UNIVERSITY OF WAIKATO

Hamilton
New Zealand

Jabbing the Economy Back to Life?

John Gibson

Working Paper in Economics 11/21

October 2021

John Gibson
School of Accounting, Finance
and Economics
University of Waikato
Private Bag 3105
Hamilton, 3240
New Zealand

Tel: +64 (7) 838 4289
Email: jkgibson@waikato.ac.nz

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

Acknowledgements

I am grateful to Geua Boe-Gibson for processing the night-time lights images.

"…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]

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:

$$\Delta Y_{it} = \beta_1 V_{it} + \mu_i + \vartheta_t + e_{it}$$

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 ΔY_{it} and V_{it}. These aid comparisons for outcomes measured in different units and let correlations between ΔY_{it} and

[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).

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] This relationship is not seen if V_{it} does not distinguish between the fully and partially vaccinated rate $\left(\hat{\beta} = -0.11, p = 0.32\right)$. In fact, a higher partially dosed rate is, *ceteris paribus*, associated with greater stringency $\left(H_{0:}\, \hat{\beta}_{fully} = \hat{\beta}_{partly}, p = 0.004\right)$.

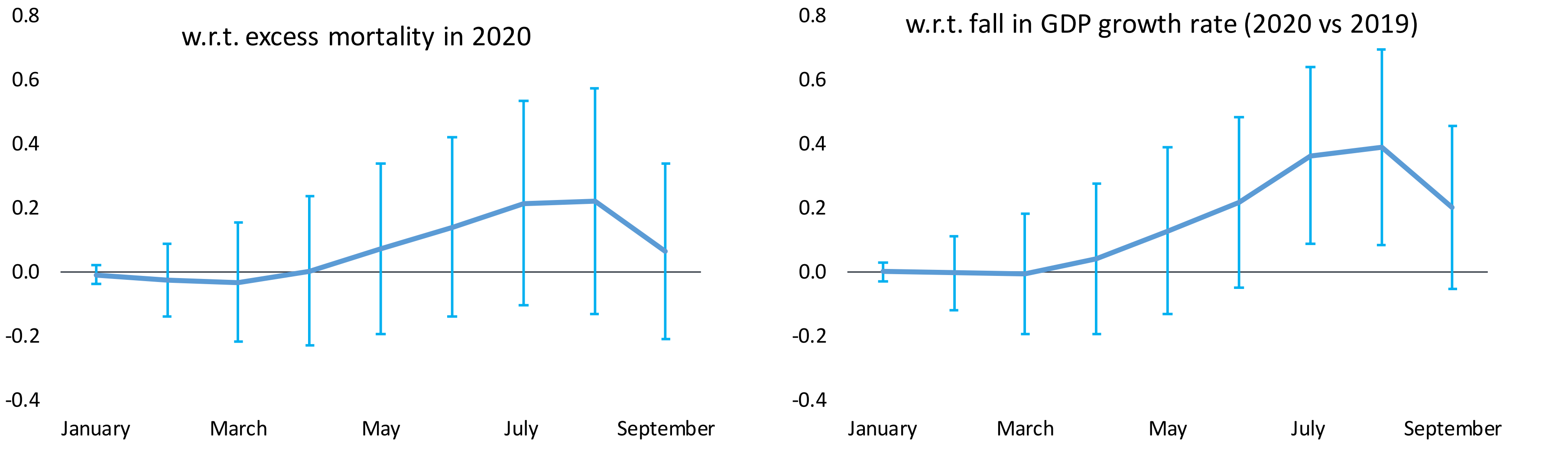
Mobility for retail locations and transit is about 0.5 SD higher than in the same month of 2020, per SD higher fully vaccinated rate, while the opposite pattern shows for residences $\left(\hat{\beta}_{fully} = -0.47, p = 0.015\right)$. These relationships are not seen if fully and partly vaccinated rates are combined. The hypothesis of both vaccination rates having equal effects on mobility $\left(H_{0:}\, \hat{\beta}_{fully} = \hat{\beta}_{partly}\right)$ 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 $\left(H_{0:}\, \hat{\beta}_{fully} = \hat{\beta}_{partly}\right)$ 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.

[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.

Figure 1: Standardized Regression Coefficients; Fully Vaccinated Rate with respect to (w.r.t.) Indicators of Prior Health and Economic Shocks



Note: Error bars show 95% confidence intervals corrected for multiple testing.

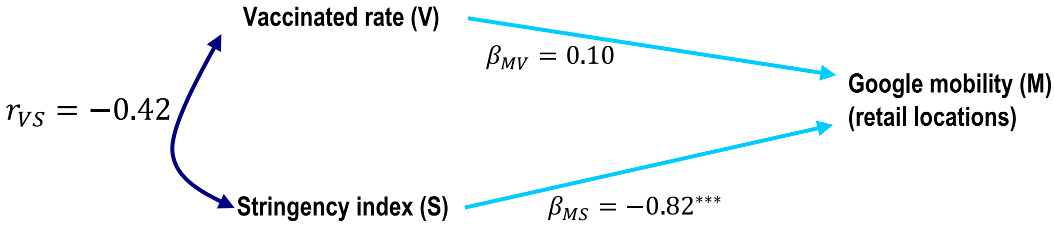
Table 1: Relationships between monthly indicators of Covid-19 vaccine rollout and monthly indicators of change in response stringency, economic activity, Covid-19 cases and mortality: OECD countries

	% 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: $\beta_{full} = \beta_{partly}$
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, $\hat{\beta}_{MS}$ gives the indirect channel, while the direct channel is the regression coefficient on the vaccinated rate, $\hat{\beta}_{MV}$ (Blalock, 1964).

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



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 ($-0.42 \times -0.82 = 0.34$). 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.

References

Agrawal, V., Cantor, J., Sood, N., & Whaley, C. (2021). The impact of the COVID-19 pandemic and policy responses on excess mortality. *Working Paper* No. w28930, National Bureau of Economic Research.

Auld, C., & Toxvaerd, F. (2021). The great COVID-19 vaccine rollout: Behavioral and policy responses. *National Institute Economic Review*, 257(1), 14-35.

Bjørnskov, C. (2021). Did lockdown work? An economist's cross-country comparison. *CESifo Economic Studies*, *67*(3), 318-331.

Blalock, H. M. (1964). *Causal Inferences in Nonexperimental Research*. Chapel Hill, N.C.: University of North Carolina Press.

Cohn, B., Cirillo, P., Murphy, C., Krigbaum, N., & Wallace, A. (2021). Breakthrough SARS-CoV-2 infections in 620,000 US veterans, February 1, 2021 to August 13, 2021. *medRxiv*. https://doi.org/10.1101/2021.10.13.21264966

Dodsworth, L. (2021) *A State of Fear : How The UK Government Weaponised Fear During the COVID-19 Pandemic* Pinter and Martin: London

Doshi P. (2020). Pfizer and Moderna's "95% effective" vaccines—let's be cautious and first see the full data. https://blogs.bmj.com/bmj/2020/11/26/peter-doshi-pfizer-and-modernas-95-effective-vaccines-lets-be-cautious-and-first-see-the-full-data

Elvidge, C. D., Baugh, K., Zhizhin, M., Hsu, F. C., & Ghosh, T. (2017). VIIRS night-time lights. *International Journal of Remote Sensing*, *38*(21), 5860-5879.

Gibson, J. (2021). Better night lights data, for longer. *Oxford Bulletin of Economics and Statistics*, *83*(3), 770-791.

Gibson, J. (2021a). Lockdowns for Covid-19 did not reduce mortality: Synthetic control evidence from the no-lockdown case of Belarus. *Working Papers in Economics* No. 21/14, Waikato Management School, University of Waikato.

Goolsbee, A., & Syverson, C. (2021). Fear, lockdown, and diversion: Comparing drivers of pandemic economic decline 2020. *Journal of Public Economics*, *193*, 104311.

Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., Webster, S., Cameron-Blake, E., Hallas, L., Majumdar, S. & Tatlow, H. (2021). A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). *Nature Human Behaviour*, *5*(4), 529-538.

Mathieu, E., Ritchie, H., Ortiz-Ospina, E., Roser, M., Hasell, J., Appel, C., Giattino, C. & Rodés-Guirao, L. (2021). A global database of COVID-19 vaccinations. *Nature Human Behaviour*, *5*, 947–953.

Németh, L., Jdanov, D., & Shkolnikov, V. (2021). An open-sourced, web-based application to analyse weekly excess mortality based on the Short-term Mortality Fluctuations data series. *PloS One*, *16*(2), e0246663.

Organization for Economic Cooperation and Development [OECD] (2021). *The Race to Vaccinate: Understanding the Policy Challenges Around Covid-19 Vaccines.* https://www.oecd.org/coronavirus/en/vaccines

Olliaro, P., Torreele, E., & Vaillant, M. (2021). COVID-19 vaccine efficacy and effectiveness—the elephant (not) in the room. *The Lancet Microbe*, *2*(7) e279-e280.

Subramanian, S., & Kumar, A. (2021). Increases in COVID-19 are unrelated to levels of vaccination across 68 countries and 2947 counties in the United States. *European Journal of Epidemiology*, 1-4.

Tartof, S., Slezak, J., Fischer, H., Hong, V., Ackerson, B., Ranasinghe, O., Frankland, T., Okun, O., Zampara, J., Gray, S., Valluri, S., Pan, K., Angulo, F., Jodar, L., & McLaughlin, J. M. (2021). Effectiveness of mRNA BNT162b2 COVID-19 vaccine up to 6 months in a large integrated health system in the USA: a retrospective cohort study. *The Lancet*, 398 (10309) 1407-16.

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*.