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 **Jabbing the Economy Back to Life?**

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**Abstract**

The pace and scope of Covid-19 vaccination has varied greatly across OECD countries. In this paper, monthly data on vaccination rates for the 32 OECD countries with all-cause mortality rates available are related to seven monthly economic activity indicators: night-time lights and *Google Mobility* reports for six types of locations. Vaccination rates are also related to Covid response stringency, to Covid cases and deaths, and to all-cause mortality. A standard deviation higher fully vaccinated rate is associated with up to an 0.5 standard deviation larger rise in economic activity over the same month in 2020; an effect due to relaxed response stringency. The partial vaccination rate has no relationship with the economic rebound. These associations with changes in economic activity occur despite no apparent relationship between vaccination rates and changes in Covid-19 cases or changes in mortality.

**Keywords**

Covid-19

Google mobility

Mortality

Night-time lights

Vaccination

**JEL Classification**

I18

O47

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*“…Imagine everyone has been inoculated against COVID-19. The pandemic that gripped the world has given way to optimism. A successful worldwide vaccination programme has paved the way for a robust global economic recovery….”*

*OECD (2021)*

**I. Introduction**

The pace and scope of Covid-19 vaccination has varied greatly across OECD countries. For example, by late July 2021, four-fifths of Iceland’s population had a dose while less than one-seventh of New Zealanders had been jabbed. Countries also varied in whether doses were spread over many partially vaccinated people or given to fewer fully vaccinated people. Thus, ranks in the vaccination stakes changed rapidly; for example, the Spearman correlation is just 0.28 for comparing March and September national rates of people having at least one dose.

This variation helps to estimate how speed and type of rollout relate to the economic rebound as OECD countries recover from Covid-induced recessions in 2020. Some variation reflects choices, such as Israel letting Pfizer have data in return for early vaccine use; without random assignment the empirical relationships are interpreted as conditional correlations. The concern that correlations reflect vaccination rates as consequences rather than causes can be mitigated by using panel data with two-way fixed effects (as in Auld and Toxvaerd, 2021) to deal with time-invariant unobserved country factors and space-invariant temporal factors. It is also true that unanticipated factors, such as manufacturing problems (e.g. Emergent Solutions in the U.S. contaminated millions of Johnson & Johnson (J&J) doses), trade disputes (e.g. between AstraZeneca (AZ) and the EU) and side-effects (e.g. Denmark and Finland stopped use of J&J due to blood clotting and Scandinavian countries restricted use of Moderna in the under-30s due to myocarditis) contribute some exogenous variation to the pace and scope of rollout, helping to lessen concerns about biases due to endogeneity.

In this paper, monthly data on Covid-19 vaccination rates for the 32 OECD countries with all-cause mortality data available are related to seven indicators of economic activity: *Google Mobility* reports for six types of locations and monthly night-time light aggregates. Vaccination rates are also related to the stringency of containment and closure responses (lockdowns), to Covid cases and death rates, and to all-cause mortality. For each indicator, the outcome studied is the change from the same month in 2020, in order to see how vaccine rollout relates to the strength of rebound from the 2020 recession.

There are several motives for providing empirical estimates rather than just relying on the assumption—as in the quotation from OECD (2021)—that vaccination paves the way to economic recovery. First, the vaccines may not work as well as advertised. When trial results were first announced, critics noted that claimed 95% relative risk reduction (RRR) ignored suspected (but untested) Covid-19 cases whose inclusion may greatly lower the RRR (Doshi, 2020). Effectiveness of a vaccine in a given setting depends on background risk; when this is low absolute risk reduction (ARR) is far smaller than RRR. The first four published Covid-19 vaccine trials had ARRs of just 0.8% to 1.3% (Olliaro et al, 2021); such small falls in risk may not generate much economic rebound. Moreover, evidence of waning immunity against Covid infection may cause governments to either not relax restrictions or to re-impose them.[[1]](#footnote-1)

Moreover, even if vaccines work and restrictions end, some people may be too fearful to return to normal. Behavioural insights helped to amplify public fear in 2020 (Dodsworth, 2021), and fear contributed to falls in economic activity (Goolsbee & Syverson, 2021). If it proves hard to unwind that fear usual economic activity may only partially resume.

**II. Data and Methods**

The sample is countries in both the OECD and the Short-term Mortality Fluctuations (STMF) database of Németh et al (2021). These countries have high Covid-19 vaccination rates and timely and reliable data. Summary statistics for the countries are in Appendix Table 1.

Vaccination data are from the *Our World in Data* (OWID) database (Mathieu et al, 2021). This updates daily from official government sources in each country, reporting the number of vaccinations administered and type of dose. The rates are expressed as a share of the total population and I use data through to the end of September 2021.

The mobility data are based on aggregated location histories from mobile devices running the *Google Maps* app. The data are in terms of percentage changes from the same day of the week in the baseline period (January 3 to February 6, 2020). The national level daily data are aggregated to monthly averages, for all six location categories: retail and recreation; groceries and pharmacies; workplaces; transit stations; parks; and, residential.

The monthly night-time lights composites are from the Visible Infrared Imaging Radiometer Suite (VIIRS), and are filtered to omit pixel-nights affected by stray light and clouds (Elvidge et al, 2017). The long summer days in northern latitudes limit the number of months with data (Gibson, 2021) and the time-series ends in July, 2021.

The OxCGRT stringency index (Hale et al, 2021), which is based on indicators of containment and closure, is obtained from the *OWID* database. Data on new Covid-19 cases and deaths per million are also from the *OWID* data. The all-cause death rates are monthly aggregates from weekly data in the STMF database of Németh et al (2021).

Changes in the monthly average for each outcome (relative to that month in 2020) are related to vaccination rates. For outcome $Y\_{it}$ in country *i* in month *t*, with vaccination rate $V\_{it},$ country fixed effects $μ\_{i},$ month fixed effects $ϑ\_{t}$, and random errors $e\_{it},$ the regression is:

$$∆Y\_{it}=β\_{1}V\_{it}+μ\_{i}+ϑ\_{t}+e\_{it}$$

Each outcome has three regressions: one using the fully vaccinated rate, one using either the fully or partly vaccinated rate, and one using both fully and partly vaccinated rates to test for coefficient equality on these two rates. Standardized variables are used for $∆Y\_{it}$ and $V\_{it}.$ These aid comparisons for outcomes measured in different units and let correlations between $∆Y\_{it}$ and $V\_{it}$ be decomposed into direct and indirect channels (Blalock, 1964).

**Results**

Patterns of vaccine rollout are shown in Figure 1. The fully vaccinated rate is regressed, each month, on severity of the pandemic (using excess mortality in 2020) and (separately) on the (unsigned) change in real GDP growth rates from 2019 to 2020 (the economic shock). A pattern evident by July 2021 is that countries with bigger economic shocks in 2020 had faster vaccine rollouts in 2021; the fully vaccinated rate is 0.4 standard deviations (SD) higher per SD of the 2020 fall in GDP. Patterns for the mortality shock are less clear. Relatedly, Auld and Toxvaerd (2021) show rollout was faster in richer, not sicker, countries. The idea that vaccine rollout relates more to economic effects than health effects also shows up below.

A SD higher fully vaccinated rate is associated with 0.46 SD lower stringency, so less lockdown (Table 1).[[2]](#footnote-2) This relationship is not seen if $V\_{it}$ does not distinguish between the fully and partially vaccinated rate $\left(\hat{β}=-0.11, p=0.32\right).$ In fact, a higher partially dosed rate is, *ceteris paribus*, associated with greater stringency $\left(H\_{0: }\hat{β}\_{fully}=\hat{β}\_{partly}, p=0.004\right).$

Mobility for retail locations and transit is about 0.5 SD higher than in the same month of 2020, per SD higher fully vaccinated rate, while the opposite pattern shows for residences $\left(\hat{β}\_{fully}=-0.47, p=0.015\right).$ These relationships are not seen if fully and partly vaccinated rates are combined. The hypothesis of both vaccination rates having equal effects on mobility $\left(H\_{0: }\hat{β}\_{fully}=\hat{β}\_{partly}\right)$ is strongly rejected. Mobility for grocery and workplaces is 0.3 SD higher per SD higher fully vaccinated rate, with no effect of the partially dosed rate.

Relationships between $V\_{it}$ and changes in monthly night lights have a similar pattern to the relationships for the changes in retail, transit and workplace mobility but estimated less precisely. The smaller available sample for night lights may account for this. For example, the hypothesis of the fully and partly vaccinated rate having equal effects on the growth in night lights $\left(H\_{0: }\hat{β}\_{fully}=\hat{β}\_{partly}\right)$ is rejected at *p*=0.12.

In contrast to apparent relationships with variables measuring economic effects, there are no significant correlations between vaccination rates (either fully or partly dosed) and the health variables: changes in new Covid-19 cases and deaths, and in all-cause mortality rates. Absence of a cross-sectional relationship between vaccination rates and new Covid-19 cases for 15 of the countries studied here plus 53 others is reported by Subramanian and Kumar (2021). The current results provide panel data evidence corroborating this lack of effect.

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| Figure 1: Standardized Regression Coefficients; Fully Vaccinated Rate with respect to (w.r.t.) Indicators of Prior Health and Economic Shocks |
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*Note:* Error bars show 95% confidence intervals corrected for multiple testing.  |

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| Table 1: Relationships between monthly indicators of Covid-19 vaccine rollout and monthly indicators of change in response stringency, economic activity, Covid‑19 cases and mortality: OECD countries  |
|  | % fully vaccinated |  | % with any vaccine dose |  | Fully dosed and partially dosed as separate covariates |
| Outcome measures | Coefficient | Within-*R*2 |  | Coefficient | Within-*R*2 |  | % fully | % partially | Within-*R*2 | F: βfull = βpartly |
|  |  |  |  |  |  |  |  |  |  |  |
| Response Stringency | -0.459\*\*\* | 0.174 |  | -0.114 | 0.007 |  | -0.315\*\* | 0.116\* | 0.208 | 9.95\*\*\* |
|  | (0.127) |  |  | (0.112) |  |  | (0.137) | (0.058) |  |  |
| *Google Mobility* |  |  |  |  |  |  |  |  |  |  |
|  Retail and recreation | 0.531\*\* | 0.104 |  | 0.112 | 0.004 |  | 0.383\*\* | -0.108 | 0.119 | 6.52\*\* |
|  | (0.197) |  |  | (0.141) |  |  | (0.179) | (0.092) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  Grocery and pharmacy | 0.290\* | 0.030 |  | 0.096 | 0.003 |  | 0.235 | -0.040 | 0.032 | 3.61\* |
|  | (0.147) |  |  | (0.132) |  |  | (0.159) | (0.060) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  Workplaces | 0.283\* | 0.034 |  | -0.090 | 0.003 |  | 0.093 | -0.139 | 0.062 | 1.86 |
|  | (0.167) |  |  | (0.141) |  |  | (0.163) | (0.087) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  Transit stations | 0.445\*\*\* | 0.109 |  | 0.139 | 0.008 |  | 0.355\*\* | -0.066 | 0.118 | 12.59\*\*\* |
|  | (0.119) |  |  | (0.142) |  |  | (0.132) | (0.080) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  Parks | 0.281 | 0.014 |  | 0.155 | 0.003 |  | 0.274 | -0.005 | 0.014 | 2.75 |
|  | (0.185) |  |  | (0.189) |  |  | (0.178) | (0.119) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  Residential | -0.470\*\* | 0.081 |  | -0.092 | 0.002 |  | -0.334\* | 0.100 | 0.093 | 5.81\*\* |
|  | (0.182) |  |  | (0.132) |  |  | (0.171) | (0.087) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Average radiance (VIIRS night lights) | 0.198 | 0.010 |  | -0.125 | 0.002 |  | 0.046 | -0.164 | 0.023 | 2.49 |
|  | (0.141) |  |  | (0.184) |  |  | (0.160) | (0.114) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Covid-19 new cases per million people | -0.313 | 0.018 |  | -0.018 | 0.000 |  | -0.174 | 0.113 | 0.025 | 1.14 |
|  | (0.254) |  |  | (0.317) |  |  | (0.322) | (0.155) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Covid-19 new deaths per million people  | -0.050 | 0.001 |  | 0.300 | 0.012 |  | 0.180 | 0.186 | 0.023 | 0.00 |
|  | (0.173) |  |  | (0.328) |  |  | (0.300) | (0.145) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| All-cause, all-age mortality rate | 0.078 | 0.001 |  | 0.373 | 0.014 |  | 0.293 | 0.174 | 0.016 | 0.43 |
|  | (0.160) |  |  | (0.347) |  |  | (0.304) | (0.154) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| *Notes:* Outcomes are changes from same month of 2020. Each outcome measure has three regressions, one using the % fully vaccinated, one using the % either fully or partially vaccinated, and one with the % fully vaccinated and the % partially vaccinated as separate covariates. All variables are standardized. All regressions include fixed effects for each country and for each month. Standard errors in ( ) are clustered at country level, with \*\*\*, \*\*, and \* denoting statistical significance at 1%, 5% and 10% level. *N*=288 for response stringency and Covid cases and deaths, *N*=248 for *Google Mobility* indicators (Iceland is not included and January is the base month), *N*=202 for night lights (post-July data are yet to be released and glare prevents measurement for northern latitudes in summer months) and *N*=268 for all-cause mortality. |

The conditional correlations in Table 1 cannot show whether vaccinations *per se* give a rebound in economic activity—perhaps from making people feel safer to go out—or instead relaxed stringency matters, which politicians may tie to progress with vaccine rollout. To help with this question, correlations can be decomposed into direct and indirect channels. A regression (in SD units) of the outcome of interest (e.g. changes in retail mobility (M) from *Google Maps*) on the fully vaccinated rate (V) and stringency index (S) gives two of the parameters needed; the correlation between V and S gives the third. The product of that correlation coefficient, $r\_{vs}$ and the regression coefficient on the stringency index, $\hat{β}\_{MS}$ gives the indirect channel, while the direct channel is the regression coefficient on the vaccinated rate, $\hat{β}\_{MV}$ (Blalock, 1964).

The direct channel linking changes in (retail) mobility with the fully vaccinated rate is small, $(\hat{β}\_{MV}=0.10, p=0.34)$ and statistically insignificant. Instead, it is the indirect effect that dominates:

$$r\_{VS}=-0.42$$

**Stringency index (S)**

**Vaccinated rate (V)**

**Google mobility (M) (retail locations)**

$$β\_{MV}=0.10$$

$$β\_{MS}=-0.82^{\*\*\*}$$

A SD decrease in the stringency index is associated with 0.8 SD higher mobility for retail locations, and the indirect channel is a (precisely estimated) three-fold larger relationship than the direct channel $\left(-0.42×-0.82=0.34\right).$ This same pattern holds for all indicators in Table 1 that had significant correlations with the fully vaccinated rate; the indirect effect via the stringency index is always at least three-times larger than the direct effect and the direct effect is always statistically insignificant (with *p*-values ranging from 0.16 to 0.80).

**IV. Interpretation**

The vaccine rollout seemingly solves a political/economic problem—getting out of ruinously expensive lockdowns that politicians imposed in 2020—rather than solving a health problem. For these countries, through September 2021, rollout was not faster where excess mortality had been higher and rollout is not correlated with aggregate health effects. Rollout is clearly correlated with rebounds in economic activity but this occurs through relaxation in lockdown restrictions. Politicians have been free at any time to undo what they imposed in 2020, with or without mass vaccination. It is increasingly clear from quasi-experimental case studies (Gibson, 2021a) and cross-country regressions (Bjørnskov, 2021) that lockdowns did not reduce excess mortality during the pandemic. Indeed, lockdowns increased excess mortality in some times and places (Agrawal et al, 2021). Given these ineffective and costly lockdowns it is unclear why mass vaccination is needed as the way out of this misguided intervention, especially as mass vaccination may create its own set of unintended consequences.

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| Appendix Table 1: Countries in the sample and summary statistics on vaccination rates |
|  |  | Fully vaccinated rate |  | Either fully or partly rate |
| Country name | iso\_code | Mean | Std Deviation |  | Mean | Std Deviation |
| Australia | AUS | 8.18 | 12.80 |  | 18.12 | 19.94 |
| Austria | AUT | 23.38 | 23.66 |  | 32.68 | 24.95 |
| Belgium | BEL | 26.32 | 28.31 |  | 36.61 | 29.88 |
| Canada | CAN | 22.59 | 28.78 |  | 39.92 | 31.58 |
| Switzerland | CHE | 23.72 | 22.42 |  | 30.16 | 23.58 |
| Chile | CHL | 36.48 | 28.46 |  | 45.25 | 28.18 |
| Czech Republic | CZE | 20.96 | 21.53 |  | 28.89 | 22.73 |
| Germany | DEU | 24.06 | 24.82 |  | 34.08 | 26.63 |
| Denmark | DNK | 27.11 | 27.91 |  | 36.44 | 30.27 |
| Spain | ESP | 27.62 | 28.98 |  | 36.49 | 30.60 |
| Estonia | EST | 20.92 | 19.69 |  | 28.93 | 20.76 |
| Finland | FIN | 16.76 | 21.05 |  | 37.32 | 28.52 |
| France | FRA | 22.79 | 24.06 |  | 34.07 | 28.12 |
| United Kingdom | GBR | 29.94 | 26.22 |  | 48.87 | 22.35 |
| Greece | GRC | 23.31 | 22.78 |  | 29.70 | 23.59 |
| Hungary | HUN | 29.28 | 24.81 |  | 37.05 | 24.55 |
| Iceland | ISL | 33.46 | 33.30 |  | 42.93 | 34.02 |
| Israel | ISR | 49.34 | 18.73 |  | 57.14 | 13.89 |
| Italy | ITA | 24.21 | 24.82 |  | 34.82 | 28.57 |
| South Korea | KOR | 9.26 | 13.87 |  | 20.29 | 24.29 |
| Lithuania | LTU | 24.05 | 22.66 |  | 31.27 | 23.52 |
| Luxembourg | LUX | 7.93 | 20.69 |  | 32.46 | 26.47 |
| Latvia | LVA | 16.74 | 18.03 |  | 21.50 | 18.10 |
| Netherlands | NLD | 24.54 | 26.44 |  | 36.70 | 30.13 |
| Norway | NOR | 20.88 | 21.91 |  | 33.60 | 28.03 |
| New Zealand | NZL | 8.31 | 11.18 |  | 14.96 | 20.45 |
| Poland | POL | 21.45 | 20.74 |  | 27.83 | 20.60 |
| Portugal | PRT | 28.25 | 30.99 |  | 37.66 | 32.64 |
| Slovakia | SVK | 17.74 | 16.45 |  | 24.42 | 17.05 |
| Slovenia | SVN | 19.01 | 17.92 |  | 26.08 | 18.89 |
| Sweden | SWE | 21.77 | 22.60 |  | 33.66 | 26.74 |
| United States | USA | 30.13 | 20.54 |  | 38.85 | 21.61 |
| *Notes:* Means and standard deviations calculated from monthly averages, from January to September 2021. The original source of the data is *OWID*. |

1. For example, a study of 3.5 million people covered by a large U.S. health insurer found vaccine efficacy (VE) for the Pfizer jab fell 10 percentage points per month (for the Delta variant, and eight points per month for other variants), to be just 53% if the second jab was more than four months ago (Tartof et al, 2021). Likewise, Cohn et al (2021) study 0.62 million U.S. veterans, vaccinated with either Pfizer, Moderna, or J&J; VE against infection started at 91-95% but after five months had fallen sharply, to 3% (J&J), to 50% (Pfizer) or to 64% (Moderna). [↑](#footnote-ref-1)
2. To translate into economic growth terms, a one SD higher mean stringency index in 2020 was associated with a 1.4 percentage point lower GDP growth rate for these countries. [↑](#footnote-ref-2)