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Which COVID-19 information really impacts stock markets? [Dataset]

SZCZYGIELSKI, J.J., CHARTERIS, A., BWANYA, P.R. and BRZESZCZYŃSKI, J.

2023

APPENDIX A: RESULTS APPENDIX

Which COVID-19 information really impacts stock markets?

Table 1A: Summary of studies examining the impact of COVID-19 on stock returns

Category	Measures	Impact on Returns	References
Panel A: Direct Measures			
Health	Deaths	Negative	Adekoy & Nti (2020); Al-Awadhi et al. (2020); Alfaro et al. (2020); Ali et al. (2020); Ashraf et al. (2020a); Capelle-Blancard & Desroziers, 2020; Ru et al. (2020).
	Cases	Negative	Adekoy & Nti (2020); Al-Awadhi et al. (2020); Alfaro et al. (2020); Ashraf et al. (2020a); Capelle-Blancard & Desroziers (2020); Mishra et al. (2020); Ru et al. (2020).
Market sentiment/attention/ uncertainty	Google Search Trends	Negative	Ahundjanov et al., (2020); Capelle-Blancard & Desroziers, 2020; Costola et al. (2020a); Liu (2020); Papadamou et al. (2020); Ramelli & Wagner (2020); Smales (2020, 2021); Szczygielski, Charteris et al. (2020); Szczygielski, Brzeszczyński et al. (2021). Szczygielski, Bwanya et al. (2021).
	Infectious Disease Equity Market Volatility Tracker	Negative	Capelle-Blancard & Desroziers (2020)
	Ravenpack Finance indices	Mixed	Cepoi (2020)
Government responses	Government Response Trackers	Mixed	Capelle-Blancard & Desroziers (2020); Szczygielski, Bwanya et al. (2021).
	Lockdowns, travel bans etc.	Mixed	Aggarwal et al. (2020); Ashraf et al. (2020b); Gormsen & Koijen (2020); Narayan et al. (2020).
	Stimulus packages		Ashraf et al. (2020b); Narayan et al. (2020)
	Apple Mobility Tracker and Google Mobility Tracker	Negative	Capelle-Blancard & Desroziers (2020)
Panel B: Indirect measures			
Volatility indices	Chicago Board of Exchange Volatility Index	Negative	Capelle-Blancard & Desroziers (2020); Salisu & Akanni (2020); Szczygielski, Bwanya et al. (2021)
Twitter indices	Twitter Economic Uncertainty and Twitter Market Uncertainty indices		Szczygielski, Bwanya et al. (2021)

Notes: This table summarises the measures used to quantify the impact of COVID-19 on financial markets. In the 'category' column, the types of measures are listed. In the 'measures' column, the base series for calculating the categorised measures are listed. The direction of impact is listed in the 'impact on returns column.' The 'references' column lists the studies that have studies the used these measures to investigate the impact of COVID-19 on financial markets.

Table 2A: Data and data sources for direct COVID-19 measures

Symbol	Measure	Source	Website/Database
CAS_t	Total cases	Our World in Data	https://ourworldindata.org/coronavirus
DEA_t	Total deaths	Our World in Data	https://ourworldindata.org/coronavirus
REC_t	Total recoveries	Our World in Data	https://ourworldindata.org/coronavirus
ACT_t	Active cases	Our World in Data	https://ourworldindata.org/coronavirus
DEC_t	Moving average of daily deaths	Our World in Data	https://ourworldindata.org/coronavirus
CAC_t	Moving average of daily cases	Our World in Data	https://ourworldindata.org/coronavirus
CFR_t	Number of deaths to number of cases, a measure of mortality	Our World in Data	https://ourworldindata.org/coronavirus
RCI_t	Deviation of expectations for reported cases in a 14-day window from present reported cases.	Our World in Data	https://ourworldindata.org/coronavirus
RDI_t	Deviation of expectations for reported deaths in a 14-day window from present reported cases.	Our World in Data	https://ourworldindata.org/coronavirus
GFI_t	Equal weighted combination of RCI_t and RDI_t	Our World in Data	https://ourworldindata.org/coronavirus
GOR_t	Weighted overall government response, combining containment, policy and economic responses and the stringency of responses.	Blavatnik School of Government, University of Oxford	https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker
GER_t	Weighted government economic support index	Blavatnik School of Government, University of Oxford	https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker
GCR_t	Weighted government health containment measures	Blavatnik School of Government, University of Oxford	https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker
GSM_t	Weighed stringency index of government lockdown style measures	Blavatnik School of Government, University of Oxford	https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker
GST_t	A composite measure of Google Search Trends for 9 COVID-19 related terms.	Google Trends	https://trends.google.com/trends/
EMV_t	Equity Market Volatility: Infectious Disease Tracker (seasonality adjusted)	Federal Reserve Bank of St. Louis Economic Data (FRED)	https://fred.stlouisfed.org/series/INFECTDISEMVTRACKD
GMT_t	Weighted Google mobility reports for constituent markets	Google COVID-19 Community Mobility Reports	https://www.google.com/covid19/mobility/
AMT_t	Weighted Apple mobility reports for constituent markets	Apple COVID-19 Mobility Trend Reports	https://covid19.apple.com/mobility
RPI_t	Ravenpack Panic Index measuring references to hysteria or panic and coronavirus.	RavenPack Analytics	https://www.ravenpack.com
MHI_t	Ravenpack Media Hype Index measuring the percentage of news talking about COVID-19	RavenPack Analytics	https://www.ravenpack.com
FNI_t	Ravenpack Fake News Index that makes reference to misinformation or fake news alongside COVID-19	RavenPack Analytics	https://www.ravenpack.com
WSI_t	Ravenpack Worldwide Sentiment Index which measures sentiment across all entities mentioned alongside COVID-19	RavenPack Analytics	https://www.ravenpack.com
INI_t	Ravenpack Infodemic Index calculating percentage of all entities (places, companies, etc.) that are linked to COVID-19	RavenPack Analytics	https://www.ravenpack.com
MCI_t	Ravenpack Media Coverage Index calculating percentage of all news topics covering COVID-19	RavenPack Analytics	https://www.ravenpack.com
VIX_t	Chicago Board of Exchange Volatility Index	Chicago Board of Exchange	Bloomberg (Database)

Notes: This table lists the direct COVID-19 measures utilised in the study in in the measure column together with the providing organisation/entity in the source column and the link/database where the data can be obtained in the website/database column.

Table 3A: Correlation matrix for COVID-19 measures over the COVID-19 crisis period

	CAS_t	DEA_t	REC_t	ACT_t	DEC_t	CAC_t	CFR_t	RCI_t	RDI_t	GFI_t	GOR_t	GER_t	GCR_t	GSM_t	GST_t	EMV_t	GMT_t	AMT_t	RPI_t	MHI_t	FNI_t	WSI_t	INI_t
DEA_t	**0.8650** 0.7652																						
REC_t	**0.8345** 0.7363	**0.8904** 0.7382																					
ACT_t	**0.8500** 0.9892	**0.6687** 0.7529	**0.5178** 0.6565																				
DEC_t	**0.4555** 0.4408	**0.4941** 0.7955	**0.2876** 0.3658	**0.4447** 0.4606																			
CAC_t	**0.4882** 0.3965	**0.3230** 0.4591	**0.2492** 0.3227	**0.4700** 0.4130	**0.4277** 0.5583																		
CFR_t	**0.0429** -0.2512	**0.3333** 0.4164	**0.1626** 0.0935	**-0.0202** -0.2515	**0.3115** 0.5374	**-0.0469** 0.0561																	
RCI_t	**-0.0970** 0.0085	**-0.1055** -0.0836	**-0.1413** -0.1364	**-0.1044** -0.0031	**-0.0075** 0.0981	**0.2029** 0.2677	**-0.1932** -0.1802																
RDI_t	**-0.0016** -0.0280	**0.0335** 0.0484	**-0.0666** -0.0312	**0.0237** -0.0051	**0.2976** 0.2032	**0.0974** 0.0138	**0.0687** 0.1131	**0.1408** 0.3510															
GFI_t	**-0.0541** -0.0192	**-0.0272** -0.0188	**-0.1264** -0.0941	**-0.0265** -0.0058	**0.2618** 0.1748	**0.1802** 0.1138	**-0.0060** -0.0233	**0.5112** 0.7129	**0.8757** 0.8840														
GOR_t	**0.3252** 0.3146	**0.4183** 0.3960	**0.2997** 0.2353	**0.2288** 0.3510	**0.3059** 0.3254	**0.3494** 0.2289	**0.3444** 0.1553	**-0.0609** 0.1245	**-0.0687** 0.0341	**-0.0682** 0.0771													
GER_t	**0.2800** 0.2998	**0.3354** 0.2895	**0.2224** 0.1584	**0.2706** 0.3150	**0.2345** 0.2587	**0.2579** 0.2540	**0.3327** 0.1547	**-0.1490** -0.0020	**-0.0553** -0.0122	**-0.0850** -0.0111	**0.3741** 0.5009												
GCR_t	**0.2973** 0.3312	**0.3901** 0.4164	**0.2779** 0.2581	**0.1988** 0.3628	**0.2928** 0.3343	**0.3296** 0.2356	**0.3154** 0.1582	**-0.0297** 0.1382	**-0.0441** 0.0408	**-0.0347** 0.0883	**0.9682** 0.9640	**0.2369** 0.2392											
GSM_t	**0.2260** 0.2827	**0.3055** 0.3447	**0.1977** 0.2268	**0.1665** 0.3234	**0.3049** 0.2668	**0.3424** 0.1981	**0.2763** 0.1193	**0.0319** 0.1117	**0.0125** 0.0000	**0.0265** 0.0419	**0.9064** 0.9396	**0.2442** 0.2437	**0.9358** 0.9703										
GST_t	**-0.0840** 0.1044	**-0.0828** 0.0678	**-0.0944** -0.2150	**-0.1072** 0.0995	**0.0242** 0.2434	**0.0326** 0.1111	**-0.0793** -0.0703	**0.1145** 0.0483	**0.1384** 0.1144	**0.1413** 0.1116	**0.1135** 0.0470	**-0.0030** -0.0630	**0.1009** 0.0688	**0.1253** 0.0476									
EMV_t	**-0.0551** 0.0013	**-0.0428** -0.0043	**0.0369** 0.0278	**-0.0939** -0.0093	**-0.0172** -0.0026	**0.0252** 0.0106	**0.0054** -0.0094	**0.0454** 0.0945	**0.0034** 0.0136	**0.0081** 0.0420	**0.0817** 0.1319	**0.0638** 0.0386	**0.0897** 0.1343	**0.1260** 0.1384	**0.0692** 0.0652								
GMT_t	**-0.1983** -0.3407	**-0.1522** -0.2992	**-0.1423** -0.1712	**-0.2084** -0.3378	**-0.1895** -0.2302	**-0.0641** -0.1330	**-0.0324** -0.0869	**0.0735** 0.0689	**-0.0159** 0.0238	**0.0110** 0.0553	**-0.1669** -0.2147	**-0.1471** -0.0558	**-0.1708** -0.2227	**-0.2237** -0.2445	**0.0935** 0.1827	**-0.0045** -0.0886							
AMT_t	**0.2866** 0.1207	**0.1758** 0.0519	**0.3043** 0.2572	**0.2111** 0.0603	**-0.1868** -0.1612	**-0.1171** -0.0915	**-0.3888** -0.1245	**-0.0474** -0.0186	**-0.0372** 0.0146	**-0.0985** -0.0037	**-0.2771** -0.2505	**-0.0959** -0.1017	**-0.3037** -0.2479	**-0.3314** -0.2803	**-0.0127** -0.0111	**-0.0784** -0.0998	**0.0870** 0.2103						
RPI_t	**0.2215** 0.1480	**0.2085** 0.1638	**0.2099** 0.1632	**0.1885** 0.1454	**-0.0108** 0.0359	**-0.0084** 0.0227	**-0.0797** 0.0257	**0.0517** 0.0184	**-0.1131** -0.0365	**-0.0910** -0.0137	**0.0332** 0.1887	**0.0461** 0.0013	**0.0346** 0.2080	**0.0258** 0.1752	**0.0157** 0.0110	**-0.1559** -0.1801	**-0.2078** -0.1585	**0.2517** 0.2580					
MHI_t	**0.2386** 0.2023	**0.2361** 0.2358	**0.1964** 0.1791	**0.2058** 0.2164	**0.1116** 0.1009	**0.1262** 0.0812	**0.0486** 0.0700	**-0.0576** 0.0051	**-0.0185** -0.0530	**-0.0429** -0.0357	**0.1162** 0.4099	**0.1961** 0.1204	**0.0824** 0.4170	**0.0733** 0.3849	**0.0564** 0.0552	**-0.1009** -0.0846	**-0.2448** -0.1773	**0.0684** 0.1269	**0.6242** 0.8251				
FNI_t	**0.1414** 0.0721	**0.1327** 0.0790	**0.1153** 0.1182	**0.0766** 0.0578	**0.0615** 0.0051	**0.0456** 0.0226	**0.0315** 0.0124	**0.0298** -0.0061	**-0.0595** -0.0882	**-0.0178** -0.0625	**0.1160** 0.1404	**0.0714** -0.0081	**0.0978** 0.1575	**0.0763** 0.1568	**0.0003** -0.0266	**-0.0896** -0.0511	**-0.1108** -0.1063	**0.0310** 0.0367	**0.3825** 0.4100	**0.3806** 0.3830			
WSI_t	**0.0938** -0.1263	**0.0484** -0.1990	**0.0762** 0.0472	**0.0579** -0.1317	**-0.0304** -0.2453	**0.0368** -0.0624	**-0.0732** -0.1377	**0.1067** 0.0538	**-0.1311** -0.1228	**-0.0799** -0.0826	**-0.0153** -0.1295	**-0.0183** -0.0865	**-0.0342** -0.1245	**-0.0500** -0.1138	**-0.0879** -0.1864	**-0.0147** -0.0490	**-0.0032** -0.0354	**0.0950** 0.0953	**0.0001** -0.0230	**-0.0361** -0.0800	**-0.0143** 0.0737		
INI_t	**-0.2100** 0.0735	**-0.1889** 0.1332	**-0.2103** 0.0060	**-0.1831** 0.0903	**0.0753** 0.1440	**0.1344** 0.0968	**0.2305** 0.1182	**-0.0090** 0.0251	**-0.0122** 0.0172	**0.0280** 0.0100	**0.1710** 0.3180	**0.1562** 0.1290	**0.1662** 0.3139	**0.1825** 0.3232	**0.0145** 0.0475	**0.2130** 0.2206	**0.0236** 0.0587	**-0.3999** -0.4388	**-0.2699** -0.2106	**-0.0182** 0.0124	**-0.1446** -0.0696	**-0.0133** -0.1167	
MCI_t	**-0.0407** 0.3861	**-0.0587** 0.3955	**-0.0790** 0.2280	**-0.0545** 0.3832	**0.0488** 0.1919	**0.1245** 0.1272	**0.1629** 0.0505	**0.0121** 0.0888	**0.0418** -0.0553	**0.0480** -0.0112	**0.2210** 0.4897	**0.1817** 0.1631	**0.2098** 0.5063	**0.2253** 0.5183	**-0.0006** 0.0857	**0.0463** 0.1142	**0.2044** 0.1099	**-0.1727** -0.0491	**-0.0324** 0.0279	**0.1393** 0.2179	**0.0852** 0.1259	**-0.0810** -0.1663	**0.4525** 0.4898

Notes: This table reports Spearman and ordinary correlations for the COVID-19 measures listed in Table 2 of the main document over the COVID-19 crisis period, 1 January 2020 to 20 October 2020. Values in bold are Spearman correlation coefficients whereas the values underneath are ordinary correlation coefficient

Table A4: Factor score regressions with breakpoints for COVID-19 crisis period

	Breakpoint	Measure			$\bar{R}^2_{k,CV19_t}$	$ShVr$
		$GST_{t,1}$	$GST_{t,2}$	$GST_{t,3}$		
$F_{1,t}$	12/03/2020 30/04/2020 (51/35/124)	-0.0497***	-0.2121***	0.0869	0.2980	0.1696
		$GSM_{t,1}$	$GSM_{t,2}$			
$F_{2,t}$	23/03/2020 (58/151)	-0.18930**	0.2430***		0.1274	0.0115
		$GOR_{t,1}$	$GOR_{t,2}$			
$F_{3,t}$	13/03/2020 (52/157)	0.1224	-0.2670***		0.1150	0.0047
$F_{4,t}$	No breaks for MHI_t					

Notes: This table reports the results of regressions of factor scores derived from returns onto the COVID-19 measures individually with breakpoints over the COVID-19 crisis period, 1 January 2020 to 20 October 2020. Least squares with Newey-West heteroscedasticity and autocorrelation consistent (HAC) standard errors is used for estimation purposes. Values in brackets (…) indicate the number of observations that comprise each breakpoint segment. Segments are identified using the Bai-Perron test of L+1 versus L sequentially determined breaks with robust standard errors (HAC) and heterogenous error distributions. GST_t are changes in worldwide COVID-19 related Google Search Trends. GSM_t are changes in the stringency of measures applied by governments to control the spread of the COVID-19 virus as measured by the Oxford Coronavirus Government Response Tracker. GOR_t are changes in the overall government response to control the spread of the COVID-19 virus as measured by the Oxford Coronavirus Government Response Tracker. MHI_t are the changes in the Ravenpack Media Hype Index. $ShVr$ is the contribution to total shared variance estimated by applying equation (3). The asterisks, ***, ** and *, indicate statistical significance at the respective 1%, 5% and 10% levels of significance.

Table 5A: Mean and variance specifications with ARCH/GARCH errors over the COVID-19 crisis period

Panel A: Mean specification estimates

	α_i	$\beta_{i,GST}$	$\beta_{i,GSM}$	$\beta_{i,MHI}$	$F^{RES}_{CV19,1}$	$F^{RES}_{CV19,2}$	$F^{RES}_{CV19,3}$	$F^{RES}_{CV19,4}$	$\sum_{\tau \geq 0}^{\tau} r_{i,t-\tau}$	$\bar{R}^2$
World	0.0005***	-0.0019***	-0.0024***	-0.0004**	0.0058***		0.0049***			0.8143
US	0.0006***	-0.0022***	-0.0029***	-0.0004**	0.0055***		0.0074***			0.8014
China	0.0004***	-0.0006***	-0.0013**	-0.0006**		0.0104***				0.7729
Japan	0.0005**	-0.00002	-0.0019***	-0.0006**		0.0039***	0.0036***		-0.1471r_{t-1}***	0.2665
UK	-1.57E-05	-0.0018***	-0.0020***	-0.0004	0.0090***				0.0573r_{t-1}***; -0.0536r_{t-6}***	0.6954
France	0.0003***	-0.0023***	-0.0015***	-0.0003	0.1103***				0.0640r_{t-1}***; 0.0093r_{t-7}	0.8908
Canada	0.00004**	-0.0012****	-0.0032***	-0.0004			0.0068***		-0.0248r_{t-4}; 0.0347r_{t-7}	0.5559
Germany	0.0002**	-0.0025***	-0.0020***	-0.0005**	0.0113***	0.0021***				0.9022
Switzerland	0.0003**	-0.0016***	-0.0009**	-0.0002	0.0069***					0.6140
India	0.0003	-0.0009***	-0.0019**	-0.0015**	0.0033***	0.0036***				0.3038
Australia	0.0001	-0.0013***	-0.0025***	-0.0010*	0.0040***	0.0045***		0.0049***	-0.0671r_{t-1}***	0.4311
Korea	0.0004	-0.0010***	-0.0015*	-0.0009**		0.0068***	0.0008***	0.0055***	-0.0540r_{t-1}***	0.5321
Hong Kong	0.0003**	-0.0006***	-0.0013***	-0.0011***		0.0086***			0.0047r_{t-1}; -0.0044r_{t-2}	0.7952
Taiwan	0.0006***	-0.0006**	-0.0028***	-0.0007***		0.0064***		0.0049***	-0.0425r_{t-2}***	0.5511
Brazil	1.22E-05	-0.0034***	-0.0048***	-0.0009*	0.0083***		0.0121***			0.4519
Netherlands	0.0004***	-0.0021***	-0.0014***	-0.0003*	0.0098***	0.0022***				0.8704
Russia	0.0005	-0.0027***	-0.0029***	-0.0008*	0.0083***		0.0069***	0.0050***		0.4600
Spain	-7.82E-05	-0.0024***	-0.0011	-0.0009*	0.0116***				-0.0123r_{t-6}; 0.0231r_{t-8}	0.7534
Italy	0.0004	-0.0016***	-0.0033***	-0.0006		0.0013***			-0.0901r_{t-1}***	0.0891
Sweden	0.0002	-0.0013***	-0.0029***	-0.0003		0.0021***			-0.0955r_{t-1}***	0.0980
Saudi Arabia	0.0001	-0.0011**	-0.0013**	-0.0019***		0.0023***			-0.0791r_{t-2}**	0.1128
Thailand	0.0002	-0.0016***	-0.0025***	-0.0013***	0.0025***	0.0031***				0.3102
South Africa	-5.42E-05	-0.0025***	-0.0036***	-0.0019***	0.0110***	0.0064***	0.0072***	0.0073***		0.6172
Denmark	0.0005**	-0.0016***	-0.0010**	-0.0001	0.0074***					0.4535
Singapore	1.47E-06	-0.0008***	-0.0017***	-0.0010***	0.0036***	0.0056***		0.0045***		0.6978
Belgium	-5.95E-05	-0.0023***	-0.0020***	-0.0008**	0.0103***	0.0017***				0.7099
Indonesia	0.0002	-0.0003	-0.0025***	-0.0012***	0.0032***	0.0053***		0.0068***	-0.0791r_{t-2}***	0.4428
Malaysia	-8.70E-05	-0.0006**	-0.0020***	-0.0009***		0.0034***		0.0047***		0.5505
Mexico	4.17E-05	-0.0026***	-0.0029***	-0.0003	0.0078***		0.0075***	0.0044***		0.5592
Norway	0.0003	-0.0016***	-0.0028***	-0.0008			0.0028***	0.0029***	-0.0547r_{t-1}***	0.1859
Finland	0.0003	-0.0020***	-0.0013***	-0.0008***	0.0093***					0.6347
Philippines	0.0002	-0.0012**	-0.0027***	-0.0009*				0.0047***		0.2755
UAE	-5.54E-05	-0.0008*	-0.0039*	-0.0008**				0.0025***	-0.0545r_{t-12}**	0.1671
Qatar	-4.59E-05	-0.0006	-0.0023	-0.0007**				0.0026***		0.0860
Israel	9.58E-05	-0.0021***	-0.0019***	-0.0006	0.0054***		0.0056***			0.3897
Chile	-6.98E-05	-0.0028***	-0.0025*	-0.0012**	0.0060***		0.0057***	0.0040***	0.0835r_{t-1}***	0.4574

Table 5A: Mean and variance specifications with ARCH/GARCH errors over the COVID-19 crisis period (continued…)

Panel B: Variance specification estimates

	ω_i	α_1	α_2	β_1	β_2	$Q(1)$	$Q(10)$	ARCH(1)	ARCH(10)	Log-likelihood
World	9.91E-07***	0.1499***		0.7924***		0.7965	7.3233	0.7940	0.8292	6343.254
US	9.52E-07***	0.1218***		0.8410***		0.0016	2.1655	0.6866	0.3506	6025.293
China	2.78E-06***	0.0303	0.0911***	0.8007***		0.5701	7.4240	0.0179	1.4122	5678.738
Japan	7.82E-06***	0.2147***		0.7026***		0.9255	14.403	0.3244	0.3810	5093.661
UK	1.79E-06***	0.1042***		0.8558***		0.0263	12.539	0.1008	0.4911	5563.785
France	3.44E-07***	0.2022**	-0.0970	0.8743***		2.4613	13.262	2.6127	1.0278	6436.123
Canada	1.48E-06***	0.0694**	0.0578	0.8531***		1.5956	14.365	0.0016	1.4982	5362.271
Germany	1.58E-08*	0.1407***	-0.1105**	0.9595***		1.1824	10.948	0.4920	0.3216	6310.259
Switzerland	7.59E-07**	0.1471**	-0.1028*	0.9297***		0.1158	9.7276	1.2499	0.6501	5755.027
India	5.94E-06***	0.1185***		0.8222***		1.5336	12.758	0.0326	1.0366	4937.347
Australia	1.27E-06**	0.1437***	-0.0855**	0.9259***		2.4093	11.623	0.0021	0.7544	5070.333
Korea	8.03E-06**	0.0297	0.0877**	0.0395	0.7396***	1.0544	10.314	0.1658	1.3084	5057.663
Hong Kong	7.47E-07***	0.1141***		0.8546***		1.9693	8.9713	0.1093	0.2579	6064.290
Taiwan	2.80E-06***	0.0680***		0.8840***		0.0267	13.680	0.0913	0.1650	5286.511
Brazil	1.21E-05*	0.0829***		0.8783***		0.3923	12.515	0.0163	0.1261	4100.649
Netherlands	5.81E-07	0.0842***		0.4056	0.4735***	0.2245	4.7004	2.0956	0.7934	6288.396
Russia	4.17E-06***	0.0443**		0.9292***		1.1328	11.194	0.0807	0.0984	4525.214
Spain	2.44E-08	0.1350***	-0.1307***	1.5866***	-0.5914***	1.3385	12.038	0.0010	0.2059	5482.538
Italy	6.12E-06***	0.1243***		0.8520***		1.0559	6.4150	0.0090	0.9780	4422.894
Sweden	3.63E-06**	0.0845***		0.8943***		0.0488	6.2680	0.7665	0.4162	4608.052
Saudi Arabia	0.0001***	0.3615				0.3451	13.178	1.1182	0.8390	4577.781
Thailand	9.42E-07**	0.0986**	-0.0396	0.9311***		1.1959	6.8039	0.0442	1.6795	5061.901
South Africa	1.07E-05	0.0927***		0.8315***		0.4996	10.272	0.0024	0.9148	4608.933
Denmark	8.16E-06*	0.0635***		0.8222***		1.4641	14.050	0.0010	0.2333	5108.55
Singapore	2.69E-06***	0.1271***		0.7887***		2.0936	8.5265	2.2438	1.0802	5762.716
Belgium	1.49E-05***	0.2532***		0.4646***		1.8061	7.1314	0.2747	0.1482	5443.142
Indonesia	5.03E-06	0.1190***		0.8440***		1.1887	6.4923	0.2544	0.4396	4800.539
Malaysia	5.34E-07**	0.0803***		0.9076***		0.7948	9.4728	0.0478	0.2285	5683.037
Mexico	8.49E-06***	0.1222**		0.7974***		0.0185	9.0174	0.1667	1.2594	4881.696
Norway	3.02E-06**	0.0733***		0.9105***		1.4199	7.5543	0.7941	0.8031	4502.338
Finland	1.01E-05	0.1068**	-0.0606	0.7733***		2.6900	13.697	1.1964	0.2175	5284.373
Philippines	6.75E-06***	0.1192***		0.8249***		0.0734	7.2561	0.5300	0.8784	4809.190
UAE	9.94E-06***	0.0453	0.1915*	0.6973***		0.0056	9.4094	0.4515	1.0287	4873.032
Qatar	1.10E-05*	0.0327	0.1132	0.7789***		2.5322	7.8799	0.2608	1.1275	4745.017
Israel	4.06E-06	0.0333***		0.9264***		2.1712	12.437	1.7437	0.3900	4854.206
Chile	4.43E-06**	0.1585***		0.8117***		0.9836	7.5308	0.0056	0.2182	4928.573

Notes: This table reports the results of regressions of the COVID-19 measures onto returns on the MSCI All Country World Index and the MSCI country indices with conditional variance modelled as an ARCH/GARCH process over the COVID-19 crisis period, 1 January 2020 to 20 October 2020. Model estimation sample is 1 January 2015 to 20 October 2020. Panel A reports the results for the mean specification and Panel B reports the results for the variance specification. Models are estimated using maximum likelihood estimation. If residuals depart from normality, quasi-maximum likelihood estimation is applied. $F_{CV19,1}^{RES}$ are statistically derived factors from returns orthogonalised against the COVID-19 measures. These factors act as proxies for influences other than the selected COVID-19 measures. $\sum_{\tau \geq 0}^{\tau} r_{i,t-\tau}$ are autoregressive terms included to account for any remaining residual serial correlation. The asterisks, ***, ** and *, indicate statistical significance at the respective 1%, 5% and 10% levels of significance.

Table 6A: Country OIU Estimates over the COVID-19 crisis period

	$\beta_{i,GST}$	$\varphi_{i,GST}$	$OIU_{i,GST}$
World	-0.0021	0.274	-0.0006
United States	-0.0022	0.485	-0.0011
Canada	-0.0027	0.421	-0.0011
Brazil	-0.0036	2.32	-0.0084
Chile	-0.0021	1.76	-0.0037
Mexico	-0.0021	0.654	-0.0014
Belgium	-0.0025	0.251	-0.0006
Finland	-0.0021	0.233	-0.0005
France	-0.0025	0.424	-0.0011
Germany	-0.0026	0.52	-0.0014
Italy	-0.0031	0.693	-0.0021
Netherlands	-0.0022	0.514	-0.0011
Norway	-0.0027	1.37	-0.0037
Spain	-0.0026	0.84	-0.0022
Sweden	-0.0024	0.385	-0.0009
Switzerland	-0.0018	0.291	-0.0005
United Kingdom	-0.0024	0.54	-0.0013
Russia	-0.0025	1.32	-0.0033
Denmark	-0.0016	0.23	-0.0004
Qatar	-0.0008	0.6	-0.0005
Saudi Arabia	-0.0011	1.28	-0.0014
United Arab Emirates	-0.0014	0.448	-0.0006
South Africa	-0.0022	1.26	-0.0028
Israel	-0.0023	0.641	-0.0015
India	-0.0015	0.511	-0.0008
Australia	-0.0021	0.467	-0.001
Hong Kong	-0.0008	0.146	-0.0001
Japan	-0.0009	0.244	-0.0002
Singapore	-0.0011	0.237	-0.0003
China	-0.0012	0.219	-0.0003
South Korea	-0.0016	0.45	-0.0007
Taiwan	-0.0007	0.419	-0.0003
Thailand	-0.0022	0.775	-0.0017
Indonesia	-0.001	1.05	-0.0011
Malaysia	-0.0006	0.297	-0.0002
Philippines	-0.0016	0.514	-0.0008
Average	**-0.0019**	**0.6412**	**-0.0014**

This table presents the impact of COVID-19 related uncertainty, quantified by Google search trends, on returns ($\beta_{i,GST}$), volatility ($\varphi_{i,GST}$) and overall ($OIU_{i,GST}$), on the MSCI All Country World Index and 35 country indices. $OIU_{i,GST}$ is computed as the product of $\beta_{i,GST}$ and $\varphi_{i,GST}$. The $\beta_{i,GST}$s and $\varphi_{i,GST}$s used to estimate the OIU measure in equation (7) are derived from equations (4) and (6a)/(6b)/(6c) respectively over the COVID-19 crisis period, 1 January 2020 to 20 October 2020.

Table 7A: Post COVID-19 crisis period factor structures

Panel A: Factor structure summary

Period	Factors extracted	Communality	KMO
Extended	5	0.5678	0.9334

Panel B: Proportion of variance explained during extended period

Factor	**Communality**	**Cumulative communality**
$F_{1,k}$	0.3872	0.3872
$F_{2,k}$	0.0830	0.4703
$F_{3,k}$	0.0490	0.5193
$F_{4,k}$	0.0283	0.5475
$F_{5,k}$	0.0203	0.5678

Panel C: Dependence structures

	Spearman ($\bar{\rho}_S$)	**Ordinary ($\bar{\rho}_P$)**
post-COVID-19 crisis	0.3320	0.3613

Notes: This table reports the results of factor analysis applied to returns over the post-COVID-19 crisis period, 21 October to 31 July 2021. Panel A reports the number of factors extracted for each period, associated communalities and KMO index values. KMO index values indicate suitability for factor analysis. Panel B reports the communalities associated with each extract factor score series and the cumulative communality for all four factor score series. Panel C reports average return correlations for the post-COVID-19 crisis period. Spearman and ordinary correlations are reported.

Table 8A: Final iteration results of elastic net regularization for the post-COVID-19 crisis period

	F_1: 4 iterations		
	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	0.0014	0.0014	0.0014
CAS_t	2.32E-06	2.32E-06	2.32E-06
DEA_{t-1}	0	0	0
DEC_t	0	0	0
CAC_t	0	0	0
CAC_{t-1}	0	0	0
CFR_{t-1}	0	0	0
GOR_t	0	0	0
FNI_t	0	0	0
WSI_t	0	0	0
d.f.	1	1	1
L1	0.0014	0.0014	0.0014
R^2	3.10E-09	3.10E-09	3.10E-09

	F_2: 4 iterations		
	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	-0.3194	0.0070	0.0070
CAS_t	-18.1397	0	0
CAS_{t-1}	-186.5	8.57E-07	8.57E-07
DEA_{t-1}	255.1	0	0
DEC_t	3.1272	0	0
CFR_{t-1}	-8312.5	0	0
GSM_t	0.0641	0	0
GST_t	0.0005	0	0
INI_t	-0.0825	0	0
d.f.	8	1	1
L1	8775.8	0.0	0.0
R^2	0.0768	1.66E-09	1.66E-09

	F_3: 6 iterations		
	λ_{min}	λ_{1SE}	λ_{2SE}
α_i	0.0762	0.0043	0.0043
CFR_t	2291.2	3.30E-05	3.30E-05
GOR_t	0.0942	0	0
GER_t	0.0286	0	0
GCR_t	0	0	0
GSM_t	0	0	0
AMT_t	0.0551	0	0
MHI_t	-0.0621	0	0
MCI_t	-0.0630	0	0
d.f.	6	1	1
L1	2291.6	0.0043	0.0043
R^2	0.0966	9.57E-10	9.57E-10

	F_4: 4 iterations		
	λ_{min}	λ_{1SE}	λ_{2SE}
α_i	0.0002	0.0070	0.0070
CAS_t	0	0	0
DEA_t	0	0	0
DEC_t	1.3224	5.14E-08	5.14E-08
RDI_t	0.2189	0	0
GFI_{t-1}	0.0417	0	0
GOR_t	0.0567	0	0
GER_t	-0.0304	0	0
WSI_t	0	0	0
MCI_t	0	0	0
d.f.	5	1	1
L1	1.6702	0.0070	0.0070
R^2	0.0251	3.71E-10	3.71E-10

	F_5: 4 iterations		
	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	-0.0010	-0.0010	-0.0010
CAS_t	0	0	0
REC_t	0	0	0
ACT_t	0	0	0
DEC_t	0	0	0
RDI_t	-0.1586	-0.1586	-0.1586
GOR_t	0	0	0
GSM_t	0	0	0
GST_t	0	0	0
EMV_t	0	0	0
AMT_t	0	0	0
WSI_t	0	0	0
d.f.	1	1	1
L1	0.1596	0.1596	0.1596
R^2	0.0033	0.0033	0.0033

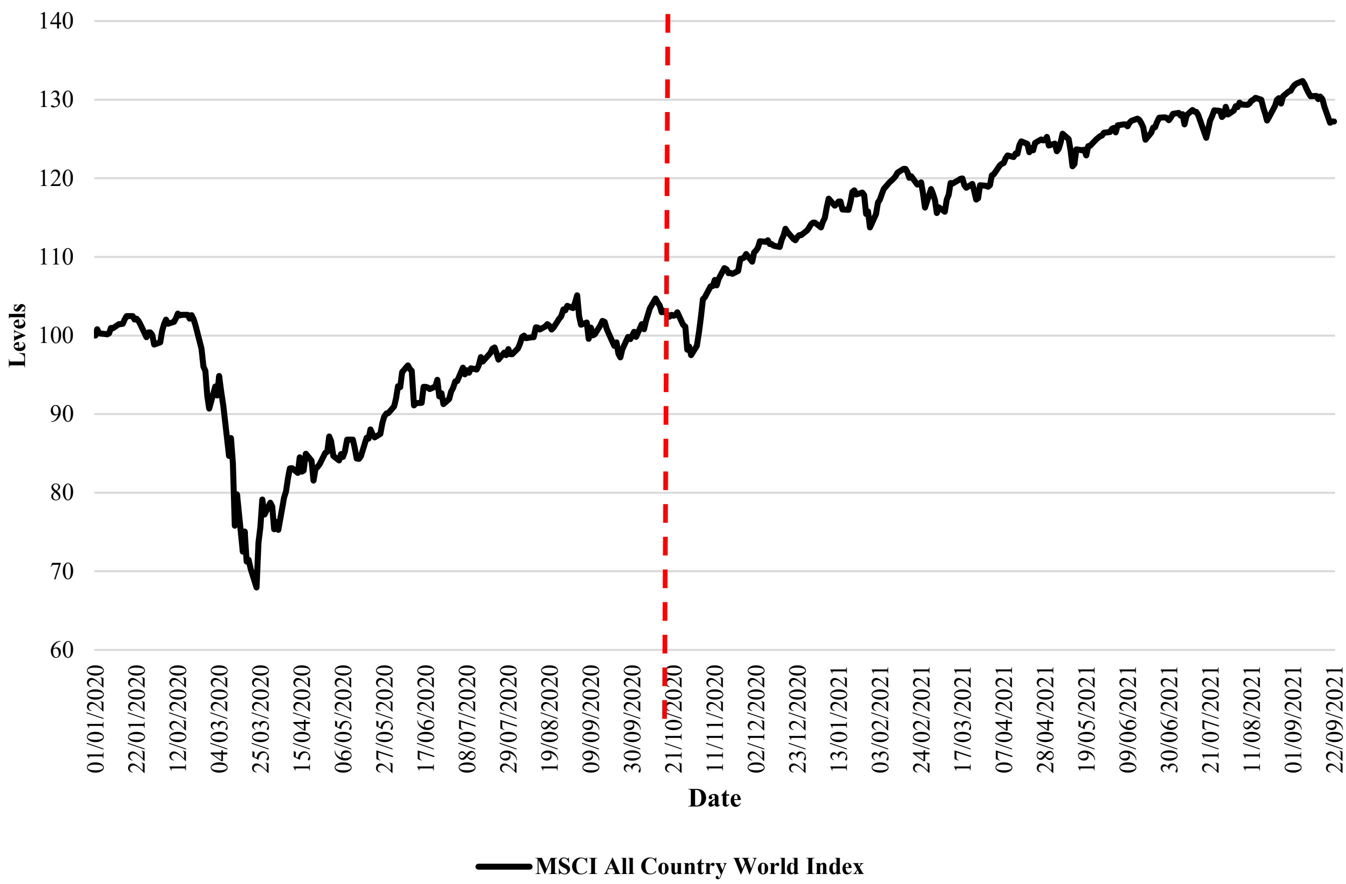
Notes: This table reports the results of the final iteration of the elastic-net based selection and identification procedure for the post-COVID-19 crisis period, 21 October 2020 to 31 July 2021. The procedure is repeated until only measures for which coefficients are non-zero for the λ_{min}, λ_{1SE} and λ_{2SE} penalties remain. *d.f.* is the number of measures with non-zero coefficients and L1 norm is the sparsity inducing penalty. R^2 is the coefficient of determination for COVID-19 measures with non-zero coefficients.

Table 9A: Factor score regressions over the post-COVID-19 crisis period

Factor	α_i	CAS_t	CAS_{t-1}	CFR_t	DEC_t	RDI_t	$R_{M\mathcal{E}t}$	$\bar{R}^2_{k,CV19}$	$ShVr$
	-0.1537	19.9893						0.0085	0.0033
	-0.1464		18.9732					0.0071	0.0027
	-0.0423			-1187.228				0.0039	0.0015
$F_{1,t}$	-0.0048				2.5553			0.0014	0.0005
	0.0014					0.2989		0	0
	-0.2183	16.5317	12.6018	262.8370	1.2151	0.1500		0	0
Std.	-0.2277*	0.1098	0.0700	0.0432	0.0374	0.0189	0.5687***	0.3234	0.1252
	-0.1695	22.7369*						0.0106	0.0009
	-0.2455**		32.4158**					0.0266	0.0022
$F_{2,t}$	-0.0409			-1300.588				0.0046	0.0004
	-0.0016				3.5031			0.0057	0.0005
	0.0070					1.1353		0.0027	0.0002
	-0.3106**	15.3701	26.9750**	399.4846	1.2044	0.9827		0.0197	0.0016
Std.	-0.3148**	0.0901	0.1464**	0.0393	0.0353	0.0785	0.2378***	0.0729	0.0061
	0.2248	-28.4132						0.0180	0.0009
	0.1833		-22.9809					0.0101	0.0005
	0.1043			2717.196*				0.0346	0.0017
$F_{3,t}$	0.0017				1.0626			0	0
	0.0043					0.1900		0	0
	0.1435	16.0976	-17.4304	3727.1**	3.6310	-0.1578		0.0314	0.0015
Std	0.1396	0.0911	-0.0938	0.2806**	0.1038	-0.0093	0.2154***	0.0742	0.0036
	0.0465	-5.0929						0	0
	-0.0461		6.8112					0	0
	0.0348			756.9272				0	0
$F_{4,t}$	-0.0041				4.5438**			0.0115	0.0003
	0.0071					1.3705		0.0053	0.0002
	-0.0327	5.3169	6.5823	1739.03	4.6174**	0.9389		0.0064	0.0002
Std.	-0.0450	0.0440	0.0313	0.1505	0.1298**	0.0770	0.6473***	0.4328	0.0122
	-0.0157	1.9043						0	0
	-0.1607		20.5087					0.0050	0.0001
	-0.0275			-720.5150				0	0
$F_{5,t}$	-0.0080				2.8938			0.0007	0
	-0.0011					-2.3428**		0.0208	0.0004
	0.0249	-33.6854	19.7487	-1933.9	4.2294	-2.6748**		0.0277	0.0006
Std.	0.0245	-0.1630	0.0957	-0.1279	0.1103	-0.1825**	0.01891	0.0231	0.0005

Notes: This table reports the results of regressions of factor scores derived from returns onto the COVID-19 measures, individually, jointly and jointly with standardised coefficients and a residual market factor incorporated (std row) over the post-COVID-19 crisis period spanning 21 October 2020 to 31 July 2021. Least squares with Newey-West heteroscedasticity and autocorrelation consistent (HAC) standard errors is used for estimation purposes. CAS_t is the growth in total COVID-19 cases. CFR_t are changes in the case fatality rate. DEC_t is the growth in the 7-day moving average of reported COVID-19 deaths. RDI_t is the growth in deviations of expectations over a 14-day window from present reported cases. $R_{M\mathcal{E}t}$ is the residual market factor derived by a regression of the MSCI All Country World Index onto the four measures. $ShVr$ is the contribution to total shared variance estimated by applying equation (3). The asterisks, ***, ** and *, indicate statistical significance at the respective 1%, 5% and 10% levels of significance.

Figure 1A: MSCI All Country World Index



Notes: This figure plots levels of the MSCI All World Market Index between 1 January 2020 and 31 July 2021. The red dashed line delineates the COVID-19 crisis period (1 January 2020 to 20 October 2020) and the post COVID-19 crisis period (21 October 2020 to 31 July 2021).

APPENDIX B: METHODOLOGICAL APPENDIX

Which COVID-19 information really impacts stock markets?

In this Appendix, we set out a methodological improvement that permits the disentanglement of the impact of correlated variables without the need to transform either variable of interest – the dependant or independent variables – through orthogonalisation (Wurm & Fisicaro, 2014). We apply this approach to investigate whether there could be other COVID-19 measures that matter aside from those identified in Section 3.2. We re-estimate equation (1) (in the main paper) by applying elastic net estimators for the purposes of measure selection. However, instead of using $F_{k,t}$, the original factor score series derived over the COVID-19 crisis period, as our dependant series, we use the residuals of the regressions of $F_{k,t}$ onto the three COVID-19 measures jointly, which we define as $F_{K\varepsilon,t}$. Our measure set now excludes GST_t, GSM_t and MHI_t and we repeat the measure selection exercise twice, first with all measures and then with all measures with over 200 observations and the original measures excluded in both cases. The results of the final iterations are reported in Table 1B below. By using factor score series that are orthogonal to influences reflected in GST_t, GSM_t and MHI_t, we identify measures that capture aspects of COVID-19 that impact international markets but are unrelated to these measures.

When all measures are considered – including those with under 200 observations - changes in the Google Mobility Tracker data, GMT_t, changes in levels of the Ravenpack Fake News Index, FNI_t, the (lagged) growth in the number of active cases, ACT_{t-1}, and changes in the Apple Mobility Tracker data, AMT_t, are associated with $F_{1\varepsilon,t}$, $F_{2\varepsilon,t}$, $F_{3\varepsilon,t}$ and $F_{4\varepsilon,t}$, respectively. When measures with over 200 measures are considered, the (lagged) growth in the number of active cases, ACT_{t-1}, the lagged growth in the 7-day moving average of reported COVID-19 deaths, DEC_{t-1} and changes in Apple Mobility Tracker data, AMT_t, are related to $F_{1\varepsilon,t}$, $F_{3\varepsilon,t}$ and $F_{4\varepsilon,t}$, respectively. Coefficients on all COVID-19 measures are zero for $F_{2\varepsilon,t}$ across penalties indicating no measure is related to $F_{2\varepsilon,t}$. We designate these as alternative measures, $F_{CV19A,t}$.

Table 1B: Final iteration results of elastic net regularisation for alternative COVID-19 measures over the COVID-19 crisis period

Panel A: All measures

$F_{1,t}$: 4 iterations	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	-0.0121	-0.0105	-0.0105
DEA_t	0	0	0
CAC_t	0	0	0
CFR_{t-1}	0	0	0
GER_t	-0.0037	0	0
GMT_t	-0.0225	-0.0035	-0.0035
d.f.	2	1	1
L1	0.0383	0.0140	0.0140
R^2	0.0394	0.0071	0.0071

$F_{2,t}$: 6 iterations	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	0.0047	0.0047	0.0047
CAS_t	0	0	0
CAS_{t-1}	0	0	0
DEA_t	0	0	0
ACT_t	0	0	0
CAC_t	0	0	0
CFR_t	0	0	0
RCI_{t-1}	0	0	0
RDI_t	0	0	0
RDI_{t-1}	0	0	0
GFI_{t-1}	0	0	0
FNI_t	-6.68E-	-6.68E-	-6.68E-
WSI_t	0	0	0
INI_t	0	0	0
d.f.	1	1	1
L1	0.0047	0.0047	0.0047
R^2	4.68E-07	4.68E-07	4.68E-07

$F_{3,t}$: : 7 iterations	λ_{min}	λ_{1SE}	λ_{2SE}
α_i	-0.0286	-0.0286	-0.0286
DEA_t	0	0	0
ACT_{t-1}	5.51E-08	5.51E-08	5.51E-08
DEC_t	0	0	0
RCI_t	0	0	0
RDI_{t-1}	0	0	0
GER_t	0	0	0
GMT_t	0	0	0
MCI_t	0	0	0
d.f.	1	1	1
L1	0.0286	0.0286	0.0286
R^2	9.42E-10	9.42E-10	9.42E-10

$F_{4,t}$: 3 iterations	λ_{min}	λ_{1SE}	λ_{2SE}
α_i	-0.0106	-0.0106	-0.0106
CAS_t	0	0	0
DEA_t	0	0	0
REC_t	0	0	0
DEC_t	0	0	0
AMT_t	-6.98E-10	-6.98E-10	-6.98E-10
RPI_t	0	0	0
INI_t	0	0	0
MCI_t	0	0	0
d.f.	1	1	1
L1	0.0106	0.0106	0.0106
R^2	6.24E-10	6.24E-10	6.24E-10

Panel B: Measures with over 200 observations

$F_{1,t}$: 4 iterations	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	-0.05161	-0.00168	-0.00168
ACT_{t-1}	1.0886	0.0874	0.0874
CFR_{t-1}	-28.2804	0	0
INI_t	-0.03766	0	0
d.f.	3	1	1
L1	29.4582	0.0891	0.0891
R^2	0.0551	0.0049	0.0049

$F_{2,t}$: : 6 iterations	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	-0.0019	-0.0065	-0.0065
DEA_{t-1}	-0.1359	0	0
DEC_{t-1}	0	0	0
CAC_t	0	0	0
CFR_{t-1}	34.334	0	0
FNI_t	-0.3976	0	0
INI_t	0.0164	0	0
d.f.	4	0	0
L1	34.8861	0.0065	0.0065
R^2	0.0331	0	0

$F_{3,t}$: : 7 iterations	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	-0.0709	-0.00588	-0.00588
CAS_t	0.2333	0	0
DEA_t	0.1792	0	0
DEC_{t-1}	1.0082	0.0941	0.0941
d.f.	3	1	1
L1	1.4916	0.1000	0.1000
R^2	0.0279	0.0038	0.0038

$F_{4,t}$: 2 iterations	λ_{min},	λ_{1SE}	λ_{2SE}
α_i	0.0056	-0.0018	-0.0018
CAS_t	0	0	0
DEA_t	0	0	0
CAC_t	0	0	0
CFR_t	0	0	0
AMT_t	-0.0944	-2.4E-10	-2.4E-10
FNI_t	0	0	0
FII_t	0	0	0
MCI_t	-0.0220	0	0
d.f.	2	1	1
L1	1.22E-01	1.79E-03	1.79E-03
R^2	6.48E-02	2.15E-10	2.15E-10

Notes: This table reports the results of the final iteration of the elastic-net based selection and identification procedure over the COVID-19 crisis period, 1 January 2020 to 20 October 2020. The procedure is repeated until only measures for which coefficients are non-zero for the λ_{min}, λ_{1SE} and λ_{2SE} penalties remain. *d.f.* is the number of measures with non-zero coefficients and L1 norm is the sparsity inducing penalty. R^2 is the adjusted coefficient of determination for COVID-19 measures with non-zero coefficients. The measure set employed includes all 24 measures but excludes GST_t (changes in worldwide COVID-19 related Google searches), GSM_t (changes in the stringency of measures applied by governments to control the spread of the COVID-19 virus as measured by the Oxford Coronavirus Government Response Tracker) and MHI_t (changes in the Ravenpack Media Hype Index). The dependent series are statistical factor scores derived from returns on the 35 stock markets in the sample, adjusted for GST_t, GSM_t and MHI_t – the three primary COVID-19 measures identified in the study.

Next, we regress each alternative measure, $F_{CV19A,t}$, onto the respective orthogonalised factor score series, $F_{K\varepsilon,t}$. Here we face a limitation. If we were to use the original factor series, $F_{K,t}$, and treat the resultant $\bar{R}^2$s as indicators of each alternative COVID-19 measure's ability to proxy for shared variance, then the amount of shared variance seemingly reflected by each COVID-19 measure will be misleading. This is because the alternative measures would also reflect that portion of shared variance which arises due correlation with the COVID-19 measures identified in Section 3.2. As the $F_{K\varepsilon,t}$s are adjusted for GST_t, GSM_t and MHI_t, the resultant $\bar{R}^2$s reflect the amount of shared variance that is reflected by each alternative measure but is *unrelated* to GST_t, GSM_t and MHI_t. In this case, we cannot claim that the resultant $\bar{R}^2$s are representative of explanatory power for $F_{K,t}$ as we are not using the original factor scores in our regressions onto the alternative measures.

We therefore propose an adjustment to the $\bar{R}^2$s from regressions of $F_{CV19A,t}$ onto $F_{K\varepsilon,t}$. We begin by relating the original factor scores to the orthogonalised factor scores, with the resultant $\bar{R}^2$ designated as $\bar{R}^2_{K\varepsilon}$. The $\bar{R}^2_{K\varepsilon}$s represent the remaining proportion of shared variance reflected by $F_{K\varepsilon,t}$ following the orthogonalisation of $F_{K,t}$ against the original COVID-19 measure set:

$$F_{K,t} = \alpha_i + \beta_{K\varepsilon} F_{K\varepsilon,t} + \varepsilon_{k,t} \quad \text{(B1)}$$

and

$$F_{K,t} = \alpha_i + \beta_{K,GST'} GST_t + \beta_{K,GSM} GSM_t + \beta_{K,MHI} MHI_t + \pi_{k,t} \quad \text{(B2)}$$

where the residuals of equation (B2), $\pi_{k,t}$, are now $F_{K\varepsilon,t}$ in equation (B1). Next, we regress each $F_{CV19A,t}$ against the respective $F_{K\varepsilon,t}$ that it is found to be associated with following after applying the iterative procedure:

$$F_{K\varepsilon,t} = \alpha_i + \beta_{K\varepsilon,CV19A} F_{CV19A,t} + \varepsilon_{k\varepsilon,t} \quad \text{(B3)}$$

The resultant $\bar{R}^2$s, denoted as $\bar{R}^2_{CV19A,\varepsilon}$s, represent the proportion of explanatory power associated with an alternative measure that is *not* attributable to correlation with the original measures, GST_t, GSM_t and MHI_t, because $F_{K\varepsilon,t}$ is orthogonal to these measures. However, the communality reflected by $\bar{R}^2_{CV19A,\varepsilon}$ for each measure associated with $F_{K\varepsilon,t}$ will be overstated. This is because the $F_{K\varepsilon,t}s$ are adjusted for GST_t, GSM_t and MHI_t and do not reflect the same amount of shared variance as $F_{K,t}$, such that in terms of shared variance reflected, $F_{K,t} > F_{K\varepsilon,t}$. It therefore follows that for a regression of $F_{K,t}$ onto the alternative measures, the $\bar{R}^2_{CV19A}$ must be less than $\bar{R}^2_{CV19A,\varepsilon}$ because $F_{K,t} > F_{K\varepsilon,t}$ in terms of total shared variance.

Consequently, the next step is to adjust the $\bar{R}^2_{CV19A,\varepsilon}$ to reflect the unrelated proportion of shared variance that would be explained if an alternative measure was regressed against an unorthogonalised factor score series, $F_{K,t}$. The reason why we need to make this adjustment is because if we regress $F_{K,t}$ – the unadjusted factor score series – onto our alternative measures, the resultant $\bar{R}^2_{CV19A}$ will reflect the portion of shared variance that is also attributable to correlation between $F_{CV19A,t}$ and GST_t, GSM_t and MHI_t and therefore the $\bar{R}^2$ will be overstated. We thus adjust $\bar{R}^2_{CV19A,\varepsilon}$ derived from equation (B3) by the proportion of remaining shared variance reflected by $F_{K\varepsilon,t}$, $\bar{R}^2_{\varepsilon}$ as determined by equation (B1):

$$OSV = \bar{R}^2_{CV19A,\varepsilon}\bar{R}^2_{K\varepsilon} \quad \text{(B4)}$$

where OSV is the "orthogonal shared variance" – the amount of total shared variance explained by an alternative measure that is uncorrelated with the original measure set. In summary, this approach allows us to attribute orthogonal explanatory power without the need to transform the explanatory variables through orthogonalization (see Wurm & Fisicaro, 2014).[1]

We begin by estimating equation (B1) and estimate $\bar{R}^2_{K\varepsilon}$s of 0.8100, 0.8803, 0.9096 and 0.8831 for $F_{1\varepsilon,t}$, $F_{2\varepsilon,t}$, $F_{3\varepsilon,t}$ and $F_{4\varepsilon,t}$ respectively. Next, each $F_{K\varepsilon,t}$ series is regressed onto each associated measure and then onto all measures jointly for both alternative measure sets. Both the $\bar{R}^2_{CV19A,\varepsilon}$ and OSV measures for each respective alternative measure are lower than that for the measures reported in Table 5. For example, the $\bar{R}^2$ for the regression of $F_{1,t}$ onto GST_t is 0.1758. For regressions for the corresponding orthogonalised factor score series, $F_{1\varepsilon,t}$ and the related measures, GMT_t and AMT_t , the $\bar{R}^2_{CV19A,\varepsilon}$ and OSV measures in Panels A and B in Table 2B are 0.0449 and 0.0364, and 0.0279 and 0.0226, respectively. We expect this to be the case, given that the alternative measures are "secondary" measures – measures that are relevant but were not selected in the first instance.

Next, the respective OSV measures are then multiplied by the communalities associated with each $F_{K,t}$ by applying equation (3). Following the methodology outlined above, the first alternative set explains an additional 2.20% (2.65%) of shared variance whereas the second alternative set explains an additional 1.36% (2.01%) of shared variance over and above the original measure set when the alternative measures are related to factor scores individually (jointly). After adjusting for structural breaks in ACT_{t-1} and AMT_t in the respective alternative sets, total shared variance explained increases marginally to 2.68% and 1.72% when calculated considering measures individually. When the $F_{K\varepsilon,t}$s are related to the first and second set of alternative measures jointly with adjustments for structural breaks, the total shared variance explained increases to 4.67% and 3.10% respectively.

[1] See Wurm and Fisicaro (2014) for a discussion of orthogonalisation (and its pitfalls) to account for correlation between explanatory variables.

Table 2B: Orthogonalised factor score regressions onto alternative COVID-19 measures over the COVID-19 crisis period

Panel A: First alternative measure set							
Factor	α_i	GMT_t	FNI_t	ACT_{t-1}	AMT_t	$\bar{R}^2_{CV19A,\varepsilon}$	OSV
$F_{1\varepsilon,t}$	-0.0200	-0.0473**				0.0449	0.0364
	-0.0519	-0.0488**	-0.2413	1.2170	0.0690	0.0497	0.0403
$F_{2\varepsilon,t}$	0.0015		-0.5248			0.0128	0.0113
	-0.0012	0.0042	-0.4714	0.3395	0.0398	0.0000	0.0000
$F_{3\varepsilon,t}$	-0.0480			0.7725**		0.0084	0.0076
	-0.1543**	0.0380	0.4833*	4.5369**	0.0279	0.0367	0.0334
$F_{4\varepsilon,t}$	-0.0022				-0.1370**	0.0559	0.0494
	0.1213	-0.0190	-0.3035	-4.3433	-0.1829**	0.0818	0.0722

Panel B: Second alternative measure set							
Factor	α_i	ACT_{t-1}	-	DEC_{t-1}	AMT_t	$\bar{R}^2_{CV19A,\varepsilon}$	OSV
$F_{1\varepsilon,t}$	-0.0701	1.0951***				0.0279	0.0226
	-0.0535	1.6084***		-1.0080**	0.0214	0.0387	0.0313
$F_{2\varepsilon,t}$	-	-				-	-
	0.0157	-0.8423***		0.7282***	0.0332	0.0043	0.0038
$F_{3\varepsilon,t}$	-0.0514			1.2183***		0.0204	0.0186
	-0.0691	0.3830		1.0853***	0.0267	0.0147	0.0134
$F_{4\varepsilon,t}$	-0.0022				-0.1369**	0.0559	0.0494
	0.0226	-0.6236		0.3198	-0.1424**	0.0526	0.0465

Notes: This table reports the results of regressions of orthogonalised factor scores onto the COVID-19 measures individually with breakpoints over the COVID-19 crisis period, 1 January 2020 to 20 October 2020. Least squares with Newey-West heteroscedasticity and autocorrelation consistent (HAC) standard errors is used for estimation purposes. GMT_t are changes in the Google Mobility Tracker. FNI_t are changes in the Ravenpack Fake News Index. ACT_{t-1} are changes in the number of active cases. AMT_t are changes in Apple Mobility Tracker data. DEC_{t-1} is the growth in 7-day moving average of reported COVID-19 deaths. $F_{K\varepsilon.t}$ are factor scores that are orthogonal to the three COVID-19 measures identified in Section 3.2. $\bar{R}^2_{CV19A.\varepsilon}$ is the adjusted coefficient of determination for each alternative measure regressed against the orthogonal factor score series. OSV is the orthogonal shared variance, which is the coefficient of determination for each alternative measure adjusted by the amount of shared variance reflected by each $F_{K\varepsilon.t}$ as a fraction of the original factor score series. The asterisks, ***, ** and *, indicate statistical significance at the respective 1%, 5% and 10% levels of significance.

What emerges from these results and those presented in Section 3.2 is that there is a set of key COVID-19 measures that move international markets, these being GST_t and MHI_t and two highly correlated (and related measures), GSM_t and GOR_t. Depending upon how total shared variance is determined – whether measures are considered individually, jointly, with or without structural breaks – these measures explain between just over 10% and 20% of shared variance across national markets. Then, there are other measures that are far less important. These alternative measures explain, at most, just over 4.6% of shared variance. The conclusion that follows is that most of the impact of COVID-19 over the COVID-19 crisis period on international markets can be summarised by small number of COVID-19 related measures.