Policy and The Swedish Model*. Retrieved from https://www.hhs.se/contentassets/119de1b2f4fc4364a55657b4ba1d4196/a10.pdf

Shaha, Safria, Thevadasb, Noordinc, Rahmand, Sekawie, Iderisf & Sultana (2020). COVID-19 outbreak in Malaysia: Actions taken by the Malaysian government. *International Journal of Infectious Diseases*. 97, 108-116.

Siu, A., & Wong, Y. R. (2004). Economic impact of SARS: the case of Hong Kong. *Asian Economic Papers*, *3*(1), 62-83.

Summary table of SARS cases by country. (2003). World Health Organization. Retrieved from https://www.who.int/csr/sars/country/2003_08_15/en/

Warner, M., & Lee, G.O.M. (2005). Epidemics, Labour-Markets and Unemployment: The impact of SARS on human resources management in Hong Kong service sector. *International Journal of Human Resource Management*, *16*(5), 752-771.

Warner, M., & Lee, G.O.M. (2007). Human Resources, Labour Markets and Unemployment: The Impact of the SARS Epidemic on the Service Sector in Singapore. *Asia Pacific Business Review*, *12*(4), 507-527.

Warner, M., & Lee, G.O.M. (2007). The impact of SARS on China's human resources: implications for the labour market and level of unemployment in the service sector in Beijing, Guangzhou and Shanghai. *The International Journal of Human Resource Management*, *17*(5), 860-880.

Appendices

Appendix A: Basic Model (POLS)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel Least Squares
Date: 03/12/21 Time: 15:37
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WORKPLACE_MOBILITY	0.003313	0.029524	0.112211	0.9108
RESIDENTIAL_MOBILITY	0.073234	0.063145	1.159768	0.2482
C	5.994199	0.517650	11.57964	0.0000

R-squared	0.019435	Mean dependent var	6.526429
Adjusted R-squared	0.005120	S.D. dependent var	3.146921
S.E. of regression	3.138854	Akaike info criterion	5.146788
Sum squared resid	1349.780	Schwarz criterion	5.209824
Log likelihood	-357.2752	Hannan-Quinn criter.	5.172404
F-statistic	1.357667	Durbin-Watson stat	0.144666
Prob(F-statistic)	0.260699		

Appendix B: Basic Model (FEM)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel Least Squares
Date: 03/12/21 Time: 15:37
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WORKPLACE_MOBILITY	-0.060198	0.016638	-3.618026	0.0004
RESIDENTIAL_MOBILITY	-0.055625	0.036205	-1.536386	0.1270
C	5.602785	0.232677	24.07963	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.855631	Mean dependent var	6.526429
Adjusted R-squared	0.838167	S.D. dependent var	3.146921
S.E. of regression	1.265958	Akaike info criterion	3.416746
Sum squared resid	198.7286	Schwarz criterion	3.752934
Log likelihood	-223.1722	Hannan-Quinn criter.	3.553363
F-statistic	48.99399	Durbin-Watson stat	1.014002
Prob(F-statistic)	0.000000		

Appendix C: Basic Model (REM)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 03/12/21 Time: 15:38
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WORKPLACE_MOBILITY	-0.058160	0.016507	-3.523326	0.0006
RESIDENTIAL_MOBILITY	-0.051328	0.035906	-1.429494	0.1551
C	5.613999	0.871051	6.445085	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	3.141290	0.8603
Idiosyncratic random	1.265958	0.1397

Weighted Statistics

R-squared	0.131310	Mean dependent var	0.825066
Adjusted R-squared	0.118628	S.D. dependent var	1.343318
S.E. of regression	1.261126	Sum squared resid	217.8902
F-statistic	10.35432	Durbin-Watson stat	0.921092
Prob(F-statistic)	0.000065		

Unweighted Statistics

R-squared	-0.014235	Mean dependent var	6.526429
Sum squared resid	1396.127	Durbin-Watson stat	0.143753

Appendix D: Extended Model (Model 1)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 04/10/21 Time: 22:16
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDENTIAL_MOBILITY	-0.051328	0.035906	-1.429494	0.1551
WORKPLACE_MOBILITY	-0.058160	0.016507	-3.523326	0.0006
C	5.613999	0.871051	6.445085	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	3.141290	0.8603
Idiosyncratic random	1.265958	0.1397

Weighted Statistics

R-squared	0.131310	Mean dependent var	0.825066
Adjusted R-squared	0.118628	S.D. dependent var	1.343318
S.E. of regression	1.261126	Sum squared resid	217.8902
F-statistic	10.35432	Durbin-Watson stat	0.921092
Prob(F-statistic)	0.000065		

Unweighted Statistics

R-squared	-0.014235	Mean dependent var	6.526429
Sum squared resid	1396.127	Durbin-Watson stat	0.143753

Appendix E: Extended Model (Model 2)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 04/10/21 Time: 22:17
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDENTIAL_MOBILITY	-0.054723	0.034690	-1.577485	0.1170
WORKPLACE_MOBILITY	-0.043283	0.016562	-2.613384	0.0100
LNCASES	0.147618	0.044801	3.295002	0.0013
C	4.618660	0.882232	5.235199	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	2.985699	0.8564
Idiosyncratic random	1.222805	0.1436

Weighted Statistics

R-squared	0.195463	Mean dependent var	0.838252
Adjusted R-squared	0.177716	S.D. dependent var	1.344895
S.E. of regression	1.219549	Sum squared resid	202.2727
F-statistic	11.01379	Durbin-Watson stat	1.028802
Prob(F-statistic)	0.000002		

Unweighted Statistics

R-squared	0.060181	Mean dependent var	6.526429
Sum squared resid	1293.691	Durbin-Watson stat	0.160856

Appendix F: Interaction Variables (Model 1)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 04/10/21 Time: 22:19
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDENTIAL_MOBILITY	0.020251	0.050818	0.398504	0.6909
WORKPLACE_MOBILITY	-0.066899	0.017067	-3.919884	0.0001
WORKRESIDENTIAL	0.001749	0.000914	1.913673	0.0578
C	5.269548	0.746724	7.056887	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	2.568958	0.8073
Idiosyncratic random	1.254908	0.1927

Weighted Statistics

R-squared	0.147826	Mean dependent var	0.996345
Adjusted R-squared	0.129028	S.D. dependent var	1.365571
S.E. of regression	1.274431	Sum squared resid	220.8877
F-statistic	7.863926	Durbin-Watson stat	0.958042
Prob(F-statistic)	0.000071		

Unweighted Statistics

R-squared	0.013946	Mean dependent var	6.526429
Sum squared resid	1357.335	Durbin-Watson stat	0.155908

Appendix G: Interaction Variables (Model 2)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 04/10/21 Time: 22:20
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDENTIAL_MOBILITY	-0.051354	0.058805	-0.873301	0.3841
WORKPLACE_MOBILITY	-0.063481	0.029127	-2.179453	0.0310
LNCASES	0.145757	0.044917	3.245051	0.0015
GSCRESIDENTIAL	-0.000530	0.002691	-0.196789	0.8443
GSCWORKPLACE	0.001103	0.001294	0.852872	0.3953
C	4.660195	0.926256	5.031219	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	3.166240	0.8705
Idiosyncratic random	1.220974	0.1295

Weighted Statistics

R-squared	0.211688	Mean dependent var	0.790010
Adjusted R-squared	0.182274	S.D. dependent var	1.339240
S.E. of regression	1.211051	Sum squared resid	196.5303
F-statistic	7.196708	Durbin-Watson stat	1.031101
Prob(F-statistic)	0.000005		

Unweighted Statistics

R-squared	0.070962	Mean dependent var	6.526429
Sum squared resid	1278.851	Durbin-Watson stat	0.158457

Appendix H: Interaction Variables (Model 3)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 04/10/21 Time: 22:21
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDENTIAL_MOBILITY	-0.376747	0.232532	-1.620195	0.1075
LNCASES	0.184897	0.043299	4.270286	0.0000
INTERRESIDENTIAL	0.004603	0.002702	1.703763	0.0907
C	4.672095	0.756457	6.176285	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	2.455476	0.7995
Idiosyncratic random	1.229720	0.2005

Weighted Statistics

R-squared	0.169240	Mean dependent var	1.020862
Adjusted R-squared	0.150914	S.D. dependent var	1.369065
S.E. of regression	1.261537	Sum squared resid	216.4406
F-statistic	9.235155	Durbin-Watson stat	0.953615
Prob(F-statistic)	0.000013		

Unweighted Statistics

R-squared	-0.008345	Mean dependent var	6.526429
Sum squared resid	1388.019	Durbin-Watson stat	0.148702

Appendix I: Extension on Stock Market Return (Model 1)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 04/10/21 Time: 22:23
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDENTIAL_MOBILITY	-0.054650	0.034275	-1.594436	0.1132
WORKPLACE_MOBILITY	-0.036896	0.016687	-2.211137	0.0287
LNCASES	0.125019	0.045609	2.741110	0.0070
STOCK_MARKET_RETURN____	0.027801	0.013813	2.012704	0.0461
C	4.958529	0.914623	5.421392	0.0000

Effects Specification	S.D.	Rho
Cross-section random	3.063239	0.8655
Idiosyncratic random	1.207438	0.1345

Weighted Statistics			
R-squared	0.219990	Mean dependent var	0.807257
Adjusted R-squared	0.196879	S.D. dependent var	1.341226
S.E. of regression	1.201967	Sum squared resid	195.0377
F-statistic	9.518701	Durbin-Watson stat	1.010701
Prob(F-statistic)	0.000001		

Unweighted Statistics			
R-squared	0.057411	Mean dependent var	6.526429
Sum squared resid	1297.504	Durbin-Watson stat	0.151926

Appendix J: Extension on Stock Market Return (Model 2)

Dependent Variable: UNEMPLOYMENT_RATE
Method: Panel EGLS (Cross-section random effects)
Date: 04/10/21 Time: 22:24
Sample: 2020M02 2020M11
Periods included: 10
Cross-sections included: 14
Total panel (balanced) observations: 140
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDENTIAL_MOBILITY	-0.431341	0.225889	-1.909527	0.0583
WORKPLACE_MOBILITY	-0.031339	0.016532	-1.895629	0.0602
LNCASES	0.132085	0.044689	2.955647	0.0037
STOCK_MARKET_RETURN____	0.029969	0.013605	2.202827	0.0293
INTERRESIDENTIAL	0.004493	0.002653	1.693236	0.0927
C	4.954401	0.781677	6.338168	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	2.514695	0.8186
Idiosyncratic random	1.183582	0.1814

Weighted Statistics

R-squared	0.229998	Mean dependent var	0.960795
Adjusted R-squared	0.201267	S.D. dependent var	1.360639
S.E. of regression	1.216029	Sum squared resid	198.1493
F-statistic	8.005114	Durbin-Watson stat	0.964632
Prob(F-statistic)	0.000001		

Unweighted Statistics

R-squared	-0.050196	Mean dependent var	6.526429
Sum squared resid	1445.628	Durbin-Watson stat	0.132220