The effects of the government interventions towards Covid-19 on the retail and hospitality sectors for OmniCorp

Group 1 ST344 Group Report

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1 Introduction

Sudden shock, obscurity and change descended upon mankind throughout 2020. COVID-19 sweeping across the world changed the social and economic landscapes, forcing companies to adapt to remain successful. It was evident that with the introduction of government mandated lockdowns that many sectors were going to struggle. OmniCorp, a large player in the retail and hospitality sector, has experienced difficulty in adapting their operations in Europe, North America, Oceania and Asia. The most important effects were: the closure of restaurants and various hospitality venues; change in the consumer's shopping and recreational habits; high numbers of staff self-isolations and illnesses; and panic buying and supply issues.

This report provides an unbiased initial look at the effects of government intervention to plan and prepare for the next phase effectively. Thus, analysis is being conducted on the following areas of interest: Australia and New Zealand; South Korea, Japan and Singapore; Canada and USA; France, Italy and UK, to answer important questions, namely:

- The impacts of different government actions such as quarantine and others.
- Possible difference of results in various countries and why might it be.
- How the insights might improve given more time, data and resources.

2 The data

The tidycovid19 dataset is our primary given source of information, containing a number of variables used with main focus on dates from February until October in 2020[1]. Centre of attention was on COVID-19 case data provided by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU) [2] as well as the Google COVID-19 Community Mobility Reports [3]. The Google data provides the percentage change of people visiting places of interest. However, this data has limitations as it only measures those who use Google services (e.g. maps), therefore information for some groups may be more limited (e.g. older people). The daily cases data from the JHU data was used for analysis of the efficacy of government imposed restrictions. This source is likely to be reliable, but also comes with its own limitations (e.g. the amount of COVID-19 tests conducted would not be the same throughout the period [skews results][how willing the public is to be tested]; some countries may not have been honest with cases). To supplement this provided dataset we also included additional data from Our World in Data [4], Office for National Statistics (ONS) [5] and local government income data (more references). Our World in Data gives vaccination figures and stay-at-home restrictions of our interest. This data should be accurate as vaccination uptake is closely monitored by governments and stay-at-home restrictions [6] are public knowledge. The income data [7] taken from ONS shows the change in retail sales relative to the baseline period of early January to mid February. The description of variables used from all datasets is given below.

Table 1:

Description of variables

Variable	Description
gcmr_retail_recreation	The frequency, expressed as a percentage change relative to the baseline period Jan 3 - Feb 6 2020, of people visiting retail and recreation places
gcmr_workplaces	The frequency, expressed as a percentage change relative to the baseline period Jan 3 - Feb 6 2020, of people visiting workplaces
gcmr_residential	The frequency, expressed as a percentage change relative to the baseline period Jan 3 - Feb 6 2020, of people visiting residential places
gcmr_grocery_and_pharmacy	The frequency, expressed as a percentage change relative to the baseline period Jan 3 - Feb 6 2020, of people visiting grocery and pharmacy places
confirmed	Confirmed Covid-19 cases are reported by JHU CSSE
RSI	A business indicator showing monthly activity of the retail sector in value and volume, relative to February 2020
people_vaccinated	Number of people vaccinated as reported by the government
stay_home_requirements	Variable in the interval [0,3] describing the stringency of government lockdown measures

3 Effects of lockdown

3.1 What if there were no lockdowns?

We wish to ascertain whether the implementation of lockdown is an effective measure in preventing the spread of coronavirus. This has implications for OmniCorp as results that suggest lockdowns are effective at providing a route back to normality, as shown by the data on Oceania, might lead to a recommendation to prioritise countries whose governments intervene.

To explore the effects of a national lockdown, we created a model to predict the outcome of if no government action was taken. Our model suggested that the daily cases would be significantly higher in this case.

To make predictions, we first need a model which fits the real data up to the point of lockdown.

The following table gives us the Akaike Information Criterion (AIC) [17] value for all the models considered for each country:

Table 2:

AIC values for model fit

	Poisson	Normal	Log-normal	Negative Binomial
Australia	884.0	508.5	157.2	521.8
New Zealand	947.3	519.7	161.6	527.5
South Korea	914.6	517.2	153.1	523.9
Japan	599.6	446.7	123.9	484.3
Singapore	797.6	494.4	150.4	515.8
Canada	886.4	509.1	157.6	522.4
United States	871.4	507.5	157.2	522.3
France	816.5	496.6	152.6	516.7
Italy	703.3	471.6	143.6	505.7
United Kingdom	801.1	492.8	151.5	514.9
Average	**822.2**	**496.4**	**150.9**	**515.5**

We decided that a Normal or Log-Normal model, despite having the lowest AIC values, would not be suitable to fit the data as these model continuous data; also, there are multiple days where no cases were recorded. As daily cases are discretised, we therefore considered fitting the Poisson or Negative-Binomial models.

As the Normal and Log-Normal models are not suitable, and a low AIC is desirable, the Negative-Binomial model is the best model for the data. Hence, we will use this for our projection of the outlook of cases in the absence of a lockdown.

3.2 Epidemiology background:

Two important metrics are the R-value and the doubling time. R is the reproduction rate, meaning it is the expected number of people one infected person will pass the virus on to. Critically, if R¿1 then the number of cases will grow whereas if R¡1 then the number of cases will fall. Our negative binomial model gives us an R-value of 2.44; so the number of cases would grow exponentially in the absence of a lockdown. The following table shows us the predicted number of cases every 4 days for a month against the real values for which there was a lockdown:

Table 3:

First lockdown (every 4 days)

Model values	Real values	%reduction due to lockdown
3084	3084	0
12336	4273	-65.4
49344	4915	-90.0
197376	5450	-97.2
789504	3577	-99.5
3158016	5065	-99.8

Clearly, lockdown has a significant impact on the number of cases, reducing the number by more than 99% when compared to our model. This value should be taken with care as the modelling technique we have used is fairly basic. Factors such as, people becoming not susceptible, self-isolation, population density across a country have not been taken into account.

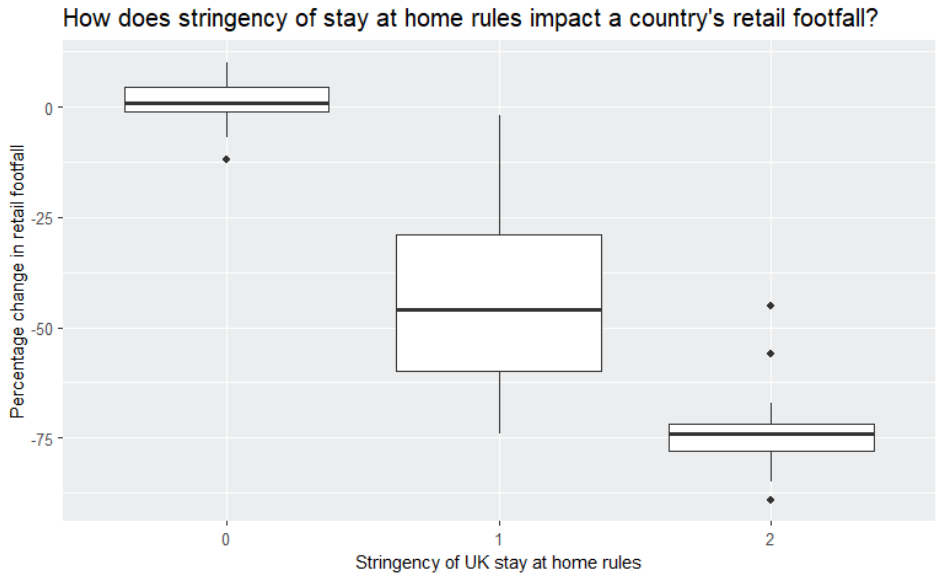
3.3 What were the negatives of lockdown to OmniCorp?

Our current models use data up to 24 September 2020 and the stay at home restrictions dataset [6] from Our World in Data focuses on the UK.

The first thing we want to explore is the relationship between the number of people visiting retail and recreation areas and the stringency of government restrictions; this will help us ascertain whether regulation is impacting the retail income OmniCorp will be receiving. Stringency is considered in three levels:

- Level 0: no measures
- Level 1: recommended not to leave the house
- Level 2: required not to leave the house with exceptions for exercise, grocery shopping and essential trips

Figure 1:



The box plot above is broadly similar to those for all other countries we have studied, it demonstrates how retail footfall decreases with increasing stringency. The coefficients of the binary variables are -44% for stringency 1 and -74% for stringency 2; these coefficients are confirmed by significant t-values at the 1% level.

There is significantly more variation in retail percentage when the stringency is 1. This could be because with this level of restriction the public had to exercise their own judgement on what is a necessary reason for leaving home; since people have a varying level of self-discipline and understanding of regulation this would naturally lead to some variation. Alternatively, it may be because a stringency level of 1 covers a range of rules (rather than none or a full lockdown). One could potentially gain further insight on expected retail footfall figures by including the workplaces variable in our model.

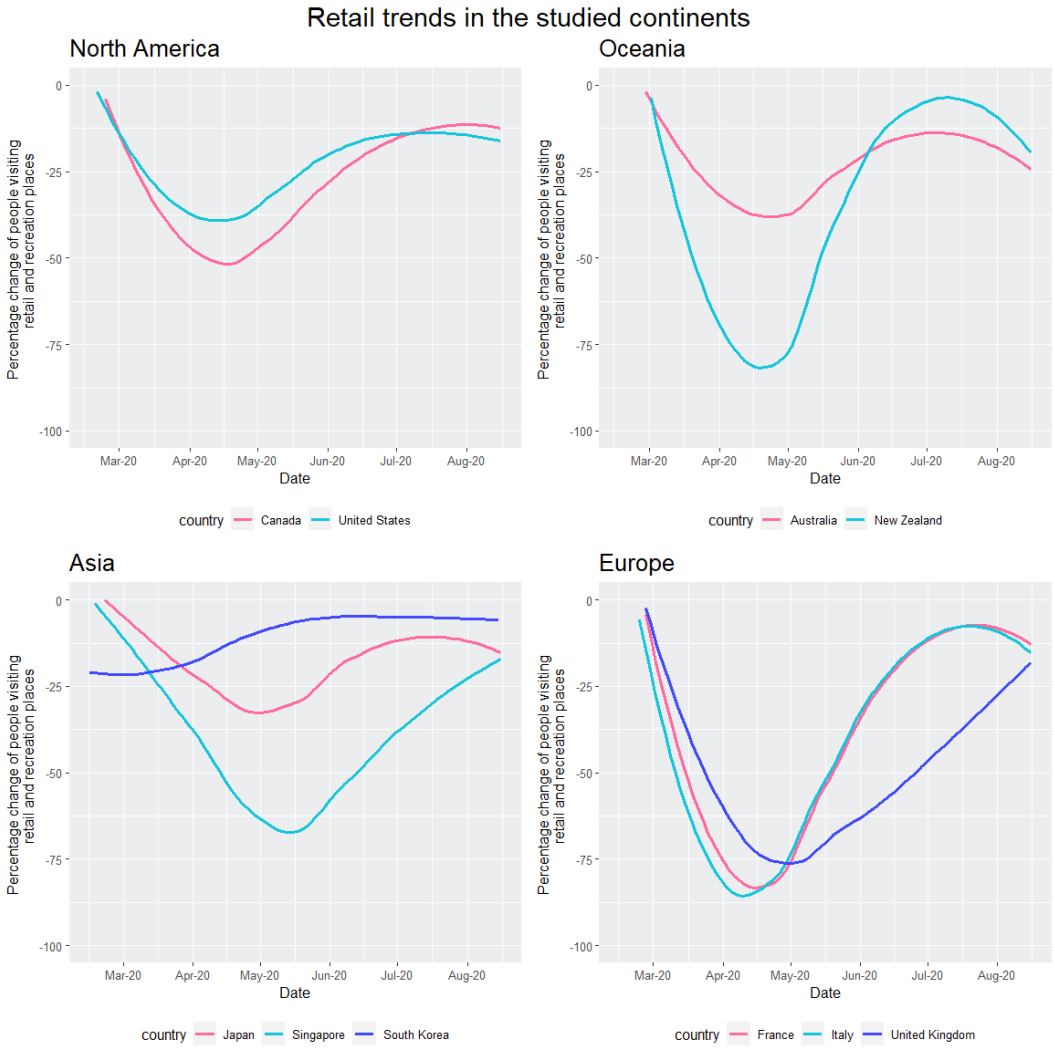
A sequential anova table tells us that including workplaces is an improvement to the model and that the number of people commuting for work is positively related to the number of retail visits. So it will be of interest to OmniCorp what the specific regulations are regarding travelling for work in a country as well as the stay-at-home rules.

Is the impact of workplaces on retail different for different stringencies? We test this using an interaction. The ANOVA table suggests there is a steeper increase in retail against the number of commuters when the stringency is 1, however the t-values are far from significant so we should remain with the second model.

3.4 How were the effects of lockdown different in different countries?

There were a range of strategies with regards to the timings of government interventions across the world, which had varying effects. The most relevant variable to OmniCorp is the number of people visiting retail and recreation venues, so we have compared this with the date across all countries:

Figure 2:



3.4.1 Europe:

Italy was the first European country to declare a national lockdown with France and the UK following days later [8]. The impact is similar for each of them however the countries differ in their lifting of lockdown; the UK's retail visits take longer to recover than France and Italy's which are comparable. One possible reason for this is the difference between the countries in their tendency to shop online rather than in the shops [9]. One might suggest that this change in consumer habits influenced the retail footfall experienced in these countries. If this is the case then it makes sense the UK took longer to recover its retail numbers than Italy and France because of the higher proportion of people were converted to shopping online, with the below figure demonstrating this.

Table 4:

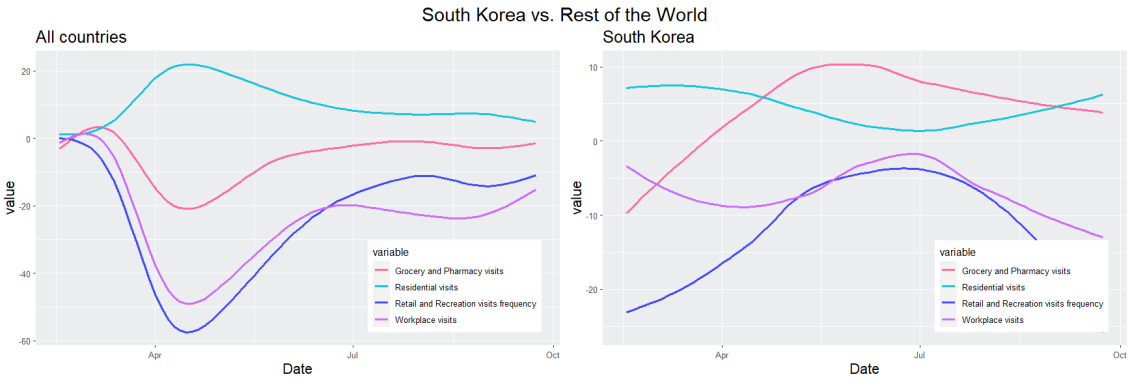
E-commerce spending per capita in UK, France and Italy, 2019-2020

	2019	2020	Percent increase
United Kingdom	921	1020	**10.75**
France	746	752	**0.80**
Italy	668	674	**0.90**

3.4.2 Asia:

South Korea maintained strong retail numbers as they did not implement a national lockdown. Their approach to the pandemic was focused on quick testing, contact tracing and phone alerts [10]. This is contrasted by Singapore's and Japan's experiences for retail, which fell to less than -60% and -25% of their February levels respectively. South Korea is a stark contrast to all the countries we studied, as demonstrated by the following graphs:

Figure 3:



One could postulate that South Korea had a better idea about what they should do in this situation more than other countries due to the previous outbreak of SARS in 2003.

OmniCorp could use this information for future outbreaks. For instance, if a country announces it won't have a national lockdown but will adopt a large testing and tracing programme like South Korea, this could influence OmniCorp to prioritise the supply of products to this country as its retail footfall would be less affected. Also, it may be that a country which has had a recent experience of dealing with a pandemic will be better prepared for a new one and so their economy would be more accommodating to businesses, such as OmniCorp, in this situation [11]. Given more time to construct this report, we would delve deeper into our analysis of the difference in approaches to COVID-19 between the countries that suffered with SARS and those which didn't.

3.4.3 North America:

The retail footfall in this region did not suffer as badly as others, falling by a maximum of 50% whereas in Europe the drop hit 86%. Many US states were not as proactive in the prevention of the spread when compared to others [12]. While this is the case with footfall, the income generated by retail outlets in the US and Canada fell to levels akin to Europe [5]. Potentially, this is a result of the global supply crisis. This means that although people are in shops, they have little to buy.

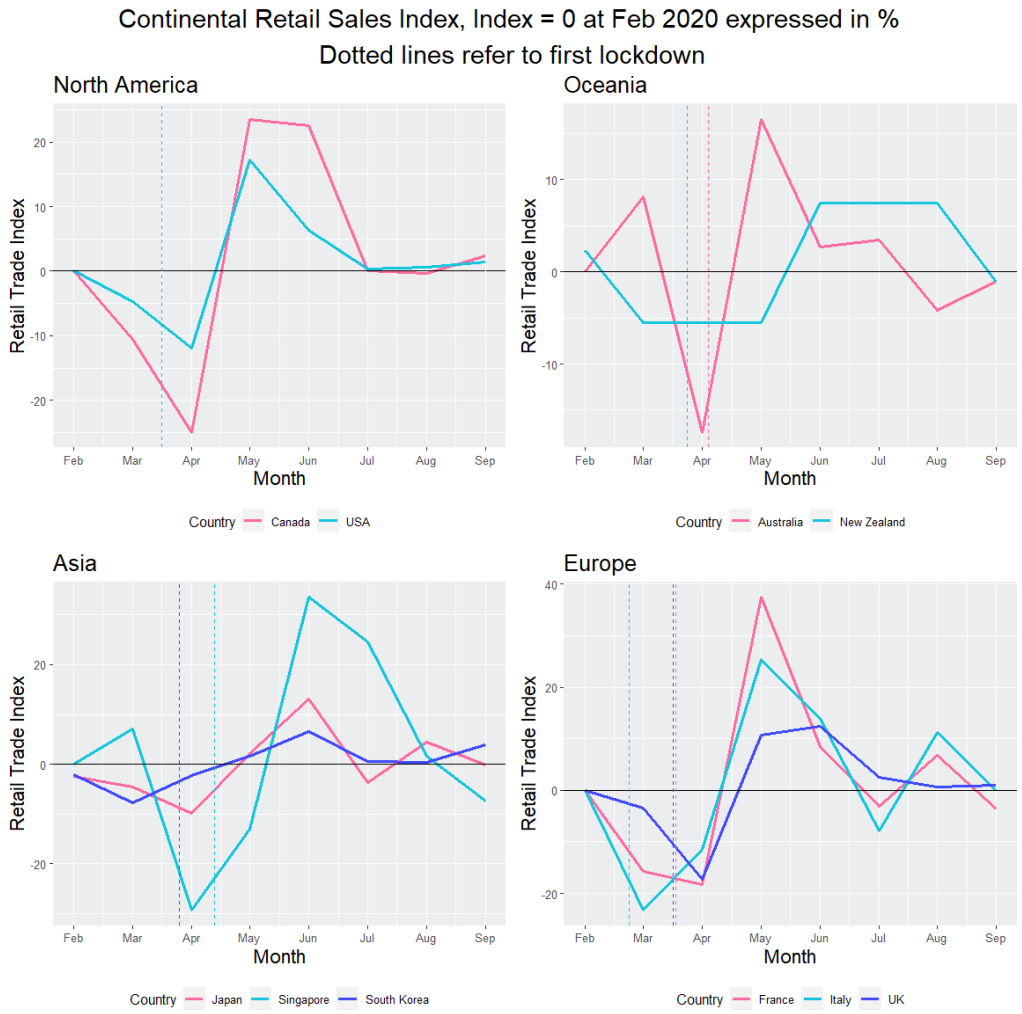
3.4.4 Oceania:

Government intervention, in Australia, was initially lenient, whereas New Zealand was like Europe in their strict approach. Consequently, New Zealand's retail fell far lower than Australia's as shown in figure 2, however it recovered to better levels than Australia as well. This could be evidence of how an early harsh lockdown is the best strategy in the long term and that OmniCorp should consider countries adopting this strategy to conduct most of their business in a repeat pandemic. Alternatively, OmniCorp may not wish to endure a plummet, albeit short term, in footfall so prioritise maintaining supply of resources to the more lenient countries. It is also worth considering that the graph suggests the average footfall over the whole of 2020 favours Australia's strategy, but would this correspond with greater sales after we account for supply chain issues? As we have seen with the US, a more resilient footfall does not necessarily mean resilient sales.

3.5 Analysis of the income data

The retail sector experienced a painful downfall once measurements were introduced to slow down the spread of the virus across the world. We conducted an analysis comparing the retail trade index (a business indicator showing monthly activity of the retail sector in value and volume) during the period of the first lockdown in order to ascertain whether government interventions had any impact on retail sales. With lockdowns sweeping across the world, we observed a steep decline in the retail trade index in April 2020. One notable exception, Italy, experienced its drop a month earlier. This can be put down to the earlier imposed lockdown date when compared with the rest of the world.

Figure 4:



In this universal drop in retail sales, we observed some differences :

- France and the UK suffer a drop in the retail trade index of approximately 20% compared to February's level [13].
- Australia did not commit to a nationwide lockdown but experienced the same drop of 20% in retail as comparable European countries, who did mandate stay at home restrictions.
- South Korea, USA and Japan, who never did full nationwide lockdowns [14] experienced a drop of around 10%
- Italy, Singapore and Canada had it more severe [15], falling down by almost 30%.
- New Zealand has a limited quarterly data available; thus it is difficult to draw any precise conclusions from it.

The majority of the countries recovered to their pre-February levels by May, following that in June the retail trade index went back up in all countries to its pre-pandemic level, carrying on with not too drastic fluctuations from July till the end of September.

Overall, we can conclude that lockdown stringency appears to be a significant variable when gauging the effect of retail sales.

4 Conclusion

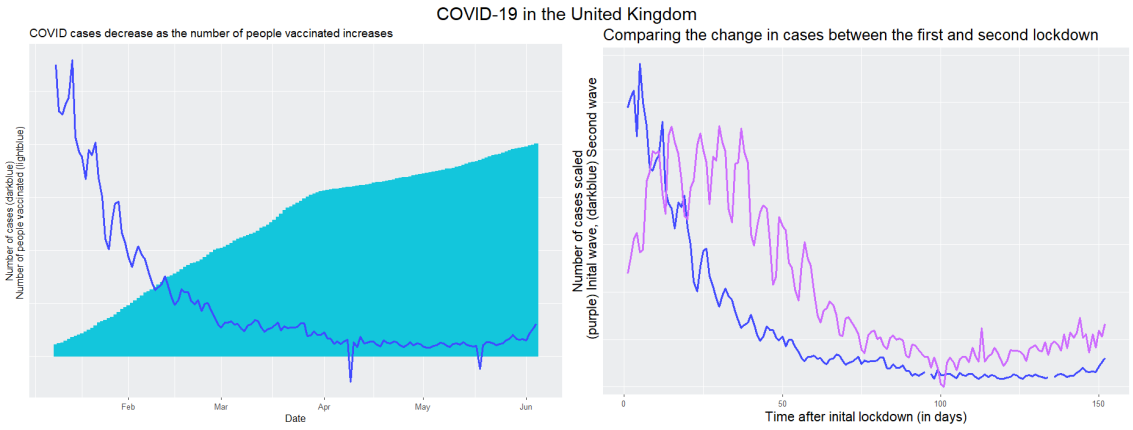
In our analysis, conclusions drawn from the data are:

- Lockdowns are successful in limiting the number of cases of coronavirus in countries.
- Retail trade recovered to higher levels in countries that implemented a lockdown.
- Lockdowns greatly restricted people's mobility across the world. As a result, OmniCorp's retail sales dropped in all countries.
- South Korea maintained strong retail figures as it didn't implement lockdown nationwide, while other countries were affected by various government restrictions.
- If we have more time, we would fit more linear models and collect more data (all states' data in the USA, all countries' timeline, etc), then analyse all data.

4.1 Which data did we use and why? What's the relevance of the new data?

We have constructed linear models and fitted generalised linear models for extrapolation and prediction based on the data of the first lockdown only. As we felt that the impact of the first lockdown would be a more accurate suggestion on what a repeat situation would cause. This is due to other lockdowns having other factors involved such as vaccinations. Vaccinations are perhaps the reason the second lockdown in the UK in particular was more effective as shown by the following figure:

Figure 5:



For example, models based on the second or third lockdowns might be too optimistic in how long another lockdown would last (in that they would predict a shorter time period than what it actually would be).

The new data is still relevant to us as it makes the impact of vaccinations apparent.

4.2 What would we research if we had more time

There are areas we would have liked to have researched further for the report to OmniCorp however due to time and word constraints this couldn't be included. Among these is the analysis of the difference in the ability of countries' ability to deal with Covid 19 based on their experience with other viruses. South Korea's strategy is evidence of a recent experience with a virus (SARS) being beneficial to the prevention of the spread of another. However, this is one country so it is not sufficient to draw a concrete conclusion.

Our analysis of the US must be taken with a pinch of salt. A country with fifty self-governed states will have vast differences in restrictions; it is not ideal that the data from states in lockdown is mixed with the data of states without restrictions. Taking an average of these

states will not be representative of a significant part of the country, it is therefore dangerous to draw conclusions from this. If we had more time, we could have analysed every restriction's data in all fifty states.

Each country had different restrictions or regulations at different time points. For our analysis, we use the UK's timeline [16] to compare with other countries. Although the process of restrictions were similar among the countries, the time periods and the time points were totally different. In other words, we can hardly draw a concrete conclusion by using one country's timeline compared to others. If we had more time, we could analyse the timeline of all countries which is more cogent and reliable.

4.3 Advice to OmniCorp moving forward

There is no one correct answer to navigating a pandemic for a business and it depends on the company's attitude to risk.

If OmniCorp is more risk averse then our recommendation would be to prioritise countries that are implementing lockdowns. This is because while the damage to retail is certain and substantial, OmniCorp can rest assured the levels of retail will recover to pre-pandemic levels.. That said, the potential for keeping high levels of retail throughout the pandemic as well as after is lost, which would've been the case for a business who kept up usual investment in South Korea who also didn't implement a lockdown.

If OmniCorp is less risk averse, we recommend OmniCorp prioritises the countries which didn't implement lockdown to put its main retail business in them because OmniCorp's retail shops are likely to have a consistent customer base. In other words, the business would not be affected too much as these countries showed a relatively higher level of retail than those implementing lockdowns during the pandemic. However, these countries may potentially not recover back to the pre-pandemic levels as quickly as the countries implement lockdown.

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