

Introduction

Tango is an especially interesting case because its pekin corona cases was very short lived and its increase we very rapid. There also was no general lockdown and forced closures of businesses by the government was limited two a very small number of categories such as gyms that were deemed to have a large potential of becoming outbreak hot spots. The lack of such force government influence revise a unique opportunity to study how the population voluntarily restricted it movement in response to the outbreak off Covid-19. The very rapid decline after the peak especially sat Daegu apart from other regions in the world and can be used to investigate how quickly people are willing to go back to their normal lives and whether there are any lingering after effects.

Link between total ridership and Covid-19

Peak Decline

Exploratory

[monthly_transportation.png]

The year-to-year change in monthly ridership of Daegu buses and metros is shown in Figure 1. While the first confirmed case of Covid-19 in Korea was on January 21, the first case in Daegu was not until February 18. Yet it can be seen that while in December ridership was still up 0%~5% year-to-year, it was down by 3%~7% in January, showing that Daegu citizens were already starting to limit their movement before the pandemic had hit the city. Changes in metro and bus usage followed similar trends although metro has been affected worse with an additional 6 to 7 percentage point decline in passengers compared to the bus.

The relative decline was the largest in March at respectively 62.5% and 69.5% less passengers for bus and metro, less than half of March 2019. Metro data for May was not yet available at the time of the study and for the rest of 2020 was only available on a monthly basis. Since both methods of transportation show very similar trends in usage and daily bus data was available up to June 14, the more complete bus data will be used in most of the analyses in this paper.

The thirty percent decrease in late January and the similar increase in early February can be explained by the different timing of the Seollal national holiday, taking place one week earlier in 2020 compared to last year. The relative similarity of the effect of this holiday in both years shows that the emergence of Covid-19 in the country did not significantly affect Daegu yet at that point.

[bus_daegu_new_cases.png]

A comparison of the weekly number of passengers with the number of new cases in Daegu shows that ridership was clearly the lowest during the period with the most new Covid-19 cases. However it can also be seen that the recovery of passengers after the peak of the decline has been much more gradual than the very steep decline in the number of infections.

[bus_daegu_new_cases_peak.png]

Exploring the graph around the peak more closely shows that starting February 19, the first day that more than 1 new case was confirmed in Daegu with 15 new cases, daily ridership entered an almost perfectly linear decline. This daily decline of 6~8 percentage points lasted for one week until February 26, when the decline slowed down. During these 7 days, the number of bus passengers decreased from a decline of 12% to one of 62% compared to the same week in 2019.

The two local minima in passengers occurred during the weeks from February 23 until February 29 and the week of March 2 to March 8. Each of these weeks saw a decline passengers of around 69 percent compared to the previous year. Meanwhile the days with the highest numbers of new Corona cases in Daegu were February 29 with 656 new cases and March 3 with 520 new cases. Importance to note is that this peak in new cases actually came a day after the decrease in passengers stabilized on February 28, staying within one percentage point until March 11th.

[bus_daegu_active_cases_peak.png]

The relation of bus passengers and the number of active Covid-19 cases in Daegu looks to be less significant. Ridership started recovering from March 10, whereas the number of active cases peaked on March 12 and stayed relatively constant until March 16. The later acceleration of the decrease in active cases also does not seem to have boosted the recovery of ridership.

[bus_korea_new_cases.png]

The new Covid-19 cases in Korea were dominated by Daegu until the end of March, after which the focus changed to Seoul and the Gyeonggi-Do area. The lowest number of new cases was on May 6th with only 2 cases in the country, after which it has increased to 30 to 60 new cases in June. We can see that these new outbreaks in and around Seoul have not affected the use of public transport in Daegu.

Interpretations

The most likely theory that would explain the slightly bigger decrease in metro passengers is that a relatively smaller share of its traffic is comprised of commuters as compared to bus traffic. Since Daegu did not at any point instate a full-scale lockdown offices and factories generally did not shut down, leading to the expectation that commuter traffic was less affected than other, less essential traffic.

The peculiarly linear decline of passengers during the start of the first peak of new cases its interpretable in many ways. One possibility is that different people have different thresholds that need to be reached before they are willing to limit their movement. It could also be that people started out limiting there outside activities only a little, but restricted themselves more and more as the number of Covid-19 cases increased. Despite the linearity of the decline, the rapidness at which it took place makes clear that the Daegu public was very rapid in their actions and committed to showing self restraint in order to stop the spread of the virus. On February 26, the number of bus passengers had declined by more than fifty percent compared to the previous week.

The stabilization of the number of passengers occurring before the peak of new Covid-19 cases suggests that by February 28 all use of public transport except for commuting and otherwise non-essential travel had already come to a standstill, leaving no room for a further decline despite the increase in new cases. This theory is supported by the relative decline remaining stable for as many as 13 days, staying between -67.5% and -69.2%. It suggests that even if the number of new cases had risen even further, this would not have been matched with a similar decline in passengers unless businesses had been forced to shut down.

[bus_daegu_new_cases_log_peak]

Plotting the log of the daily new Covid-19 cases

Recovery

[bus_daegu_new_cases_recovery]

The recovery of passenger numbers began after March 8 when the lowest relative number of passengers was recorded at -69.2% compared to the same week in 2019. During the following days, the number of new Covid-19 cases in Daegu slowed down to 50-100 per day, down from its peak of 656. The number of new cases has kept declining ever since and has stayed under 10 for every day after April 7. This continuous decline in new cases did not show a clear relation with the pace of the recovery in passengers which has stayed relatively constant throughout.

[bus_daegu_recovery_time_regression]

Just like the decline, the recovery showed a remarkably consistent linear trend. Starting on March 8 of there was an average daily recovery of roughly 0.45 percentage points, reaching a maximum of -23.1% on June 11. The simple linear regression shown above with the number of days since March 8 taken as the independent variable had an R squared of 0.99, showing an almost perfect fit.

[bus_daegu_new_cases_recovery_mid]

[bus_korea_new_cases_recovery_mid_regression_scatter.png]

Around the middle of the recovery during late April - early May, a pattern is visible with two similar peaks and troughs. Occurring on different weekdays, no relation was found with the time of the week here, and with new Covid-19 cases in Daegu staying close to zero during the time period, the remaining factor to investigate were the outbreaks on a national level. The initial plot showed some similarities which lead to the attempt to capture a relation in a linear regression. The dependent variable was chosen to be the difference of the change in weekly passengers compared to the previous day, with the independent variable being a time-lagged version of the number of new cases in Korea. Lags of 1 to 5 days were considered to allow the public to react to outbreaks. The 2-day and 3-day lags showed most promise but ultimately none of them was significant.