KPMG

Vaccinations Report 2021

Back to normality – the value of vaccination

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Executive summary

Countries in ASPAC are intensifying their COVID-19 vaccination efforts to bolster economic recovery post the COVID-19 pandemic. To date, South Korea has majority (62.5%) of its population fully vaccinated, and one of the highest vaccination rates in the world. Although developing markets such as the Philippines and Indonesia lag, they have managed to fully vaccinate at least a quarter of their population. As vaccination coverage in ASPAC increases, countries could seek to unlock the economic benefits that come with it.

Individual

- South Korea is best placed with the lowest infection rate and the highest vaccination rate.

- In comparison, the Philippines falls on the opposite end of these two indicators (highest infection rate and lowest vaccination rate).

- The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country, therefore, cases avoided are highest for India and lowest for Vietnam.

	India	Indonesia	South Korea	The Philippines	Vietnam
Cases avoided	213,728,624	46,002,024	23,177,338	19,222,808	8,836,603
Symptomatic	198,557,754	42,656,992	21,458,729	7,945,062	8,230,260
Hospitalised	12,570,144	2,781,233	1,446,131	1,085,443	508,988
ICU	430,377	98,734	42,592	29,954	11,073
Deaths	2,170,350	465,065	229,886	162,349	86,282

Government

- In terms of absolute values, South Korea has the highest healthcare cost avoided reflecting high case costs due to its high-income status.

- The lowest healthcare costs avoided are in the Philippines and Vietnam, both of which have relatively low hospital costs avoided reflecting low overall case costs and less cases avoided than India and Indonesia, which are the two most populous countries of the five.

	India	Indonesia	South Korea	The Philippines	Vietnam
Total	6,255,463,502	8,141,784,516	22,363,026,592	3,225,511,409	3,498,805,358
Symptomatic	5,705,259,476	7,177,618,463	7,095,868,670	1,064,226,211	2,685,254,772
Hospitalised	425,877,596	698,471,971	3,451,090,574	1,903,752,623	544,607,234
ICU	24,433,916	58,304,198	385,276,537	54,834,541	41,860,616
Death	99,892,513	207,389,884	1,430,790,811	202,698,034	227,082,736

Economy

- For S.Korea, all variables (consumption, exports, GDP and tax revenue) indicate a positive effect except lower consumption in 2021 compared to the base year.

- The long-term macroeconomic effects for other countries are much smaller. In terms of GDP, we observe – Indonesia 0.45%, the Philippines 0.24%, Vietnam 0.23% and India.

About the research

"Back to Normality – the Value of Vaccination" is a report by KPMG that examines the benefits of COVID-19 vaccination for individuals, governments, and economies in the Asia-Pacific region with a focus on India, Indonesia, S.Korea, the Philippines and Vietnam as case study markets. This report was commissioned by AstraZeneca plc, as part of an engagement delivered by KPMG Services Pte. Ltd. The research centres on assessing the current and future opportunities that countries in ASPAC reap as they embark on a national COVID-19 vaccination strategy and majority of the population becomes fully vaccinated. The report explores the benefits of COVID-19 vaccination across three pillars – Individuals, Government and Economy (see below).

Category	Description
Patient	
Cases Avoided	The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country at the moment of study.
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical).
Hospitalized	Cases hospitalized but not in ICU.
ICU	Cases hospitalized and in an Intensive Care Unit.
Deaths	Cases that resulted in death.
Healthcare costs avoided (USD)	Costs by case type were collected through primary and secondary research methods and applied to the estimated cases avoided to evaluate the value of healthcare costs avoided in each country due to vaccinations. The total cost savings across the public and private healthcare sectors are summarised in in the following.
Government	
Labour productivity effects of increased vaccination (%)	Lost workdays avoided by due to increased vaccination were estimated in order to evaluate the overall labour productivity effects.
Risk premium effect due to increased vaccination (percentage-point change)	Investor risk premiums fall due to vaccinations as policymakers have touted the importance of vaccinations in moving to more normal economic conditions without a continuous cycle of imposing and removing prophylactic measures.
Net Present Value of Welfare Gains ($USD Bn)	The net present value (NPV) of economic welfare or utility is defined as the sum of the value of leisure and household consumption.
Economy	
Macroeconomic Effects	We analyse the macroeconomic effects of increasing COVID-19 vaccinations. These numbers represent the impacts on consumption, expenditure, exports, GDP and tax revenue for all countries in 2021 and 2050.
Industry Impacts	Due to the benefit of vaccination and lost workdays avoided, together with increase investor confidence, Agriculture, Mining, Manufacturing, Trade, Transport, Utilities, Construction, Other Services and Government Services are projected to resume normal economic conditions.

KPMG research: KPMG carried out extensive desk research and evidence review of the health policies and macroeconomic trends of COVID-19 vaccination in India, Indonesia, S.Korea, the Philippines and Vietnam. We further supplemented the research with in-depth interviews with health economists and public health experts across the five in-scope countries.

Impact calculations: The analysis presented in this paper is based on the data and research on COVID-19 from Our World in Data. The available COVID-19 dataset is a collection of daily data on key COVID-19 indicators like case numbers, tests, deaths and vaccinations compiled from various global and country-specific health organisations and other government sources. The analysis uses data for the five countries of interest, where available.

KPMG global model: A dynamic computable general equilibrium (CGE) model representing the regional and global economies with a detailed representation of the economic activities of industries, households, governments and foreigners. We apply KPMG-Global in this work to estimate the economywide effects of vaccination for the five countries of interest.

Introduction and ASPAC vaccination effort

The COVID-19 pandemic has had a huge impact on the Asia Pacific (ASPAC) economy, resulting in a contraction of over 4% from 2019-2020 alone.[1]

Consumer-facing industries such as retail, hospitality, and travel, among others, were the most badly affected as countries closed their borders and entered a state of lockdown to contain the spread of the virus.

Looking across the countries analysed for this paper, a "reverse-migration" also swept across business districts such as Ho Chi Minh and New Delhi as people were put out of work. According to a project director interviewed for this paper at PATH Vietnam, "many factories had to shut down and workers lost their jobs. We saw the biggest migration of over one million people out of the city (Ho Chi Minh)".

In terms of infections, India and Indonesia took the biggest hit in the region, with over 400,000 and 50,000 infections a day respectively at the peak of the COVID-19 outbreak in mid-2020 (See figure 1).[2]

India was faced with a second wave of infection in May 2021 caused by the Delta variant, which resulted in over 19 million infections[3] and more than 200,000[4] deaths within a span of only four months. The COVID-19 pandemic placed a huge strain on healthcare systems across Asia Pacific as countries struggled to keep pace with the surge in testing demand and patient volumes as the virus outbreak progressed.

> "Many factories had to shut down and workers lost their jobs. We saw the biggest migration of over one million people out of the city (Ho Chi Minh)"
> – Project Director, PATH, Vietnam

Figure 1. Daily COVID-19 cases in India and Indonesia
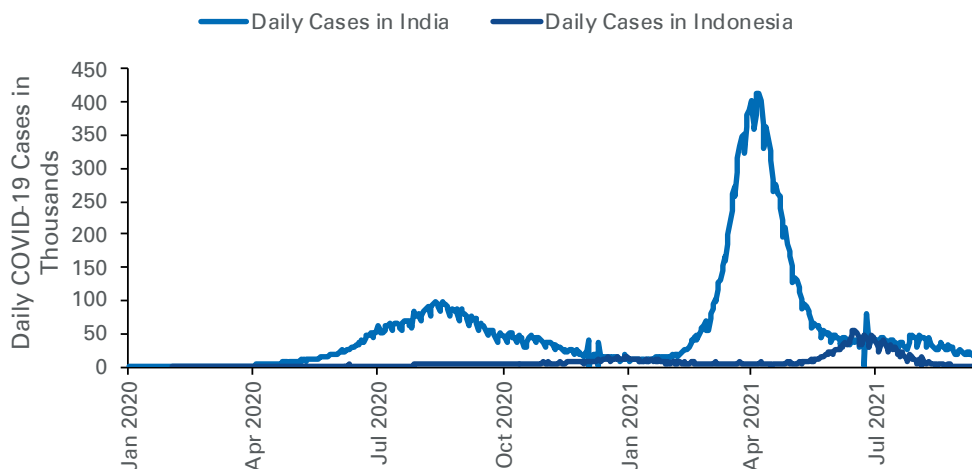
Source: Our World in Data

[1]The World Bank, (2020), "From Containment to Recovery: Economic Update for East Asia and the Pacific October 2020", accessed on 2 November 2021, available at https://www.worldbank.org/en/region/eap/publication/east-asia-pacific-economic-update
[2]COVID-19 Cases, Our World in Data, 2021
[3]COVID-19 Cases, Our World in Data, 2021
[4]Times of India, (2021), "Covid-19: Deaths in 2nd wave cross 2 lakh at daily average…", accessed on 2 November 2021, available athttp://timesofindia.indiatimes.com/articleshow/83414459.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cpps

Some countries such as South Korea however, emerged stronger than others pre-Omicron in terms of managing the spread of COVID-19 (table 1). The country adopted an aggressive surveillance strategy at the onset of the pandemic where rapid testing centres were set up across the country to screen potential asymptomatic carriers. People who tested positive for COVID-19 were subsequently quarantined at hospitals and infection control centres.

As of March 2020, more than 250,000 people had been tested in South Korea, roughly 1 in 200 people.[5] The country had managed to keep death rates low (at 0.77% in November 2021) despite two major outbreaks.[6]

Table 1. COVID-19 infection and death rates in ASPAC as of October, 2021

	South Korea	India	Vietnam	The Philippines	Indonesia
Total COVID-19 cases (per million people)	342,396 (6,673)	34,067,719 (24,449)	860,860 (8,769)	2,713,509 (24,435)	4,234,011 (15,320)
Total COVID-19 deaths	2,660 (0.77%)	452,124 (1.32%)	21,131 (2.45%)	40,580 (1.49%)	142,933 (3.38%)

Source: Our World in Data

Most ASPAC countries have employed a combination of measures such as safe distancing, contact tracing, lock down and travel restrictions to flatten the COVID-19 virus infection curve.

However, these have usually come at a cost to the economy as businesses shut down and consumer spending plunges as a result.

Vaccination stands out as the most effective measure to contain the degree of serious COVID-19 health consequences, such as hospitalisation and death due to COVID-19, while allowing economies to recover.

COVID-19 vaccines became available to countries at the start of 2021. The UK was one of the first countries worldwide to roll out a national vaccination program with vaccines manufactured by Oxford University and AstraZeneca, which helped to curb the spread of an Alpha virus variant in the country.[7]

Countries in ASPAC begin to follow suit in the first quarter of 2021; by then, governments such as India and the Philippines had already announced ambitious plans to vaccinate the majority of the population by the end of the year.

However, developing markets faced barriers to vaccine access, often at odds with the access provided to citizens of high-income countries. By the end of January 2021 alone, developed countries who made up only 16% of the world's population had already secured a whopping 60% of the total COVID-19 vaccine supply.[8] These countries bought first dibs in vaccine supply via lucrative pre-purchase agreements with multiple vaccine manufacturers. The US for instance had purchased over four times the number of vaccines it needed for its population. Similarly, South Korea had secured more than 176 million vaccine doses for its population of 52 million (see figure A.13).

To mitigate the deepening vaccine inequity, COVAX was set up by the World Health Organization (WHO) to supply underserved countries with lower priced vaccines. To date COVAX has distributed over 435 million COVID-19 vaccines to over 144 participating countries.[9] Indonesia and the Philippines are two countries which have greatly benefited from COVAX, receiving more than 20 million and 39 million vaccination doses respectively. "The COVAX vaccines have been a huge support for the country, allowing us to fill the gap in elderly vaccination and promoting quicker vaccination coverage", an interviewed public health expert from the Asian Development Bank, the Philippines, stated.

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[5] Lee & Lee. (2020), 'Testing on the move: South Korea's rapid response to the COVID-19 pandemic', Elsevier Public Health Emergency Collection
[6] CNBC (2021), 'South Korea loosens restrictions in step toward 'living with Covid-19' accessed on 3 November 2021 at https://www.cnbc.com/2021/10/29/south-korea-loosens-restrictions-in-step-toward-living-with-covid-19.html
[7] AJMC, (2021), "A Timeline of COVID-19 Vaccine Developments in 2021", accessed on 2 November 2021, available at https://www.ajmc.com/view/a-timeline-of-covid-19-vaccine-developments-in-2021
[8] Vox, (2021), "Rich countries are hoarding Covid-19 vaccines", accessed on 2 November 2021, available at https://www.vox.com/2021/1/29/22253908/rich-countries-hoarding-covid-19-vaccines
[9] Vaccine roll-out, Gavi , 2021

> *"The COVAX vaccines have been a huge support for the country, allowing us to fill the gap in elderly vaccination and promoting quicker vaccination coverage",*
> *– Public health expert, Asian Development Bank, the Philippines*

In 2021, the top three vaccines distributed by COVAX included AstraZeneca, Pfizer BioNTech and Moderna, according to data from Gavi, the vaccine alliance that co-manages the programme with the World Health Organization (WHO). Vaccine prices ranged from $2-$40 USD per dose; Biological E, Covishield, Sputnik-V and AstraZeneca were among the cheapest vaccines in the market[10]. In 2022, it is anticipated that Pfizer will become the largest supplier to COVAX. Countries such as India and Indonesia further leveraged their domestic biopharma manufacturing capabilities to produce COVID-19 vaccines on their own. The Serum Institute of India (SII) for example, is now the world's largest vaccine manufacturer and quadrupled their manufacturing capacity to produce between 220 to 240 million vaccines per month. It has also supplied around 90% of India's COVID-19 vaccines, including the production of AstraZeneca's vaccine.[11] Additionally, SII has plans to produce Novavax and Sputnik Light vaccines for international exports.

ASPAC countries continue to intensify their vaccination efforts in an attempt to bolster economic recovery. South Korea has majority of its population fully vaccinated, and one of the highest vaccination rates in the world. Countries like the Philippines and Indonesia lag behind but had at least almost a quarter of their population fully vaccinated (table 2) by October 2021. As vaccination coverage increases throughout 2022, countries are beginning to unlock the economic benefits that come with it.

Table 2. Comparison across nations of COVID-19 vaccination rates as of October 17, 2021

	South Korea	India	Vietnam	The Philippines	Indonesia
% population that received at least 1 dose	78.44%	51.4%	42.5%	26.9%	39.59%
% fully vaccinated population	62.5%	20.7%	17.82%	22.7%	22.5%

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[8] Vox, (2021), "Rich countries are hoarding Covid-19 vaccines", accessed on 2 November 2021, available at https://www.vox.com/2021/1/29/22253908/rich-countries-hoarding-covid-19-vaccines
[9] Vaccine roll-out, Gavi , 2021

Case Study 1: S. Korea's "Vaccine Reservation" system

In a bid to increase COVID-19 vaccine access, the South Korean government created an online vaccine reservation system where individuals could track in real-time the stockpile of vaccines available in each city and ballot for leftover vaccines if available.[1]

The system generated huge buzz among young adults, allowing them to secure a vaccine before they were eligible under the national vaccination program. Concurrently, it incentivized more elderly people to get vaccinated considering the huge demand for leftover vaccines among their younger peers.

Demand for vaccines has surged across the nation, according to a Deputy Director of KDCA, "people were very persuaded to get the vaccine once they saw that other people were booking leftovers…it also convinced the older people to get vaccinated", he adds. Currently, South Korea has one of the highest vaccination rates globally, with the large majority of its population fully vaccinated, due in large part to the success of its vaccine reservation system.[2]

> "People were very persuaded to get the vaccine once they saw that other people were booking leftovers…
> it also convinced the older people to get vaccinated"
> – *Deputy Director, Korea Disease Control and Prevention Agency*

[1] Korea Herald, (2021), "The 'impossible' race for leftover vaccines", accessed on 1 November 2021, available at http://www.koreaherald.com/view.php?ud=20210616000953&kr=1
[2] COVID-19 Vaccinations, Our World in Data, 2021

Different countries across the region employed different strategies to get their mass vaccination program off the ground. And in turn, we have seen varied health and economic value attached to each program.

Economic impact of vaccination

4.1 Benefits to patients

Individuals could seek to reap huge opportunities from being fully vaccinated for the COVID-19 virus. One key benefit is the avoidance of healthcare expenditure, especially in countries such as the Philippines where patients have to co-pay the treatment of COVID-19. A study by the University of the Philippines-Philippine General Hospital (UP-PGH) found that patients aged 60 and above paid an average of USD84-685 in hospitalization fees for the treatment of COVID-19, those under 60 years paid USD540-930 and those between 19-30 beared the highest cost of over USD930.[12] The costs would have been significantly reduced among fully vaccinated individuals. An official at the National Economic and Development Authority of the Philippines explains, "vaccinated individuals are less likely to suffer from severe and critical COVID-19 symptoms that need close monitoring in intensive care units – and for many, the cost of not being able to work would simply have been too high for them and their families."

> **"Vaccinated individuals are less likely to suffer from severe and critical COVID-19 symptoms that need close monitoring in intensive care units"**
> *-Official, National Economic and Development Authority, the Philippines*

At the workplace, vaccination helps to guard employees against potential losses in productivity in terms of absenteeism and presenteeism (see definitions).[13] In severe cases, employees could lose their jobs altogether if they require long-term treatment for chronic symptoms such as fatigue, muscle pain, depression and anxiety that linger for months after an infection.[14] Employers understand the value of vaccines, and some make it mandatory for employment. "Workers must be fully vaccinated and provide a vaccination certificate… companies will only hire people that are fully vaccinated", says a medical officer at the World Health Organization, India.

Studies also show that an effective age-based targeting COVID-19 vaccination strategy could reduce the disability-adjusted life year (DALY) of a population by as much as 40%.[15] The WHO defines one DALY as the loss of the equivalent of one year of full health.[16] Severe COVID-19 infections could result in permanent damage to a patient's organs and blood vessels and chronic diseases such as heart complications and stroke, which could be mitigated by vaccination for the virus.

Although the COVID-19 vaccine does not completely eradicate the threat of an infection, it does help to prevent employees from becoming seriously ill if they do get infected; this is especially relevant when it comes to the Omicron variant in 2022, where the prevention of COVID-19 related hospitalisation and death is the primary goal. Workers in India for instance, have already benefited in 2021 from the

> **"Workers must be fully vaccinated and provide a vaccination certificate…companies will only hire people that are fully vaccinated"**
> *-Medical Officer, World Health Organization, India*

vaccination efforts by the government. According to a department head at the COVID-19 Volunteer Health Services, "since the vaccination program started in early 2021, employees started to get vaccinated and fewer people got sick…businesses could then resume operations again".

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[12] Hospitalization Expenditure of COVID-19 Patients at the University of the Philippines-Philippine General Hospital (UP-PGH) with PhilHealth Coverage, Acta Medica Philippina, 2021
[13] Yuasa, A. et al (2021), 'Productivity loss/gain in cost-effectiveness analyses for vaccines: a systematic review', Expert Review of Pharmacoeconomics & Outcomes Research 21(2)
[14] COVID-19 Long-term effects, Mayo Clinic, 2021
[15] Chapman, L. et al (2021), 'Comparison of COVID-19 vaccine prioritization strategies'. medRxiv
[16] Disability-adjusted life years (DALYs), WHO, 2021

Studies also show that an effective age-based targeting COVID-19 vaccination strategy could reduce the disability-adjusted life year (DALY) of a population by as much as 40%.

From a healthcare perspective, COVID-19 vaccination helps to reduce the spread of the virus as well as severity of infections among individuals, which ultimately cuts down the infection, hospitalization, and death rates in a population. The vaccination program in South Korea for instance has helped to flatten the rate of infections significantly. Of the new infections between February and August in 2021, 91% of them were unvaccinated, 7% were not fully vaccinated and only 2% were fully vaccinated.[17] The rate of breakthrough COVID-19 cases among those

> **"Vaccination lowers the number of symptomatic infections studies confirm vaccine effectiveness in preventing infection, the vaccination program has helped the country to return to normalcy and people to go back to their normal lives"**
> *-Director, Korea Disease Control and Prevention Agency*

fully vaccinated was only 0.04%.[18] The research is indisputable, according to a director at the Korea

Disease Control and Prevention Agency, "studies confirm vaccine effectiveness in preventing infection, the vaccination program has helped the country to return to normalcy and people to start getting back to their normal lives", he adds.

Further, hospitalization rates have plunged because of vaccination programs, especially among the elderly. A US study found that vaccination reduced the hospitalization rates for the elderly aged 80 and above by as much as 80%.[19] In Indonesia, "lives are saved, and infections are less severe, so people do not need to be hospitalized", says an economist at Prospera, Indonesia. This has freed up resources for hospitals to provide non-essential healthcare services that had been previously deferred. "Hospitals are starting to treat more patients for chronic diseases such as hypertension, if these patients do not receive treatment, it could result in long term adverse impact to their health", adds a project director at PATH, Vietnam.

> **"Hospitals are starting to treat more patients for chronic diseases such as hypertension, if these patients do not receive treatment, it could result in long term impact to their health"**
> *– Project Director, PATH, Vietnam*

Finally, COVID-19 death rates are also curtailed because of vaccination, especially among individuals who have received two doses of the COVID-19 vaccine. In the UK, death rates among fully vaccinated individuals in their 30s dipped by 90%. Among the elderly, those over the age of 80, the fatality rate was cut by over 70% (see figure 2).[20] Similarly, in Indonesia, "the vaccination program has led to a dramatic decrease in death rates of over 20% to fewer than 1,000 deaths a day", says a director at the Ministry of Health in Indonesia.

Figure 2. Percentage cut to fatality rate for those fully vaccinated

	18-29	30s	40s	50s	60s	70s	80+
-50.0%	-75.0%	-90.0%	-87.1%	-89.7%	-84.0%	-82.3%	-70.4%
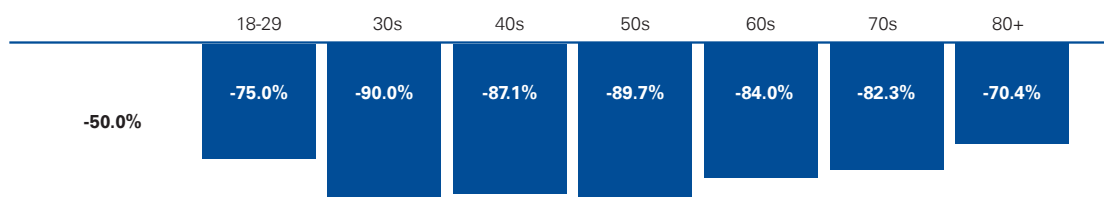
Source: Public Health England

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[17] The Hankyoreh (2021), 'S. Korea reports 91% of COVID-19 cases are among unvaccinated people', accessed 29 October 2021, available at https://english.hani.co.kr/arti/english_edition/e_national/1008948.html
[18] YonHap News (2021), 'Breakthrough cases reach 4,000, most frequent among those in 30s', accessed 29 October 2021, available at https://en.yna.co.kr/view/AEN20210907005200320
[19] Roghani, A. (2021), 'The Influence of Covid-19 Vaccine on Daily Cases, Hospitalization, and Death Rate in Tennessee', medRxiv.
[20] COVID-19 vaccine surveillance report, UK Government, 2021

Case Study 2:
UK's Multipronged vaccine strategy

The United Kingdom's vaccination program proved to be a huge success because of the government's adept management of its vaccine supply and healthcare resources. The country adopted a multipronged approach (see below), which led to full vaccination among majority (67%) of its population as of October 2021.[1]

Funding: allocated a healthcare budget of USD191.5 billion at the onset of the pandemic and a yearly additional USD46.8 billion until 2024[2]

Vaccine supply: funded the vaccine development efforts of local biopharma companies e.g. AstraZeneca, CureVac and Novavax and secured contracts from US companies e.g. Moderna and Pfizer early in the vaccine race

Infrastructure: National Health Service (NHS) mobilized public and private hospitals and clinics to administer vaccines to the population

Workforce: NHS rehired their retired workforce to increase their manpower capacity to support ongoing vaccination efforts

Prioritization: vaccination started in December 2020 with focus on frontline workers and at-risk population, which prevented an estimated 120,000 deaths[3]

From an economic perspective, vaccination has allowed the UK to reopen and resume business as normal. As a result, unemployment rates have dropped by 0.4% from June to August 2021[4] alone and its GDP is also set to increase by 7.1% by the end of 2021[5].

[1] COVID-19 Vaccinations, Our World in Data, 2021.
[2] Budget 2020, UK Government, 2022.
[3] COVID-19 vaccine surveillance report, UK Government, 2021, available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1019992/Vaccine_surveillance_report_-_week_38.pdf.
[4] Labour Market Overview, UK: October 2021, Office for National Statistics, 2021.
[5] United Kingdom Economic Snapshot, OECD, 2021.

4.2 Benefits to governments

From a policy and planning perspective, governments stand to unlock huge cost savings by driving down infection rates and subsequently, healthcare expenditure for COVID-19 treatment. Currently, governments in ASPAC markets including India, South Korea and Indonesia bear the full costs of COVID-19 treatment including medication and

> **"The government is investing in vaccination as a cost-saving strategy to cut cost on COVID-19 treatment and hospitalization in the long-term of up to USD3,500 per person"**
> *– Department Head, Voluntary Health Services, India*

hospitalization in public hospitals. Hospitalization fees for intensive care treatment alone could cost the government upwards of USD10,000 per patient. As such, policy makers look to vaccination to alleviate healthcare expenditure on COVID-19. A department head at Voluntary Health Services, India, explains "the government is investing in vaccination as a cost-saving strategy to cut costs on COVID-19

> **"Healthcare initiatives such as education campaigns have led to an improvement in sanitation and personal hygiene, which has resulted in a drop in respiratory diseases such as pneumonia especially among the elderly, and in turn healthcare savings for the government"**
> *– Director, Korea Disease Control and Prevention Agency*

treatment and hospitalization in the long-term of up to USD3,500 per person".

In addition, COVID-19 public health measures can contribute to a contraction in other infectious diseases such as influenza and pneumonia especially among the elderly. According to a director at the Korea Disease Control and Prevention Agency, "healthcare initiatives such as education campaigns have led to an improvement in sanitation and personal hygiene, which has resulted in a drop in respiratory diseases like pneumonia among the elderly, and in turn healthcare savings for the government". These campaigns also help to boost the health literacy of a population and could lead to

further long-term healthcare savings through the prevention and/ or early treatment of diseases.

Governments also reap greater tax revenues because of COVID-19 vaccination. As vaccination rates further pick up, quarantine restrictions ease and businesses resume operations. Further, workers are allowed to return to work after they are fully vaccinated. In Vietnam for instance, "local authorities allow fully vaccinated people to go back to work and over 100,000 workers have returned to Ho Chi Minh city since", adds a project director at PATH, Vietnam. Employment rates have rebounded as a result, contributing to direct tax returns for the government.

Similarly, consumer spending intensifies when COVID-19 measures are relaxed for fully vaccinated individuals; retail, F&B and entertainment sectors in particular, resume pent up demand. "The accelerated implementation of the vaccine deployment program will facilitate the gradual easing of community quarantine restrictions and encourage more businesses to operate and boost consumer confidence…consequently, the increase in economic activities is expected to bring the tax collections closer to pre-pandemic levels over the medium-term", explains a government official from the National Economic and Development Authority of the Philippines. "Tax revenues increased by 8.4 percent year-on-year to PHP 2.7 trillion or 13.7 percent of GDP in 2021, while they are projected to grow by 15.1 percent to PHP 3.1 trillion or 14.2 percent of GDP in 2022", she adds.

> **"The accelerated implementation of the vaccine deployment program will facilitate the gradual easing of community quarantine restrictions and encourage more businesses to operate and boost consumer confidence"**
> *– Official, National Economic and Development Authority, the Philippines*

4.3 Benefits to economy

Countries could unlock economic growth as they transition into a state of endemic.[21] Indonesia is already on the path to recovery according to a head researcher at the Eijkman Oxford Clinical Research Unit, prior to Omicron, "it looks like an endemic transition right now because we do not see spikes, rise and fall, the infection rate is flat and has been flat for a couple of months now." However, he cautions that current vaccination efforts must persist.

"The middle class pays 20% of hospital fees out of pocket, which costs around USD1,000 on average"
– Vice Head, National Institute of Hygiene and Epidemiology, Vietnam

Similarly, Hanoi expects to reach the initial stages of an endemic state in the foreseeable months. As of December 2021, 95% of the population is partly vaccinated and 12% is fully vaccinated. It is one of the first large cities in Southeast Asia to begin its reopening, returning to business as usual. Experts are confident in the current pace of vaccination and optimistic towards a reopening soon, "every day we face a risk of an outbreak case however with the rate of the vaccine we have so far I can see that it is a disease we can control and return to normal life in no time", says a head at the National Institute of Hygiene and Epidemiology, Vietnam.

Further, fully vaccinated individuals save thousands of dollars on the treatment of COVID-19; the cost saved could help to stimulate household consumption. A government official from the National Economic and Development Authority in the Philippines explains, "it is expected that expenditure on hospitalization will be reduced as vaccinated individuals are less likely to suffer from severe and critical COVID-19 symptoms that need close monitoring in intensive care units". This is more significant in countries like Vietnam and the Philippines where patients bear a higher out-of-pocket payment for COVID-19 treatment." The middle class pays 20% of hospital fees out of pocket, which costs around USD1,000 on average", says a vice head at the National Institute of Hygiene and Epidemiology, Vietnam.

Finally, countries with a higher vaccination coverage could begin easing COVID-19 measures, promoting GDP growth. The economy starts to pick up as people go out to spend, employees return to work, and businesses resume operations. The opening of borders also alleviates labor constraints and boosts consumer-facing sectors and international trade. Indonesia, for instance is already experiencing an upward GDP growth with over a quarter (26.5%) of the population fully vaccinated.[22] The country has delivered over 150 million COVID-19 vaccine shots, overtaking Japan to be fifth highest globally.[23] A director at the Ministry of Health adds, "GDP could grow by 1-2% as a result of vaccination, it is an important factor along with other measures such as contact tracing, testing, social distancing and travel restrictions".

Countries such as the Philippines prioritize vaccination efforts at the economic centers in a bid to accelerate GDP growth. Over eight in ten people are fully vaccinated in the National Capital Region (NCR) compared to less than a quarter (24%) in the entire country.[24][25] A public health expert from the Asian Development Bank explains, "the government focuses on vaccinating the national capital region (NCR) as it is the entry point for foreign businesses and contributes to over 30% of the country's GDP." "Studies estimate GDP from NCR alone will improve by 3-5%", she adds.

"Vaccination efforts are focused on NCR as it is the entry point for foreign businesses, and contributes to 30% of the country's GDP...studies estimate GDP from NCR alone will improve by 3-5%"
– Public Health Expert, Asian Development Bank, the Philippines

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[21] Herd immunity, lockdowns and COVID-19, WHO, 2021
[22] Covidvax.Live, Indonesia Government, 2021
[23] The Straits Times (2021), 'Indonesia hits 150 million mark in Covid-19 vaccine jabs', accessed 29 October 2021 at https://www.straitstimes.com/asia/se-asia/indonesia-hits-150-million-mark-in-covid-19-jabs
[24] Philippines' COVID-19 vaccine distribution, Rappler News, 2021
[25] ABS-CBN News (2021), '81 pct fully vaccinated vs COVID-19 in NCR', accessed on 29 October at https://news.abs-cbn.com/news/10/21/21/81-pct-fully-vaccinated-vs-covid-19-in-ncr

Case Study 3:
India's vaccine manufacturing hub

India has stepped up to become one of the world's largest COVID-19 vaccine producers, supplying over a tenth (13.0%) of global COVID-19 vaccine exports.[1] Its biopharma industry has thrived during the pandemic in part due to strong financial backing from the government; the India Serum Institute is now the largest vaccine maker in the world and top supplier of vaccines to COVAX.[2]

According to a medical officer from WHO, "the Indian government subsidizes around 70% of the cost of manufacturing for local manufacturers and subsequently purchase the vaccines from these companies for the national vaccination program". This ensures a reliable supply of vaccines for the country with a population of over 1.39 billion people. In April 2021, the country was hit with a second wave of the COVID-19 Delta variant, which the government redirected vaccine exports to its domestic vaccination program.[3]

India has since resumed COVID-19 vaccination exports after vaccination coverage picked up with almost a quarter (23.9%) of the population fully vaccinated as of October 2021.[4] Its biopharma sector could grow by USD10-11 billion in the next three years from the sales of COVID-19 vaccines alone and serves as a driver of economic recovery for the country.[5]

"The Indian government subsidizes around 70% of the cost of manufacturing for local manufacturers and subsequently purchase the vaccines from these companies for the national vaccination program"
– Medical Officer, World Health Organization, India

[1] Vaccine production by country, Affinity, 2021
[2] SCMP (2021), 'India's Serum Institute, the world's biggest Covid-19 vaccine manufacturer, is at the centre of global shortage' accessed on 2 November 2021 available at India's Serum Institute, the world's biggest Covid-19 vaccine manufacturer, is at the centre of global shortage | South China Morning Post (scmp.com)
[3] CNBC (2021), 'India resumes vaccine exports as domestic stocks build up', accessed on 2 November 2021 at https://www.cnbc.com/2021/10/14/india-resumes-vaccine-exports-as-domestic-stocks-build-up.html
[4] COVID-19 Vaccinations, Our World in Data, 2021
[5] The Economic Times (2021), 'Covid-19 vaccine: India looking at $11 billion market opportunity' accessed on 2 November 2021 at Covid-19 vaccine: India looking at $11 billion market opportunity - The Economic Times (indiatimes.com)

Estimates of the economic impacts of vaccination

The rapid development and roll out of vaccines for the novel coronavirus since the start of 2021 has had varying impacts on each region. Based on previous experiences with infectious diseases around the world, substantial inoculation rates are directly linked with favorable health and economic outcomes. This section estimates the economic impacts of high COVID-19 vaccination rates for each of the five countries.

5.1 Impacts of COVID-19 vaccination

The analysis presented in this paper is based on the data and research on COVID-19 from Our World in Data.[26] This study focuses on the health and economic outcomes of increasing COVID-19 vaccinations in five Asian countries - India, Indonesia, the Philippines, South Korea and Vietnam. Our analysis focuses on 2021, which is when worldwide distribution and inoculation with COVID-19 vaccines began. We use data on some key COVID-19 indicators, aggregated over the months of January to September 2021. Details on how the data is applied to make the calculations

is provided in Appendix A. All impacts in this paper are reported as an aggregate number for 2021 unless otherwise specified.

To gain an understanding of the baseline COVID-19 situation in each of the five countries of interest, Table 1 shows the total new cases and new vaccinations in 2021. Note that a 'vaccination' counts only those people who have received all recommended doses (2 or more) of any given vaccine. We assume data on new cases is net of vaccination for each country.

Table 1. Absolute and per capita new cases and vaccinations, by country, 2021

	New cases	New vaccinations	Infection rate	Vaccination rate
India	23,479,998	237,476,249	1.7%	17.2%
Indonesia	3,471,906	51,113,360	1.3%	18.7%
South Korea	252,004	25,752,598	0.5%	49.7%
The Philippines	2,075,902	21,358,676	1.9%	19.5%
Vietnam	789,290	9,818,448	0.8%	10.1%

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26 https://ourworldindata.org/coronavirus

5.1.1 Vaccinations and cases avoided

A key parameter in estimating the impact of COVID-19 vaccinations on economic and health outcomes is to identify a reasonable relationship between vaccinations and cases avoided. This relationship can be summarised by the elasticity (or responsiveness) of cases avoided to vaccinations. Note that we use the terms 'infections' and 'cases' interchangeably in this study.

The novelty of the coronavirus and the very short duration since vaccines have been made available means there is insufficient historical data to statistically estimate the relationship between vaccinations and cases avoided. To overcome this problem, KPMG conducted a brief literature review and has relied on some key recently published studies to derive a reasonable relationship between these variables. The literature on this topic is, however, mostly limited to the United States and some other developed countries. Given our literature review, we find that an elasticity of 0.9 seems reasonable; that is, 1 full vaccination leads to 0.9 cases of infection avoided. This ratio is comprised of a 0.6 reduction in infected cases for the person vaccinated and a 0.3 reduction in infected cases due to transmission of the virus to someone else.[27] Below we discuss our literature review.

5.1.1.1 Literature review

COVID-19 is a highly infectious disease that has been classified by the World Health Organization (WHO) as a pandemic. Many mathematical models, regression estimates and simulation models have been published recently attempting to model the spread of coronavirus disease. A number of studies have attempted to investigate the evolution of COVID-19 epidemiology to predict the coronavirus transmission mechanism and to analyse the transmission rate.

This section reviews studies focused on measuring the relationship between the transmission rate of the virus and the vaccination rate (pre-Omicron). Most studies modelling the spread of COVID-19 make parameter assumptions based on the current fragmented nature of knowledge of COVID-19 (Nabir 2020). Most studies use variants of the Susceptible-Exposed-Infectious-Recovered (SEIR) and Susceptible-Infectious-Recovered (SIR) epidemiological models to reflect the dynamics of infections. As their name suggests, these models represent infections mainly in four states: susceptible, exposed, infectious and recovered. These models consider the outbreak of the virus in the population subject to various control measures undertaken by the health authorities. The infectious cases may decrease due to containment measures (e.g., travel restrictions, public gatherings, etc.) and vaccination rollouts.

The literature review focuses on studies that have analysed the relationship between the vaccination rate and infection numbers to estimate a potential elasticity of infections in response to vaccinations. An elasticity value measures the percentage change in infectious cases in response to the percentage change in vaccinations. Although there is no evidence that coronavirus-related epidemiological models aim to calculate such an elasticity, some studies provide simulated data that allows enough information to calculate such an elasticity.

COVID-19 models incorporate vaccination efficiency, vaccination scheduling and non-pharmaceutical interventions (NPIs) when measuring the effectiveness of vaccines to reduce the number of cases. Webb (2021) developed a COVID-19 epidemic model to predict the effectiveness of vaccination in the US. The study sets the fraction of the population vaccinated to 90%, 85% and 80%. Normal social behaviour is scaled to four different levels as vaccination proceeds. Taken together, these outcomes predict the effect of vaccination for the COVID-19 epidemic in the US. Based on the data extracted from this study, we calculate elasticity values for different scenarios (daily reported cases, susceptible, and cumulative reported cases) that range from -4.96 to -12.6.

Table 2. Summary of research studies and findings

Author	Research focus	Country	Methodology	Findings
Chen (2021)	The effect of vaccination rates on the infection of COVID-19	Israel, UAE, Chile, UK, USA, Qatar, Serbia	Regression analysis	Inverted U-shaped relationship between the vaccination rate and the infection rate
Guo and Chang (2021)	Modelling-Based Estimate of the Vaccination Rate, Lockdown Rules and COVID-19	Brazil, South Africa and UK	Epidemic modelling	R falls 5.5 to 3 with 100000 vaccinations per day

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[27] A 0.9 elasticity between vaccinations and cases avoided is supported by others working in this area (L. Steuten, personal communication, 18/11/2021).

Author	Research focus	Country	Methodology	Findings
Mahajan (2021)	Estimation of undetected symptomatic and asymptomatic cases of COVID-19 infection and prediction of spread	USA	Epidemic modelling	20% of the US population would be affected if social distancing is absent
Moghadas et al. (2021)	The impact of vaccination on COVID-19 outbreaks in the United States	USA	Agent-based model of SARS-CoV-2 transmission and parameterized	The highest relative reduction (54–62%) was observed among individuals aged 65 and older.
Moore et al. (2021)	Vaccination, non-pharmaceutical interventions and prediction of reproduction number (R)	UK	Epidemic modelling	In the absence of NPIs, the vaccine will prevent 85% of infections, and R to be 1·58
Patel et al (2021)	Relationship between vaccination and non-pharmaceutical interventions with infections, hospitalisations and mortality	USA	Integrated compartmental disease transmission model	higher vaccine coverage reduces infections than higher vaccine efficacy when NPIs are relaxed
Webb (2021)	Epidemic model predicting effectiveness of vaccination	USA	Ordinary differential equations for the epidemic population compartments	Number of susceptible individuals is reduced due to vaccination
Zawbaa (2021)	Factors affecting COVID-19 severity and effect of social distancing	China	Artificial intelligence and machine learning	COVID-19 has a very low spread in the African countries with all the four variables (average young age, hot weather, BCG vaccine and malaria treatment); a very high spread in European countries

Patel et al (2021) simulated a combination of scenarios of vaccine efficacy (50% and 90%), vaccine coverage (25%, 50%, and 75%) and with and without NPIs[28] during vaccine distribution. The highest infection occurred with a 50% efficacy and 25% coverage and no NPIs. The number of infections fell with higher vaccine efficacy and vaccination coverage with constant NPIs. Based on simulated new infections and vaccinations data from Patel et al (2021), we calculated elasticity values that range from -0.16 to -0.34.

Patel et al (2021) and Webb (2021) provided the main basis for our chosen elasticity of -0.9. In the course of the literature review we surveyed many other related studies: these are summarised in Table 2. Simulation models analysing COVID-19 data face a major challenge to establish a robust relationship between vaccination rates and the impact on infection and transmission (Caldwella et al, 2021). As the coronavirus pandemic is ongoing, new studies and reports are being produced and published daily. Isolating the reduction in infection due to vaccination alone has become complicated by other factors that are changing rapidly and simultaneously. Wage-dependent factors, changing levels of

infection, and relaxation of non-pharmaceutical interventions and changing social behaviours also affect the infection rate. Our literature review only reflects the contemporaneous understanding of the relationship between vaccination and infections.

5.1.2 Direct effects of vaccination

The COVID-19 pandemic has had several health and economic effects on regional and global economies. In this analysis, we focus on two types of direct economic costs that are generated due to COVID-19 and that could be avoided with increased vaccination rates in the five countries – healthcare costs and labour productivity costs. These costs can vary with the severity of a COVID-19 case. Someone with a mild case of the disease will be able to recover relatively quickly and will likely incur only a small expense in the form of a doctor's consultation and medicines. In contrast, someone who is hospitalised due to COVID-19 will bear a significantly higher treatment cost and be absent from work for several days to several weeks. This section describes the direct effects of COVID-19 vaccination with details on the estimation methodology described in Appendix A.

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[28] NPIs include travel restrictions, school closures, and the use of face masks.

An elasticity of -0.9 between infections and vaccinations means each new vaccination is expected to avoid 0.9 COVID-19 cases in the community. Using the elasticity and data on new vaccinations for each country (from Table 1), we estimate the total number of cases avoided as a result of increased vaccination rates. Moreover, since each case of COVID-19 can impose varying healthcare costs depending on the severity of the infection, we categorise the total cases avoided into the following types:

a. symptomatic but not hospitalised (subclinical),

b. hospitalised but not in ICU (intensive care unit),

c. ICU, and

d. death.

To categorise cases into the four types, we collated average hospitalisation and ICU admissions data from 27 middle- to high-income countries (this data was not available for the five countries of interest in this study) to determine the non-hospitalisation, hospitalisation, ICU and death rates due to COVID-19. The data shows that 91% of new COVID-19 cases in 2021 are subclinical. This means that they show mild to moderate symptoms that can be treated by resting at home or with over-the-counter medicines. The hospitalisation rate is 7.1% on average, with 0.3% of those cases being admitted to an ICU. The death rate from COVID-19 is 1.5% on average. These rates are then applied to the total cases avoided to categorise cases avoided by type for each country, as shown in Table 3.

The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country (shown in Table 1). Therefore, cases avoided are highest for India and lowest for Vietnam. The breakdown of cases avoided by type forms the basis for our estimates of the direct economic impacts of COVID-19 vaccinations described below.

5.1.2.1 Healthcare costs avoided

In a pandemic event like COVID-19 there is a temporary increase in demand for healthcare services and associated expenditure relative to a country's baseline expenditure on healthcare. As people are vaccinated against the virus, the risk of infection falls resulting in avoided healthcare costs.

The costs of treating a COVID-19 case can vary substantially depending on the severity of the disease and local health care costs. Costs by case type were collected for the five countries through primary and secondary research methods and applied to the estimated cases avoided (from Table 3) to evaluate the value of healthcare costs avoided in each country due to vaccinations. The total cost savings across the public and private healthcare sectors are summarised in Table 4. In terms of absolute values, South Korea has the highest healthcare cost avoided reflecting high case costs due to its high-income status. The lowest healthcare costs avoided are in the Philippines and Vietnam, both of which have relatively low hospital costs avoided reflecting low overall case costs and less cases avoided than India and Indonesia, which are the two most populous countries of the five.

5.1.2.2 Lost workdays avoided

One of the biggest economic impacts of COVID-19 has been the loss in workdays due to various factors such as individuals or family members contracting the virus, prophylactic measures taken by authorities or extended periods of lockdowns. Lost workdays translate directly into lower labour productivity as they represent a fall in output per worker. The duration of absenteeism from work varies depending on the severity of the infection. As vaccination rates start increasing, it is expected to have a direct effect on reducing infections and thereby avoiding lost workdays.

For estimating this set of direct impacts, we attribute lost workdays to two effects – workers themselves

Table 3. Breakdown of COVID-19 cases avoided due to vaccination. (Source: KPMG calculations based on Our World in Data)

	India	Indonesia	South Korea	The Philippines	Vietnam
Cases avoided	**213,728,624**	**46,002,024**	**23,177,338**	**19,222,808**	**8,836,603**
Symptomatic	198,557,754	42,656,992	21,458,729	7,945,062	8,230,260
Hospitalised	12,570,144	2,781,233	1,446,131	1,085,443	508,988
ICU	430,377	98,734	42,592	29,954	11,073
Deaths	2,170,350	465,065	229,886	162,349	86,282

Source: KPMG calculations based on Our World in Data

falling sick or taking time off to care for sick children. Applying estimates of workdays lost due to each type of COVID-19 case to the avoided cases, we estimate lost workdays avoided due to increased vaccination in each country. This is then used to estimate the overall labour productivity effects for each country, as shown in Table 5.

5.1.2.3 Other effects of vaccinations
Besides healthcare costs and lost workdays avoided, we assume a further benefit of vaccination: reduced investor risk premiums. We assume that investor risk premiums fall due to vaccinations as policymakers have touted the importance of vaccinations in moving to more normal economic conditions without a continuous cycle of imposing and removing prophylactic measures. The fall in the risk premium is assumed to be 0.5 percentage points for South Korea and for other countries is scaled to reflect the relative size of the labour productivity effects. The risk premium effects are summarised in Table 6.

Table 4. Healthcare costs avoided by case type ($US). (Source: KPMG calculations)

	India	Indonesia	South Korea	The Philippines	Vietnam
Total	**6,255,463,502**	**8,141,784,516**	**22,363,026,592**	**3,225,511,409**	**3,498,805,358**
Symptomatic	5,705,259,476	7,177,618,463	7,095,868,670	1,064,226,211	2,685,254,772
Hospitalised	425,877,596	698,471,971	3,451,090,574	1,903,752,623	544,607,234
ICU	24,433,916	58,304,198	385,276,537	54,834,541	41,860,616
Death	99,892,513	207,389,884	1,430,790,811	202,698,034	227,082,736

Source: KPMG calculations

Table 5. Labour productivity effects of increased vaccination.

	India	Indonesia	South Korea	The Philippines	Vietnam
Labour productivity effect	0.27%	0.30%	0.80%	0.30%	0.16%

Source: KPMG calculations

Table 6. Risk premium effect due to increased vaccination (percentage-point change)

	India	Indonesia	South Korea	The Philippines	Vietnam
Risk premium effect	-0.0017	-0.0019	-0.005	-0.0019	-0.001

Source: KPMG calculations

5.2 Economic analysis

Having estimated the direct effects of increased COVID-19 vaccinations, we now estimate the indirect or flow-on effects using a dynamic multi-country computable general equilibrium (CGE) model of the five economies and the rest of the world. Taken together, the direct and indirect effects estimated below represent the economy-wide effects of vaccination in the five countries.

Figure 1. Inter-agent flows in KPMG-Global
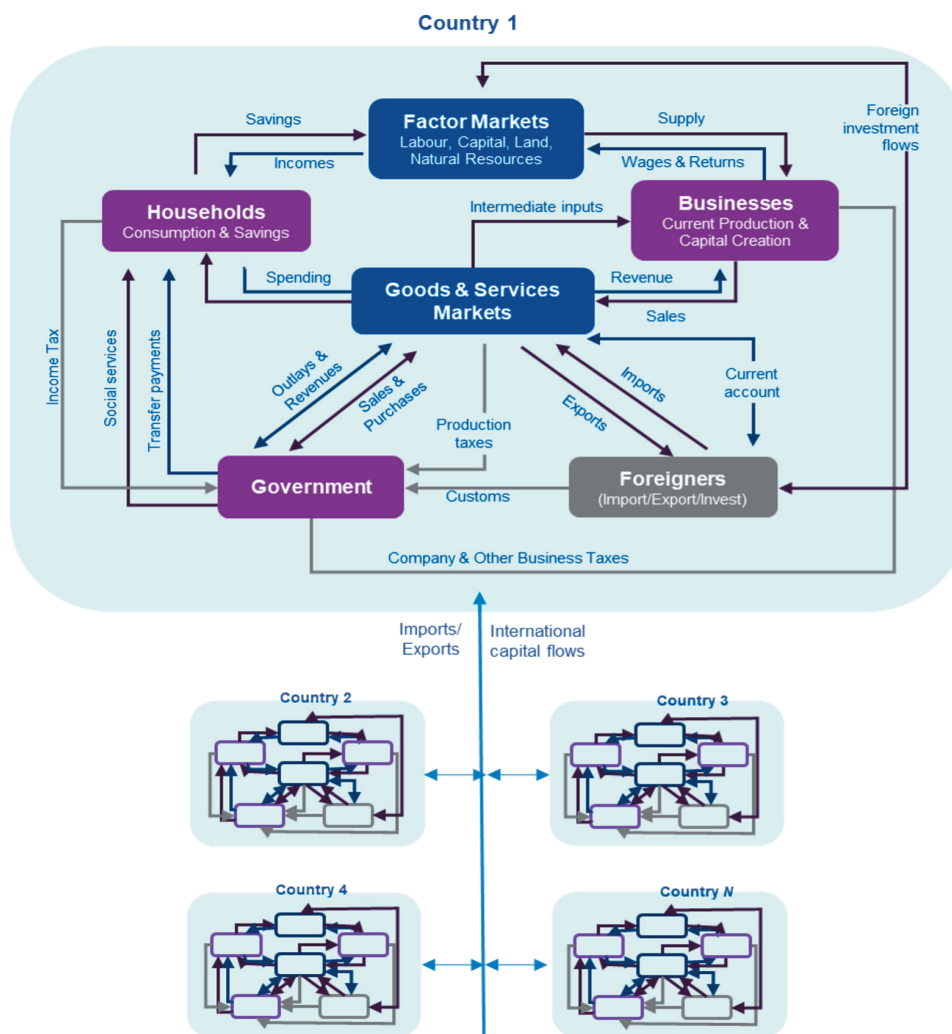
5.2.1 Modelling approach – the KPMG-Global model

To estimate the economy-wide effects of vaccinations we apply KPMG-Global - a global CGE model representing regional and global economies with a detailed representation of the economic activities of industries, households, governments and foreigners. Figure 1 provides a schematic representation of the flows across economic agents within each region. An important aspect of the model is that all regional economies are explicitly linked via international trade in goods and services and international flows of direct and portfolio investment. A detailed description of the model's micro-foundations appears in Appendix B.

5.2.2 Economy-wide impacts

This section presents the economy-wide effects of vaccinations in the five countries in terms of macroeconomic, industry and welfare impact in the short-term (2021) and long-term (2050). The short-term results are a period of time where the economy has had little to time to respond to the vaccine-related changes. The long-term results reflect the economic effects after the capital stock and financial assets and liabilities have had adequate time to respond the vaccine-related changes.

5.2.2.1 Macroeconomic impacts

We analyse the macroeconomic effects of increasing COVID-19 vaccinations in five Asian countries - India, Indonesia, the Philippines, South Korea and Vietnam. Figures 2 to 6 represent the impacts on consumption expenditure, exports, GDP and tax revenue for all countries in 2021 and 2050.

For South Korea, all variables indicate a positive effect except lower consumption in 2021 compared to the base year. This reflects the strong export response in the short-term. In the long-term these four variables show a positive economic impact of increasing vaccination. In the long-term these effects are much larger: e.g., GDP is 0.55% higher in the short-term and 1.1% higher in the long-term. This pattern of larger effects in the long-term is true for all countries.

The long-term macroeconomic effects for other countries are much smaller than those observed for South Korea. In terms of GDP, we observe the following results: Indonesia 0.45%, the Philippines 0.24%, Vietnam 0.23% and India 0.15%. The

main drivers of these effects are the changes in labour productivity and risk premiums. Much larger effects are observed for South Korea than the other countries. This is consistent with the country vaccination rates presented in Table 1: South Korea's vaccination rate is around 50% whereas most other countries are less than half this. India's vaccination rate is the lowest at around 10%; consistent with this it experiences the smallest GDP increase.

For some countries consumption is lower in the short-term (South Korea, the Philippines), for others tax revenue is lower in the short-term (the Philippines, Vietnam). These short-term responses reflect the strength of the export and wage rate response. As vaccinations move expenditure away from healthcare (which is labour intensive) to other areas, wage rates tend to fall in the short term. This effect can lead to a fall in total tax revenue in the short-term. If the fall in the wage rate is strong enough, exports will respond strongly and consumption may fall. These effects are ameliorated in the long-term.
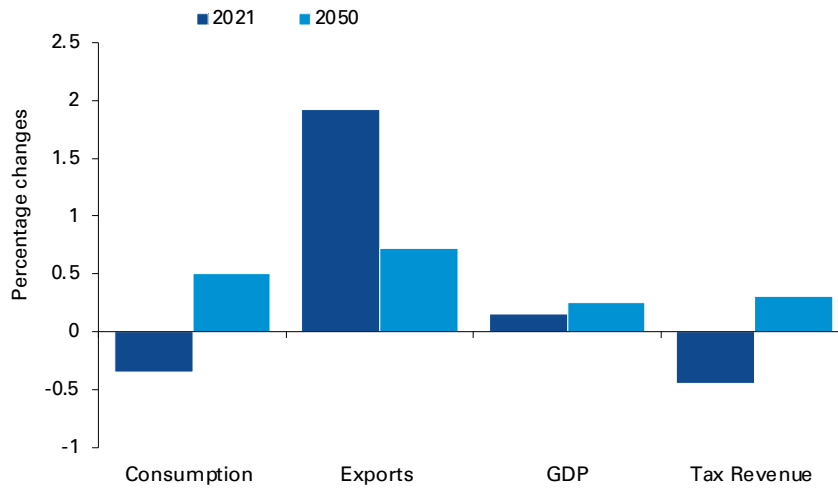
Figure 2. Effect on South Korea
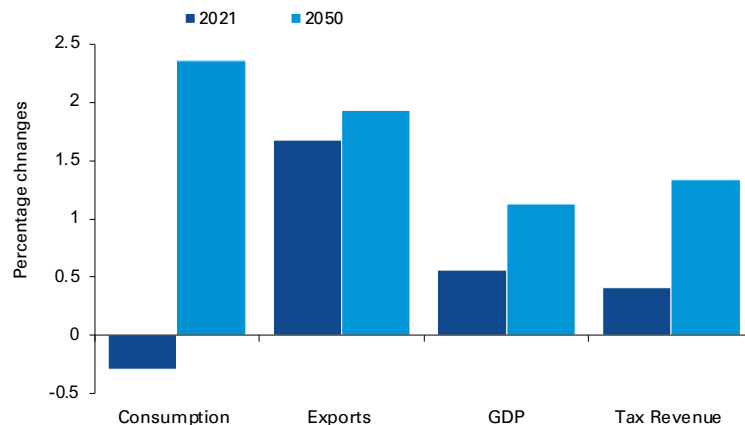
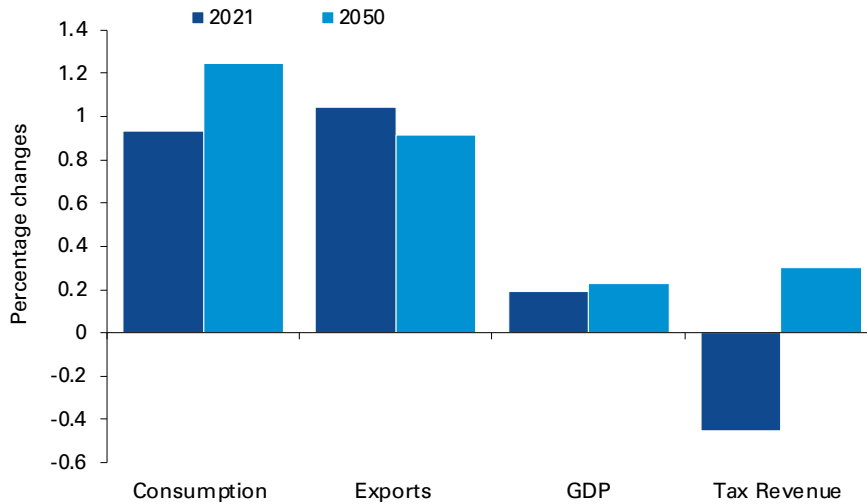*Source: KPMG Economics*

Figure 3. Effect on Indonesia
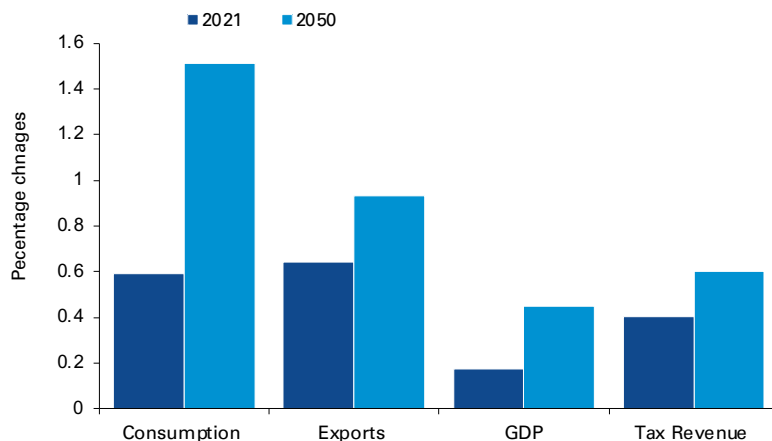
Source: KPMG Economics
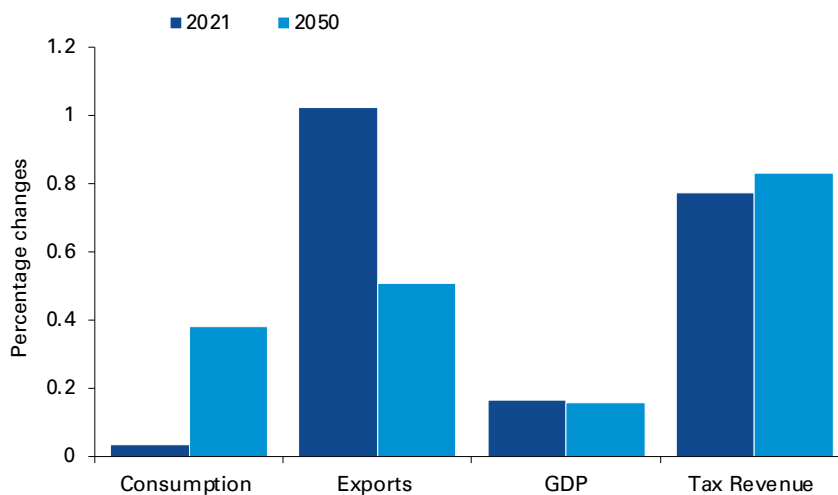
Figure 4. Effect on the Philippines

Source: KPMG Economics

Figure 5. Effect on Vietnam

Source: KPMG Economics

Figure 6. Effect on India

Source: KPMG Economics

5.2.2.2 Industry impacts

Figures 6 to 10 present the industry effects for the five countries. Due to the benefit of vaccination and lost workdays avoided and together with increase investor confidence, all industries projected to resume normal economic conditions. All sectors in the five countries projected to record a positive economic growth in 2021 except government services. Notably, sectoral growth in 2050 is higher than in 2021 except for government services. Government services contract reflecting the healthcare costs avoid due to vaccination.

Consistent with the GDP effects, South Korea shows the highest increases in industry output. Manufacturing, trade, transport, utilities and other services gain the most from vaccination across all countries. The construction sector is unique in that its output response is larger in the short-term than the long-term. This reflects strong growth in capital stocks in the short-term and much smaller growth in the long-term.

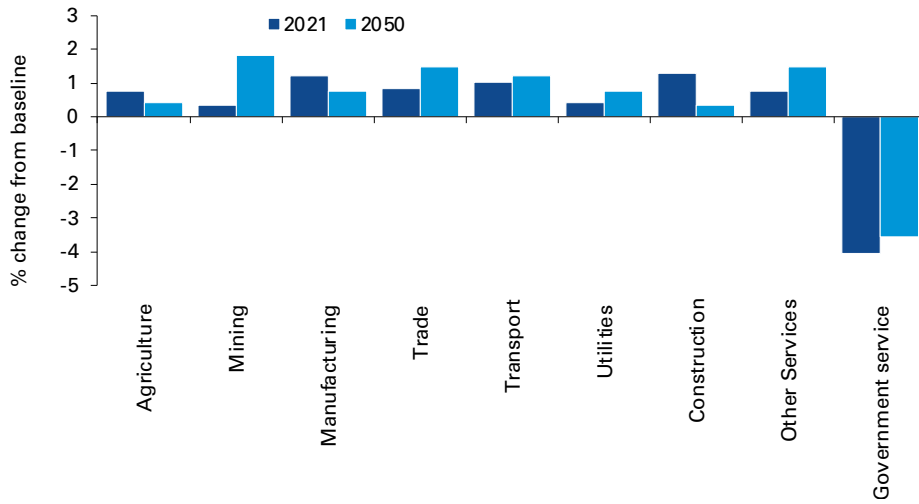**Figure 7.** Industry impact; South Korea
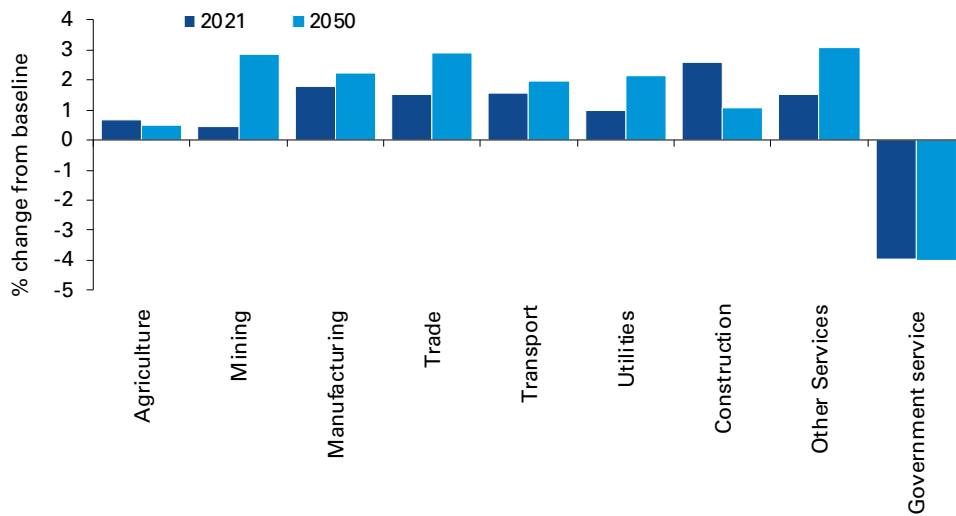
Source: KPMG Economics

Figure 8. Industry impact; Indonesia
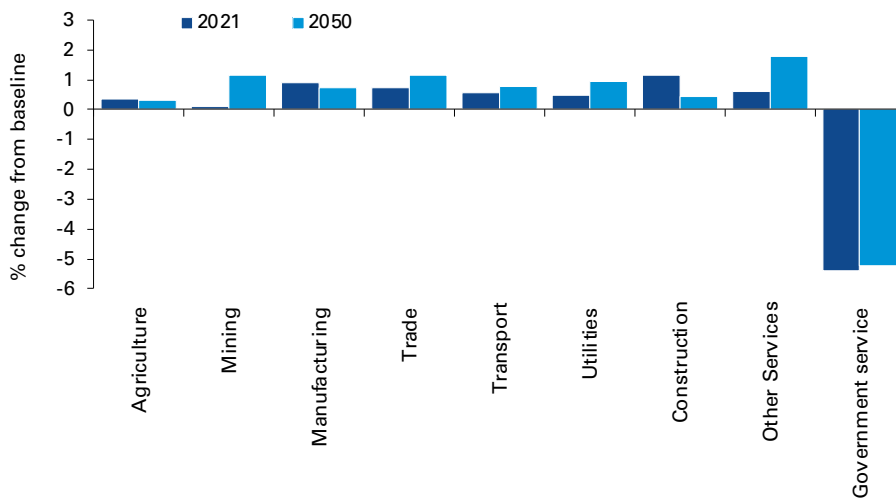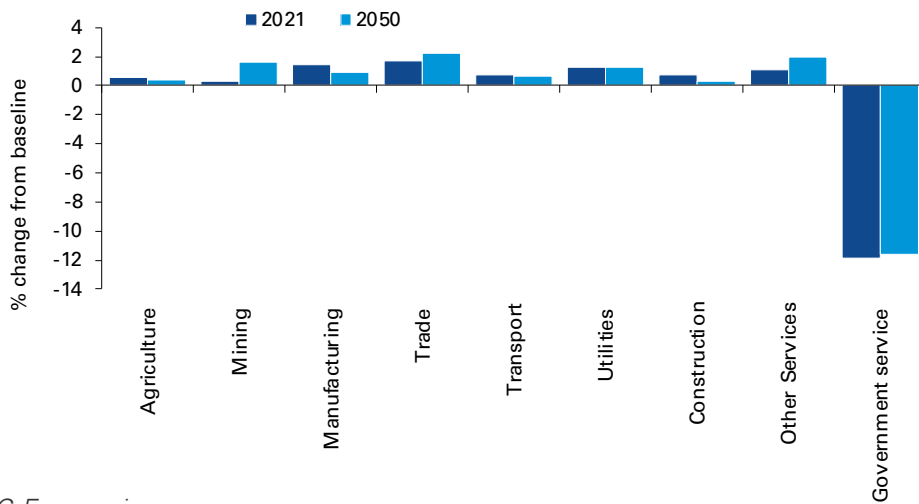

Source: KPMG Economics

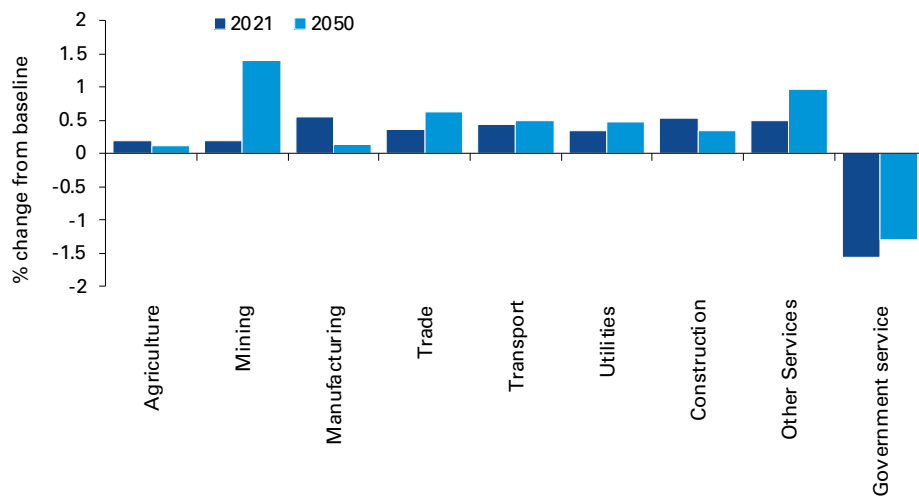**Figure 9.** Industry impact; the Philippines

Source: KPMG Economics

Figure 10. Industry impact; Vietnam

Source: KPMG Economics

Figure 11. Industry impact; India

Source: KPMG Economics

5.2.2.3 Welfare impacts

Another way of understanding the economy-wide effects of increasing vaccinations is in terms of the net present value (NPV) of economic welfare or utility – this is defined as the sum of the value of leisure and household consumption. Figure 12 shows the NPV welfare effects. Vaccinations generate substantial increases in economic welfare of US$109 billion in Korea, with less significant increases of around US$49 billion in Indonesia and India.

Figure 12: Net present value welfare gains
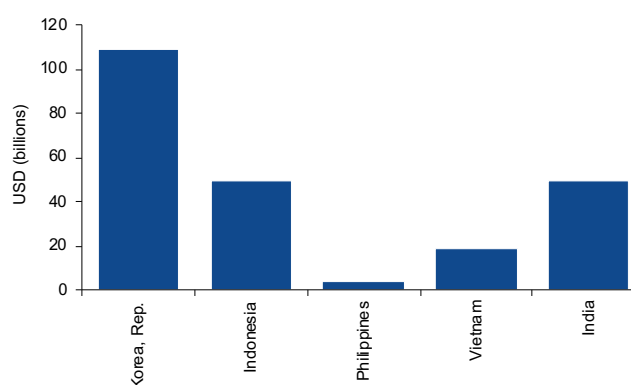
5.2.2.4 Comparison with previous results

With the emergence of the COVID-19 pandemic, a growing literature has emerged to measure the range of economic impacts due to the pandemic: Table 7 summarises the major studies. The negative economic implications have been wide-ranging as COVID-19 has created uncertainty on trade, investment, labour markets, production supply chains, financial markets, and production levels. These studies focus on measuring the economic impact of COVID-19 at the sectoral, regional, and international levels. Here we emphasise the propagation effects on macroeconomic variables by other studies and compare our findings in the current study. The literature uses a range of modelling approaches including CGE and econometric methods. Note that the literature surveyed here estimates the effect of the pandemic on the economy whereas the current study measures the effect of increasing vaccination through controlling the number of infections.

Table 7. Summary of major studies estimating the economic effects of the COVID-19 pandemic

Author	Socioeconomic theme	Country	Methodology	Economic effects
Chitiga-Mabugu et al (2021)	Economic and Distributional Impact of COVID-19: Macro-Micro Modelling	South Africa	CGE-microsimulation modelling	10.3% fall in GDP in the mild scenario; 14.14% fall in the severe scenario
Jawad, Maroof and Naz (2021)	Impact of Pandemic COVID-19 on Global Economies (a seven-scenario analysis)	20 countries	global hybrid DSGE/CGE modelling	2020 GDP declines by 1.2%-3.6% in 5 scenarios and by 3.4-9.8% in 2 scenarios
Jena et al (2021)	Impact of COVID-19 on GDP of Major Economies	USA, Mexico, Italy, Germany, Spain, France, Japan, India	artificial neural network forecasting	Major economies of the Eurozone – France, Spain, Italy, and Germany– are predicted to contract by 1.78%, 2.72%, 2.4% and 1.04%, respectively.
Maliszewska et al (2020)	The Potential Impact of COVID-19 on GDP and Trade	World, developing countries and industrial countries	CGE modelling	GDP falls by 2 % for the world: 2.5% for developing countries and 1.8 % for industrial countries.
Malliet et al (2021)	Short Term and Long Term Economic and Environmental Effects	France	CGE modelling	GDP fall by -5.1% in 2020, increase in 0.5% by 2026 and 2.5% by 2040.
McKibbin and Fernando (2021)	The Global Macroeconomic Impacts of COVID-19:	G20 countries	global hybrid DSGE/CGE modelling	2020 GDP declines by 0.2%-2% in 5 scenarios, and by 4%-8.7 in 2 scenarios

Studies measuring the economic impact of COVID-19 are mostly focused on the short-term contraction of economic activity (World Bank, 2020; IMF, 2020; OECD,2020;). McKibbin and Fernando (2021) estimated the potential global economic costs of COVID-19 under different policy scenarios. They projected declines in GDP ranging from -0.2% to -2% in 2020 based on 7 scenarios. According to these authors, the GDP decline can be as high as -7% with higher case-fatality rate and mortality rate. Their results for India and Indonesia range from -0.2% to -1.3% and South Korea from -0.1% to -1.3% across 5 scenarios.

Jawad, Maroof and Naz (2021) conducted analysis similar to McKibbin and Fernando (2021). They found GDP declines in 20 countries ranging from -1.2% to -8.2% in 2020 based on 7 scenarios. This included GDP losses in 2020 for India and Indonesia ranging from -1.6% to -4.2% and for South Korea from -1.5% to -3.6% in 5 scenarios.

A CGE analysis by Maliszewska et al (2020) projected GDP falling globally by 2%, for developing countries by 2.5% and for industrial countries by 1.8% as a result of lower employment, increased costs of international transactions, a drop in travel, and decline in demand for services. Chitiga-Mabugu et al (2021) assessed the short-term effect of COVID-19 impact on the South African economy using a CGE-microsimulation approach. They found that COVID-19 affected the household sector disproprortionately, pushing more people below the poverty line. According to this study, the South African economy was projected to decline by 10.3% to 14.4% in GDP depending on the magnitude of the decline in exports, world oil prices, remittances, and productivity.

Based on the above review of previous work, we find that our estimates are consistent and closely align with other studies given the sector- and country-specific variations in methodology.

Conclusion

Vaccination is one of the most effective strategies to flatten COVID-19 infection rates and severe COVID-19 outcomes such as hospitalization and death due to COVID-19. ASPAC. ASPAC countries such as South Korea and Singapore have already achieved full vaccination among majority (>70%) of the population.[29] Countries could accelerate their transition to a state of endemic as they continue to intensify national vaccination efforts. Those with an effective vaccination strategy in place could seek to unlock huge opportunities for individuals, the government, and their economy.

At the population level, COVID-19 vaccination helps to increase productivity at work while reducing infection, hospitalization, and death rates. From a policy and planning perspective, governments benefit from cost savings on COVID-19 treatment and hospitalization as well as generate higher tax dollars. Finally, the economy starts to rebound when countries reach a state of endemic and GDP progressively picks up to that of pre-pandemic levels (see figure 3 for a summary of the benefits of COVID-19 vaccination).

Figure 3. Benefits of COVID-19 vaccination

Patient	Government	Economy
Productivity – curb potential losses in absenteeism and presenteeism from work	**Health expenditure saved** – government cost savings on COVID-19 treatment and hospitalization	**State of endemic** – countries reach an endemic state quicker with higher vaccination coverage
Lives saved – drop in COVID-19 mortality rates		**Household consumption** – cost savings on COVID-19 health expenditure drives consumer spending
Infections prevented – drop in COVID-19 infection rates	**Tax contribution** – generate higher tax dollars from direct and indirect taxes	**GDP improvement** – economic recovery as the country returns to normality
Hospitalizations avoided – decrease in hospitalization rates for COVID-19 cases		

Some ASPAC countries have done better than others in rolling-out a successful COVID-19 vaccination strategy. Below are some key highlights and best practices from around the region.

Invest in vaccines for long-term returns: The Indian government invests heavily in COVID-19 vaccination in the short term to cut down on healthcare expenditure on COVID-19 treatment and unlock cost savings in the long term

Leverage on domestic manufacturing to produce vaccines: India and Indonesia tap into their domestic biopharma manufacturing capabilities to produce COVID-19 vaccines for the domestic and international markets

Collect and analyze data to generate strategic insights: The South Korean government publishes comprehensive COVID-19 data e.g National Health Insurance Service (NHIS) and Ministry of Health and Welfare (MOHW) database, which are used to inform policy decisions and measure their outcomes

Prioritize business centers for economic recovery: Countries such as the Philippines and Vietnam direct vaccine supplies to business centres such as Metro Manila and Ho Chi Minh City respectively, to fortify their economy

Tap into digital solutions to support vaccine efforts: South Korea leverages on the country's robust ICT infrastructure to develop a vaccine reservation system, which tracks the supply and distribution of vaccines at the national level in real-time

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[29]COVID-19 Vaccinations, Our World in Data, 2021

India country snapshot

Patient impact

- India has the highest performance for number of cases avoided because of their relatively high vaccination rates and large population (See A1).

- The country had an average performance regarding healthcare costs avoided, with a large majority being from symptomatic cases, showcasing the effects of a large population with an uncompleted vaccination dose.

Table A1. COVID-19 vaccination – Patient Impacts (India)

Category	Description	India
Patient		
Cases Avoided	The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country at the moment of study	213,728,624
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	198,557,754
Hospitalized	Cases hospitalized but not in ICU	12,570,144
ICU	Cases hospitalized and in an Intensive Care Unit	430,377
Deaths	Cases that resulted in death	2,170,350
Healthcare costs avoided by case type ($US)	Costs by case type were collected through primary and secondary research methods and applied to the estimated cases avoided to evaluate the value of healthcare costs avoided in each country due to vaccinations. The total cost savings across the public and private healthcare sectors are summarised in in the following.	6,255,463,502
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	5,705,259,476
Hospitalized	Cases hospitalized but not in ICU	425,877,596
ICU	Cases hospitalized and in an Intensive Care Unit	24,433,916
Deaths	Cases that resulted in death	99,892,513

Government impact

- India had the second lowest score for labour productivity effect due to strict lockdown measures in its densely inhabited cities after the Delta outbreak in Q2 2021.

- In addition, it has a low-risk premium effect due to uncertainty regarding COVID-19 measures as the country manages one of the largest vaccination programs in the world.

Table A2. COVID-19 vaccination – Government impact (India)

Category	Description	India
Government		
Labour productivity effects of increased vaccination (%)	Lost workdays avoided by due to increased vaccination were estimated in order to evaluate the overall labour productivity effects	0.27%
Risk premium effect due to increased vaccination (percentage-point change)	Investor risk premiums fall due to vaccinations as policymakers have touted the importance of vaccinations in moving to more normal economic conditions without a continuous cycle of imposing and removing prophylactic measures.	-0.0017
Net Present Value of Welfare Gains ($USD Bn)	The net present value (NPV) of economic welfare or utility is defined as the sum of the value of leisure and household consumption.	49.2

Economic impact

- India had the lowest GDP change, consistent with the changes in labour productivity and risk premiums.

- Similarly, household consumption will have a slow recovery due to unemployment and wage cuts in the short term.

- Despite India's GDP, exports continued to grow due to India's strong manufacturing capacity, especially in the healthcare industry which is in high demand due to the pandemic.

Table A3. COVID-19 vaccination – economic impact 2021 (India)

Category	Description	India	ASPAC 5	India	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Macroeconomic Effects	We analyse the macroeconomic effects of increasing COVID-19 vaccinations. These numbers represent the impacts on consumption, expenditure, exports, GDP and tax revenue for all countries in 2021 and 2050.				
Consumption (% change)	The use of goods and services by households	0.03	0.19	0.38	1.20
Exports (% change)	Goods and services produced in the country and sold to buyers in another	1.02	1.26	0.05	1.00
GDP (% change)	Gross Domestic Product (GDP), total of all value added created in the economy	0.16	0.25	0.15	0.44
Tax Revenue (% change)	Revenue collected form taxes on income and profits	0.77	0.14	0.83	0.67

Category	Description	India	ASPAC 5	India	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Industry Impacts					
Agriculture (% change)		0.19	0.52	0.12	0.34
Mining (% change)		0.20	0.28	1.40	1.76
Manufacturing (% change)	The following data present the industry effects for the five countries and India.	0.54	1.17	0.13	0.96
Trade (% change)	Due to the benefit of vaccination and lost workdays avoided, together with increased investor confidence, Agriculture, Mining, Manufacturing, Trade, Transport, Utilities, Construction, Other Services and Government Services are projected to resume normal economic conditions.	0.37	0.90	0.63	1.67
Transport (% change)		0.44	0.86	0.50	1.02
Utilities (% change)		0.34	0.69	0.47	1.11
Construction (% change)		0.53	1.26	0.34	0.50
Other Services (% change)		0.49	0.89	0.97	1.80
Government Services (% change)		-1.55	-5.36	-1.28	-5.14

COVID-19 infection & vaccination status

Figure A1. COVID-19 key figures in India; **Figure A2**. Infection & vaccination rates in India

34,067,710
Total COVID-19 cases

24,449
per mil. people

452,124
COVID-19 deaths

1.32%
COVID-19 death rate

20.7%
Population fully vaccinated

51.4%
Population ≥ 1 dose

3.7% GDP
USD98.5bn
Healthcare

Vaccination and New Cases of COVID-19
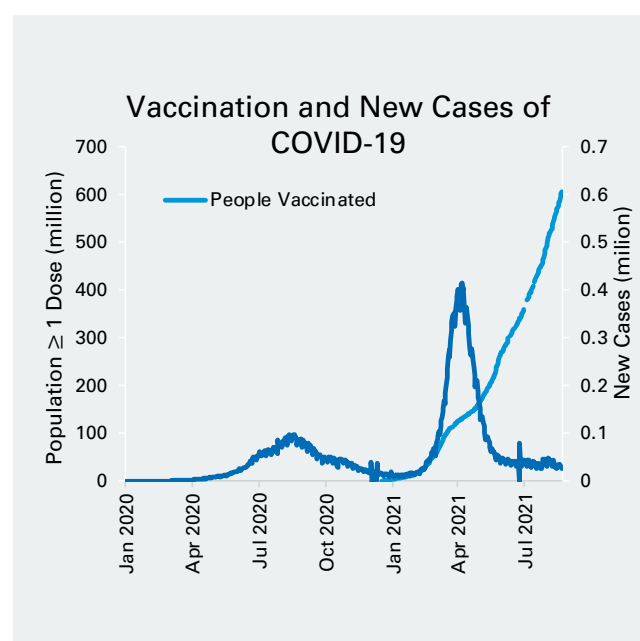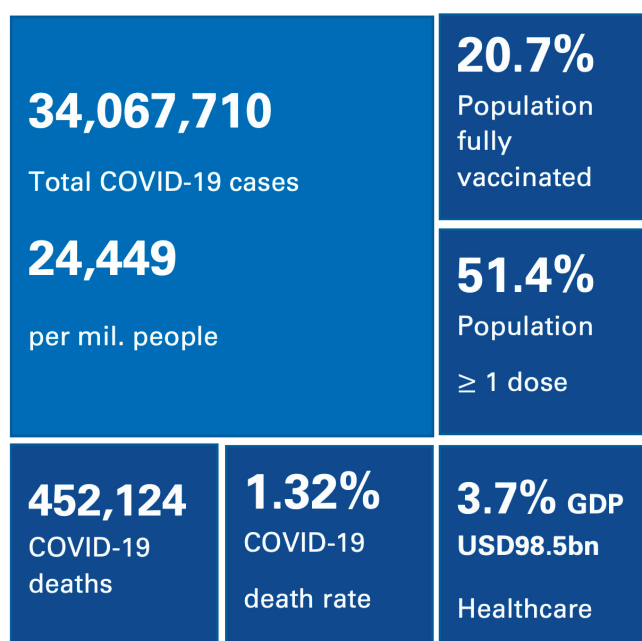
Supply & distribution of vaccines

Figure A3. Market share – supply of vaccines in India (%)

Legend:
- 44.8% Oxford/AstraZeneca
- 27.3% Bharat Biotech
- 15% Biological E*
- 12.5% Gamaleya Research Institute
- .3% Zydus Cadilia

.3%
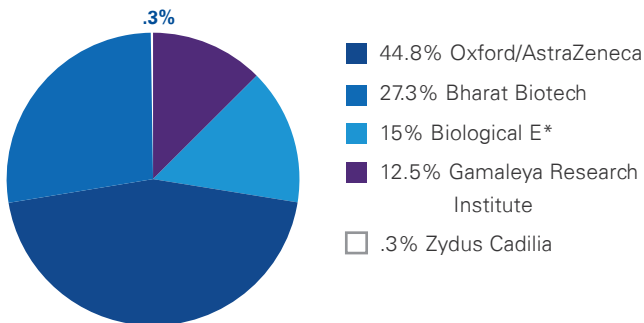
Over 1.99 billion COVID-19 vaccines supplied

- The largest suppliers in India are Astra Zeneca (Covishield) and Bharat Biotech (Covaxin) who make up 72.1% of the market

- Domestic players, Bharat Biotech, Zydus Cadila & Biological E make up two-fifths (42.6%) of the market

- Zydus Cadila is poised to deliver between 4-5 million doses by end of 2021 for the vaccination of children

Figure A4. Market share – vaccine delivery in India (%)

Legend:
- 87. 9% Oxford/AstraZeneca
- 11.5% Bharat Biotech
- .4% Gamaleya Research Institute

.4%
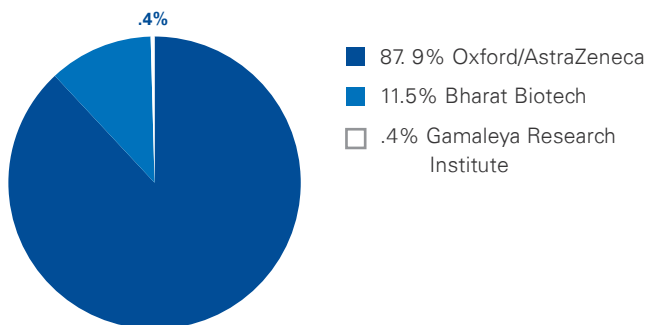
Total of 962 million COVID-19 delivered

- As of October 17, almost half (48.6%) of the vaccine supply, 962 million doses, has been administered to the public

- Astra Zeneca is the largest vaccine contributor, followed by Bharat Biotech, delivering 87.9% and 11.5% of vaccines respectively

- India's vaccines are mainly delivered through private contracts (98.7%) while donations and COVAX make up the remaining 1.2%

- Sputnik-V is only administered in private clinics, which patients pay out-of-pocket

Figure A5. Vaccination sites in India (%)

Legend:
- 94% Public
- 6% Private
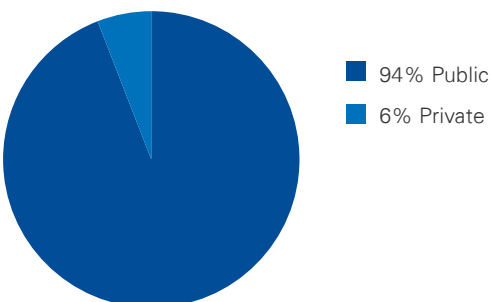
Points of vaccination

- Majority (94.1%) of vaccines are administered at public vaccination sites eg. hospitals, clinics, and vaccination centres

- Individuals can skip the queue and purchase the vaccine at private clinics but pay out-of-pocket

- Covishield: USD10.68/ dose

- Sputnik-V: USD15.68/ dose

- Covaxin: USD19.30/ dose

India's vaccination strategy

Table A4. India's vaccination timeline

Date	
Jan 3, 2021	Emergency Use Authorization was granted to AstraZeneca (Covishield) and Bharat Biotech (Covaxin)
Jan 16, 2021	First phase of COVID-19 vaccination began, it focused on vaccinating frontline and healthcare workers
Mar 1, 2021	Second phase started. People over 60 or aged between 45-59 who have co-morbidities e.g. hypertension, diabetes were eligible for vaccination
Apr 1, 2021	Third phase started, persons aged 45 or above became eligible for vaccination
Apr 12, 2021	Sputnik-V was given Emergency Use Authorization
May 1, 2021	All adults above 18 became eligible for vaccination
Jun 30, 2021	Moderna was granted Emergency Use Authorization
Aug 7, 2021	Janssen vaccine was granted Emergency Use Authorization
Aug 20, 2021	Zydus Cadila was granted Emergency Use Authorization, it became the only vaccine approved for children
Oct 2021	Government began vaccination of children with comorbidities using Zydus Cadila vaccine
Target by Dec 2021	India aims to vaccinate its entire adult population of 940 million by end of the year

Funding for COVID-19 vaccines

- The government allocated an estimated USD 98.5 billion or 3.7% of its GDP for healthcare spending in 2021

- USD 4.6 billion was set aside from the central and state reserves for the purchase of COVID-19 vaccines[30]

- The country further applied for a USD 2 billion loan from the Asian Infrastructure bank and the Asian Development bank to finance the cost of 667 million doses of COVID-19 vaccines[31]

> "In this year's budget there has been one single outplay for COVID-19 vaccination, I definitely see that this would be repeated in the second year's budget although not in the same amount as we have a substantial amount of people with at least one dose of the vaccine"
> – *Healthcare Lead, World Economic Forum*

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[30]The Economic Times, (2021), "Budget 2021: Vaccine allocation and other major announcements for healthcare", accessed on 1 November 2021, available at https://economictimes.indiatimes.com/industry/healthcare/biotech/healthcare/budget-2021-vaccine-allocation-and-other-major-announcements-for-healthcare/articleshow/80631571.cms

[31]The Economic Times (2021), "ADB,AIIB processing $2billion loan for India to buy COVID-19 vaccines", Accessed on 2 Novemebr 2021, available at https://economictimes.indiatimes.com/news/economy/finance/adb-aiib-processing-2-billion-loan-for-india-to-buy-covid-19-vaccines/articleshow/87310509.cms

Success

- The Indian government invests heavily in domestic biopharma manufacturing to secure COVID-19 vaccines for the country; USD550million worth of investments were delivered in April 2021[32]

- Manufacturers including Serum Institute of India and Bharat Biotech play a pivotal role in supplying vaccines for the national vaccination program

- India was able to redirect their vaccination exports towards their national vaccination program to combat the Delta variant outbreak in October 2020

Challenges

- India faces an arduous challenge of vaccinating its entire population of 1.39 billion people; rural areas are especially difficult to penetrate

- Low health literacy especially in the provinces of West Bengal, Jharkhand, Meghalaya, Manipur and Nagaland continue to pose a barrier to vaccine uptake

- People do not take the second vaccine dose as it is not a mandate for domestic travel and or employment

"The rural population are still having vaccine hesitancy, because of the socioeconomic conditions, social demographic conditions and their level of awareness, they are not much sensitized"
– *Medical Officer, World Health Organization*

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[32] Health Policy Watch, (2021), "As COVID Cases Surge – India Makes US$ 550 Million Investments In Local Vaccine Production & Opens Private Market To Vaccine Imports", accessed on 1 November 2021, available at https://healthpolicy-watch.news/india-makes-us-550-million-investments-in-local-vaccine-production-opens-private-market-to-vaccine-imports/

Vietnam country snapshot

Patient impact

- Vietnam performs relatively well for healthcare costs avoided largely because of the low hospital costs in the country; patients tend to pay around 20% of expenses out-of-pocket.

- The country performs poorly on total cases avoided because it has the lowest vaccination rate among the in-scope countries, with only 17.82% of its population fully vaccinated (see table A5).

Table A5. COVID-19 vaccination - patient impacts (Vietnam)

Category	Description	Vietnam
Patient		
Cases Avoided	The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country at the moment of study	8,836,603
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	8,230,260
Hospitalized	Cases hospitalized but not in ICU	508,988
ICU	Cases hospitalized and in an Intensive Care Unit	11,073
Deaths	Cases that resulted in death	86,282
Healthcare costs avoided by case type ($US)	Costs by case type were collected through primary and secondary research methods and applied to the estimated cases avoided to evaluate the value of healthcare costs avoided in each country due to vaccinations. The total cost savings across the public and private healthcare sectors are summarised in in the following.	3,498,805,358
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	2,685,254,772
Hospitalized	Cases hospitalized but not in ICU	544,607,234
ICU	Cases hospitalized and in an Intensive Care Unit	41,860,616
Deaths	Cases that resulted in death	227,082,736

Government impact

- Vietnam has the lowest score for labour productivity effect due to a slow start to its vaccination program. Additionally, strict lockdown measures in its business centres e.g. HCM prevented individuals from returning to work.

- Similarly, it has a low-risk premium effect due to initial uncertainty around guidelines for people to return to work (see table A6).

Table A6. COVID-19 vaccination – government impact (Vietnam)

Category	Description	Vietnam
Government		
Labour productivity effects of increased vaccination (%)	Lost workdays avoided by due to increased vaccination were estimated in order to evaluate the overall labour productivity effects	0.16%
Risk premium effect due to increased vaccination (percentage-point change)	Investor risk premiums fall due to vaccinations as policymakers have touted the importance of vaccinations in moving to more normal economic conditions without a continuous cycle of imposing and removing prophylactic measures.	-0.001
Net Present Value of Welfare Gains ($USD Bn)	The net present value (NPV) of economic welfare or utility is defined as the sum of the value of leisure and household consumption.	18.68

Economic impact

- Trade is the fastest growing industry in the near term, in part due to Vietnam's strong manufacturing capacity and output.

- Government services is the slowest to recover in the near term as government resources were largely directed towards national vaccination efforts.

- Tax revenue will continue to lag in the long term due to a dip in wage rates and exports.

- Similarly, household consumption will take years to pick up as it took a huge hit from unemployment and wage cuts (see table A7).

Table A7. COVID-19 vaccination – economic impact 2021 (Vietnam)

Category	Description	Vietnam	ASPAC 5	Vietnam	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Macroeconomic Effects	We analyse the macroeconomic effects of increasing COVID-19 vaccinations. These numbers represent the impacts on consumption, expenditure, exports, GDP and tax revenue for all countries in 2021 and 2050.				
Consumption (% change)	The use of goods and services by households	0.93	0.19	1.25	1.20
Exports (% change)	Goods and services produced in the country and sold to buyers in another	1.04	1.26	0.91	1.00

Category	Description	Vietnam	ASPAC 5	Vietnam	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
GDP (% change)	Gross Domestic Product (GDP), total of all value added created in the economy	0.19	0.25	0.23	0.44
Tax Revenue (% change)	Revenue collected form taxes on income and profits	-0.45	0.14	0.30	0.67
Industry Impacts					
Agriculture (% change)	The following data present the industry effects for the five countries and Vietnam. Due to the benefit of vaccination andvlost workdays avoided, together with increase investor confidence, Agriculture, Mining, Manufacturing, Trade, Transport, Utilities, Construction, Other Services and Government Services are projected to resume normal economic conditions.	0.59	0.52	0.38	0.34
Mining (% change)		0.28	0.28	1.58	1.76
Manufacturing (% change)		1.41	1.17	0.95	0.96
Trade (% change)		1.69	0.90	2.22	1.67
Transport (% change)		0.75	0.86	0.69	1.02
Utilities (% change)		1.23	0.69	1.26	1.11
Construction (% change)		0.76	1.26	0.33	0.50
Other Services (% change)		1.08	0.89	2.00	1.80
Government Services (% change)		-11.89	-5.36	-11.65	-5.14

COVID-19 infection & vaccination status

Figure A6. COVID-19 status in Vietnam; **Figure A7.** Infection & vaccination rates in Vietnam

860,860

Total COVID-19 cases
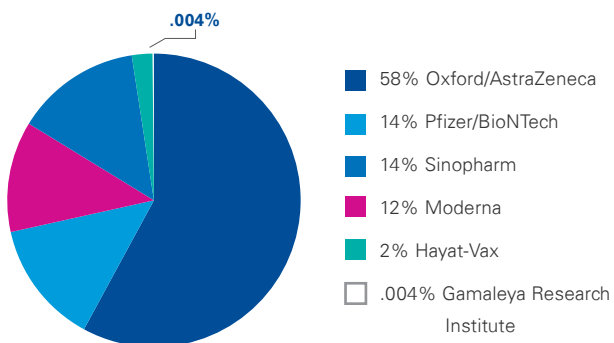
8,769

per mil. people

17.82%
Population fully vaccinated

42.5%
Population ≥ 1 dose

21,131
COVID-19 deaths

2.45%
COVID-19 death rate

6.1% GDP
USD 21 bn
Healthcare

Vaccination and New Cases of COVID-19
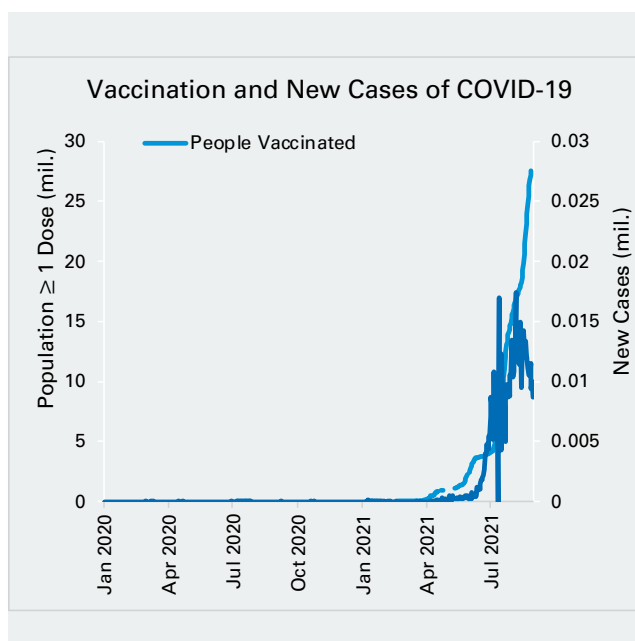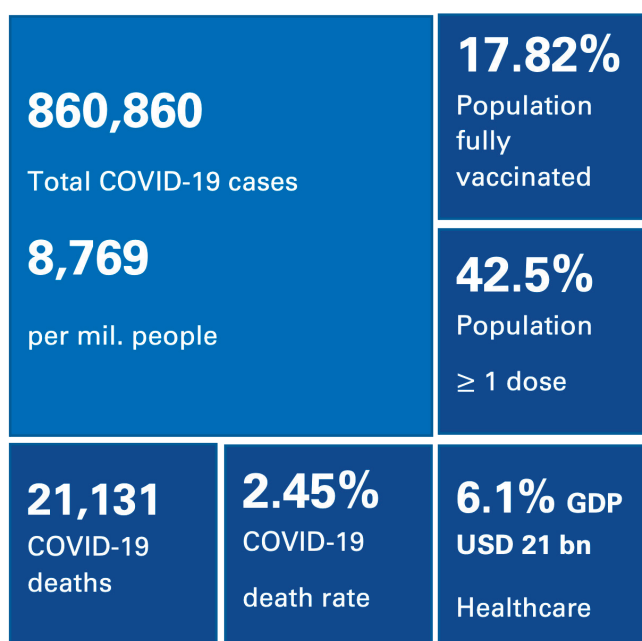
Supply & distribution of vaccines

Figure A8. Market share – supply of vaccines in Vietnam (%)

- 31.4 % Pfizer/BioNTech
- 26.7% Oxford/AstraZeneca
- 18.28% Hayat-Vax
- 12.2% Gamaleya Research Institute
- 6.09% Abdala
- 3.5% Sinopharm
- 1.8% Medigen/Dynavax
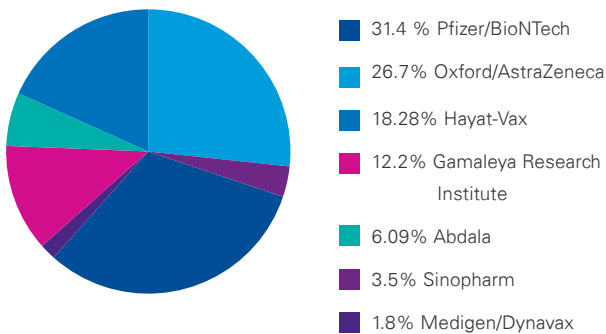
Over COVID-19 164 million vaccines supplied

- Pfizer, Astra Zeneca and Hyat-Vax are the key vaccine suppliers contributing to 76.38% of vaccines

- Vietnam is currently developing four local vaccines that are expected to be available by 2022

- Vietnam's emerging vaccines Nano Covax, Corivac, Vabiotech and Polyvac are expected to enter the market by 2022 and become key suppliers for the vaccination program

Figure A10. Vaccination sites in Vietnam (%)

.004%

- 58% Oxford/AstraZeneca
- 14% Pfizer/BioNTech
- 14% Sinopharm
- 12% Moderna
- 2% Hayat-Vax
- .004% Gamaleya Research Institute

Total of 41.2 million COVID-19 delivered

- As of October 17, a quarter (25%) of the vaccine supply, total of 41.2 million doses, has been administered to the public

- Astra Zeneca is the largest vaccine contributor, followed by Pfizer delivering 58% and 14% of vaccines respectively

- Vietnam's vaccines are mainly delivered through COVAX (43.9%) followed by private contracts (41.5%) and donations (14.48%)

- Moderna is the only vaccine that does not have a private contract and was delivered through COVAX and donations

Figure A10. Vaccination sites in Vietnam (%)
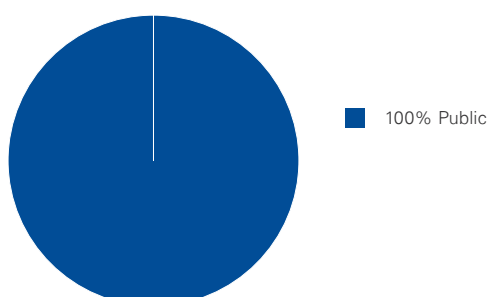
- 100% Public

Points of vaccination

- All vaccines are administered at public vaccination sites e.g. hospitals, clinics, and vaccination centres

- There are approximately 19,500 vaccination centres for COVID-19 across the country

Vietnam's vaccination strategy

Table A8. Vietnam's vaccination timeline

Date	
Feb 1, 2021	Emergency Use Approval is granted to AstraZeneca
Mar 8, 2021	Vietnam's vaccination program begins inoculating frontline workers. The program focuses on vaccinating larger cities where cases are prevalent.
Mar 23, 2021	Sputnik-V was granted Emergency Use Approval
Apr 19, 2021	Vaccination program extended to all medical workers and those who have contact with international arrivals
Apr 30, 2021	Moderna was granted Emergency Use Approval
May 14, 2021	Third phase of vaccination program began. Private companies were encouraged to vaccinate their workers in order to aid the country's vaccination program
Jun 3, 2021	Sinopharm vaccine was granted Emergency Use Approval
Jun 12, 2021	Pfizer vaccine was granted Emergency Use Approval
Jun 16, 2021	Fourth phase of vaccination program began, it extended to include industry workers
Jul 22, 2021	Fifth phase of vaccination program began, Vietnamese government opened vaccination to a wider adult population in order to increase vaccination rates
Aug 4, 2021	Sixth phase of vaccination program began, more than 1 million doses were directed to HCMC
Sep 9, 2021	Vietnam allowed mixing of Pfizer and Moderna due to supply shortages. Vaccination speeds up in Hanoi in order to reopen the city
Sep 18, 2021	Abdala vaccine is granted Emergency Use Approval
Sep 24, 2021	Local pharmaceutical company Vabiotech started production of Sputnik-V
Target by Dec 2021	Vietnam expects to vaccinate 50% of adult population by end of year and aims to vaccinate 70% by early 2022

Funding for COVID-19 vaccines

- May 2021, Vietnam set up a USD 1.1 billion vaccination fund to procure 150 million COVID-19 vaccine doses[33], it expects to cover the cost of vaccines, transport, storage and injecting the doses

- The vaccination fund received USD 795 million from state budget and as of October the fund raised more than USD 380 million in private donations[34]

- Initially the fund aimed to secure enough doses for 70% of the population however with the additional donations Vietnam is now able to fully vaccinate its entire population

> "Government was able to mobilize resources and created fundraising campaigns where everyone can make contributions and resources from national reserves and provincial funds would be approved for use"
> - *Project Director, Path*

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[33] CNA, (2021), "Vietnam to set up a US$1.1 billion COVID-10 vaccine fund" accessed on 2 November 2021, available at https://www.channelnewsasia.com/asia/covid-19-vietnam-vaccine-fund-1384431
[34] VnExpress, (2021), "Vietnam can buy covid-19 vaccines for all citizens", accessed on 2 November 2021, available at https://e.vnexpress.net/news/news/vietnam-can-buy-covid-19-vaccines-for-all-citizens-4375064.html

Success

- Vietnam's strong government position allowed for a control on misinformation regarding vaccination

- Although safety concerns and vaccine hesitancy emerged, Vietnam was able to manage the narratives around the vaccine and raise awareness on the importance of vaccination with tight regulation of the press

- Furthermore, Vietnam prioritized vaccination in business centers such as Hanoi and Ho Chi Minh City to fortify their economy

- In efforts to reactivate tourism, Vietnam opened tourism for vaccinated travelers from 72 countries and territories[35]

Challenges

- The government was unable to allocate enough resources for the procurement of vaccinations, which delayed Vietnam's response against COVID-19

- Lack of vaccination supply prompted Vietnam to depend on strict lockdowns as the main measure to combat their increase in cases

- As a result, several industries were forced to shut down for approximately two months[36] which incurred great losses for the economy and the private corporations

"It [lockdowns] hurts the image of the economy, when we have vaccines, we control the disease, everything returns to normal and the city is alive again"
- Vice head, National Institute of Hygiene and Epidemiology

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[35] Reuters, (2021), "Vietnam accepts vaccine passports from 72 countries, territories", accessed on 2 November 2021, available at https://e.vnexpress.net/news/news/vietnam-accepts-vaccine-passports-from-72-countries-territories-4375068.html
[36] Aljazeera, (2021), "Vietnam to end COVID lockdown in Ho Chi Minh City", accessed 2 November 2021, available at https://www.aljazeera.com/news/2021/9/30/vietnam-to-end-covid-lockdown-in-ho-chi-minh-city

South Korea country snapshot

Patient impact

- South Korea ranked the highest for total healthcare costs avoided reflecting the high healthcare costs due to its high-income status and its high vaccination rate

- Despite having the highest vaccination rate, South Korea ranked third for cases avoided when compared to more populous countries such as India and Indonesia

Table A9. COVID-19 vaccination – patient impacts (South Korea)

Category	Description	South Korea
Patient		
Cases Avoided	The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country at the moment of study	23,177,338
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	21,458,729
Hospitalized	Cases hospitalized but not in ICU	1,446,131
ICU	Cases hospitalized and in an Intensive Care Unit	42,592
Deaths	Cases that resulted in death	229,886
Healthcare costs avoided by case type ($US)	Costs by case type were collected through primary and secondary research methods and applied to the estimated cases avoided to evaluate the value of healthcare costs avoided in each country due to vaccinations. The total cost savings across the public and private healthcare sectors are summarised in in the following.	22,363,026,592
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	7,095,868,670
Hospitalized	Cases hospitalized but not in ICU	3,451,090,574
ICU	Cases hospitalized and in an Intensive Care Unit	385,276,537
Deaths	Cases that resulted in death	1,430,790,811

Government impact

- South Korea had the highest score in investor risk premium showcasing the government's priority to move towards normal economic conditions by utilizing a strong vaccination program and avoiding the use of strict lockdowns

- Similarly, South Korea had a substantial increase in the net present value of welfare gains of USD 49 billion, showcasing the economic-wide effects of increased vaccination

Table A10. COVID-19 vaccination – government impact (South Korea)

Category	Description	South Korea
Government		
Labour productivity effects of increased vaccination (%)	Lost workdays avoided by due to increased vaccination were estimated in order to evaluate the overall labour productivity effects	0.80%
Risk premium effect due to increased vaccination (percentage-point change)	Investor risk premiums fall due to vaccinations as policymakers have touted the importance of vaccinations in moving to more normal economic conditions without a continuous cycle of imposing and removing prophylactic measures.	-0.005
Net Present Value of Welfare Gains ($USD Bn)	The net present value (NPV) of economic welfare or utility is defined as the sum of the value of leisure and household consumption.	109.24

Economic impact

- Consumption was the only macroeconomic variable that fell for 2021 while exports, GDP and tax revenue indicated a positive effect in both the short and long term because of increased vaccination

- Similarly, consistent with its high vaccination rates, South Korea had the largest GDP increase in the long term of 1.12% compared to the average of 0.44% in the region (See A11)

- South Korea shows the highest increases in industry output across all industries, especially manufacturing, trade, transport, utilities, and other services which benefit the most from vaccination
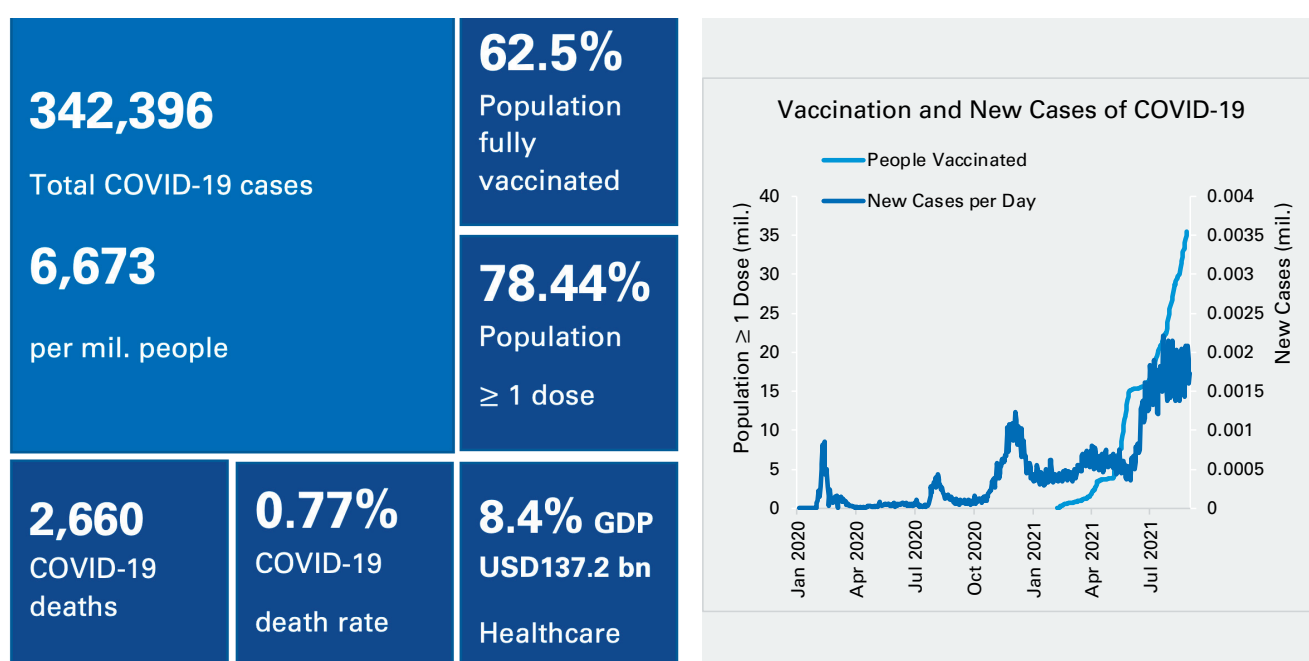
Table A11. COVID-19 vaccination – economic impact 2021 (South Korea)

Category	Description	South Korea	ASPAC 5	South Korea	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Macroeconomic Effects	We analyse the macroeconomic effects of increasing COVID-19 vaccinations. These numbers represent the impacts on consumption, expenditure, exports, GDP and tax revenue for all countries in 2021 and 2050.				
Consumption (% change)	The use of goods and services by households	-0.28	0.19	2.35	1.20

Category	Description	South Korea	ASPAC 5	South Korea	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Exports (% change)	Goods and services produced in the country and sold to buyers in another	1.67	1.26	1.93	1.00
GDP (% change)	Gross Domestic Product (GDP), total of all value added created in the economy	0.55	0.25	1.12	0.44
Tax Revenue (% change)	Revenue collected form taxes on income and profits	0.40	0.14	1.33	0.67
Industry Impacts	The following data present the industry effects for the five countries and South Korea.				
Agriculture (% change)		0.68	0.52	0.47	0.34
Mining (% change)		0.46	0.28	2.86	1.76
Manufacturing (% change)	Due to the benefit of vaccination and lost workdays avoided, together with increase investor confidence, Agriculture, Mining, Manufacturing, Trade, Transport, Utilities, Construction, Other Services and Government Services are projected to resume normal economic conditions.	1.78	1.17	2.21	0.96
Trade (% change)		1.53	0.90	2.89	1.67
Transport (% change)		1.54	0.86	1.95	1.02
Utilities (% change)		0.97	0.69	2.13	1.11
Construction (% change)		2.57	1.26	1.05	0.50
Other Services (% change)		1.52	0.89	3.08	1.80
Government Services (% change)		-3.94	-5.36	-4.01	-5.14

COVID-19 infection & vaccination status

Figure A11. COVID-19 status in South Korea; **Figure A12**. Infection & vaccination rates in South Korea

342,396
Total COVID-19 cases

6,673
per mil. people

62.5%
Population fully vaccinated

78.44%
Population ≥ 1 dose

2,660
COVID-19 deaths

0.77%
COVID-19 death rate

8.4% GDP
USD137.2 bn
Healthcare

Vaccination and New Cases of COVID-19

— People Vaccinated
— New Cases per Day

Supply & distribution of vaccines

Figure A13. Market share – supply of vaccines in South Korea (%)

- 37.8% Pfizer/BioNTech
- 22.9% Moderna
- 22.6% Novavax
- 12.5% Oxford/AstraZeneca
- 4.1% J&J
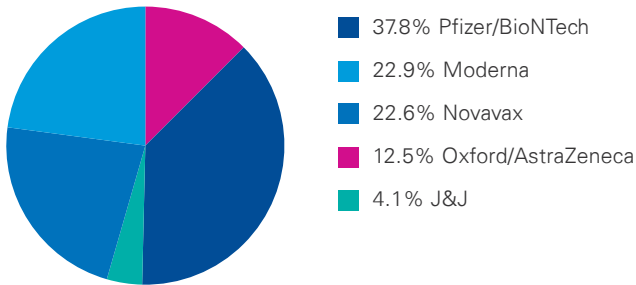
Over COVID-19 176.9 million vaccines supplied

- Pfizer, Moderna and Novavax are expected to become the key vaccine suppliers for the country, contributing 83.3% of vaccines

- South Korea has secured enough doses to fully vaccinate their population including "booster" shots

Figure A14. Market share – vaccine delivery in South Korea (%)

- 50% Pfizer/BioNTech
- 30% Oxford/AstraZeneca
- 18% Moderna
- 2% J&J
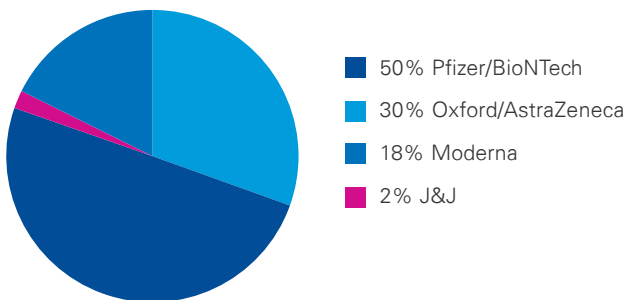
Total of 72.5 million COVID-19 delivered

- As of October 17, two fifths (40%) of the vaccine supply, total of 72.5 million doses, has been administered to the public

- Pfizer is the largest vaccine contributor, followed by AstraZeneca delivering 50% and 30% of vaccines respectively

- South Korea's vaccines are mainly delivered through private contracts (93%) followed by COVAX (3%) and donations (3%)

Figure A15. Vaccination sites in South Korea (%)
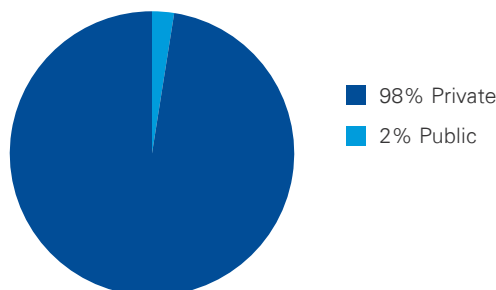
- 98% Private
- 2% Public

Points of vaccination

- South Korea has 250 government run centres that only distribute the mRna vaccines and 10,000 private centres distribute AstraZeneca, and Johnson & Johnson vaccines

- The health authorities visit nursing homes and hospitals to administer the vaccines to patients and senior citizens who are restricted from going outdoors

South Korea's vaccination strategy

Table A12. South Korea's vaccination timeline

Date	
Feb 10, 2021	Emergency Use Approval is granted to AstraZeneca
Feb 26, 2021	Inoculation drive started and focused on healthcare workers and patients aged under 65 in care facilities
Mar 8, 2021	Medical personnel working in "high risk" areas and frontline workers became eligible for vaccination as well as adults 65 and older
Mar 5, 2021	Pfizer is granted Emergency Use Approval
Apr 2021	Vaccination is extended to elderly, medical workers, police, fire officials, soldiers, flight attendants
Apr 7, 2021:	Janssen is granted Emergency Use Approval
May 20, 2021	Due to vaccine shortages, clinical trials started mixing AstraZeneca and Pfizer doses to complete full 2-dose vaccination
May 21, 2021	Moderna is granted Emergency Use Approval
Jun 29, 2021	Manufacturing employees were given permission to vaccinate in-house to speed up inoculation for their employees
Jul 12, 2021	Adults aged 50 years or older became eligible for vaccination
Jul 30, 2021	All adults between 18 and 64 became eligible for vaccination
Aug 3, 2021	Vaccination bookings focused on the young adult population aged from 49 to 18
October 2021	Pregnant woman and children became eligible for the vaccine. Booster shots will begin to be administered for high-risk populations
Target by Dec 2021	Korean Disease Control and Prevention Agency aims to immunise 70% of the population to achieve herd immunity by end of year

Funding for COVID-19 vaccines

- South Korean government initially allocated USD 1.2 billion for its 2021 vaccine budget[37]

- In July, government allocated extra budget for COVID-19 efforts of which approximately USD 1.27 billion were allocated to the purchasing of vaccines[38]

- South Korea has spent roughly around 1.8% of its GDP in COVID-19 vaccination procurement

"Government will continue to allocate budget for COVID-19, especially vaccination as it is extending well into 2022 and is 100% paid by the government"
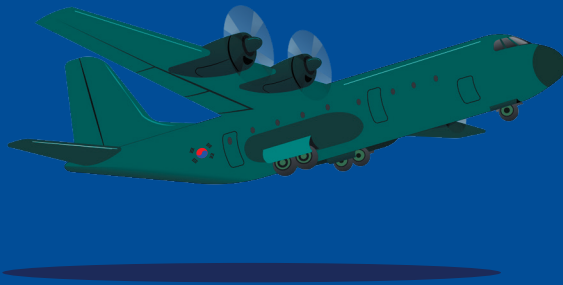*– Deputy Director, Korea Disease Control and Prevention Agency*

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[37] Reuters, (2020), "Update 3-S.Korea to import J&J, Pfizer COVID-19 vaccines for 16 mln people", accessed on 2 November 2021, available at https://www.reuters.com/article/health-coronavirus-southkorea-vaccine-idCNL1N2J4004
[38] Yonhap News Agency, (2021) "KDCA to use 3.6 tln won from extra budget to fight pandemic", accessed on 2 November 2021, available at https://en.yna.co.kr/view/AEN20210729011300320

Success

- Government's focused on creating accessible and an efficient vaccine distribution for their COVID-19 vaccination program allowing them to already achieve full vaccination among the majority (>70%) of the population

- The deployment of mobile teams allowed for vaccination to reach those individuals unable to leave their homes or care facilities

- Korea's military also played an important role as escorts and main transport for vaccinations[39]

- South Korea utilized digital solutions to support the vaccination program by implementing a vaccine reservation system that would show the supply and distributions of vaccines in real-time

"Military is a big part of the response team for vaccine delivery as they are in charge of security and delivery of vaccines…they supplied airplanes and ships to distribute vaccines in rural areas"
– Director, Korea Disease Control and Prevention Agency

[39] Financial Times, (2021), "South Korea leans on military to accelerate COVID vaccine rollout", accessed on 2 November 2021, available at https://www.ft.com/content/c9d8f4a0-5712-44ed-97f2-361b4cf53bad

| **47**

The Philippines country snapshot

Patient impact

- In number of cases avoided, The Philippines performed poorly due to its high infection rate (1.9%) and shipment delays for their vaccination program
  .

- The Philippines had one of the lowest scores in terms of healthcare costs avoided because to the relatively low hospital costs and lower number of cases avoided as a result of their vaccination rates

Table A13. COVID-19 vaccination – patient impacts (the Philippines)

Category	Description	The Philippines
Patient		
Cases Avoided	The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country at the moment of study	19,222,808
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	7,945,062
Hospitalized	Cases hospitalized but not in ICU	1,085,443
ICU	Cases hospitalized and in an Intensive Care Unit	29,954
Deaths	Cases that resulted in death	162,349
Healthcare costs avoided by case type ($US)	Costs by case type were collected through primary and secondary research methods and applied to the estimated cases avoided to evaluate the value of healthcare costs avoided in each country due to vaccinations. The total cost savings across the public and private healthcare sectors are summarised in in the following.	3,225,511,409
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	1,064,226,211
Hospitalized	Cases hospitalized but not in ICU	1,903,752,623
ICU	Cases hospitalized and in an Intensive Care Unit	54,834,541
Deaths	Cases that resulted in death	202,698,034

Government impact

- The Philippines had a substantially lower net present value of welfare gains demonstrating the economic wide impact of a low vaccination rate

- Similarly, the labour productivity effect remained relatively low (See A14) showcasing the Philippines' slow vaccination roll out in the economic centres, eg. National Capital Region, and high infection rates despite strict lockdowns

Table A14. COVID-19 vaccination – government impact (the Philippines)

Category	Description	The Philippines
Government		
Labour productivity effects of increased vaccination (%)	Lost workdays avoided by due to increased vaccination were estimated in order to evaluate the overall labour productivity effects	0.30%
Risk premium effect due to increased vaccination (percentage-point change)	Investor risk premiums fall due to vaccinations as policymakers have touted the importance of vaccinations in moving to more normal economic conditions without a continuous cycle of imposing and removing prophylactic measures.	-0.0019
Net Present Value of Welfare Gains ($USD Bn)	The net present value (NPV) of economic welfare or utility is defined as the sum of the value of leisure and household consumption.	4.47

Economic impact

- Consumption and Tax Revenue fell in the short-term reflecting the drop-in wage rate (See A15) however, these effects are amended in the long-term

- All industries are expected to have a positive impact except for Government Services. Manufacturing, transport, and construction are expected to have the highest increase in the short-term showcasing the country's strong manufacturing and export capacity

- Mining, Trade and Other Services are expected to have the highest increase in the long-term reflecting the economic gain from vaccination and a prompt return to normalcy

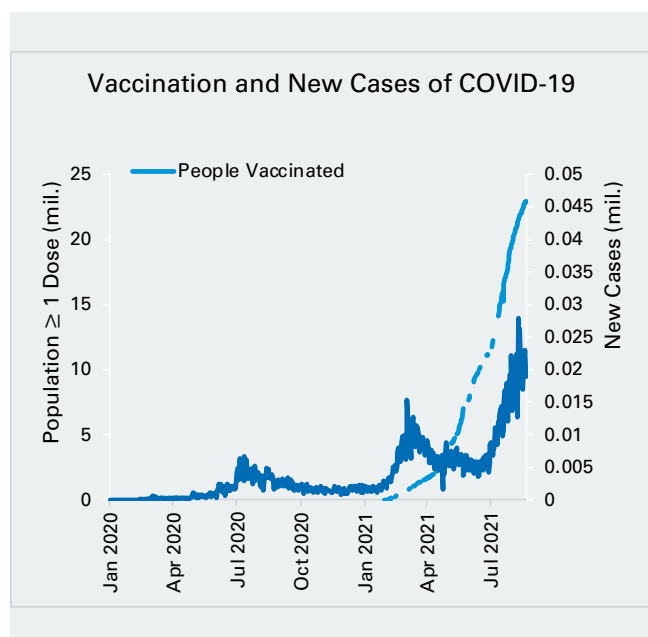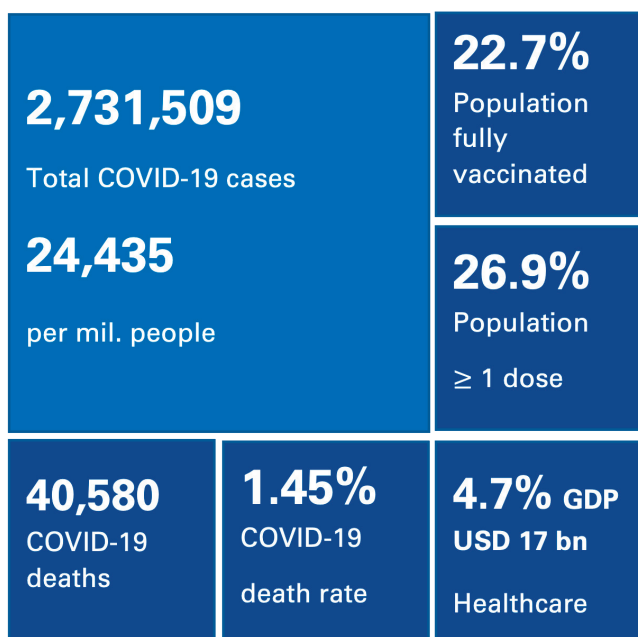**Table A15.** COVID-19 vaccination – economic impact 2021 (the Philippines)

Category	Description	The Philippines	ASPAC 5	The Philippines	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Macroeconomic Effects	We analyse the macroeconomic effects of increasing COVID-19 vaccinations. These numbers represent the impacts on consumption, expenditure, exports, GDP and tax revenue for all countries in 2021 and 2050.				

Category	Description	The Philippines	ASPAC 5	The Philippines	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Consumption (% change)	The use of goods and services by households	-0.34	0.19	0.49	1.20
Exports (% change)	Goods and services produced in the country and sold to buyers in another	1.92	1.26	0.71	1.00
GDP (% change)	Gross Domestic Product (GDP), total of all value added created in the economy	0.14	0.25	0.24	0.44
Tax Revenue (% change)	Revenue collected form taxes on income and profits	-0.45	0.14	0.30	0.67
Industry Impacts					
Agriculture (% change)	The following data present the industry effects for the five countries and The Philippines. Due to the benefit of vaccination and lost workdays avoided, together with increase investor confidence, Agriculture, Mining, Manufacturing, Trade, Transport, Utilities, Construction, Other Services and Government Services are projected to resume normal economic conditions.	0.76	0.52	0.42	0.34
Mining (% change)		0.33	0.28	1.79	1.76
Manufacturing (% change)		1.20	1.17	0.76	0.96
Trade (% change)		0.84	0.90	1.48	1.67
Transport (% change)		1.01	0.86	1.20	1.02
Utilities (% change)		0.42	0.69	0.74	1.11
Construction (% change)		1.27	1.26	0.32	0.50
Other Services (% change)		0.74	0.89	1.48	1.80
Government Services (% change)		-4.02	-5.36	-3.55	-5.14

COVID-19 Infection & vaccination status

Figure A16. COVID-19 status in the Philippines; **Figure A17.** Infection & vaccination rates in the Philippines
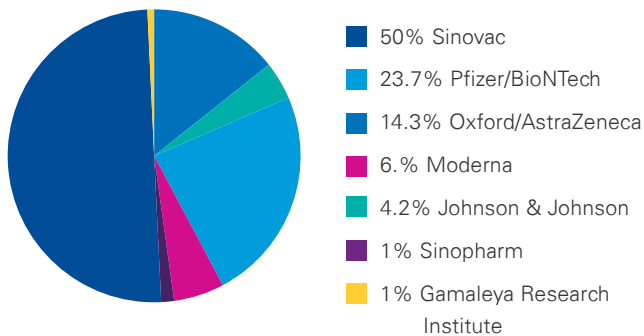
2,731,509
Total COVID-19 cases

24,435
per mil. people

22.7%
Population fully vaccinated

26.9%
Population ≥ 1 dose

40,580
COVID-19 deaths

1.45%
COVID-19 death rate

4.7% GDP
USD 17 bn
Healthcare

Vaccination and New Cases of COVID-19

Supply & distribution of vaccines

Figure A18. Market share – supply of vaccines in the Philippines (%)

- 37.5% Pfizer/BioNTech
- 18.49% Sinovac
- 17.5% Oxford/AstraZeneca
- 16.4% Moderna
- 7.11% Gamaleya Research Institute
- 2.3% Johnson & Johnson
- .8% Sinopham
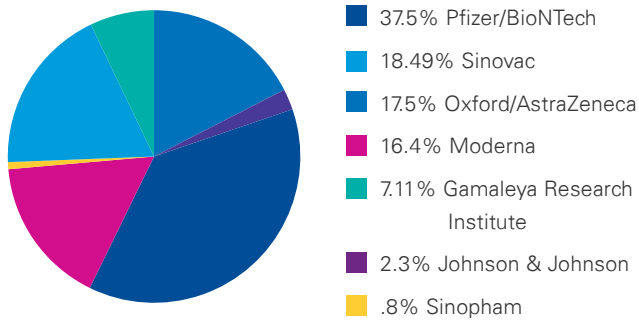
Over 140 million COVID-19 vaccines supplied

- The largest suppliers in the Philippines are Pfizer and Sinovac who make up 55.99% of the market

Figure A19. Market share – vaccine delivery in the Philippines (%)

- 50% Sinovac
- 23.7% Pfizer/BioNTech
- 14.3% Oxford/AstraZeneca
- 6.% Moderna
- 4.2% Johnson & Johnson
- 1% Sinopharm
- 1% Gamaleya Research Institute

Total of 76.9 million COVID-19 delivered

- As of October 17, more than half (54.7%) of the vaccine supply, 76.9 million doses, has been administered to the public

- Sinovac is the largest vaccine contributor, followed by Pfizer, delivering 50% and 23.7% of vaccines respectively

- The Philippines's vaccines are mainly delivered through private contracts (62.9%) while donations followed by COVAX (32%) and donations make up the remaining 5%

Figure A20. Vaccination sites in the Philippines (%)
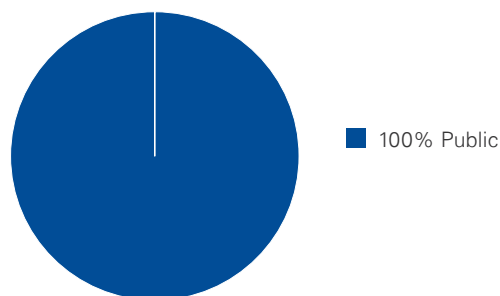
- 100% Public

Points of vaccination

- All vaccines are administered at public vaccination sites e.g. hospitals, clinics, and vaccination centres

- The Philippines has 3,263 vaccination sites across 17 different regions in where individuals can obtain a vaccine for free

The Philippines' vaccination strategy

Table A16. The Philippines' vaccination timeline

Date	
Dec. 1, 2020	Emergency Use Authorization was given to AstraZeneca, Sinovac, Gamaleya Institute, Johnson & Johnson, Bharat Biotech, Pfizer-BioNTech, and Moderna by President Duterte
Mar 1, 2021	Vaccination program began using Sinovac and AstraZeneca for frontline workers
Mar 29, 2021	Metro Manila started vaccinating senior citizens and adults with comorbidities
May 1, 2021	Vaccination program extends to include for minimum wage workers
Jun 7, 2021	Vaccine program extends and includes essential workers in larger cities
Jun 15, 2021	Vaccine program starts to include indigent residents in San Juan and Mandaluyong
Aug 11, 2021	Hayat-Vax COVID-19 is granted Emergency Use Authorization
Aug 23, 2021	Sputnik Light is granted Emergency Use Authorization
Sep 2021	The Philippines directs vaccination program resources to provinces with high number of cases
Oct 2021	The Philippines started vaccination for general adult population and children with comorbidities
Target by Dec 2021	President Duterte expects to fully immunize up to 70 Mn by early 2021

Funding for COVID-19 vaccines

- The Philippines enacted the Bayanihan Act as a response to the pandemic and allocated USD3.2billion for the pandemic response and recovery[40]

- The Philippines secured $1.2 Bn USD in loans from World Bank, Asian Development Bank and Asian Infrastructure Investment Bank for the procurement of COVID-19 vaccines[41]

- Government allotted USD899million for COVID-19 booster shots under its 2022 budget[42]

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[40] COVID-19 Budget Utilization Reports as of September 30, 2021, Department of Budget and Management, 2021.
[41] Department of Finance, (2021), "Gov't taps P58.4 billion from multilateral lenders for COVID-19 vaccines", accessed on 2 November 2021, available at https://www.dof.gov.ph/govt-taps-p58-4-billion-from-multilateral-lenders-for-covid-19-vaccines/
[42] Reuters, (2021)," Philippines earmarks $899 mln for COVID-19 booster shots", accessed on 2 November 2021, available at https://www.reuters.com/world/asia-pacific/philippines-earmarks-899-mln-covid-19-booster-shots-2021-08-19/

Success

- The Philippines prioritized vaccinating the National Capital Region to boost the economy
- The National Capital Region has more than 75%[43] of its population fully vaccinated compared to other regions where vaccination averages between 25% to 30%
- Targeted vaccination allowed the National Capital Region to reopen and have workers return to the city
- Government is planning on implementing a series of mandates that would allow tight government intervention regarding mandatory vaccination, which will be in effect in 2022

"In the National Capital Region around 3.5 million were unemployed in a span of two weeks' time, then vaccination came in for front liners and the industrial sector, increasing employability and employment"
– Public Health Expert, Asian Development Bank

Challenges

- The Philippines faces a difficult challenge tackling vaccine hesitancy as an average of 30% of the population do not wish to obtain the vaccine, especially among the elderly
- For instance, only 55% of the estimated 8.3 million senior citizens have been fully vaccinated although they were given priority in the COVID-19 vaccination program[44]
- Another challenge for the Philippine government is the distribution of vaccines around the nation regions such as Mindanao due to logistical issues regarding distribution and storage of vaccines[45]

"The knowledge of vaccine and benefits is still very low especially since it's not mandatory, they only "People do not believe in the vaccine, they don't trust the government, do not like the vaccine from China, believe in conspiracy theories or are hardcore antivaxxers"
– Professor, Ateneo Centre for Research and Innovation

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[43] Philippine Information Agency, (2021), "PH records new milestones: 21 M Filipinos now fully vaccinated…" accessed on 2 November 2021, available at https://piagov.wordpress.com/2021/10/06/ph-records-new-milestones-21-m-filipinos-now-fully-vaccinated-ncr-at-75-vaccination-coverage/
[44] Updates on COVID-19 Vaccines, Department of Health (2021).
[45] PhilStar, (2021), "Vaccination rate lowest in BARMM", accessed on 2 November 2021, available at https://www.philstar.com/nation/2021/07/10/2111401/vaccination-rate-lowest-barmm

Indonesia country snapshot

Patient impact

- Indonesia ranked second for number of cases avoided due to its relatively high vaccination rates for partial vaccinations (1 dose) and fully vaccinated individuals (See A17) when compared to the in-scope countries

- Similarly, Indonesia has the second highest score for healthcare costs avoided primarily due to its large population. For COVID-19 patients, treatment costs were fully covered by the national health insurance

Table A17. COVID-19 vaccination – patient impacts (Indonesia)

Category	Description	Indonesia
Patient		
Cases Avoided	The estimated impact of vaccinations on total cases avoided is directly linked to baseline vaccination numbers in each country at the moment of study	46,002,024
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	42,656,992
Hospitalized	Cases hospitalized but not in ICU	2,781,233
ICU	Cases hospitalized and in an Intensive Care Unit	98,734
Deaths	Cases that resulted in death	465,065
Healthcare costs avoided by case type ($US)	Costs by case type were collected through primary and secondary research methods and applied to the estimated cases avoided to evaluate the value of healthcare costs avoided in each country due to vaccinations. The total cost savings across the public and private healthcare sectors are summarised in in the following.	8,141,784,516
Symptomatic	Cases which are symptomatic but not hospitalised (subclinical),	7,177,618,463
Hospitalized	Cases hospitalized but not in ICU	698,471,971
ICU	Cases hospitalized and in an Intensive Care Unit	58,304,198
Deaths	Cases that resulted in death	207,389,884

Government impact

- Indonesia has a moderate score for labour productivity effect showcasing a slow start to its vaccination program and the strict public activity measures (PPKM) in larger cities. e.g. Jakarta

- Likewise, a moderate score was given for the risk premium effect because of Indonesia's vaccination outlook, to have 70% of the population to be vaccinated by March 2022, and prioritization of economic interests by avoiding lockdowns

Table A18. COVID-19 vaccination – government impact (Indonesia)

Category	Description	Indonesia
Government		
Labour productivity effects of increased vaccination (%)	Lost workdays avoided by due to increased vaccination were estimated in order to evaluate the overall labour productivity effects	0.30%
Risk premium effect due to increased vaccination (percentage-point change)	Investor risk premiums fall due to vaccinations as policymakers have touted the importance of vaccinations in moving to more normal economic conditions without a continuous cycle of imposing and removing prophylactic measures	-0.0019
Net Present Value of Welfare Gains ($USD Bn)	The net present value (NPV) of economic welfare or utility is defined as the sum of the value of leisure and household consumption	49.41

Economic impact

- Manufacturing and construction are the fastest growing industries in the near term, in part due to Indonesia's strong industrial capacity

- Government services is the slowest to recover in the long term as government resources were largely directed towards national vaccination efforts

- GDP will be the slowest to recover in the near term as a reflection of the changes in labour productivity and risk premiums

Table A19. COVID-19 vaccination – economic impact 2021 (Indonesia)

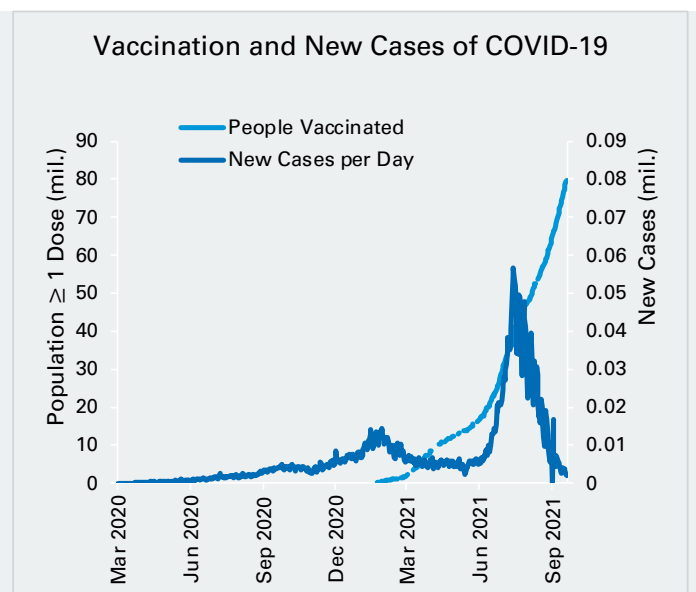| Category	Description	Indonesia	ASPAC 5	Indonesia	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
Macroeconomic Effects	We analyse the macroeconomic effects of increasing COVID-19 vaccinations. These numbers represent the impacts on consumption, expenditure, exports, GDP and tax revenue for all countries in 2021 and 2050.				
Consumption (% change)	The use of goods and services by households	0.58	0.19	1.51	1.20
Exports (% change)	Goods and services produced in the country and sold to buyers in another	0.64	1.26	0.93	1.00

Category	Description	Indonesia	ASPAC 5	Indonesia	ASPAC 5
Economy		**2021**	**2021**	**2050**	**2050**
GDP (% change)	Gross Domestic Product (GDP), total of all value added created in the economy	0.17	0.25	0.45	0.44
Tax Revenue (% change)	Revenue collected form taxes on income and profits	0.40	0.14	0.59	0.67
Industry Impacts					
Agriculture (% change)	The following data present the industry effects for the five countries and Indonesia. Due to the benefit of vaccination and lost workdays avoided, together with increase investor confidence, Agriculture, Mining, Manufacturing, Trade, Transport, Utilities, Construction, Other Services and Government Services are projected to resume normal economic conditions.	0.36	0.52	0.29	0.34
Mining (% change)		0.11	0.28	1.14	1.76
Manufacturing (% change)		0.90	1.17	0.74	0.96
Trade (% change)		0.73	0.90	1.13	1.67
Transport (% change)		0.56	0.86	0.77	1.02
Utilities (% change)		0.48	0.69	0.93	1.11
Construction (% change)		1.35	1.26	0.44	0.50
Other Services (% change)		0.61	0.89	1.78	1.80
Government Services (% change)		-5.39	-5.36	-5.24	-5.14

COVID-19 Infection & vaccination status

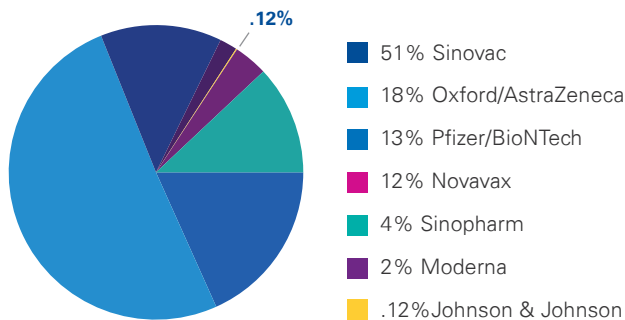**Figure A21.** COVID-19 status in Indonesia; **Figure A22**. Infection & vaccination rates in the Indonesia

4,234,011
Total COVID-19 cases

15,320
per mil. people

142,933
COVID-19 deaths

3.38%
COVID-19
death rate

22.5%
Population
fully
vaccinated

39.59%
Population
≥ 1 dose

3.2% GDP
USD33.6 bn
Healthcare

Vaccination and New Cases of COVID-19

— People Vaccinated
— New Cases per Day

Supply & distribution of vaccines

Figure A23. Market share – supply of vaccines in Indonesia (%)

- 51% Sinovac
- 18% Oxford/AstraZeneca
- 13% Pfizer/BioNTech
- 12% Novavax
- 4% Sinopharm
- 2% Moderna
- .12% Johnson & Johnson

Over 416 million COVID-19 vaccines supplied

- The largest suppliers in Indonesia are Sinovac and AstraZeneca who make up 69% of the market

- Sinovac is the only vaccine produced locally by Bio Farma

Figure A24. Market share – vaccine delivery in Indonesia (%)

- 80.7% Sinovac
- 9.2% Oxford/AstraZeneca
- 3.3% Pfizer/BioNTech
- 3.2% Moderna
- 3% Sinopharm
- .2% Johnson & Johnson
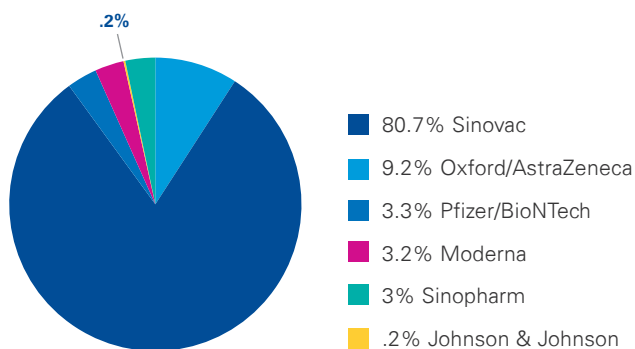
Total of 247 million COVID-19 delivered

- As of October 17, more than half (59.4%) of the vaccine supply, 247 million doses, has been administered to the public

- Sinovac is the largest vaccine contributor, followed by AstraZeneca, delivering 80.7% and 9.2% of vaccines respectively

- Indonesia's vaccines are mainly delivered through private contracts (81.49%) while donations, followed by COVAX (16.16%) and donations make up the remaining 2.35%

Figure A25. Vaccination sites in Indonesia (%)
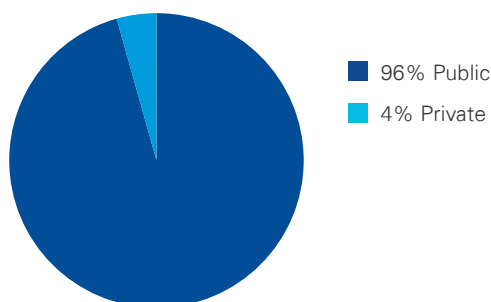
- 96% Public
- 4% Private

Points of vaccination

- Majority (96%) of vaccines are administered at public vaccination sites e.g. hospitals, and Puskesmas (community health centres)

- The private vaccination centres are for the Gotong Royong program. Employers can purchase Sinopharm vaccine doses for their employees and accelerate vaccination

  - Price per shot is around USD 35 and is sold by KADIN

Indonesia's vaccination strategy

Table A20. Indonesia's vaccination timeline

Date	
Jan 11, 2021	Sinovac was granted Emergency Use Authorisation
Jan 13, 2021	Vaccination program started, focused on frontline workers and medical professionals
Feb 17, 2021	Second phase of vaccination program starts, public servants and members of the public workforce became eligible for vaccination
Feb 22, 2021	AstraZeneca was granted Emergency Use Authorisation
Apr 30, 2021	Sinopharm was granted Emergency Use Authorisation
May 17, 2021.	Gotong Royong scheme was approved and started allowing private companies to vaccinate their works. More than 22,700 employers registered
May 28, 2021	Third vaccination phase started, adults living in the high-risk zones (those with the high risk of virus transmission) became eligible for vaccination
Jul 2, 2021	Moderna was granted Emergency Use Authorisation
Target by March 2021	Indonesia aims to vaccinate 208 Mn people

Funding for COVID-19 vaccines

- Indonesian government allocated USD 2.8 billion to the development and procurement of COVID-19 vaccines for 2021[46]

- For 2022, Indonesia allocated approximately USD 17.8 billion for healthcare expenditure including testing, tracing, and treatments for COVID-19[47]

- Approximately 40% of healthcare spending goes towards vaccination, screening, medications and salaries

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[46]Jakarta Globe, (2021), "Indonesia allocates $2.8b for Covid -19 vaccine", accessed on 2 November 2021, available at https://jakartaglobe.id/news/indonesia-allocates-28b-for-covid19-vaccine
[47]Reuters, (2021), "Indonesia proposes $188 bln 2022 budget with shrinking fiscal deficit", accessed on 2 November 2021, available at https://www.reuters.com/article/indonesia-politics-economy-budget-idUSL4N2PK194

Success

- Indonesia leveraged their domestic pharmaceutical company Bio Farma to produce COVID-19 vaccinations for the country; they are currently the largest producers in Indonesia
- Indonesian government used national influencers to raise awareness on vaccination benefits as a strategy to tackle vaccine hesitancy
- Influencers were given priority in vaccination along with healthcare workers in efforts to influence the younger population to obtain the vaccine[48]

"Influencers played a large role, first president played a role, then the other national influencers were brought in as government tried to push a social media strategy"
– Economist, Prospera

Challenges

- Vaccination hesitancy is high in Indonesia as individuals have negative sentiments towards vaccines due to political beliefs
- South Sumatra and Papua are two of the regions where vaccination rates are the lowest and vaccine hesitancy predominates
- Furthermore, based on their income bracket individuals have a preference for vaccine brands - higher income groups favor western vaccines and lower income brackets favor Sinovac

"The knowledge of vaccine and benefits is still very low especially since it's not mandatory, they only know the importance for babies, but adults don't understand they also need vaccination"
– Director, Ministry of Health

* Data for country snapshots collected up until October 2021

[48]Reuters, (2021), "Instagram influencers are a vaccine priority in wary Indonesia", accessed on 2 November 2021, available at https://www.reuters.com/business/media-telecom/instagram-influencers-are-vaccine-priority-wary-indonesia-2021-01-14/

Definitions

SN	Term	Definition	Source
1	Productivity loss	Combination of absenteeism and presenteeism. Absenteeism refers to productivity losses from time off required due to an illness or treatment while presenteeism refers to productivity losses at work due to an illness or treatment	Yuasa, A. et al (2021), 'Productivity loss/gain in cost-effectiveness analyses for vaccines: a systematic review', Expert Review of Pharmacoeconomics & Outcomes Research 21(2).
2	Disability-adjusted life year (DALY)	DALYs are the sum of the years of life lost to due to premature mortality (YLLs) and the years lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population	WHO, 2021

Appendix A – Impact calculations

The analysis presented in this paper is based on the data and research on Coronavirus Pandemic (COVID-19) from Our World in Data. The available COVID-19 dataset is a collection of daily data on key COVID-19 indicators like case numbers, tests, deaths and vaccinations compiled from various global and country-specific health organisations and other government sources. The dataset on key indicators is available for roughly 200 countries, but more detailed data like hospitalisation and ICU admission numbers are only available for a small group of countries.

The analysis uses data for the five countries of interest, where available. The data for assessing the impact of COVID-19 vaccinations has been calibrated in the following way:

- For each country, we use daily data for each variable and aggregate it by month for the months of January through September 2021. All impacts are estimated for these nine months and reported as a 2021 aggregate number across the months.

- We use data on new cases, new deaths and new full vaccinations for the five countries. This captures the incremental changes in each of these variables and enables us to assess the incremental impact of one extra vaccination in the economy.

- Data on hospital and ICU admissions is only available for 27 (mostly developed) countries, which does not include any of the five countries of interest. We use the data for these 27 countries[49] to calculate average non-hospitalisation, hospitalisation, ICU and death rates. We then apply these rates to the total number of cases avoided to get a breakdown of COVID-19 cases avoided by type for each country.

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[49] Belgium, Croatia, Cyprus, Czechia, Denmark, Estonia, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Latvia, Liechtenstein, Luxembourg Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Switzerland, United Kingdom, United States.

Healthcare costs avoided

To estimate the total healthcare costs avoided in each of the five countries due to vaccinations, the starting point was to collect treatment costs per case of COVID-19 by type. The treatment costs (for non-hospitalised, hospitalised and ICU cases) in public and private healthcare were collated partly from the information collected in interviews with health experts and partly from research studies on COVID-19 costs in the five countries. A cost figure is also assigned to death due to COVID-19, which only represents the cost of dying in a hospital (which are typically higher than the cost of dying at home). As such, we assume that all COVID-19 deaths occur in a hospital ICU and use a death cost to ICU cost ratio from a study on the pandemic influenza[50]. Lastly, using shares of public and private healthcare expenditure for each country, we produce Table 8 which shows the costs for each type of COVID-19 case in the public and private healthcare system for each country. All costs are converted to US dollars (USD) using an average 2020 exchange rate.

Table 8. Healthcare costs of COVID-19, USD

	India	Indonesia	South Korea	The Philippines	Vietnam
Public healthcare					
Non-hospitalised	**5**	**23**	441	21	83
Hospitalisation	**10**	**106**	2,030	1,716	826
ICU	33	445	8,690	1,792	3,537
Death	22	301	5,868	1,210	2,388
Private healthcare					
Non-hospitalised	24	145	356	38	244
Hospitalisation	58	239	1,641	3,141	1,123
ICU	110	**2,906**	7,024	3,240	4,805
Death	74	**1,962**	4,743	2,188	3,245

The cost estimates have been sense checked to ensure they are representative of each country's healthcare expenditure. These costs were then applied to the cases avoided by type to estimate the total health expenditure avoided due to increased vaccinations in each of the five countries.

Lost workdays avoided

In this analysis, we consider workdays being lost via two mechanisms – workers themselves falling sick or taking time off work to stay at home and look after sick children. Note that our workday losses assume neither prophylactic absenteeism nor lower productivity by workers who may not present to the health system but who will be less productive than would otherwise be the case, both of which would increase the workday losses.

Due to the lack of any studies undertaken specific to COVID-19, we again use the pandemic influenza paper by Verikios et al (2016) to assign the following number of lost workdays to each working-age person falling sick due to COVID-19:

- each non-hospitalised case (subclinical or treated at home) misses 1.5 workdays;
- each hospital and ICU case misses 13.9 workdays.

For workers who have to take time off to take care for sick children, lost parent workdays are calculated as a proportion (75 per cent) of workdays lost due to workers falling ill. The table below shows the total workdays lost (from both effects) for each type of COVID-19 case.

This calculation on total lost workdays is then applied to cases avoided in each country and summed up across case types to get the total lost workdays avoided. The total number of lost workdays avoided in each country is then adjusted by the employment-to-population ratio for each country to account for differences in country unemployment rates.

Next, we compare our estimate of each country's adjusted total lost workdays avoided to an estimate of each country's business-as-usual total number of annual workdays (based on each country's total labour force in 2020). This way we calculate the temporary proportional reduction in labour productivity (output per worker) avoided due to vaccinations; this proportional increase is then applied to the model.

	Total lost workdays
Each non-hospitalised case	**2.5**
Each hospital and ICU case	**24.3**

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[50] Assessing Regional Risks from Pandemic Influenza: A Scenario Analysis, 2016, G Verikios et al

Appendix B – The KPMG-Global model

KPMG-Global model is a dynamic computable general equilibrium model representing the regional and global economies. We apply KPMG-Global in this work to estimate the economywide effects of vaccination for the five countries of interest. Below we describe key features of the model.

Production technology

The model distinguishes representative multinational firms and hence production by location and owner. Each representative firm is assumed to treat the factors of production (land, labour and physical capital) and intermediate inputs (of which there are nine) as variable and take factor prices as given in minimising costs. Demands for primary factors and intermediate inputs are modelled using nested production functions. At the top level, a firm's activity is determined as a CES combination of the primary factor composite (an aggregate of land, labour and capital) and the nine composite intermediate inputs using CES production technology.

At the second level, firms combine the three factors of production using CES production technology. At level three, firms determine composite intermediate inputs by combining domestic and imported intermediate inputs using CES production technology. All firms are assumed to operate in perfectly competitive markets and so a zero-pure-profits condition is imposed that equates revenues with costs.

Market clearing

The supply price for an industry is linked to the market price inclusive of an output tax. The market price is determined via a market-clearing condition where the aggregate of domestic sales (to firms, capital creators, households and government) and export sales to each destination equals total output. Total domestic sales by domestic firms and multinationals are combined to form a CES composite. Total imports of the nine commodities in each region is a CES composite of exports from all export sources.

Investment and capital accumulation

It is assumed there is a single capital good used by all firms in each industry. Investment by the industry is determined as a positive function of the post-income-tax, net-of-depreciation rate of return on industry capital. During a simulation the rate of return fluctuates in the short run. However, it returns to its initial value in the long run by making investment in year t a positive function of the rate of return in year t. Inputs to investment are a CES composite of imported and domestic inputs to investment. Capital creators are assumed to operate in perfectly competitive markets; hence a zero-pure-profits condition is imposed equating revenues with costs.

All firms in an industry use capital specific to their industry. An industry's capital stock for use in year t equals its capital at the start of year t-1 less any capital depreciation during year t-1 plus investment during year t-1. For each type of capital, there is an industry-specific rental rate determined by a market-clearing condition. Given industry capital stocks, the movement of capital between owners (foreign and domestic) in each industry is determined by a CET function.

We define a market-clearing condition for capital that sets a common rental price of capital for all owners of capital in an industry. Thus, any change that lowers the price of capital for any supplier of capital in a given industry will reduce the price of capital for all owners of capital in that industry. Consistent with this treatment of rental prices by industry, in the initial data we set net

rates of return to capital equal across all suppliers of capital to a regional industry. Thus, rates of return vary across industries within a region, but do not vary across owners of capital within the same industry in a region.

Household and government consumption

The consumer's utility function in each region is a CES combination of leisure (L) and consumption (C). The consumer's budget constraint requires that the post-tax value of the labour endowment (W.H) plus post-tax value of non-labour income (NLY) should equal expenditure on consumption (P.C) and leisure (W.L). Here leisure is valued at the post-tax wage rate (W) and consumption at the post-tax price of consumption (P). Thus, full income is defined as Y = W.H + NLY = P.C + W.L. The time endowment is E = H + L where H is the labour endowment. E is set arbitrarily to 1 and the value of L is set so that labour supply elasticities approximately match those in the literature.

Aggregate consumption in each region is a CDE (constant-difference-elasticity) combination of the six composite commodities. The allocation of aggregate consumption across commodities applies the CDE functional form (Hanoch, 1975) which specifies non-homothetic preferences. Composite consumption commodities are a CES combination of domestic and imported commodities. Real government consumption is assumed exogenous.

The current account to GDP ratios diverge from zero for all regions in the initial database. These ratios are slowly moved towards balance over the simulation horizon. This is achieved by allowing the saving rate to adjust. This condition determines the value of consumption in every period.

Foreign assets and liabilities

Wealth in each region consists of two assets: physical capital (direct investment) and financial capital (portfolio investment). Physical capital (K) is defined by industry, location, and owner. Foreign capital assets by regional owner are the sum of capital assets owned in all foreign locations. Foreign capital liabilities in a region are the sum of all capital owned by foreigners in the region. Each region also holds a debt instrument representing a composite of net financial assets held by each region.

For each region debt fluctuates to enforce the budget constraint on net foreign liabilities. Debt is allocated across regions by movements in the global interest rate, which is indexed to the net

rate of return on capital. Note also that there is only a single interest rate as we assume perfect international arbitrage in financial assets. Thus, at the global level investors will equalise the rate of return on capital and portfolio investment ensuring the efficient allocation of global saving.

GDP from the supply side is defined as the sum of labour income, capital income and indirect tax receipts. GDP from the demand side equals the sum of consumption, investment, government expenditure and net exports. Regional income is then defined as GDP plus capital income on FDI received by the region minus capital income paid on FDI in the region plus net interest receipts on debt held by the region.

Calibration and baseline

The initial equilibrium is calibrated on version 9 of the GTAP database representing the world economy in 2011 (Aguiar et al., 2016). The data are aggregated to represent the five countries of interest, the USA and a composite region representing the rest of the world. The activities of foreign-owned firms are determined by applying data on foreign affiliate sales from Lakatos and Fukui (2012). We assume a common rate of return for all firms in a given industry to reflect a long run equilibrium. Returns to foreign-owned firms represent part of net foreign income in each region. Net interest receipts on debt are calibrated so that the capital account balance matches observed values based on IMF data for 2020. Net debt for each region is then calculated for consistency with net interest income and the interest rate. The interest rate is set equal to the rate of return on capital.

The baseline path of the model begins from an initial equilibrium that evolves towards a balanced growth path. For high-income countries, the baseline is designed to move the economy from an initial steady-state to a new steady-state via a balanced growth path where all quantities eventually grow by between 2.8% and 3.3% per annum. Other countries are assumed to have not yet reached a steady-state, and so the baseline is designed to move the economy from an initial non-steady state towards a new steady-state via a balanced growth path where all quantities eventually grow by between 3% and 4%. Global consumer prices grow by 3.5% per annum (the recent average growth rate). Population and labour supply grow by 1% per annum and labour productivity by 2% per annum in all countries. Thus, divergences in the growth path across countries reflect initial differences in their investment-capital ratios.

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