Covid-19 Vaccination: Health and Economic Correlations

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Abstract. Vaccination program is an important strategy in eradicating Covid-19 pandemic. Vaccination can intervene to accelerate the formation of herd immunity. When herd immunity is formed later, it is believed that the Covid-19 virus will gradually eradicated. Furthermore, economic activity will return to normal. Then, has the vaccination program run by the Indonesian government had an impact on health and economic recovery? Some claim that this vaccination program has had a positive impact. However, in-depth research is felt to be done to really look at this impact. As a first step, it is necessary to look at the relationship between vaccination, health and economic development. This relationship will be an early indication of whether the vaccination program is successful or not. In fact, vaccination was strongly correlated with a decrease in the transmission of new cases and moderately correlated with the recovery rate. Overall, vaccination is strongly correlated with health based on the canonical correlation. Meanwhile, for the economy, vaccination has a weak correlation with the poverty rate and Gini ratio. However, overall based on the canonical correlation, vaccination is strongly correlated with the economy. Furthermore, the development of tourism shows an indication of a correlation with vaccination.

1. Introduction

Vaccination is a breath of fresh air in the effort to eradicate the Covid-19 outbreak in Indonesia. It is one of the keys to achieve herd community. Herd immunity itself is a key concept for epidemic control. It states that only a proportion of a population needs to be immune (through overcoming natural infection or through vaccination) to an infectious agent for it to stop generating large outbreaks [1]. Herd immunity that will be formed open the gate for the community to be able to carry out normal activities as usual. Physical and social restriction policies will be stopped. This means that economic activities can return back to normal.

In theory, mass vaccination is necessary to eradicate an infection of virus by vaccinating a proportion of each cohort of the population, including children. It is because vaccination during the period of maternally derived protection usually fails to protect the child adequately from subsequent infection. Such as to eliminate measles and pertussis, it is estimated that 92-96 percent of children must be vaccinated, 84-88 percent to eliminate rubella and 99-92 percent to eliminate mumps in Western Europe and the United States [2-5].

Besides of that, The Royal Society stated when a sufficiently large fraction of people are immune to an infectious disease, the entire population can be protected by "herd immunity". But herd immunity acquired by natural infection has several disadvantages as a means of COVID-19 control: (1) the build-up of herd immunity would be associated with a high burden of illness and death; (2) while infection is spreading through a population, it is not yet clear that the most vulnerable can be

protected from severe and fatal COVID-19; and (3) it may not be possible to achieve herd immunity by natural infection if protection against reinfection is partial and transient. The preferred route to herd immunity is not through natural infection but by vaccination. While awaiting population-wide coverage of COVID-19 vaccines, the principal method of control is to prevent transmission between infectious and uninfected people using non-pharmaceutical interventions, i.e. antiviral hygiene, physical barriers and personal distancing [6].

In line with what was stated above, The Minister of Communication and Information, Johnny Plate, stated that orderly health protocols and vaccinations are the main keys to handling Covid-19 [7]. Related to economic improvement, economists have predicted since the beginning that the discovery of vaccine will be the key to improve global economy [8]. The Director of the Macroeconomic Policy Department of Bank Indonesia then emphasized the same thing, vaccination acceleration is the key to improve global economy [9]. In line with all of this, the Minister of Health stated that health recovery is the key to improving Indonesia's economy [10].

Statements related to economy above are in line with Dabla-Norris et al's statement at IMF Working paper. It was stated that quick vaccine rollouts are crucial for a strong economic recovery, and vaccine hesitancy could prolong the pandemic and the need for social distancing and lockdowns [11]. This is a bad news for economy. Because of that, timely and universal access to COVID-19 vaccines will remain critical for ensuring broad-based and inclusive recovery of the world economy. Widespread vaccinations will help to create herd immunity and allow reopening and resumption of economic activities [12].

The first wave of vaccination programs in Indonesia began during the first four months of 2021. The first wave was aimed to health workers and public service workers, with the consideration of interacting directly with Covid-19 patients. Unfortunately, the implementation of the first batch of vaccinations had been delayed compared to the target for completion in April 2021. However, a number of parties claim that the vaccination program has succeeded in suppressing the Covid-19 outbreak, besides the implementation of Community Activity Restrictions/*Pemberlakuan Pembatasan Kegiatan Masyarakat* (PPKM).

Siti Nadia Tarmizi, the Director of Prevention of Infectious Disease Control of the Ministry of Health, claimed the decline in daily cases of Covid-19 in mid-August 2021 as the result of PPKM and vaccinations [13]. Not only nationally, the Governor of West Java, Ridwan Kamil, also claimed to find a correlation between the Covid-19 vaccination vacancies and death cases. The higher the vaccination coverage, the lower the death rate caused by Covid-19 [14]. On the other hand, Griffith University epidemiologist Dicky Budiman doubted vaccination reduce Covid-19 patients. With vaccination coverage of only 1-2 percent of the entire population at that time, he felt that it has not had a significant impact on the decline in positive cases. The tracking and testing process that had not been good is one of the factors in the decline in Covid-19 cases [15].

A quantitative approach can be used to take a deeper look at the impact of vaccination in Indonesia. Not only from health perspective, but also from economic perspective. Correlation analysis will be used to look at the relationship between vaccination coverage and the development of Covid-19 cases, as well as a number of economic indicators, both macro and micro. The scope of the research is 34 provinces in Indonesia. With the new vaccination program starting in January 2021, the data processed is data for first semester of 2021. The availability of tracing data, the total number of people examined for Covid-19, per province that was not found is one of the limitations of this study. Furthermore, data regarding the orderly implementation of health protocols is also limited. The available data only cover a small part of the observations, so it is feared that it will be biased.

For a more specific point of view, the development of tourism sector will also be shown to strengthen observations about correlation between vaccination and economy. Tourism is one of the sectors most affected by Covid-19 pandemic. Moreover, this sector doesn't only stand alone, but is closely related to transportation, accommodation, also food and beverage sectors. Given the large relations between these sectors, there is no specific sector or subsector of tourism in GDP. Therefore, to look at economic correlation trough tourism sector, it can be done with approaches trough other sectors as previously mentioned. This approaches will strengthen the correlation between vaccination

and economic recovery. Later, the results of this study can be used as an evaluation material for the government to take the next vaccination policy.

2. Literature review

Individually, Covid-19 vaccination had proven to be effective in reducing the infection rate in Italy. The infection rate of Bari Policlinico University Hospital health care workers who had been vaccinated is lower than those who had not. The difference in infection rates was significant. Although vaccination did not really prevent the transmission of Covid-19, the infection rate tended not to increase significantly [16].

Two-dose vaccination in the UK with BNT162b2 or ChAdOx1 nCoV-19 vaccine was effective up to 93.7 percent for the alpha variant and 88.0 percent for the delta variant. While the single dose vaccination recorded an effectiveness of 48.7 percent for the alpha variant and 30.7 percent for the delta variant [17].

While relating to general health recovery, Haas et al [18] presented the good news that vaccination had a significant impact on reducing Covid-19 cases in Israel. The number of Covid-19 cases had decreased drastically from 109,876 cases to only 6,266 after 2 vaccines were administered, or in proportion per 100,000 people, decreased from 91.5 to only 3.1 cases. Not only for daily cases, vaccination is also effective in reducing the number of people with Covid-19 symptoms and hospital occupancy.

Alagoz [19] in his research stateed that controlling the Covid-19 pandemic is closely related to vaccination coverage, effectiveness, and adherence to non-pharmaceutical interventions. In Dane County and Milwaukee, if 50 percent of the population is vaccinated with a daily vaccination capacity of 0.25 percent of the population, vaccine effectiveness reaches 90 percent, and adherence to non-pharmaceutical interventions reaches 60 percent, then the spread of Covid-19 can be controlled by June. 2021. Non-pharmaceutical intervention itself is an action other than vaccination and consumption of drugs that can be carried out by the community to help slow the spread of a disease, in this case Covid-19.

On the other hand, World Bank [20] predicted that the global economy will increase by 4 percent in 2021, after contracting up to 4.3 percent in 2020 due to Covid-19. This prediction assumes the availability of the Covid-19 vaccine is increasing and can be given to many countries.

In the United States, the pace of economic recovery in 2021 was claimed to depend on the rate of Covid-19 vaccinations, according to a summary of the Penn Wharton Budget Model. It was projected that increasing the number of doses of vaccine administered daily to 3 million will create more than 2 million jobs and increase real GDP by about 1 percent over the summer of 2021 [21].

From the general health and economy relationship point of view, The World Bank stated that healthcare is not an expenditure, but an investment. They stated that 100 million people improverished by medical expenses each year, 24 percent of full income growth in developing countries from health improvements, and 10 percent increase in life expectancy associated with 0.4 percent increase in annual economic growth. Besides of that, they conclude that investments in immunization are a critical component of Universal Health Coverage and a strong force for poverty reduction [22]. It means that worse healthcare is closely related to higher poverty. In line with that, Tur-Sinai et al stated that negative correlation was found between vaccination uptake and income inequality index in the municipality, meaning that the greater the income inequality in the municipality where the mother-and-child clinic is situated, the lower the vaccination uptake is. In other words, insofar as the mother-and-child clinic is situated in a municipality typified by greater income inequality, vaccination uptake in that municipality is lower [23].

In a more specific point of view, tourism is one of the sectors most affected by the Covid-19 pandemic. Indeed, the number of international tourist arrivals declined by 84 percent between March and December 2020 compared with the previous year, according to data observed by UNWTO. A drop in tourist sales leaded to a 2.5-fold loss in real GDP, on average, in the absence of any stimulus measures. The economic losses could range between $1.7 trillion and $2.4 trillion in 2021. The results highlight the importance of the vaccine rollout in getting global tourism restarted and other mitigating measures [24].

3. Data and methods

The availability of insufficient data on the distribution of Covid-19 is one of the obstacles in this study. The data dissemination is not same across provinces. Many provinces do not provide complete daily data that is easy to be downloaded. But luckily, KawalCOVID19 provides a complete daily data timeline for each province. All data related to the spread of Covid-19 was obtained from KawalCOVID19. The variable data are as follows.

1. Number of people who had been injected with 1 dose of vaccine until July 31 2021
2. Number of people who had been injected with 2 doses of vaccine until July 31 2021
3. Total daily cases during first semester of 2021, January 1 to July 31 2021
4. Total patients recovered during first semester of 2021, January 1 to July 31 2021
5. Total patients died during first semester of 2021, January 1 to July 31 2021

The vaccination program in Indonesia only started in early 2021. So, the impact will begin to be felt during 2021. The limitation of data coverage is only until July 2021 regarding economic variables that describe conditions until the second quarter of 2021 or first semester of 2021.

In addition, so that the processed data is representative and can be compared between provinces, 3 variables are proportioned to the total population and 2 variables are proportioned to the total daily cases during first semester of 2021. The population of each province itself is taken from the results of the 2020 Population Census/*Sensus Penduduk 2020* which had been released by Statistics Indonesia/*Badan Pusat Statistik*. The 3 variables proportioned to population are the number of people who had been injected with 1 dose of vaccine, the number of people who had been injected with 2 doses of the vaccine, and the total daily cases during the first semester of 2021. Then the 2 variables that are proportioned to the daily total cases are the total recovered patients and the total patients died, all of these during the first semester of 2021. These two variables are to show the level of vulnerability to Covid-19 in each province.

The economic variables used in this study are variables that indicate the macro economy, welfare, and employment. The variables are as follows.

1. Economic growth in the second quarter of 2021 (year-on-year)
2. Poverty rate (percentage)
3. Gini ratio
4. Labor force participation rate (LFPR)
5. Unemployment rate

Economic growth is one of the strategic indicators of development. This indicator is one of the benchmarks for the development success. Although the scope is very broad, because it is a macro economy, this indicator is often the main concern of evaluation. Along with economic growth, poverty rate is also often a major concern related to development. In semester 2 of 2021, Indonesia's poverty nationally has been hit hard by the pandemic. So it will be good news if poverty is closely related to vaccination. The Gini ratio was chosen because it describes the welfare of the community. In semester 2 of 2020, Indonesia's Gini ratio nationally increased by 0.003 points compared to semester 1 of 2020. This indicates an increasing welfare gap due to the pandemic.

Meanwhile, the LFPR and unemployment rate indicators show people's economy in terms of employment. Massive layoffs occurred because companies experienced a decline in profits. Even many companies went out of business because of pandemic. So, the vaccination program should be a bright spot to return back to normal employment

The economic growth used is in the second quarter of 2021 on a year-on-year basis because it shows the macroeconomic development of a region that is more real because it is not related to seasonality which in the province occurs between quarters. The variable poverty rate and Gini ratio used is the change from September 2020 to March 2021. The value of this change shows the development of the impact of Covid-19 as well as the policies implemented, one of which is the vaccination program. Similar to the LFPR and unemployment rate, the value used is the change from August 2020 to February 2021.

The number of people who had been injected with 1 dose and 2 doses of the vaccine became the independent variable in this study. Meanwhile, the variables related to Covid-19 and the economy are all dependent variables, either partially or collectively. The analytical method used is correlation analysis (Pearson) and canonical correlation. Correlation analysis is used to see the level of relationship between each dependent variable and each independent variable. The results of this analysis will show whether the development of vaccination rates, 1 dose and 2 doses, will change the development of each dependent variable, either increasing or decreasing. While the canonical correlation will show a collective correlation between all dependent variables and all independent variables, which are grouped into the dependent variable of health (related to Covid-19 cases) and the economy. The results of the canonical analysis will show in general whether the development of vaccination rates has a correlation to the development of Covid-19 and the economy.

Based on the paper of Schober et al, the correlation coefficient is divided into 5 classification classes [25]. This classification is a conventional method that has been commonly used as a basis for interpreting correlation coefficients. The classification is as follows.

Table 1. Classification of correlation coefficient

Size of Correlation	Interpretation
0.90 to 1.00 (-0.90 to -1.00)	Very strong correlation
0.70 to 0.89 (-0.70 to -0.89)	Strong correlation
0.40 to 0.69 (-0.40 to -0.69)	Moderate correlation
0.10 to 0.39 (-0.10 to -0.39)	Weak correlation
0.00 to 0.09 (0.0 to -0.09)	Negligible correlation

Meanwhile, approaches were taken to see correlations between vaccination and tourism as one of the sectors most affected by the Covid-19 pandemic. With limited indicators that are directly related to tourism, approaches are carried out through indicators in the supporting sectors. The variables are as follows.

1. Google's Community Mobility Reports (CMR) to look at community mobility.
2. The growth of the Rail and Air Transportation subsectors year-on-year in the first and second quarters of 2021. These two sub-sectors are taken because people that take a holiday generally use train or plane to travel, especially inter-city and provincial holiday. Meanwhile, other modes of transportation are also encouraged by other activities that are not related to tourism.
3. The growth of the Accommodation and Food Beverage Provision subsectors in the first and second quarters of 2021. Although not really supported by the tourism industry, these two subsectors are an important part of the tourism industry. Thus, it can be used as an indication of improvement in the tourism sector.
4. The visit of domestic tourists is considered more appropriate, but the latest data is not yet available so it is not possible to use it. However, foreign tourist visits will show tourism policies that go hand in hand with the development of Covid-19.

4. Results and discussions

4.1. Covid-19 and health

DKI Jakarta was the province with the highest 1 dose vaccination achievement in Indonesia. As of July 31 2021, DKI Jakarta has provided 7.8 million of 1 dose of vaccine. This achievement was followed by East Java and West Java, with 7.7 and 6.2 million doses, respectively. Meanwhile, for the 2 dose vaccination, East Java was the top province with 3.2 million doses. Higher than West Java and DKI Jakarta, where respectively the provinces were 2.9 and 2.8 doses.

Provinces in Java-Bali dominated the highest vaccination rates, both 1 dose and 2 doses. It was recorded that 7 out of 10 provinces with the highest dose vaccination achievement came from Java-Bali. Consideration of Java-Bali being the economic center in Indonesia underlay this. Because the

vaccination program is not only a health policy, but also an economic policy. With the return of the normal wheels of the economy in Java-Bali, it was hoped that it will boost the national economy again

In proportion to the total population as shown in **Table 2**, DKI Jakarta again became the province with the highest vaccination achievement, both 1 dose and 2 doses. This achievement was in line with the recovery rate of Covid-19 patients which reached 0.982. This indicates that for every 100 positive Covid-19 patients in Jakarta, 98 of them had recovered. In terms of mortality rate, DKI Jakarta became the third best province, amounting to 0.014. This figure indicates that for every 1,000 positive Covid-19 patients in Jakarta, only 14 patients die.

The development of vaccination and the severity of Covid-19 in East Java was astonishing. On the one hand, the vaccination achievement rate in East Java was very good, reached 0.189 inhabitants. This achievement is the 6th highest in Indonesia. With a population of 41.66 million people, the second largest after West Java, vaccination in East Java could be said to be very good. But ironically, the mortality death rate in East Java was the highest in Indonesia, reached 0.065. So, many things must be considered again in handling Covid-19 in East Java. Health policies must be re-evaluated, the implementation of health protocols must be tightened, restriction on residents' activities must be paid more attention to, and so on.

Table 2. Covid-19 and vaccination development in Indonesia

No	Provinsi	1 Dose Vaccine Proportion	2 Doses Vaccine Proportion	Case Proportion	Recovery Rate	Mortality Rate
1	Aceh	0.129	0.052	0.003	0.682	0.044
2	North Sumatra	0.126	0.069	0.003	0.592	0.019
3	West Sumatra	0.113	0.042	0.009	0.775	0.021
4	Riau	0.140	0.089	0.011	0.803	0.028
5	Jambi	0.183	0.073	0.005	0.721	0.022
6	South Sumatra	0.115	0.062	0.004	0.709	0.041
7	Bengkulu	0.124	0.057	0.007	0.715	0.012
8	Lampung	0.069	0.043	0.003	0.724	0.061
9	Bangka Belitung Islands	0.147	0.087	0.021	0.814	0.020
10	Riau Islands	0.503	0.117	0.018	0.789	0.026
11	DKI Jakarta	0.738	0.269	0.060	0.982	0.014
12	West Java	0.128	0.060	0.011	0.771	0.016
13	Central Java	0.142	0.078	0.008	0.836	0.053
14	DI Yogyakarta	0.321	0.120	0.029	0.659	0.030
15	East Java	0.189	0.078	0.006	0.712	0.065
16	Banten	0.151	0.069	0.008	0.656	0.016
17	Bali	0.711	0.202	0.014	0.779	0.028
18	West Nusa Tenggara	0.111	0.041	0.003	0.888	0.021
19	East Nusa Tenggara	0.112	0.056	0.007	0.687	0.018
20	West Kalimantan	0.102	0.049	0.004	0.773	0.027
21	Central Kalimantan	0.166	0.090	0.009	0.852	0.024
22	South Kalimantan	0.114	0.063	0.008	0.751	0.023
23	East Kalimantan	0.147	0.085	0.024	0.754	0.029
24	North Kalimantan	0.140	0.063	0.025	0.754	0.017

No	Provinsi	1 Dose Vaccine Proportion	2 Doses Vaccine Proportion	Case Proportion	Recovery Rate	Mortality Rate
25	North Sulawesi	0.289	0.076	0.006	0.758	0.026
26	Central Sulawesi	0.108	0.052	0.006	0.739	0.028
27	South Sulawesi	0.160	0.072	0.006	0.843	0.014
28	Southeast Sulawesi	0.143	0.059	0.003	0.693	0.024
29	Gorontalo	0.177	0.084	0.003	0.800	0.030
30	West Sulawesi	0.131	0.056	0.005	0.795	0.021
31	Maluku	0.118	0.047	0.004	0.673	0.019
32	North Maluku	0.095	0.038	0.006	0.682	0.021
33	West Papua	0.145	0.062	0.011	0.795	0.015
34	Papua	0.086	0.041	0.003	0.404	0.008

Using correlation analysis, it is found that 2 doses vaccination in Indonesia has moderate correlation to the patient's recovery rate, reaches 0.452. While 1 dose vaccination has a weak correlation coefficient. This shows two things at once, vaccination has a relationship with the recovery rate but it needs 2 doses of vaccine to achieve this correlation. This indicates the urgency of the second injection of vaccines to achieve herd immunity. Unfortunately, vaccination rate is not closely related to mortality rates. Either the 1 dose or 2 doses vaccination has a negligible correlation to mortality rate. According to the Deputy Minister of Health, Dante Saksono, 90-94 percent of the death cases of positive Covid-19 patients in Indonesia are contributed by those who had not been vaccinated against the corona virus [26]. However, the correlation results indicate a favorable direction.

Table 3. Correlation of vaccination and health

	Case Proportion	Recovery Rate	Mortality Rate
Vaccination 1 Proportion	0.669	0.377	-0.065
Vaccination 2 Proportion	0.790	0.452	-0.054

The correlation between vaccination rates, especially 2 doses, and the recovery rate is moderate, as shown in **Table 3**, indicates that an increase in the number of people being vaccinated in a region will go hand in hand with an increase in the recovery rate. This result is good news, because it shows the Covid-19 vaccine is potentially able to increase the immunity of the Indonesian people. In the end, vaccination will encourage the creation of herd immunity and finally Indonesia can live side by side with Covid-19.

Although the correlation coefficient is negligible, the direction of the correlation between vaccination and mortality rate is also good news. At the same time, it shows the same thing with an increase in the recovery rate. The small correlation value is allegedly due to the small number of vaccinations. However, a negative correlation indicates an indication of a decrease in the mortality rate along with an increase in vaccination rates. The government needs to continue to encourage increased vaccination rates so that the mortality rate can be lowered optimally.

The thing to watch out for is that the vaccination program runs in line with the proportion of additional positive cases of Covid-19. President Director of RSPI Sulianti Saraso Jakarta, dr. M. Syahril Mansyur, said the factors for the spike in Covid-19 during 2021 in Indonesia were due to public discipline in complying with health protocols, mass gatherings that caused crowds, the entry of

more infectious variants, and the lack of vaccine coverage [27]. Further in-depth research is needed to really see the development of Covid-19 cases in Indonesia.

Table 4. Canonical correlation of vaccination and health

Vaccination Proportion	Health Variable	Canonical Correlation
		0.834

The strong canonical correlation value, reachs 0.834, shows a close relationship between vaccination rates and health variables, namely the development of Covid-19, in Indonesia as shown in **Table 4**. Boosting the vaccination program promises to improve the health of the Indonesian people in general, in terms of daily case development, recovery rate, and mortality rate. On the one hand, the government must work harder to increase the availability of vaccines. Because until mid-2021, many people who actually want to take vaccinations but don't get them due to limited availability. On the other hand, there are still many people who are reluctant to participate in the vaccination program. To overcome this, joint work is needed to provide better education on the benefits of the Covid-19 vaccine.

4.2. Covid-19 and economy

As shown in **Table 5**, North Maluku became the province with the highest economic growth in the second quarter of 2021 (year-on-year), reachs 16.89 percent. In contrast to West Papua in the last position which is still experienced a contraction of 2.39 percent. West Papua was the only province that experienced contraction this quarter. Meanwhile, the low base effect caused the Indonesian economy to experience high growth. The economic growth of Central Sulawesi, Papua, DI Yogyakarta, DKI Jakarta, and West Kalimantan reached 2 digits (above 10 percent).

In the poverty rate indicator, as many as 22 provinces were able to reduce their poverty level. East Nusa Tenggara is the province with the highest poverty reduction, reached 0.22 percent. Meanwhile, in terms of inequality, South Kalimantan is at the top. South Kalimantan was able to reduce its Gini ratio by 0.021 percent.

Besides being able to reduce inequality, South Kalimantan is also able to increase community participation in economic activities. South Kalimantan's LFPR recorded an increase of up to 3.16 percent in February 2021 compared to August 2020. Then, DKI Jakarta became the top province in reducing the unemployment rate. During the period August 2020 to February 2021, DKI Jakarta was able to reduce its unemployment rate to 2.44 percent.

Table 5. Covid-19 and economy development in Indonesia

No	Provinsi	Economic Growth	Poverty Rate Growth	Gini Ratio Growth	LFPR Growth	Unemployment Rate Growth
1	Aceh	2,56	-0,10	0,005	0,04	-0,29
2	North Sumatra	4,95	-0,13	0,000	0,72	-0,90
3	West Sumatra	5,76	0,07	0,005	-0,60	-0,21
4	Riau	5,13	0,08	0,005	0,57	-1,36
5	Jambi	5,39	0,12	0,005	-0,49	-0,37
6	South Sumatra	5,71	-0,14	0,003	1,30	-0,34
7	Bengkulu	6,29	-0,08	0,003	0,01	-0,35
8	Lampung	5,03	-0,14	0,003	1,57	-0,13
9	Bangka Belitung Islands	6,85	0,01	-0,001	1,10	-0,21
10	Riau Islands	6,90	-0,01	0,009	0,11	-0,22
11	DKI Jakarta	10,91	0,03	0,009	1,31	-2,44
12	West Java	6,13	-0,03	0,014	0,30	-1,54
13	Central Java	5,66	-0,05	0,013	-0,05	-0,52
14	DI Yogyakarta	11,81	0,00	0,004	1,69	-0,29
15	East Java	7,05	-0,06	0,010	-0,58	-0,67
16	Banten	8,95	0,03	0,000	-0,20	-1,63
17	Bali	2,83	0,08	0,009	-0,61	-0,21
18	West Nusa Tenggara	4,68	-0,09	-0,005	0,87	-0,25
19	East Nusa Tenggara	4,22	-0,22	-0,010	0,18	-0,90
20	West Kalimantan	10,81	-0,09	-0,012	1,55	-0,08
21	Central Kalimantan	5,56	-0,10	0,003	1,04	-0,33
22	South Kalimantan	4,40	0,00	-0,021	3,16	-0,41
23	East Kalimantan	5,76	-0,10	-0,001	1,96	-0,06
24	North Kalimantan	5,81	-0,05	-0,008	-0,34	-0,30
25	North Sulawesi	8,49	-0,01	-0,003	-0,14	-0,09
26	Central Sulawesi	15,39	-0,06	-0,005	-0,51	-0,04
27	South Sulawesi	7,66	-0,21	0,000	1,96	-0,52
28	Southeast Sulawesi	4,21	-0,03	0,002	0,93	-0,36
29	Gorontalo	3,43	0,02	0,002	0,91	-0,87
30	West Sulawesi	5,44	-0,21	0,000	1,52	-0,04
31	Maluku	4,53	-0,12	-0,012	-0,67	-0,84
32	North Maluku	16,89	-0,08	0,010	0,03	-0,09
33	West Papua	-2,39	0,14	0,004	-1,44	-0,62
34	Papua	13,14	0,06	0,002	1,31	-0,51

Based on correlation analysis as shown in **Table 6**, vaccination had different correlations on economic indicators in Indonesia. Positive results were obtained on the correlation between vaccination and economic growth, LFPR (2 dose vaccination), and unemployment rate. Negative results were obtained on the correlation between vaccination with poverty rate and Gini ratio.

Table 6. Correlation of vaccination and economy

	Economic Growth	Poverty Rate	Gini Ratio	LFPR	Unemployment Rate
Vaccination 1 Proportion	0.037	0.337	0.345	-0.081	-0.302
Vaccination 2 Proportion	0.034	0.319	0.336	0.056	-0.458

Although the values are very small, only 0.037 and 0.034 which is negligible, based on correlation analysis, it is shown that vaccination is in line with economic growth. Means, increasing vaccination achievement potentially will also grow in line with the economic growth of a region. This result is quite interesting because low vaccination rate had had positive correlation with economic growth which is a macro indicator. This should be a catalyst for the government to increase its vaccination program so that the macro economy will grow.

The urgency of the 2 doses vaccination is indicated by the correlation between the vaccination rate and LFPR. The correlation value of 0.056 on the relationship between the 2 doses vaccine and LFPR shows that the improvement in employment in Indonesia is only felt after 2 doses of the vaccine were given, not just 1 dose. Even the opposite results occurred in the 1 dose vaccine. Of course, there are many factors that encourage this, but it is estimated that one of them is the government's strategy to increase vaccination coverage. The requirement of some administrations is showing vaccination certificate. Perhaps, some matters in employment also require showing a vaccination certificate.

Result above is in line with the negative correlation between vaccination and unemployment rate. This means that the increase in vaccination rate will reduce the unemployment rate. In fact, the correlation is moderate, reaches -0.458 for 2 doses vaccine. Herd immunity which is slowly starting to form encourages people to be able to do more activities, including work activities. In addition, the vaccination certificate guarantees a little more freedom of activity.

The opposite results occur in the poverty rate and Gini ratio. With results that are not much different, both 1 dose and 2 doses vaccines, as well as poverty rate and Gini ratio, show that increasing vaccination achievement actually grow in line with poverty rate and Gini ratio. These results indicate that the vaccination program has not been able to stem the increase in poverty and inequality in Indonesian society. Almost all economic sectors have been affected by the pandemic, some of which have not been able to rise, especially the informal sector which is a pocket of poverty. Poverty rate increasing will go hand in hand with inequality widening. Government assistance is allegedly not able to restrain the community from experiencing poverty. Furthermore, perhaps the increase in economic growth only occured in capital-intensive sectors so that it did not have much impact on society as individuals

Table 7. Canonical correlation of vaccination and economy

Vaccination Proportion	Economy Variable	Canonical Correlation
		0.716

Same as before, with canonical correlation, the correlation value between vaccination and economic variables reaches 0.716 as shown in **Table 7**. This value shows a strong relationship between vaccination rate and economic variable in Indonesia as a whole. Encouraging vaccination achievements promises to improve the general economic condition of the Indonesian people. However, it should be a special note for the government, all sectors of the economy need to be considered. Not only sectors that have a major contribution to the economy of a region. The informal sector also needs to be considered more deeply. Like the entertainment and accomodation sector, which is still struggling because it requires the physical presence of many people. The vaccination

program promises many positive things. In time for herd immunity to be achieved, economic activity must return to normal or even increase more rapidly.

4.3. Covid-19 and tourism

The first approach to look at the development of tourism is community mobility. Through CMR, Google provides a very useful information to see people's mobility patterns. Related to tourism, three patterns can be used in CMR, namely mobility at Retail & Recreation, Parks, and Transit Stations locations. Retail & Recreation shows the pattern of community visits to recreational areas, which is supported by movement in the Parks location. As a support, the pattern of community visits to Transit Stations location can also be an indication, because tourism is closely related to public transportation such as trains and planes.

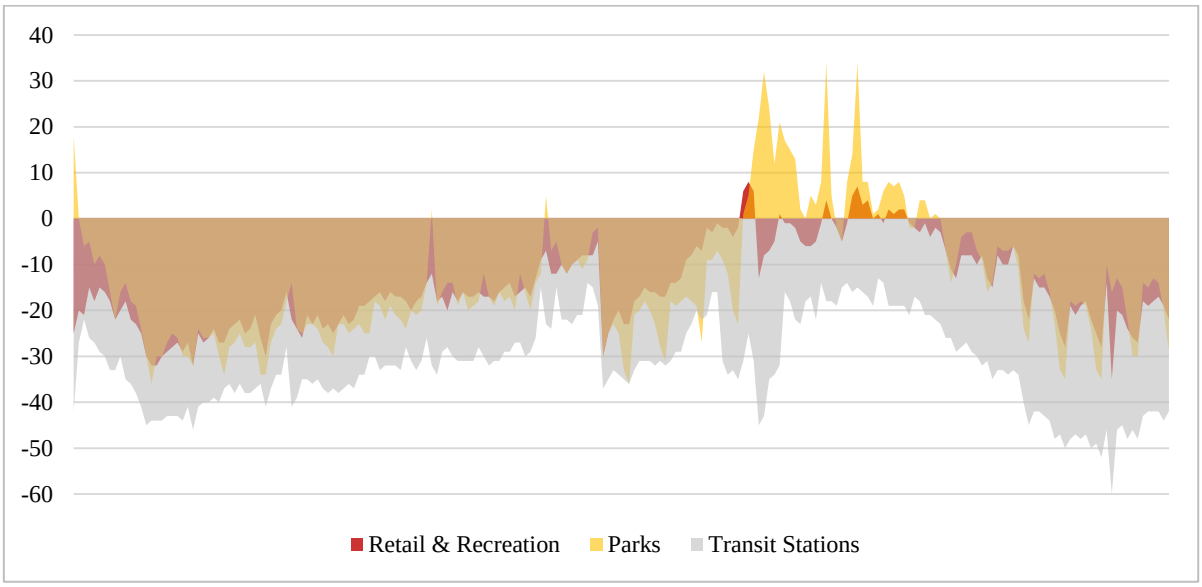

Figure 1. Indonesia people's mobility during first half year of 2021

Based on **Figure 1**, compared to baseline day, that is the median value from the 5‑ week period Jan 3 – Feb 6, 2020, community mobility in Retail & Recreation locations until May 2021 increased. Although it was still lower compared to the baseline day, this negative value continued to increase. Until the end of May to the end of June 2021 it reached a positive value. Coinciding with Eid al-Fitr and the end of the school year holiday. Indicates that people chose to went on vacation in this holiday period. Mobility at this location then decreased in line with the implementation of Emergency PPKM (*PPKM Darurat*) since late June 2021. This pattern is supported by the community mobility pattern in Parks location which had increased from February to April-June 2021, until finally it had a positive value in the period June-July 2021 before Emergency PPKM enforcement.

Community mobility at the Transit Stations location also increased in the period of May and June 2021, coinciding with the Eid al-Fitr holiday period and the end of the school year holiday. Although not entirely related to traveling, the increase in mobility at the Transit Stations also indicates an increase in the movement of people to travel. This is because people who travel, especially between cities and provinces, tend to use public transportation modes such as planes and trains.

Table 8. Growth of the Rail and Air Transportation subsectors in quarter I and II-2021

Subsector	Growth (Percent)					
	Quarter I-2021			Quarter II-2021		
	q-to-q	y-on-y	c-to-c	q-to-q	y-on-y	c-to-c
Rail Transportation	-13.39	-45.04	-45.04	24.39	67.19	-12.46
Air Transportation	-20.75	-52.45	-52.45	13.58	137.74	-17.25

Based on **Table 8**, it can be seen that there is a significant growth in the Rail and Air Transportation subsectors in the Second Quarter-2021 period. Moreover, the year-on-year growth of the two subsectors reached more than 50 percent, even for Air Transportation reached more than 100 percent. This rapid increase in Quarter II-2021 again indicates the recovery of the tourism sector, especially during the period mid-2021 before the implementation of Emergency PPKM in Indonesia. By regulation, vaccination certificates, both 1 dose and 2 doses, are one of the administrative requirements for long distance travel, either by train or plane. So, both in terms of regulation and immunity, it is indicated that vaccination is closely related to the improvement of the tourism sector in Indonesia.

Table 9. Growth in Accommodation and Food Beverage Provision subsectors in quarter I and II-2021

Subsector	Growth (Percent)					
	Quarter I-2021			Quarter II-2021		
	q-to-q	y-on-y	c-to-c	q-to-q	y-on-y	c-to-c
Accommodation Provision	-3.20	-17.61	-17.61	1.87	45.07	5.36
Food Beverage Provision	-1.52	-4.94	-4.94	1.91	17.88	5.35

Based on **Table 9**, the subsector of Accommodation and Food Beverage Provision grew in the period of Quarter II-2021. Especially in the accommodation provision, which year-on-year grew by 45.07 percent in that period. This growth is a very good news considering that accommodation is one of the worst hit industries during the Covid-19 pandemic. The vaccination program was indicated to go hand in hand with the Accommodation and Food Beverage Provision subsectors, which are tourism supporting subsectors.

Unfortunately, information of domestic tourists number is not yet available for the first semester of 2021. So that the tourism pattern of the Indonesian people cannot be observed. However, information on foreign visits can be used as an early picture of the recovery of the tourism industry from a regulatory perspective, where regulations go hand in hand with the development of the Covid-19 recovery in Indonesia.

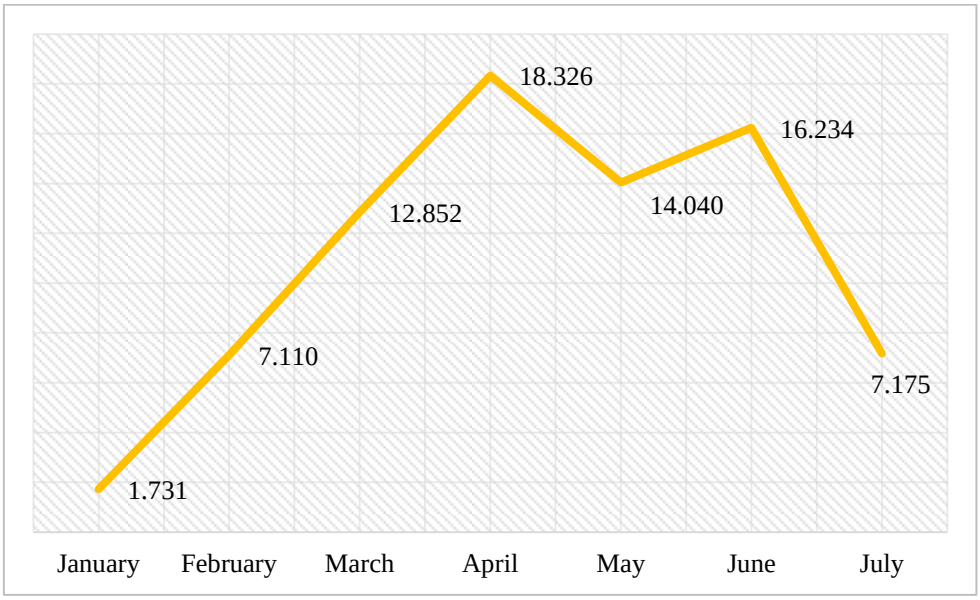

Figure 2. Number of foreign residents visiting through the air gate in 2021

Figure 2 shows an increasing in visits during 2021 until it reaches two peaks in April and June 2021. The selected visits are visits by air gates, because in general foreigners who want to travel will use air transportation modes. This number of visits has the same pattern as the previous tourism supporting indicators. Then it is go hand in hand with vaccinations which increased in mid-2021. Before this number decreased in July 2021 due to the implementation of Emergency PPKM. Indications of the entry of the Delta variant of the Covid-19 virus from foreign people became the reference for government to close the door again.

5. Conclusion

Overall, based on the canonical correlation, it can be concluded that vaccination is closely related to improving the health and economic conditions of the Indonesian people. Both generate canonical correlations of up to 0.834 (vaccination-health) and 0.716 (vaccination-economy). Meanwhile, if broken down by each variable, the increase in vaccination rate will encourage the development of recovery rate, mortality rate, economic growth, LFPR, and unemployment rate in a better direction. In a more specific point of view, there are indication that vaccination has a positive correlation to tourism sector development. Meanwhile, further research involving other, more complete factors is needed to see the impact of vaccination on positive cases, poverty rate, and Gini ratio. Bias must have occurred in this research, because it is a social research which in fact many factors are involved. However, the results of this study can provide an overview of how vaccination potentially has an impact on improving Indonesia's health and economic conditions.

The results of this study are in line with the theory put forward by experts and the history of past pandemic eradication, Covid-19 vaccination program in Indonesia indicates a positive relationship with the acceleration towards herd immunity and economy recovery. Of course, there are many factors that courage herd immunity, but the strong correlation coefficient shows that the government can accelerate the process of eradicating the pandemic through the intervention of vaccination program. Meanwhile, the government must have a special strategy related to employment because of the low correlation between vaccination and LFPR. Either through expanding employment opportunities or encouraging people to become entrepreneurs, the government must intervene immediately. In addition, Emergency PPKM in fact had a really big impact on the economy. The tourism industry, which began to improve towards the middle of 2021, then sluggish again along with the Emergency PPKM implementation. Once again, the government has to rack their brains to formulate policies that have an impact on both health and the economy.

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