REGIONAL ECONOMIC OUTLOOK

ASIA AND PACIFIC

ASIA AND PACIFIC DEPARTMENT

# Leveraging Opportunities from COVID-19 Vaccines

## Early Lessons from Asia

NOVEMBER 10, 2021

IMF REGIONAL OFFICE FOR ASIA AND THE PACIFIC

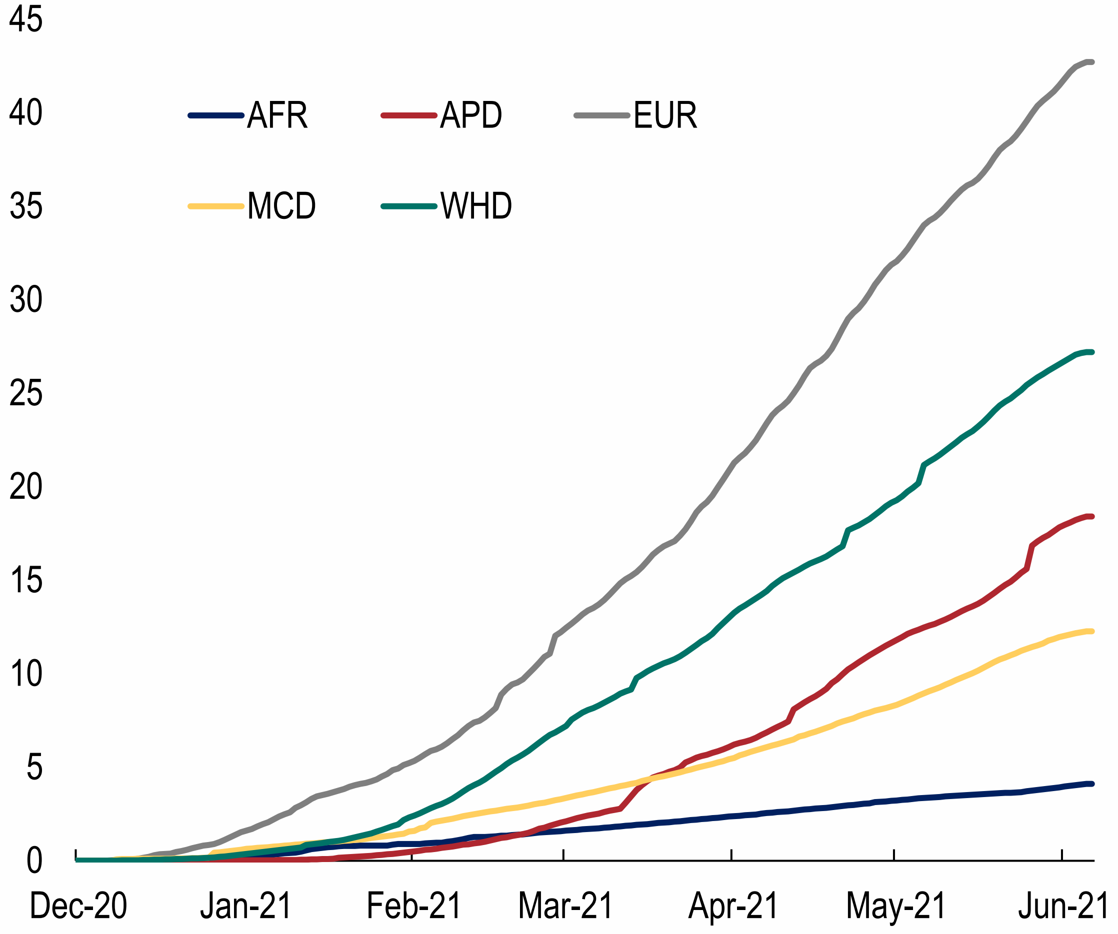
Pragyan Deb, Michael Ganslmeier, Daniel Jimenez, Siddharth Kothari, Nour Tawk, and Irina Yakadina

# Outline

- Vaccine deployment in Asia
- Determinants of vaccine rollout
- Effect of COVID-19 vaccines on health and economic outcomes
- Role of country characteristics:
  - Containment measures
  - State of the pandemic
- Spillovers from COVID-19 cases and vaccines

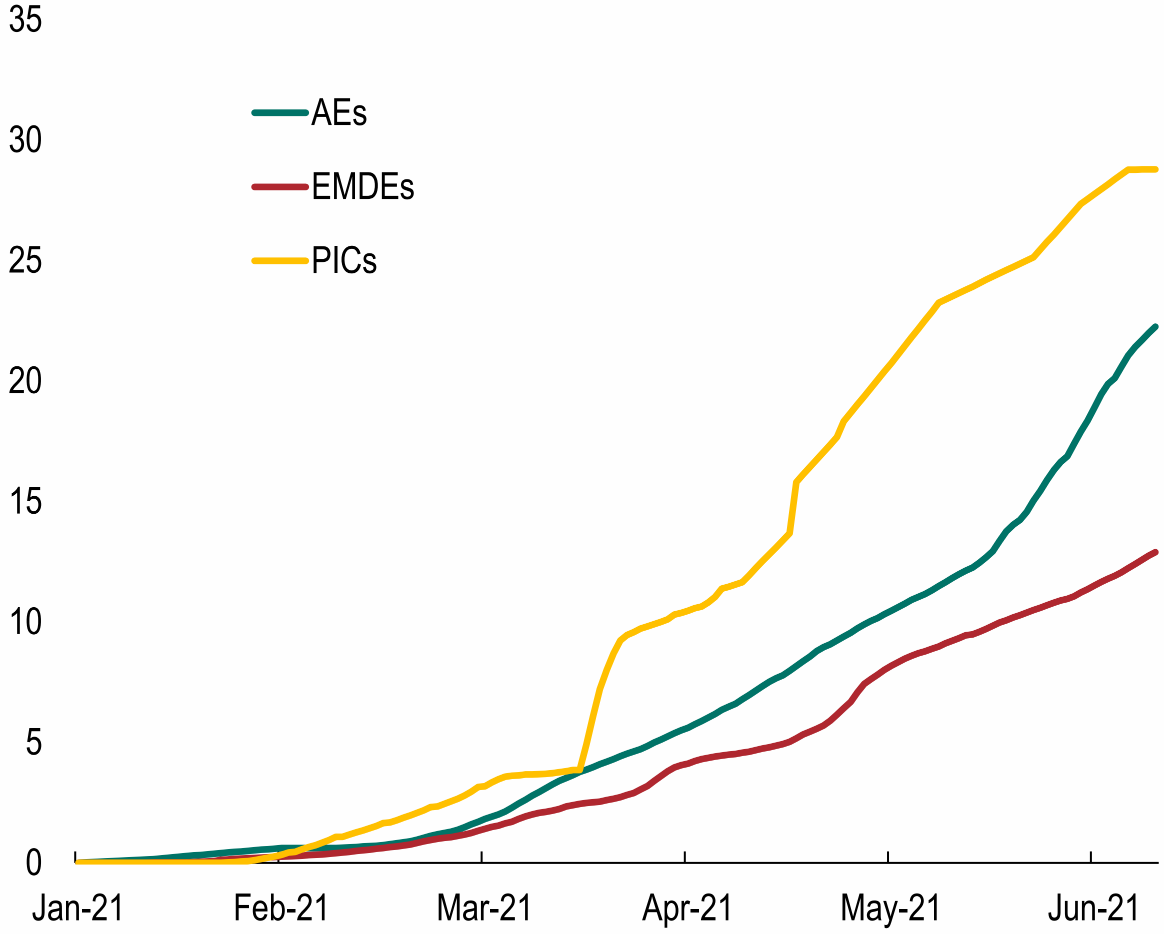
# Vaccine deployment in Asia

**Vaccinations across regions**
(per 100 population, simple average)




Source: Our World in Data. Note: the figure shows vaccines administered per region as a simple average, per 100 population.

**Vaccines administered in Asia**
(per 100 population, simple average)




Source: Our World in Data. Note: the figure shows the share of the population which has received at least one vaccine dose for each income group.

# Data sources for analysis

- We assemble of a comprehensive country-level database for empirical analysis
- Daily vaccination, health and containment data
  - COVID-19 cases, ICU admissions, and deaths
  - Vaccinations administered and procured
  - Government responses to the pandemic
- High frequency economic indicators ($NO_2$ emissions)
- COVID variants, vaccine source (domestic production), vaccine acceptance amongst the public, health infrastructure and geographic and economic proximity

# Determinants of vaccine rollout

# Methodology

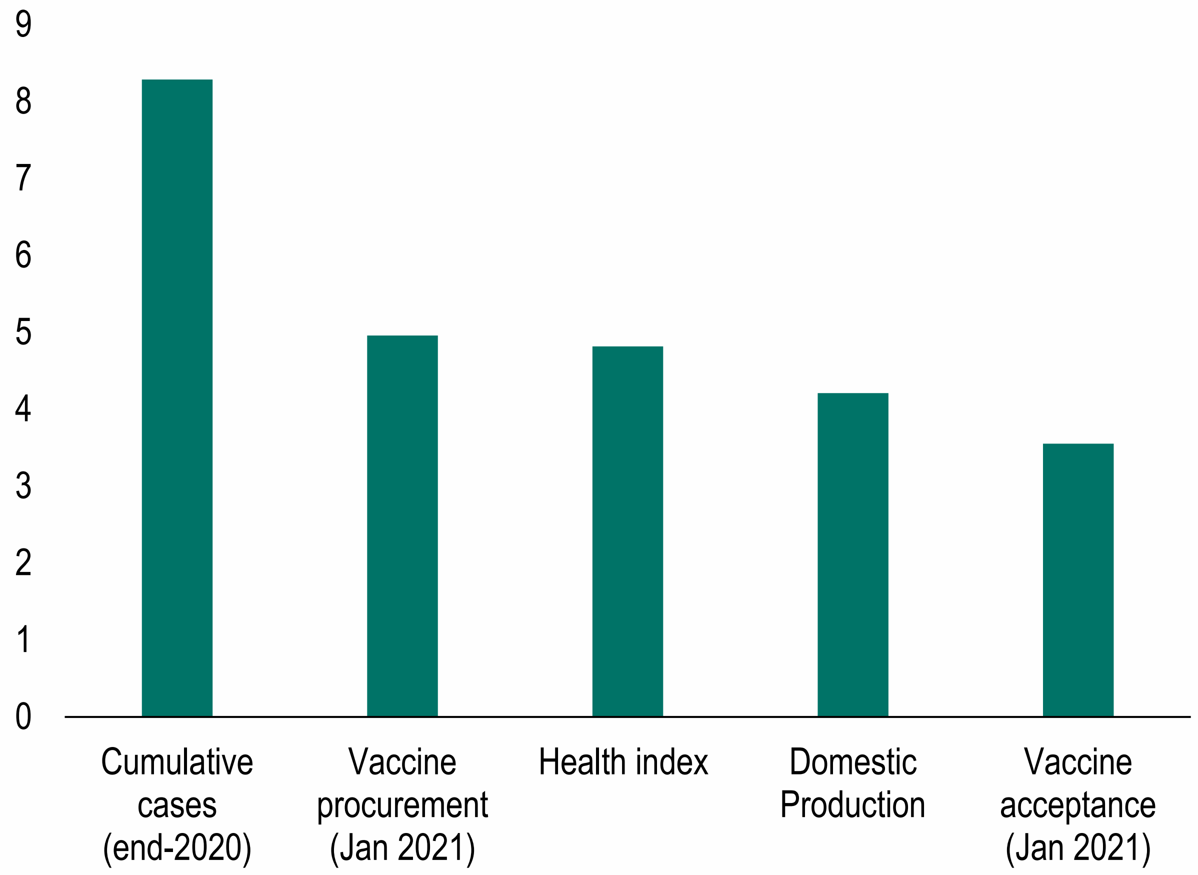
- Exploit cross sectional variation in vaccination rollout across countries to assess the role of demand and supply side factors
- Explore role of time invariant factors and past developments
  - Supply side factors: early procurement of vaccines; domestic production; health infrastructure.
  - Demand side factors: scale of the pandemic before the vaccination rollout; vaccine acceptance by population.
- Univariate regressions to identify significant factors
- Multivariate regressions to estimate relative importance

$$V_i = \alpha + \beta Proc_i + \gamma Health_i + \delta Cases_i + \theta Accept_i + \varepsilon_{i,t} \qquad (1)$$

- OLS with robust standard errors to account for heteroskedasticity.

# Factors affecting vaccination rollout

**Factors affecting vaccine rollouts**
(vaccinations per 100 population, impact of 1 standard deviation change in factor)



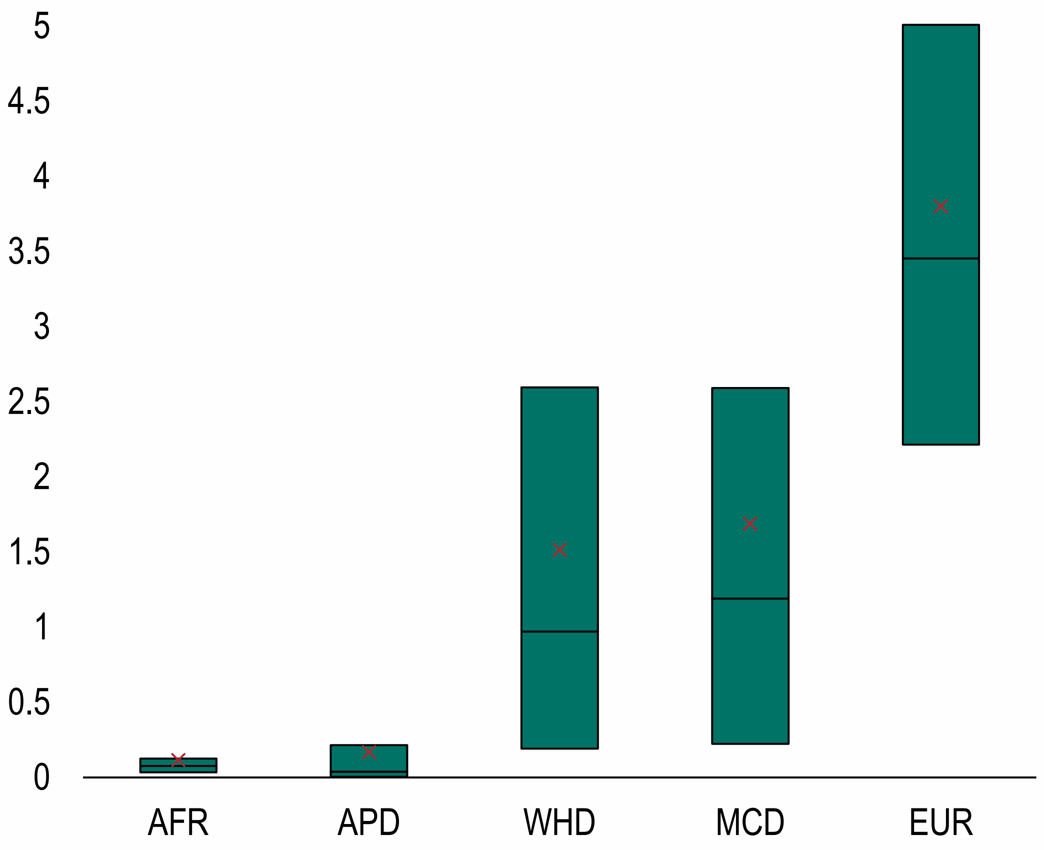

Note: The figure reports the impact of one standard deviation change in different factors on the share of population that is vaccinated with at least one dose based on estimates using equation (1).

**Results robust to alternate specifications and data**

- Alternate measures of COVID-19 impact—latest caseload (as of June 20, 2021), average number of daily confirmed cases in 2020, size of peak daily cases in 2020 and measures based on deaths
- Alternate measures of procurement (confirmed orders vs potential orders)
- Procurement at different times (October 2020, latest available data) and different data sources (Airfinity vs Duke)
- Alternative measures of health infrastructure (GHS Index, doctors per capita or hospital beds per capita)
- Alternative measures of pace of rollout—average number of daily vaccinations

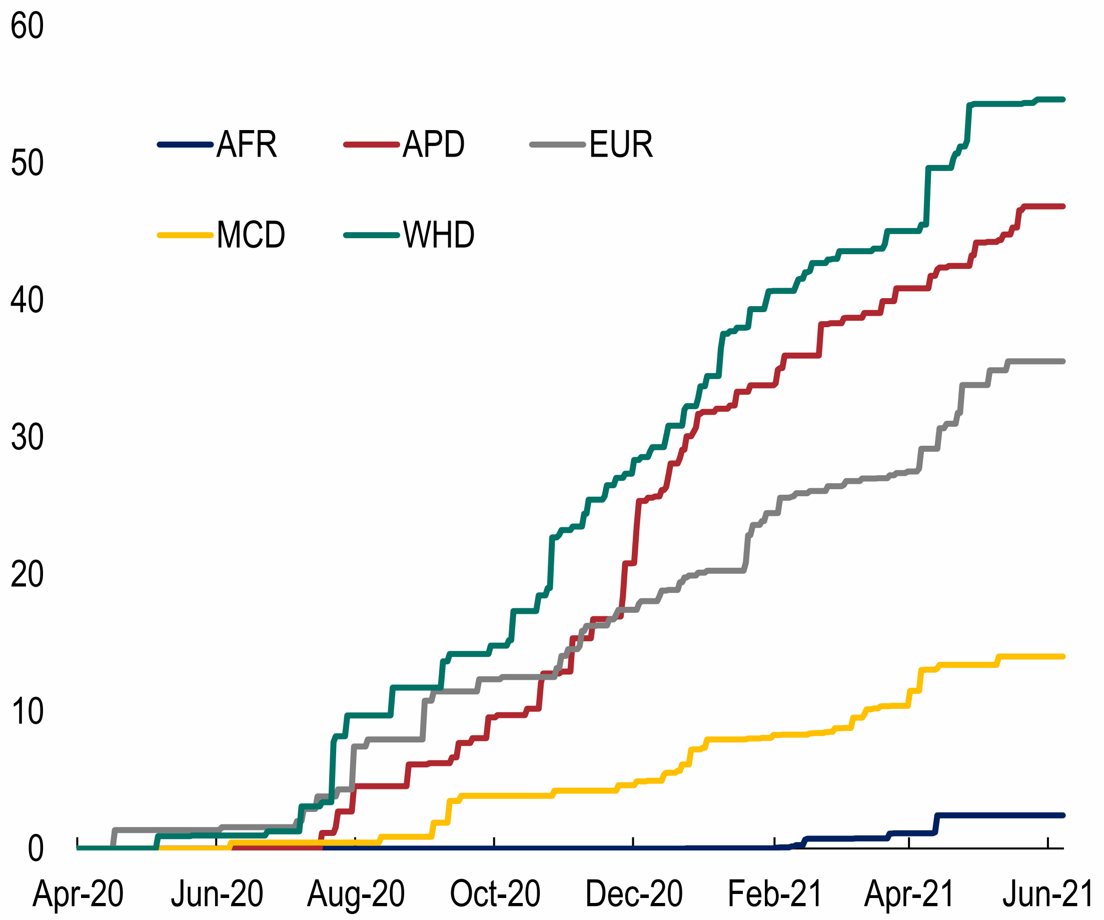
# Implications for Asia – demand and supply side

**Cumulative COVID-19 cases by end-2020**
(per 100 population, simple average)




Source: Johns Hopkins University. Note: the chart shows the cumulative number of COVID-19 cases per region at the end of 2020. The horizontal line inside each box represents the median; the upper and lower edges of each box show the top and bottom quartiles, respectively; and the top and bottom markers denote the maximum and the minimum, respectively. x is the mean.

**Vaccine procurement per region**
(per 100 population, simple average)




Source: Duke University Health Innovation Center. Note: the figure shows the confirmed vaccine orders, potential procurement deals and donations per region, per 100 population.

# Effect of COVID-19 vaccines on health and economic outcomes

# Methodology

- High frequency identification of the impact of vaccinations using a country-time panel dataset at the daily frequency
- Mitigate reverse causality using lags and controlling for country fixed effects which controls for structural factors (such as health capacity)
- Account for expectations about the country-specific evolution of the pandemic by controlling for variables which may affect future infections such as mobility, non-pharmaceutical interventions (NPIs)
- Time fixed effects to account for global factors affecting the evolution of the virus (such as new variants) and vaccination (supply disruptions).

$$\Delta C_{i,t} = \mu_i + \gamma_t + \beta V_{i,t-l} + \partial X_{i,t-l} + \varepsilon_{i,t} \qquad (2)$$

- Panel regression with standard errors clustered at country level.

# Methodology

- We explore whether impact of vaccines depends on factors such as the stringency of containment measures, the severity of the outbreak itself, the variant of COVID-19 in circulation, or the type of vaccine used.
- Simple interactions

$$\Delta C_{i,t} = \mu_i + \gamma_t + \beta V_{i,t-l} + \vartheta I_{i,t-l} * V_{i,t-l} + \partial X_{i,t-l} + \varepsilon_{i,t} \qquad (3)$$

- Smooth transition

$$\Delta C_{i,t} = \mu_i + \gamma_t + \theta^L F(z_{i,t}) * V_{i,t-l} + \theta^H (1 - F(z_{i,t})) * V_{i,t-l} + \partial X_{i,t-l} + \varepsilon_{i,t}$$
$$\text{with } F(z_{it}) = exp^{-\gamma z_{it}} / (1 + exp^{-z_{it}}) \qquad (4)$$

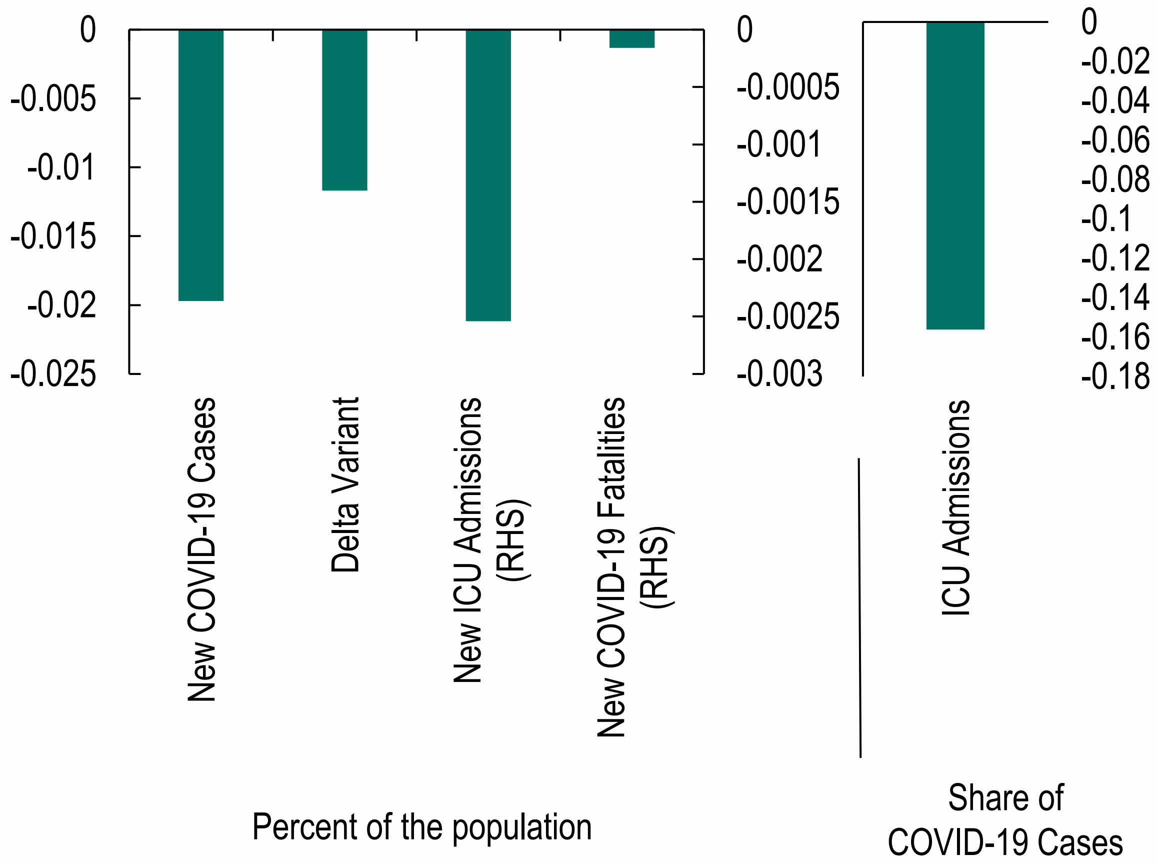
- Semi-parametric approach

$$\Delta C_{i,t} = \mu_i + \gamma_t + \beta_1 Q_1 * V_{i,t-l} + \beta_2 Q_2 * V_{i,t-l} + \beta_3 Q_3 * V_{i,t-l} + \beta_4 Q_4 * V_{i,t-l} + \sum_{j=1}^{4} \varphi_j Q_j + \partial X_{i,t-l} + \varepsilon_{i,t} \qquad (5)$$

# Effect of vaccines on health outcomes

## Effect of COVID-19 vaccines on health outcomes

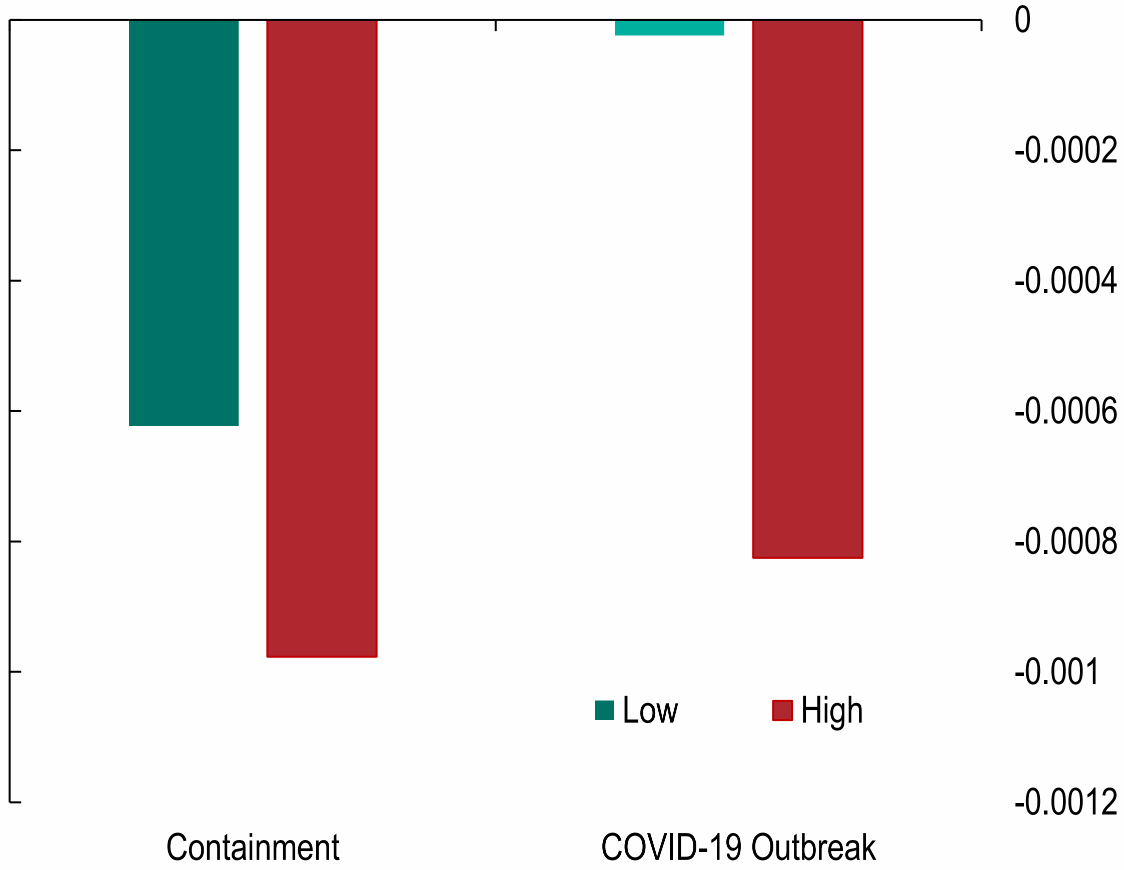
*(Percent of the population)*




Source: Deb et al. (2021a).
Note: The chart shows the daily effect of a 20 ppt increase in the administration of a first COVID-19 dose per capita on health outcomes per capita 21 days following their administration.

## Role of country's initial conditions on health outcomes

*(Cases as percent of the population)*




Source: Deb et al. (2021a).
Note: The red (green) bars show the impact of vaccines after 21 days on new COVID-19 cases when containment measures or the severity of the outbreak are (high) low.

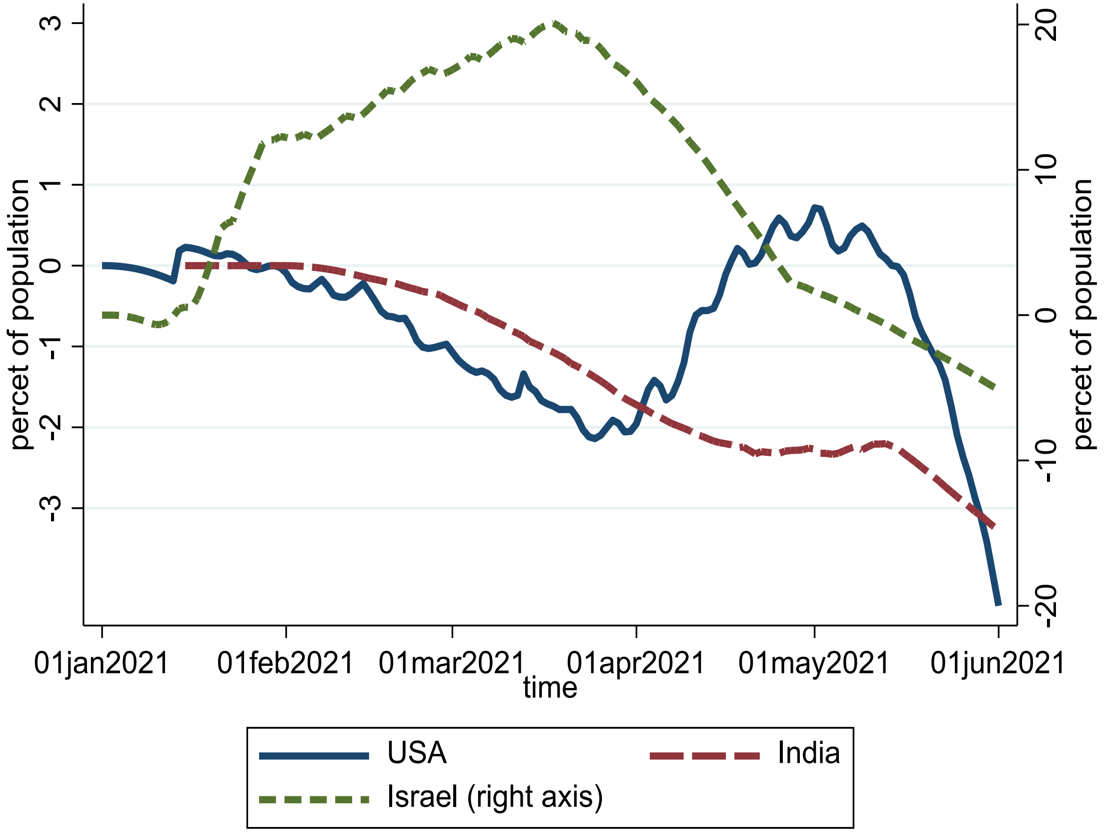
# Capturing surprise in vaccinations to address endogeneity

Measure of vaccine surprises – difference between actual vaccination rates and expected vaccination rates.

- Economic activity is more likely to increases following surprises in vaccination rates rather than to actual expected vaccination (Ramey 2011 for a similar argument, related to fiscal policy)
- Surprises in vaccination less likely to be endogenous to economic developments and COVID-19 trends allowing for better causal identification.

**Vaccine surprises, people fully vaccinated**

(percent of population)

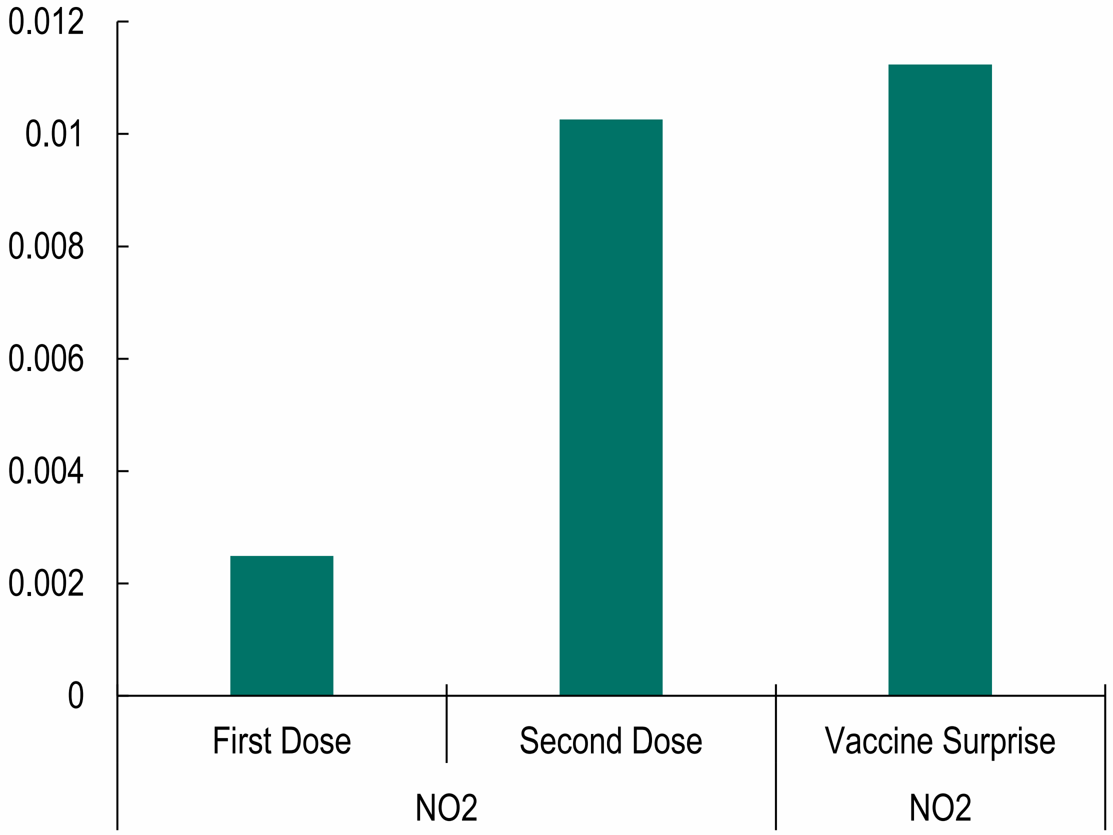



Source: Airfinity, Our World in Data, IMF staff calculations

# Effect of vaccines on economic outcomes

## Effect of COVID-19 vaccines on economic indicators

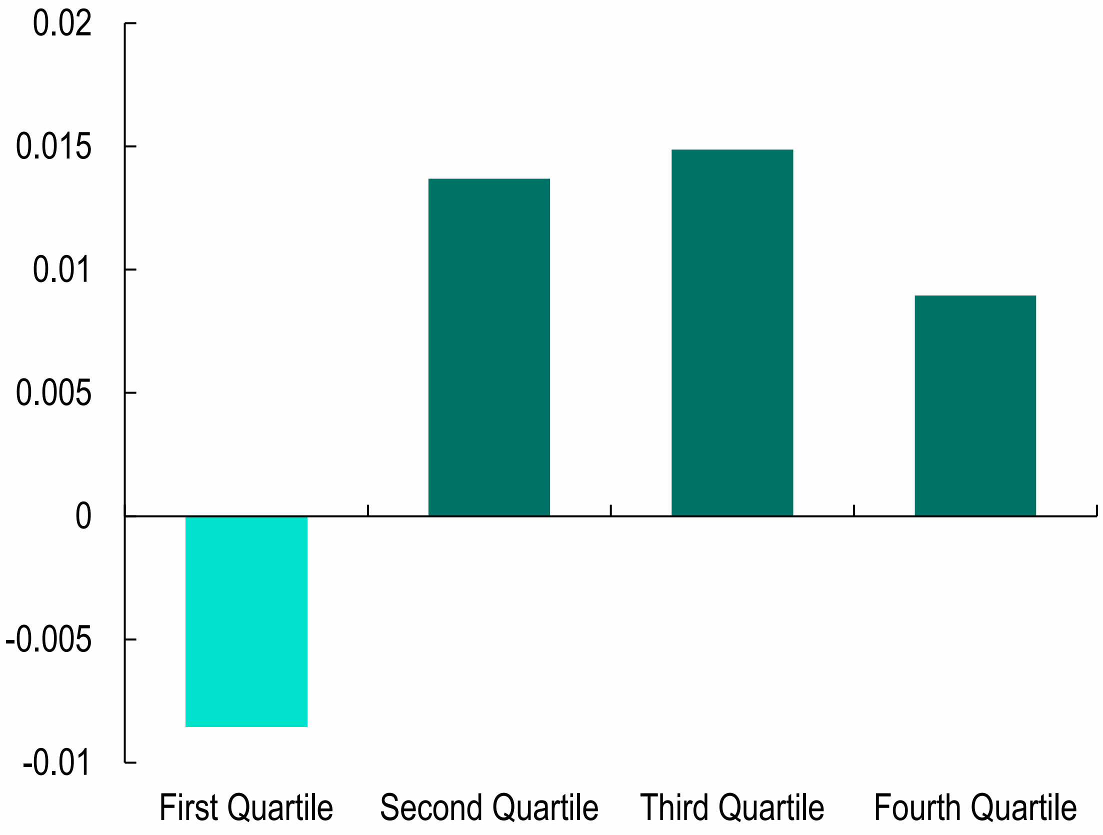
*(Emissions as percent of population)*




Source: Deb et al. (2021b).
Note: The bar shows the impact after 1 day of vaccine first and second dose per capita and vaccine surprise per capita on NO2 emissions. Vaccine surprises are defined as the difference between the expected vaccine administrations and the actual full doses administered.

## Effect of COVID-19 vaccines on Nitrogen Dioxide (NO2) emissions

*(Emissions as percent of population)*




Source: Deb et al. (2021b).
Note: The bar charts denote the impact after 1 day of vaccine surprises per capita at different quartiles on NO2 emissions. The lighter shade indicates the effect is not statistically significant at the 90 percent level. Vaccine surprises are defined as the difference between the expected vaccine administrations and the actual full doses administered.

# Spillovers from COVID-19 Cases and Vaccines

# Methodology

- Test whether the pandemic outbreak in neighboring countries can affect (or worsen) a country's own COVID-19 caseload and economic outcomes

$$Neighbour_{i,t} = \sum_{j=1}^{N} w_{i,j} * Outcomes_{j,t} \qquad (6)$$

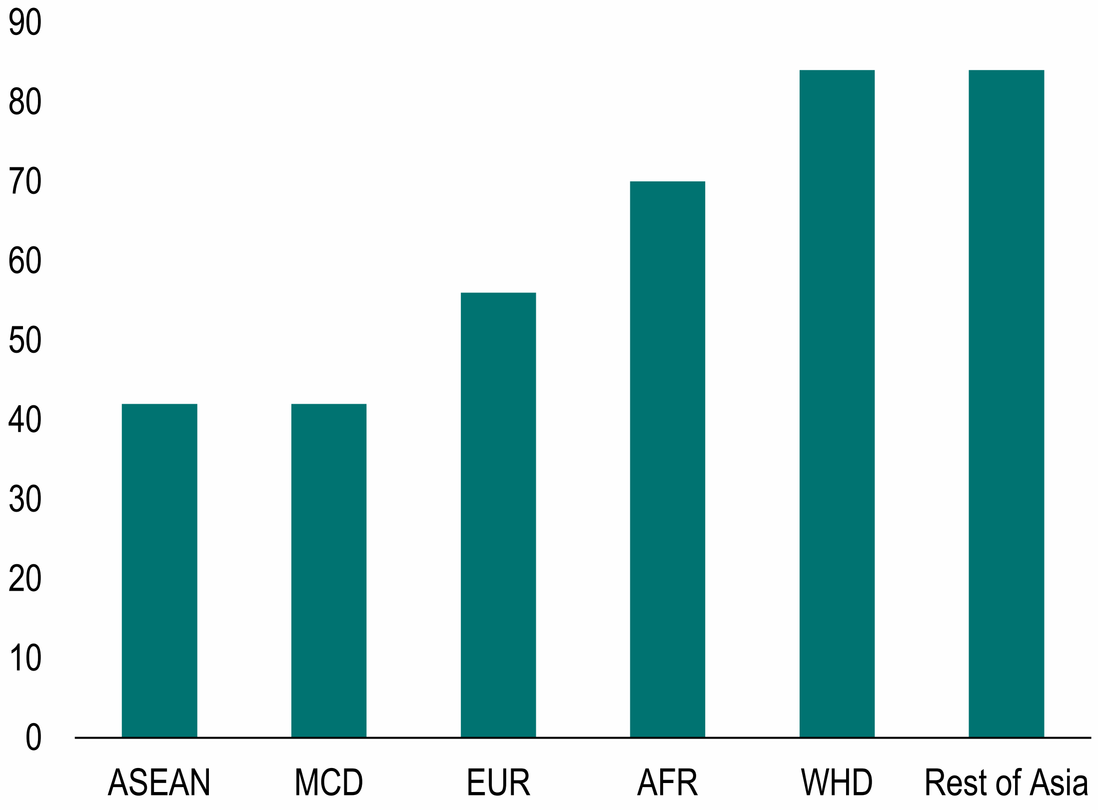
where $Neighbour_{i,t}$ alternatively denotes the COVID-19 cases or COVID-19 vaccinations in country *i's* main partners. $Outcomes_{j,t}$ refer to either country *j*'s COVID-19 cases or vaccinations as a share of population at time *t.* These outcomes are combined with $w_{i,j}$, which alternatively refer to bilateral distance or trade weights such that $\sum_{j=1}^{n-i} w_{i,j}$=1.

- This term is introduced to equation (2) and estimated using OLS, with standard errors clustered at the country level.

$$\Delta C_{i,t} = \mu_i + \gamma_t + \beta V_{i,t-l} + \gamma Neighbor_{j,t-m} + \theta X_{i,t-l} + \varepsilon_{i,t} \qquad (7)$$

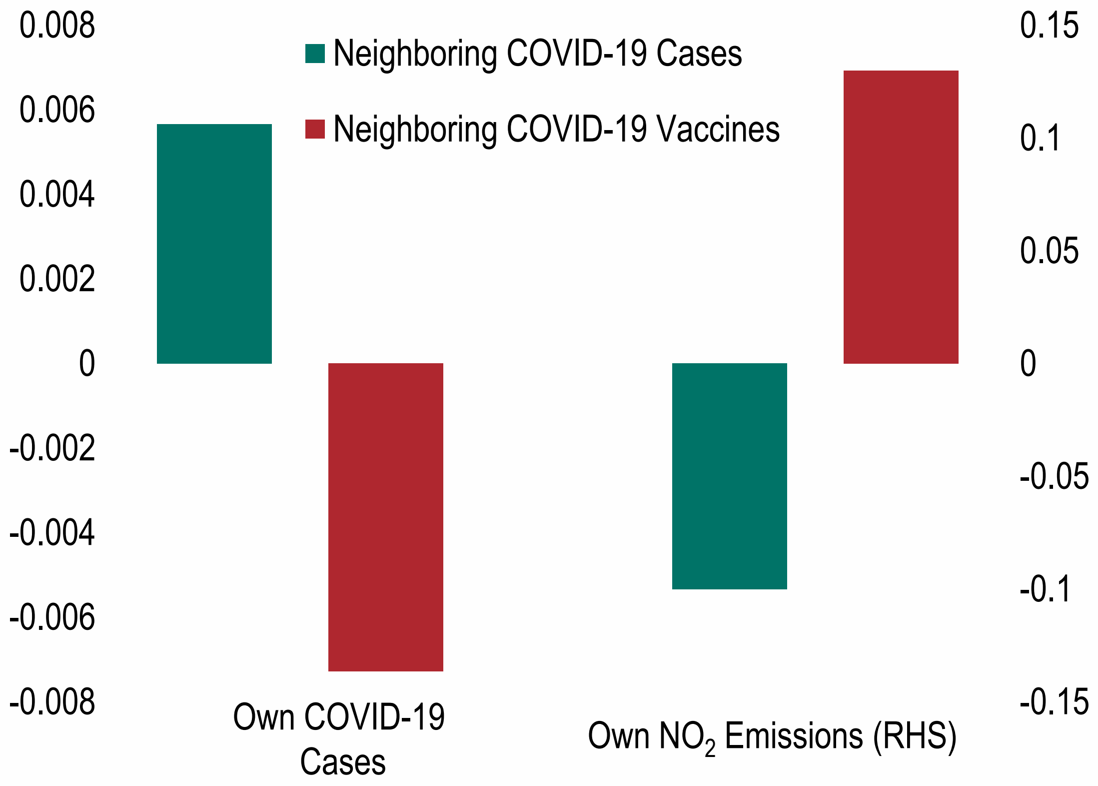
# Spillovers

**Days elapsed until Delta variant reached 50 percent of COVID-19 cases**
(number of days)




Source: GISAID, CoVariants.org. Note: the chart computes the number of days elapsed since Delta variant cases reached 50 percent of all COVID-19 cases in regions, since the date that Delta variant reached 50 percent of cases in India (April 19 2021). Rest of Asia includes Japan, Korea, China, Hong Kong SAR, Australia, New Zealand, Nepal, Bangladesh and Sri Lanka.

**Effect of neighboring COVID-19 cases and vaccines on a country's health and economic outcomes**
(% of population; emissions as % of population (RHS))




Source: The University of Maryland Social Data Science Center Global COVID-19 Trends and Impact Survey, in partnership with Facebook. Note: the chart shows the average vaccine acceptance response per region in January 2021. The horizontal line inside each box represents the median; the upper and lower edges of each box show the top and bottom quartiles, respectively; and the top and bottom markers denote the maximum and the minimum, respectively. x is the mean. The lighter shade indicates the effect is not statistically significant at the 90 percent level.

# Conclusions

- Swift and efficient vaccine deployment is crucial in reducing the spread of the coronavirus and securing a global recovery.
- The concurrent placement of social distancing measures in countries most affected by the outbreaks provides long-term economic gains.
- The bigger effect of vaccines on health outcomes can ultimately shorten the duration of the pandemic and offset short term costs of social distancing.
- The pandemic cannot be defeated without global cooperation: until all countries have effectively vaccinated and controlled the pandemic, no country is safe!

# Thank you