Mesirow

COVID-19, Economy and FX: Past, Present and Future

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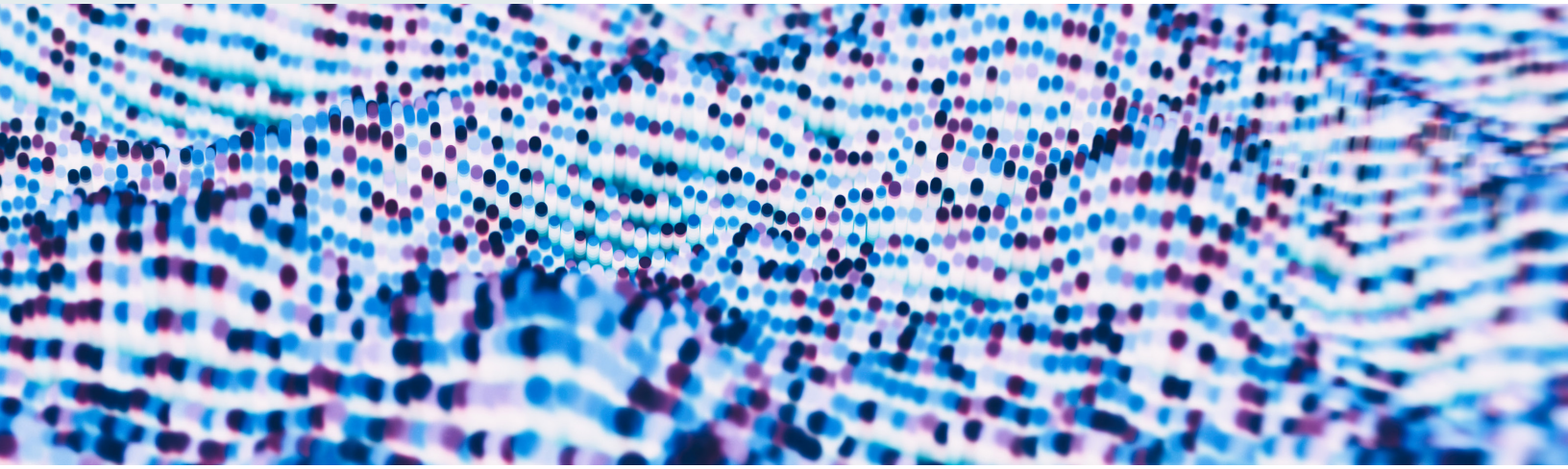
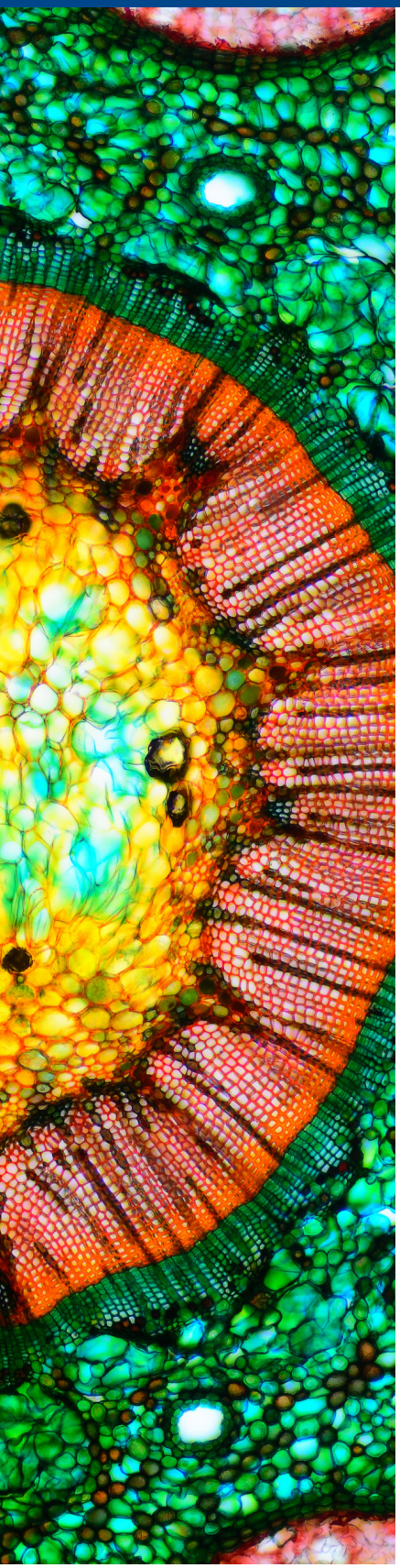
Analyzing pandemic economic effects and foreign exchange rate movements

Abstract

This paper offers an extensive analysis of the economic impact of the COVID-19 pandemic and the effects of the pandemic on several currencies. We then explain a predictive model that utilizes COVID-19 indicators to generate FX trading signals.

Over a portfolio of 28 currency pairs, the model applies a simple linear regression to the number of daily new COVID-19 cases in each country to, mainly, short the currencies against the USD. After optimizing the model's hyper-parameters over the validation data, this model results in a +3.50 return, with 0.84 standard deviation, resulting in 4.01 return-to-risk (information ratio), over the out-of-sample period.





1. Introduction

The COVID-19 pandemic created a non-homogenous effect on global economies and is causing a divergence in economic recovery rates between developed and emerging markets. This effect is evident even between advanced economies as each country has unique lockdown policies, different underlying economies, different population distributions, and varying levels of vaccination rates.

It is expected that this divergence among advanced economies (and between advanced and emerging economies) will feed through to movements in exchange rates. The goals of this paper are to 1) understand the effect of the COVID-19 pandemic on the different types of economies 2) understand the correlation between COVID-19 statistics and FX markets and 3) create a predictive model based on a COVID-19 infection rate signal to opportunistically predict currency depreciations.

The rest of this paper is broken down as follows:

- **Section 2** – Outlines the background on pandemic economies and the economic effects of COVID-19 on the selected countries of this study
- **Section 3** – Describes COVID-19 status of our selected countries (as of 12.31.21)
- **Section 4** – Considers the relationship between COVID-19 and FX rates
- **Section 5** – Describes our predictive model
- **Section 6** – Details the backtest and experimental results of our predictive model
- **Section 7** – Conclusion

2. Economic effects of COVID–19

Background ("Money, Machines and Mayhem – The Economist"[1])

The current pandemic has been unique in the measures taken to shut down parts of the economy in order to limit the strain on healthcare systems. Past global pandemics can provide valuable information towards the economic effects that result from containment measures and the rebound in activity post-pandemic.

Relevant historic global pandemics include the smallpox outbreak of the 1870s and the Spanish Flu of 1919. While the smallpox epidemic was relatively contained to Europe, the Spanish Flu was more global and fatal. It is estimated that over 500 million individuals were infected by the Spanish Flu and 50 million people died as a result.

The economies of WWI and WWII present similarities to the current pandemic economy given the level of disruption to everyday life and activity. WWI led to the deaths of 20 million people globally[2] while WWII was associated with the deaths of over 75 million people.[3] While the current pandemic has not reached these levels of lethality (as of early March 2022, approximately 6 million people have sadly died from COVID-19), the uncertainty and reduced economic activity and mobility parallels the effects on wartime economies of the 20th century.

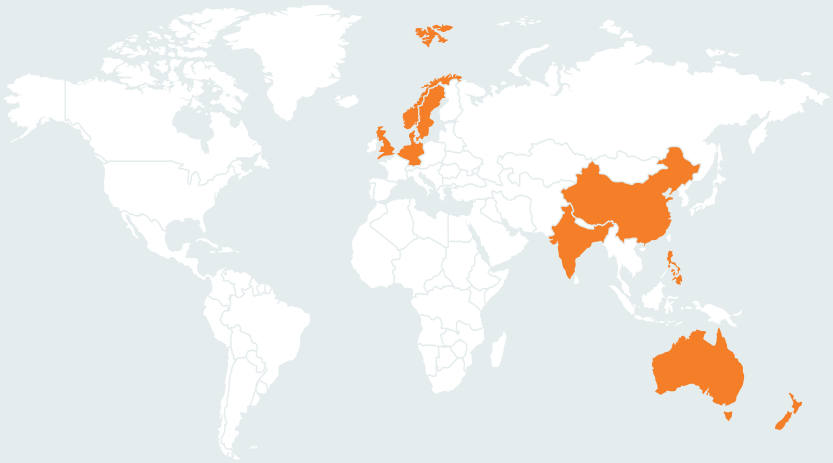
In both war and pandemic economies, there is a clear effect on household savings which has implications for demand once these events come to pass. During the smallpox epidemic, household savings in England nearly doubled. During the Spanish Flu, U.S. household savings hit their highest levels until WWII, in which they were equivalent to around 40% of GDP.

On the supply side of the economy, research studies have shown that technology and automation tend to rise following these types of disruptions. This will be an important factor in the post-COVID economy as the current pandemic has been unique in that both supply and demand were intentionally disrupted in order to curb the spread of the virus. This dynamic is evident in the economic data.

1. https://www.economist.com
2. http://www.centre-robert-schuman.org
3. https://courses.lumenlearning.com

Data | Country selection

The countries selected for this portion of the study are as follows: United Kingdom, Germany, Norway, Philippines, India, China, Australia, New Zealand, and Sweden. These countries were selected based on COVID lockdown strategies and underlying economies (services oriented vs. manufacturing oriented, export vs. import economies, etc.). Additionally, both Australia and New Zealand are unique given their locations and ability to completely close their borders to foreigners (as opposed to countries with land borders).



Sweden was selected based on its avoidance of full-scale lockdowns, which was in contrast to the Australian and New Zealand eradication approach. In between these two extremes lie the rest of the countries included in this study.

The countries selected also provide a broad sample of how the pandemic adversely affected various parts of the economy. For example, services-oriented economies, such as the U.K., Australia, and New Zealand, felt the burden of the lockdowns through the accommodation and food services industries whereas industrial-oriented export economies, such as Germany and the Philippines, experienced adverse effects to industrial production and manufacturing. Given that the shutdowns created negative demand and supply shocks, each country's dependence on the above industries generally corresponded to the magnitude in changes to real GDP.

This portion of our study leveraged the Oxford COVID-19 Government Response Trackers' stringency index to determine each country's relative level of lockdown measures enforced to curb the spread of the virus. The stringency index is derived from 23 indicators such as school closures, travel restrictions, vaccination policies, and mask mandates, that are aggregated into a single number from 0-100 (0 being the least stringent, 100 being the most stringent).

COVID-19 specific data (infections, deaths, vaccinations) was obtained from Our World in Data. Economic data for each country was obtained from Bloomberg and from the Organisation for Economic Co-operation and Development (OECD).

UK | A services oriented economy

The U.K. experienced the largest single quarterly real GDP decline of all the countries in the study. Given that services accounted for 79.6% of the U.K.'s GDP in 2020 and lockdowns directly impacted services-oriented businesses, this drop in real GDP is no surprise.

GDP

⇩ 19.4% decline in 2Q20

⇧ 17.6% rebound during 3Q20

Distribution, Transport, Hotel and Restaurants ("DTHR"), the second largest component of all services industries in the U.K., was impacted the most, falling by 31.8% in 2Q20. Like the U.K.'s real GDP, DTHR recovered by 42.8% the following quarter, although the recovery was short-lived as the renewed lockdowns continued to impact this sector throughout 2021.

The U.K.'s furlough program, a government program enacted to prevent increased unemployment rates while providing citizens with temporary income, also suggests that food and tourist related industries were most sensitive to lockdown policies. Figure 2.1 shows the number of furlough claims in Accommodation and Food Services in comparison to those in Construction, Administrative and Support Services, and Wholesale and retail.

Accommodation and Food Services accounted for the majority of total furlough claims filed in the U.K., followed by Wholesale and Retail. These industries suffered the most as their business models revolve around maximizing foot traffic, which was severely limited during lockdowns.

UNEMPLOYMENT

Because of the furlough program, the U.K.'s unemployment rate has not seen a dramatic increase throughout the pandemic thus far (Figure 2.2).

⇧ 5.2% at its apex in 4Q20, however, it dropped to

⇩ 4.10% at the end of November 2021 with Accommodation and Food Service workers feeling the greatest impact.

EXPORTS & IMPORTS

⇩ 10.1% decrease in U.K. exports during 2Q20, driven, in part by the

⇩ 59.9% decrease in U.S. imports during 2Q20

Imports fell in 2Q20 and have fluctuated since, depending on the severity of the lockdown policies.

⇩ 21.1% decrease in U.K. imports, driven by a drop in domestic consumer expenditures and the

⇩ 20.1% decrease in exports from Germany in 2Q20.

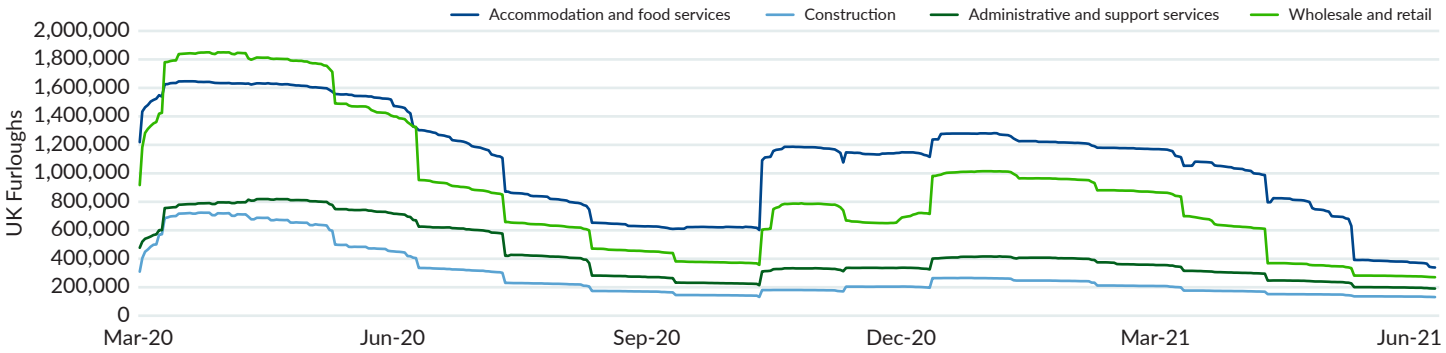
CONSUMER PRICES

Turning to CPI, prices in the U.K. remained stable as the economy experienced simultaneous supply and demand shocks. Consumer prices have increased as the economy has reopened, increasing by 5.4% YoY as of 4Q21. Manufacturing prices, however, experienced slight deflation from 2Q20 – 3Q20. Prices have since increased by 9.8% YoY as of the end of 2Q21.

Going forward, it is expected that inflationary pressures will continue to rise as U.K. household savings rates peaked at 25% during the first wave of the pandemic and sat at 20% at the end of 1Q21 (Figure 2.3) coupled with supply chain disruptions faced during the pandemic that have not yet fully recovered and may not be able to keep up with demand.

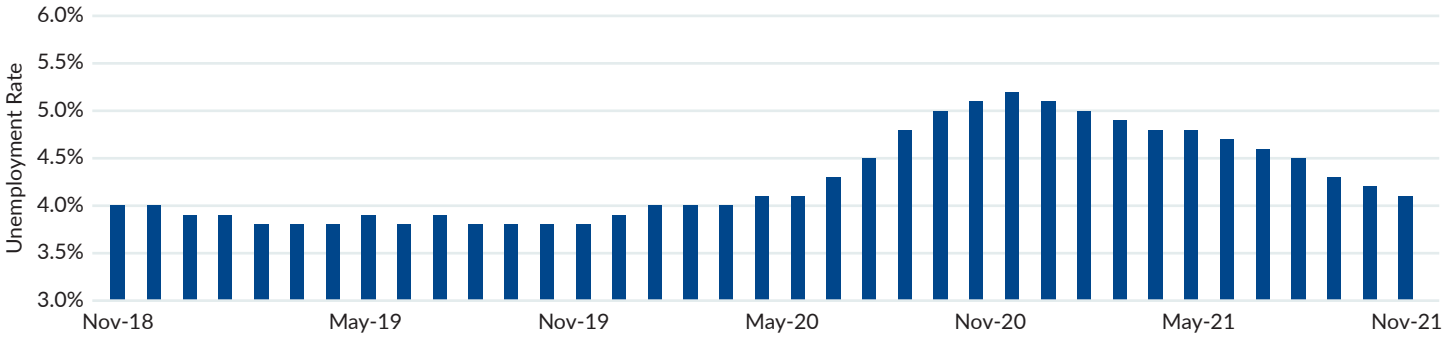
Additional sources: commonslibrary.parliament.uk, www.gov.uk

FIGURE 2.1: **UK FURLOUGHS – ACCOMMODATION AND FOOD SERVICES VS. CONSTRUCTION VS. ADMIN AND SUPPORT SERVICES (MARCH 2020 – JUNE 2021)**



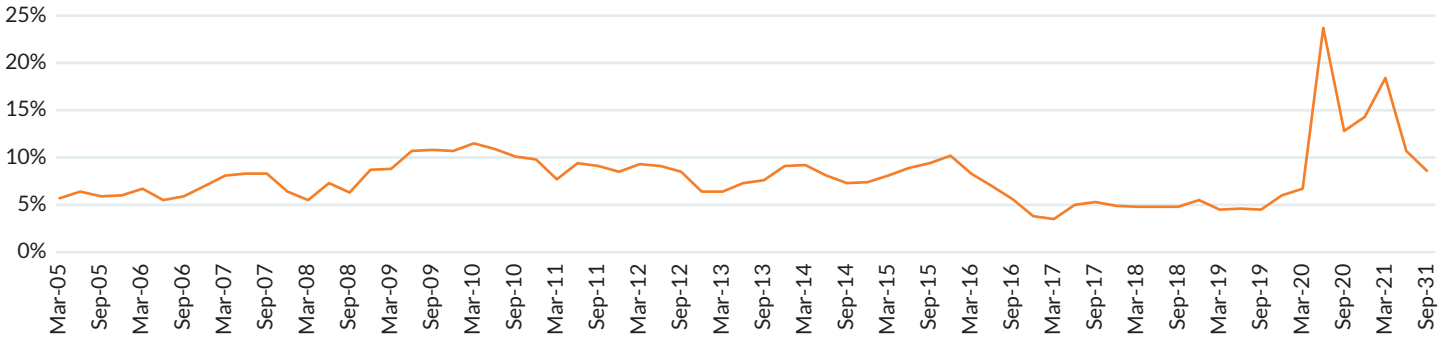
Source: www.gov.uk

FIGURE 2.2: **UK UNEMPLOYMENT RATE (NOVEMBER 2018 – NOVEMBER 2021)**



Source: www.gov.uk

FIGURE 2.3: **UK HOUSEHOLD SAVINGS (MARCH 2005 – SEPTEMBER 2021)**



Source: Bloomberg

Germany | A manufacturing and export oriented economy

GDP

⇩ 10.0% decline in 2Q20

⇧ 9.0% rebound in 3Q20 (Figure 2.4)

Given the sensitivity to the COVID-19 cycles and lockdown policies, Germany's quarterly GDP has not recovered to its pre-pandemic levels. Similarly, Germany's unemployment rate reached a peak of 6.4% in 2Q20 and has been steadily declining since.

The largest components of Germany's real GDP are industrial production (excluding construction), manufacturing, public administration and defense, and wholesale/retail trade and food services. Not surprisingly, these sectors were impacted the most from lockdown policies. In 2Q20:

⇩ 17.4% decrease in industrial production

⇩ 18.9% decrease in manufacturing output

⇩ 15.1% decrease in wholesale/retail trade and food services

⇩ 8.5% decrease in public admin and defense

Industrial production and manufacturing promptly recovered after the first COVID-19 infection cycle but continued to fall as new lockdown measures were implemented.

The lockdowns also had adverse effects on household consumption and gross capital formation. Household consumption fell by 11.6% in 2Q20. Similarly, gross capital formation fell by 8.4% in 2Q20, with machinery and equipment taking the largest decrease of 14.79% during the quarter.

EXPORTS & IMPORTS

Germany's exports decreased by 20.2%% in 2Q20 as a result of the shutdown of manufacturing facilities, supply chain disruptions that impacted the export of vehicles (such as semiconductors), and a decrease in imports from its top export recipients, such as the U.S. and the U.K.

⇩ 20.6% decrease in export of goods in 2Q20

⇩ 18.1% decrease in export of services in 2Q20

While not at pre-pandemic levels, exports have been steadily recovering, but imports were also negatively impacted by the lockdowns, falling by 16.9% in 2Q20.

⇩ 12.6% decrease in imports of goods in 2Q20

⇩ 30.9% decrease in imports of services in 2Q20

CONSUMER & PRODUCER PRICES

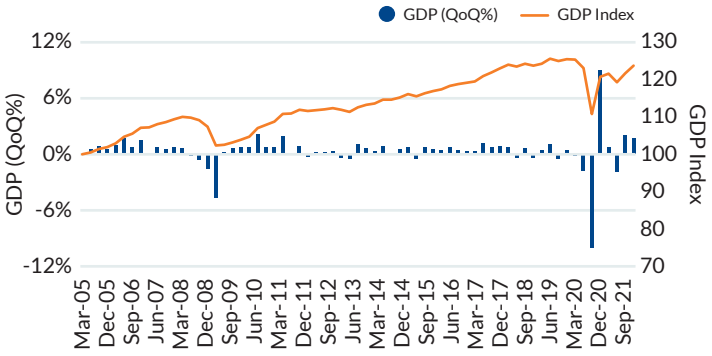
Consumer prices remained stable throughout the early stages of the pandemic, increasing by 0.8% YoY in 2Q20. Consumer prices have since risen by 5.7% YoY as of 4Q21 and is likely to persist based on increased demand.

⇩ 1.8% decrease in producer prices (YoY in 2Q20)

⇧ 24.2% increase (YoY at the end of 4Q21)

While a portion of this increase may be due to the base effect, it remains to be seen whether producer prices will continue to rise as suppliers try to keep up with demand fueled by the growth in household savings. Household savings doubled to 20.3% in 2Q20 and stands at 12.2% as of 3Q21.

FIGURE 2.4: **GERMANY'S REAL GDP (MARCH 2005 – SEPTEMBER 2021)**



Source: Bloomberg

Norway | An oil-based economy

Norway presents an interesting case study of how an oil-oriented economy performed during the pandemic.

GDP

⇩ 4.7% fall in 2Q20, but has been recovering since

Industrial production, public admin/defense and wholesale and retail trade/accommodation and food services are the three largest components of Norway's real GDP (excluding exports). Industrial production (excluding construction) was stable throughout the pandemic, only falling by 2.4% in 4Q20. Wholesale and retail trade fell by 10.0% in 2Q20 and has struggled to recover given its sensitivity to lockdowns. Public admin/defense fell by 4.5% but has recovered to its pre-pandemic levels.

EXPORTS & IMPORTS[4]

⇩ 7.5% decrease in exports of goods

⇩ 7.5% decrease in crude oil/natural gas exports

⇩ 49.3% decrease in exports of ships and oil platforms

⇩ 9.2% decrease in exports of services

Except for crude oil/natural gas, exports have returned to pre-pandemic levels.

Imports were notably more sensitive to the lockdown measures. Imports fell by 13.6% in 2Q20 and was impacted by subsequent waves of COVID-19 infections. During the second wave (March 2021), imports fell by 9.7% and still remain below pre-pandemic levels (as of 4Q21).

CONSUMER & PRODUCER PRICES

Consumer prices in Norway remained stable throughout 2020, rising by 1.4% YoY as of December 2020. As housing and utility costs have increased throughout the country, consumer prices in 2021 have increased 5.3% YoY as of 4Q21, a high not seen since 2008.

Producer prices have been much more volatile when compared to consumer prices.

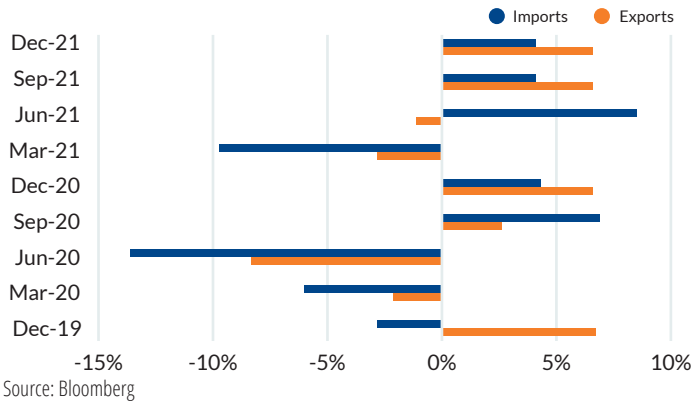
⇩ 14.4% decrease YoY through June 2020

⇩ 5.7% decrease YoY as of December 2020, but since then, prices have sharply increased by

⇧ 68.7% increase YoY as of December 31, 2021

The increase in prices is mostly likely the result of increased demand from export partners. The largest increases have come from the extraction of oil and natural gas (+179% YoY) and electricity, gas and steam supply (+112% YoY; both figures not seasonally adjusted).

FIGURE 2.5: **NORWAY EXPORTS & IMPORTS (DECEMBER 2019 – DECEMBER 2021)**



Source: Bloomberg

4. These figures are not seasonally adjusted

Philippines | An emerging economy

An example of a manufacturing and export oriented emerging economy, the Philippines was more sensitive to lockdowns relative to the other countries in this study.

GDP

The Philippines' economy is seasonal such that its major industries typically decrease during the first quarter of every year. Driving the 15.6% real GDP decrease in 2Q20 was the following:

- ⇩ 11.9% decrease in household consumption
- ⇩ 36.7% decrease in fixed capital formation
- ⇩ 8.2% decrease in construction (after contracting by 31.5% in the first quarter)
- ⇩ 17.8% decrease in manufacturing

Additionally, around 10.0% of the Philippines' real GDP is from agriculture, which decreased by 17.5% in 1Q20 and further decreased by an additional 5.4% in 2Q20.

Unemployment increased from 5.3% in January 2020 to 17.7% in April 2020 but has since recovered to 6.5% as of 4Q21.

EXPORTS &IMPORTS

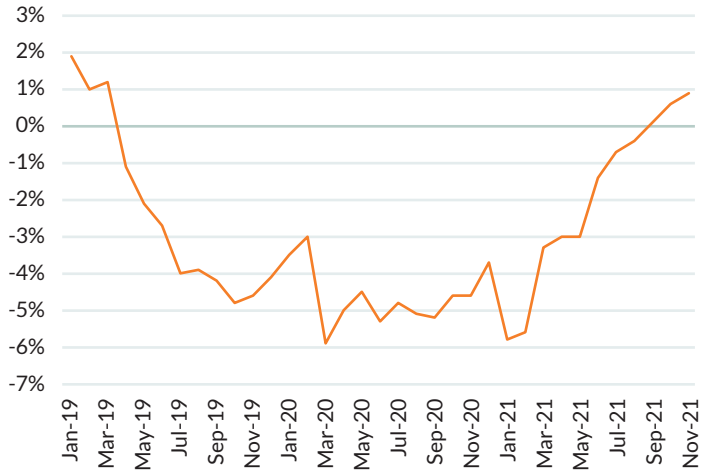
Exports fell by 24.4% in 2Q20, driven by the lockdowns and decreases in imports from its top trade partners, such as the U.S., Japan and China. Specifically, during the second quarter of 2020 there was a

- ⇩ 21.3% decrease in exports of goods
- ⇩ 27.7% decrease in exports of services

Goods imported also fell by 25.1% in 2Q20 but have nearly recovered to pre-pandemic levels. Services imported fell by 43.1% in 2Q20 and have struggled to recover since (Figure 2.6).

Consumer inflation remained on its prior trajectory of around +3% YoY. Producer prices, however, have experienced prolonged deflation throughout the pandemic. During the onset of the initial global lockdowns, producer prices fell by around 6% YoY in March 2020. Through February 2021, the YoY decrease in PPI hovered around -5%, but prices started to rise in March 2021 and as of November 30, 2021, PPI was up 0.9%.

FIGURE 2.6: **PHILIPPINE PRODUCER PRICES (JANUARY 2019 – NOVEMBER 2021)**



Source: Bloomberg

India | An emerging economy

India's emerging economy has been sensitive to the lockdown measures enforced to contain the spread of the virus. Quarterly GDP fell by around 30% (not seasonally adjusted) in 2Q20 (Figure 2.7) followed by a recovery of 22% in 3Q20 and continued growth of 10% in 4Q20.

UNEMPLOYMENT

India's unemployment rate (trailing 30-day unemployment) has also been sensitive to the COVID-19 infection cycles, reaching 23% in April and May of 2020. India's unemployment has stayed around the 7-9% range since this spike, with May 2021 being the exception where it hit close to 12% as a result of the delta variant's spread.

GDP

Driving the decrease in quarterly GDP and rise in the unemployment rate was the impact COVID-19 had on India's largest components of GDP; finance/Insurance/business services, India's largest industry as a percentage of GDP, has increased on average by around 26.0% during the second quarter of every year since 2012 (industry is cyclical), but only increased by 20.7% during 2Q20, returning to its 2018 levels.

Trade/Transport/Hotels/Communications:

⇩ 53.0% decrease in 2Q20

⇧ 55.1% recovery/increase in 3Q20

⇩ 35.3% decrease in 2Q21 (Delta variant)

Also in 2Q20, Manufacturing and Construction decreased by 38.5% and 52.6%, respectively, but have been recovering since.

EXPORTS & IMPORTS

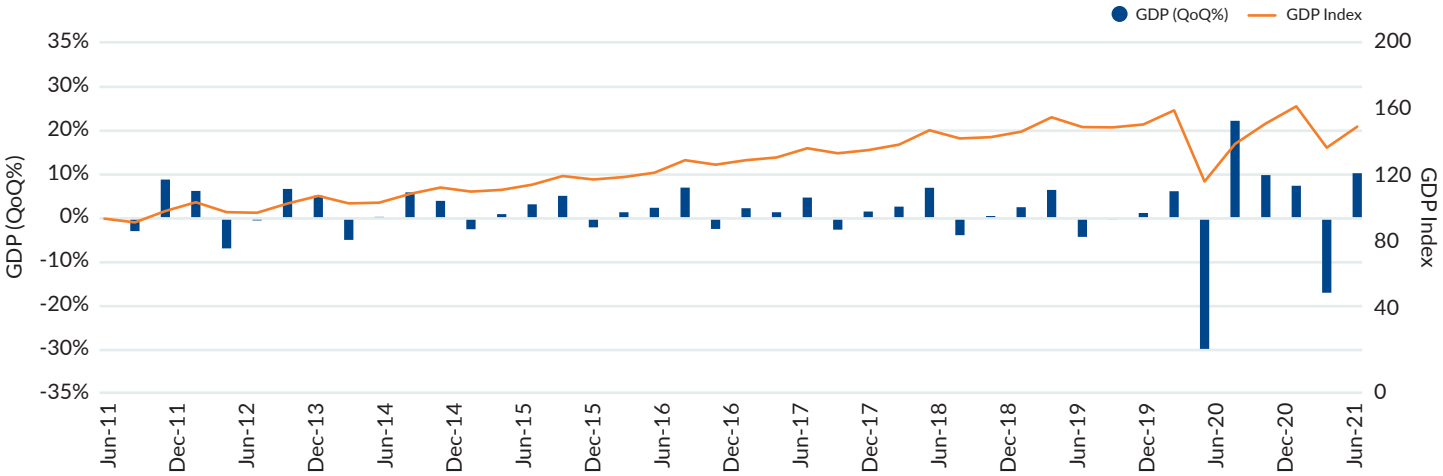
India's exports and imports were also negatively impacted by the COVID-19 infection cycles. Exports fell by 21% in 3Q20 and have yet to recover to pre-pandemic levels. Imports were more sensitive to lockdown measures, falling by 25% in 2Q20. Like exports, imports have also not recovered to pre-pandemic levels and continue to be impacted by successive waves of COVID-19 infections.

CONSUMER & PRODUCER PRICES

Consumer prices were elevated throughout 2020 relative to 2019 and increased by 4.6% YoY at year end 2020. As of December 2021, consumer prices have increased by 5.6% YoY. The increases in consumer prices were driven by increases in fuel and light, clothing, and housing costs. Wholesale prices decreased by 1.8% during the first half of 2020. Prices recovered during the second half of the year, increasing by 2.0% at year-end 2020.

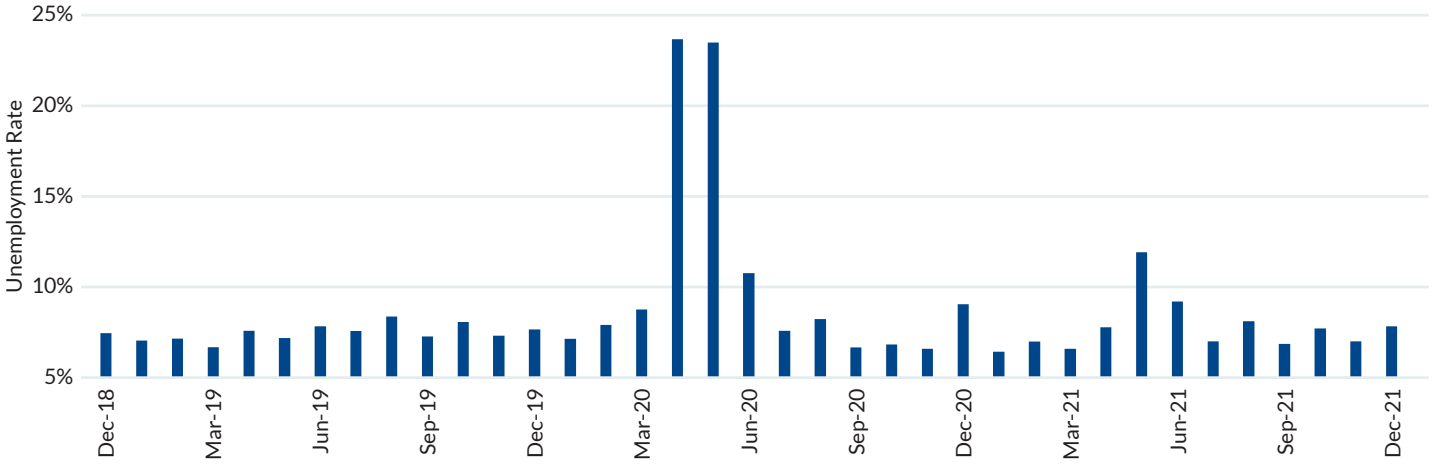
Producer prices have increased dramatically throughout 2021, increasing by 13.5% YoY as of December 2021. This increase was driven by the 32.3% increase in fuel power light prices and 10.6% increase in manufacturing prices.

FIGURE 2.7: **INDIA'S REAL GDP (JUNE 2011 – SEPTEMBER 2021)**



Source: Bloomberg

FIGURE 2.8: **INDIA'S UNEMPLOYMENT RATE (DECEMBER 2018 – DECEMBER 2021)**



Source: Bloomberg

China | Earliest economic effects

With the pandemic originating in Wuhan, the effects of the COVID-19 lockdowns affected the Chinese economy earlier relative to the rest of the world. Quarterly GDP fell by 10.5% in 1Q20 but recovered to its pre-pandemic levels the following quarter (Figure 2.9). Growth has been slower, however, throughout 2021.

GDP

Largely driving the decrease in GDP the first quarter of 2020 was China's primary and secondary industries. China's primary industries (cultivation and acquisition of raw materials) fell by 3.2% YoY in 1Q20 but have recovered to pre-pandemic levels. More importantly, China's secondary industries (manufacturing/assembly processes) fell by 9.6% YoY in 1Q20. This makes sense given the direct impact lockdowns had on manufacturing facilities.

As expected, manufacturing fell by 10.2% YoY in 1Q20. Construction, Wholesale/Retail Trade, Transportation/ Storage/Postal Services and Hotels/Catering Services all were the most impacted sectors of the economy. In 1Q20 there was a:

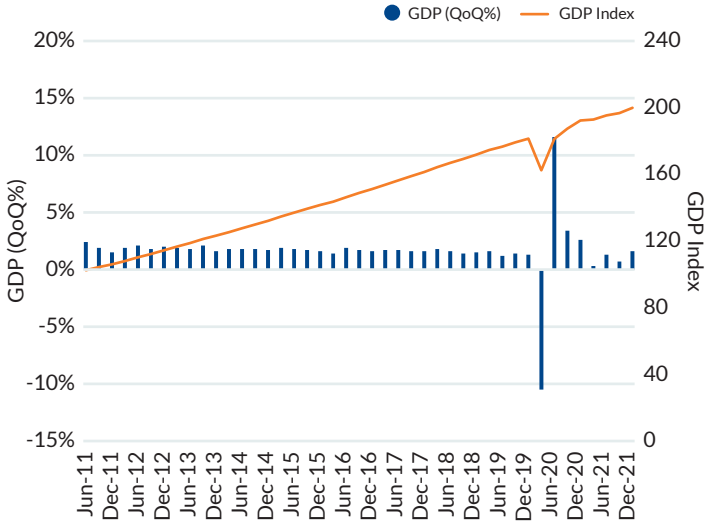
- 17.5% decrease in Construction (YoY)
- 17.8% decrease in Wholesale/Retail Trade (YoY)
- 14.0% decrease in Transportation/Storage/Postal Services (YoY)
- 35.3% decrease in Hotels/Catering Services (YoY)

CONSUMER & PRODUCER PRICES

While the current pandemic was not as deflationary to consumer prices in China relative to the Global Financial Crisis of 2007-2008 ("GFC"), consumer prices decreased slightly throughout 2020. Consumer prices have increased by 1.5% YoY as of December 2021. Similarly, producer prices in China did not decrease as much as they did during the GFC.

Industrial, Raw Materials and Wholesale PPIs all decreased YoY through 1H20, decreasing by 3.0%, 4.4% and 2.3%, respectively. Prices recovered slightly and all three PPIs stayed flat YoY through year-end 2020. However, like many of the economies across the globe, prices have increased throughout 2021 as demand has picked up.

FIGURE 2.9: **CHINA'S REAL GDP (JUNE 2011 – DECEMBER 2021)**



Source: Bloomberg

Australia and New Zealand | Strict quarantine and closure policy

Both Australia and New Zealand have similar services-oriented economies, with services driving 75% of Australia's GDP and 74% of New Zealand's GDP.

Both countries diverge from others in our current study because of their extensive approach to curb COVID-19 infections through border closures, strict quarantine policies, contact tracing, and lockdowns. New Zealand implemented a comprehensive genetic sequence testing program to pinpoint the source of any COVID-19 strains that has infected citizens and, as a result, has maintained control of most local COVID outbreaks.

GDP

In 2Q20, New Zealand's quarterly real GDP fell by 10.3% while Australia's real GDP fell by 6.8%, but both countries' quarterly real GDP has returned to pre-pandemic levels. New Zealand and Australia experienced a notable decrease in household consumption in 2020[8] with New Zealand's falling by 10.6% and Australia's by 12.1% in 2Q20, but they have since recovered to pre-pandemic levels due, in part, to the increase in household savings in both countries during the onset of the lockdowns.

Both Australia and New Zealand experienced sharp decreases to their exports and imports in 2020 and have struggled to recover to pre-pandemic levels (Figure 2.10).

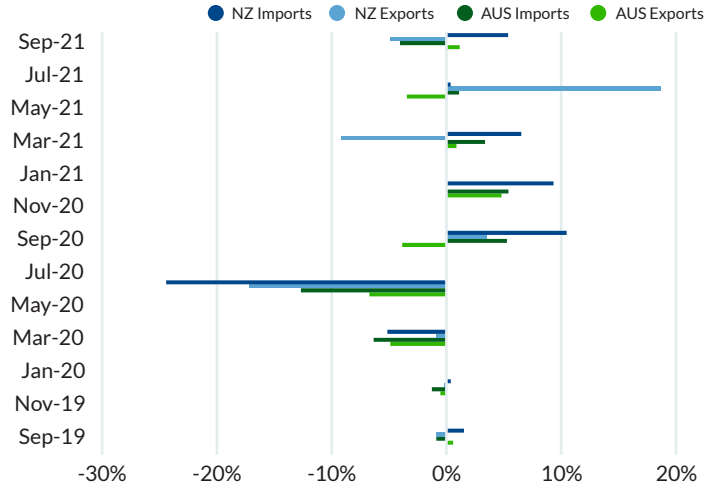
- ⇩ 17.1% decrease in New Zealand's exports (2Q20)
- ⇩ 6.7% decrease in Australia's exports (2Q20)
- ⇩ 24.4% decrease in New Zealand's imports (2Q20)
- ⇩ 12.7% decrease in Australia's imports (2Q20)

CONSUMER & PRODUCER PRICES

Consumer prices in New Zealand went up on average by around 1.5% YoY from 2Q20 – 1Q21. As of 3Q21, consumer prices increased 4.9% YoY. In Australia, consumer prices remained stable through the onset of the pandemic in 2Q20 (dropping only by 0.3% YoY) and has stayed around +1.0% YoY through 1Q21. As of 3Q21, consumer prices increased 3.0% YoY.

Producer input prices in New Zealand were stable from 2Q20 – 1Q21 but increased by 6.9% YoY as of 4Q21.[9] Driving this increase has been the rise in electricity and gas, petrol and coal manufacturing and meat/meat product manufacturing. Australia's producer prices also remained stable throughout 2020, decreasing by 0.1% YoY as of year-end[8] 2020. Australian producer prices increased by 2.9% YoY as of December 2021 due to increases in the costs of labor in construction and petrol refining/manufacturing.

FIGURE 2.10: **AUSTRALIA AND NEW ZEALAND IMPORTS & EXPORTS (SEPTEMBER 2019 – SEPTEMBER 2021)**



Source: Bloomberg

Additional sources: www.stats.govt.nz, tradingeconomics.com, www.abs.gov.au

Sweden | Lockdown resistance

Sweden presents an interesting case study of a country that resisted lockdowns in response to the initial waves of COVID-19. Sweden's quarterly GDP fell by 8 % in 2Q20 and has been recovering since.

GDP

Driving the loss in GDP included losses in wholesale retail and trade/accommodation and food services, industrial production, manufacturing and professional/scientific and support services. In 2Q20:

- 15.2% decrease in wholesale retail and trade/ accommodation and food services
- 17.9% decrease inindustrial production excluding construction
- 21.8% decrease in manufacturing
- 10.9% decrease in professional/scientific and support services

EXPORTS & IMPORTS

Exports fell by 17.2% in 2Q20. More specifically,

- goods exported fell by 16.9%
- while services exported fell by 17.8%.

While the level of goods exported has recovered to its pre-pandemic levels, services exported has struggled to recover. Similarly, imports also decreased by 12.3% in 2Q20. Goods imported decreased by 10.6% while services imported decreased by 15.7%. Like exports, imports of services have not been able to recover while imports of goods have exceeded their pre-pandemic level.

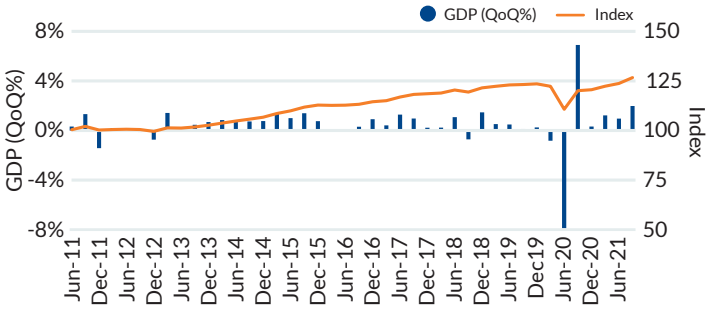
CONSUMER & PRODUCER PRICES

Consumer prices in Sweden remained stable throughout the onset of the pandemic, staying flat from March 2020 to December 2020 YoY. YYoY consumer price growth rates returned to their pre-pandemic levels before accelerating to 3.9% as of December 2021. Producer prices decreased throughout all of 2020. Producer prices have since risen by 18.1% YoY as of November 2021.

UNEMPLOYMENT

Sweden's unemployment rate increased from 7% (Sweden's unemployment is seasonal and typically varies by quarter) up to 10% in 2Q21 (Figure 2.12). Sweden's unemployment rate is slowly approaching its pre-pandemic but remained in the 7-8% range July – November 2021.

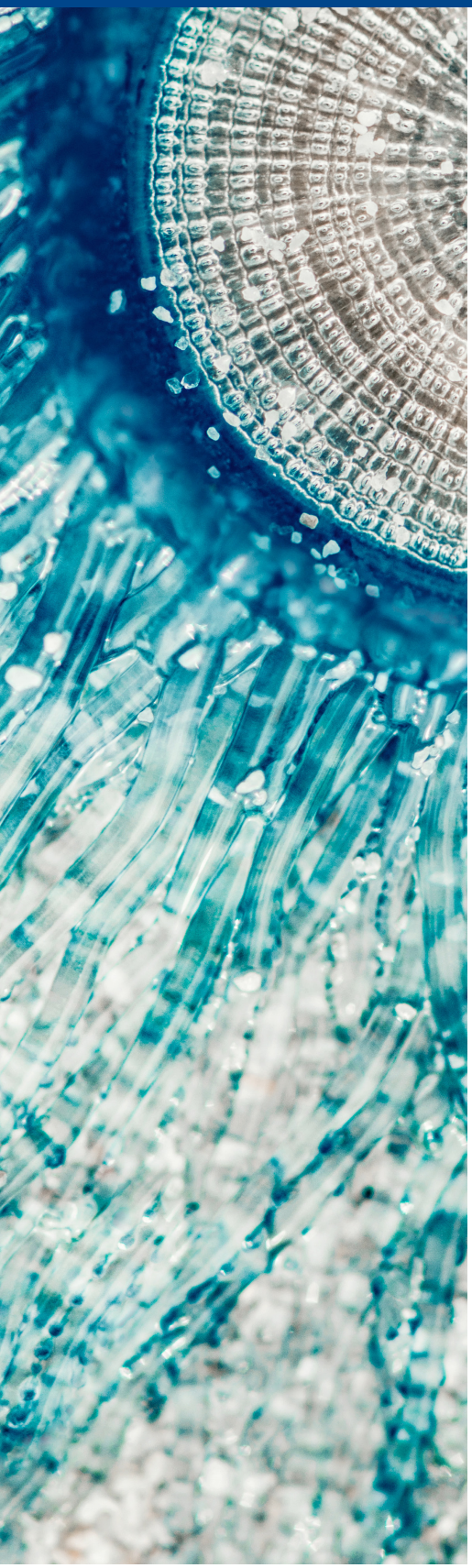
FIGURE 2.11: **SWEDEN'S REAL GDP (JUNE 2011 – SEPTEMBER 2021)**



Source: Bloomberg

FIGURE 2.12: **SWEDEN'S UNEMPLOYMENT RATE (NOVEMBER 2018 – NOVEMBER 2021)**

Source: Bloomberg



3. State of the world

TABLE 3.1: COVID-19 STATUS IN SEVERAL COUNTRIES AROUND THE WORLD (AS OF DECEMBER 31, 2021)

Country	Total cases (per million)	Total deaths (per million)	% population fully vaccinated*	% population boosted*	New cases 21 day moving average	As of date
Australia	16,500	87	77%	9%	8,360	2021-12-31
Brazil	104,171	2,894	67%	12%	4,888	2021-12-31
Canada	57,339	796	77%	20%	17,401	2021-12-31
Chile	94,028	2,036	86%	57%	1,339	2021-12-31
China	71	3	84%	0%	129	2021-12-31
Colombia	100,602	2,535	55%	6%	3,226	2021-12-31
Czechia	230,847	3,369	62%	22%	7,762	2021-12-31
Hungary	130,412	4,067	62%	33%	3,500	2021-12-31
India	25,019	346	43%	0%	8,521	2021-12-31
Indonesia	15,424	521	45%	*	189	2021-12-31
Israel	148,954	887	64%	46%	1,645	2021-12-31
Japan	13,743	146	78%	0%	214	2021-12-31
Mexico	30,552	2,299	56%	0%	3,239	2021-12-31
New Zealand	2,754	10	75%	7%	64	2021-12-31
Norway	72,134	239	72%	29%	3,975	2021-12-31
Philippines	25,611	464	45%	0%	370	2021-12-31
Poland	108,692	2,568	56%	18%	15,389	2021-12-31
Romania	94,569	3,072	41%	0%	828	2021-12-31
Russia	70,730	2,074	46%	5%	25,604	2021-12-31
Singapore	51,233	152	86%	40%	332	2021-12-31
South Africa	57,598	1,518	26%	0%	16,467	2021-12-31
South Korea	12,382	110	83%	36%	5,937	2021-12-31
Sweden	129,406	1,507	73%	0%	4,075	2021-12-31
Switzerland	152,902	1,402	67%	25%	10,509	2021-12-31
Taiwan	714	36	68%	1%	15	2021-12-31
Thailand	31,786	310	66%	10%	2,984	2021-12-31
Turkey	111,503	968	61%	27%	22,837	2021-12-31
United Kingdom	190,089	2,181	70%	50%	105,995	2021-12-31
United States	164,584	2,486	62%	22%	233,858	2021-12-31

Source: Our World in Data. Data pulled January 31, 2022 | *indicates data is unavailable

Australia

As previously discussed, Australia's comparatively low level of deaths (87 per million, Figure 3.1), the fourth lowest in the study, could be due to the strict containment measures enacted to eradicate COVID-19 infections from its borders.

Brazil

Given the hesitancy towards lockdown measures at the beginning of the pandemic, the high rate of fatalities from COVID-19 in Brazil are no surprise.

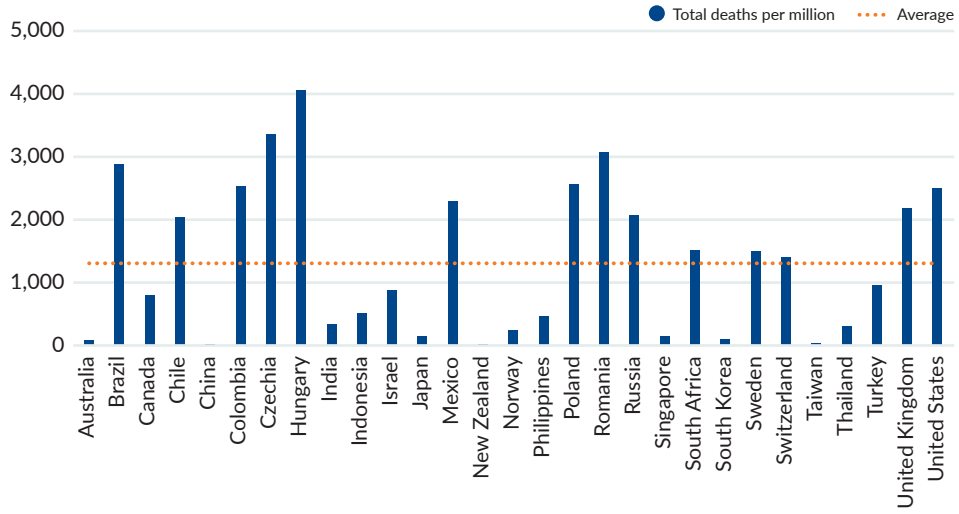
Canada

Canada has the sixth highest vaccination rate within our study, with 77% of its population fully vaccinated as of December 31, 2021 (Figure 3.2).

TABLE 3.2: **% OF POPULATION FULLY VACCINATED (AS OF DECEMBER 31, 2021)**

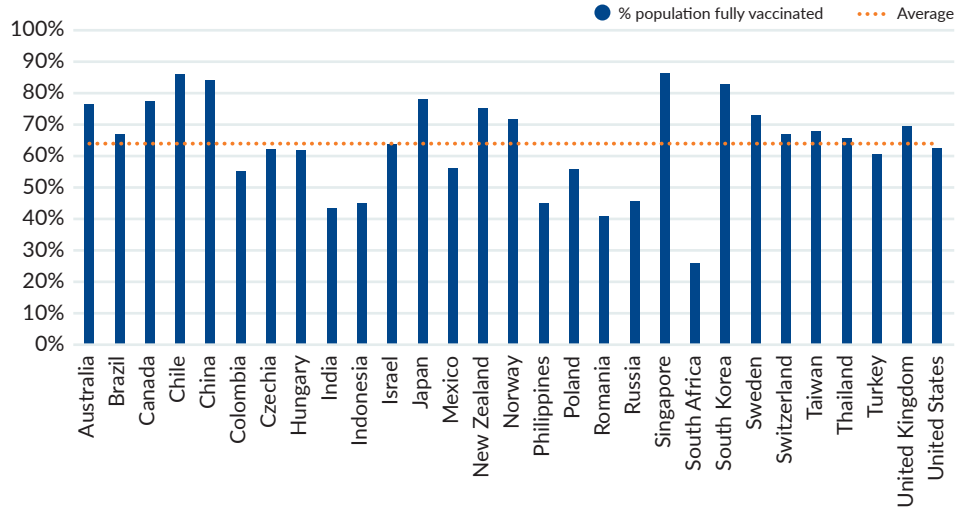
Country	% population fully vaccinated*
Singapore	86%
Chile	86%
China	84%
South Korea	83%
Japan	78%
Canada	77%
Australia	77%
New Zealand	75%
Sweden	73%
Norway	72%
United Kingdom	70%

FIGURE 3.1: **TOTAL COVID-19 DEATHS (PER MILLION, AS OF DECEMBER 31, 2021)**



Source: Our World in Data. Data pulled January 31, 2022

FIGURE 3.2: **% OF POPULATION FULLY VACCINATED (AS OF DECEMBER 31, 2021)**



Source: Our World in Data. Data pulled January 31, 2022

Chile

Chile has the highest % of population boosted (57%) as of December 31, 2021.

China

China reports that COVID-19 has caused a total of three deaths per million while only infecting 0.01% of its population, the lowest levels of all countries in the study, and reports that 84% of its population is fully vaccinated. As of December 31 2021, China reports a 21-day moving average of 129 daily new cases, well below the median moving average of 3.975 new cases.

Czech Republic

COVID-19 has caused a total of 3,369 deaths per million in the Czech Republic, the highest level in our study. 23% of its population has been infected by the virus, the highest infection rate of all countries in our study. 62% of its population is fully vaccinated and 22% is boosted.

TABLE 3.3: COVID-19 CASES (AS OF DECEMBER 31, 2021)

Country	Total cases per million
Czech Republic	230,847
United Kingdom	190,089
United States	164,584
Switzerland	152,902
Israel	148,954

TABLE 3.4: COVID-19 DEATHS (AS OF DECEMBER 31, 2021)

Country	Total cases per million
Hungary	4,067
Czech Republic	3,369
Romania	3,072
Brazil	2,894
Poland	2,568

Source: Our World in Data. Data pulled January 31, 2022

Hungary

As of December 2021, COVID-19 has caused a total of 4,067 deaths per million, which is the highest level of deaths per million in our study. There are several potential reasons that explain Hungary's high death rate. The first being that Hungary was infected by a more aggressive variant of COVID-19 that originated in the U.K. in early 2021. In conjunction with this more aggressive variant, Hungary's government was slower to respond to the surge in cases as the country did not experience a high infection or death rate during the first wave that impacted most of the world. Influencing the slower government response was also the quality of domestic COVID-19 data and testing protocols. These factors, along with idiosyncratic demographic conditions, seemed to lead to higher deaths per million. 13.0% of Hungary's population has been infected by the virus, which is 5.7 percentage points higher than the average of 7.7%. 62% of Hungary's population is fully vaccinated.

India

India reports a total of 346 deaths per million in India, well below the average of 1,348 deaths per million. This low death rate could be due to India only including confirmed COVID-19 deaths in hospitals in the official tally. India's official statistics report that only 2.5% of its population has been infected.

Indonesia

Indonesia has a relatively low infection rate, with the virus infecting only 1.5% of its population. According to Reuters, a seroprevalence study revealed that this number is most likely underreported as Indonesia had low contact tracing processes and insufficient laboratory capacity to process COVID-19 tests. The seroprevalence study estimated that closer to 15.0% of Indonesia's population has been infected (report as of June 2021).[5]

5. Source: www.reuters.com

Japan

COVID-19 has caused a total of 146 deaths per million in Japan. COVID-19 has infected 1.3% of Japan's population, which is relatively low compared to the other countries in the study. 78% of Japan's population is fully vaccinated, above the average vaccination rate of 64%.

New Zealand

New Zealand's strict quarantine and closure policies could be the reason for the country's low infection rate of 0.28% of total population and 10 deaths per million.

Romania

Romania has the third highest level of total deaths per million (4,067). 41% of the population is fully vaccinated.

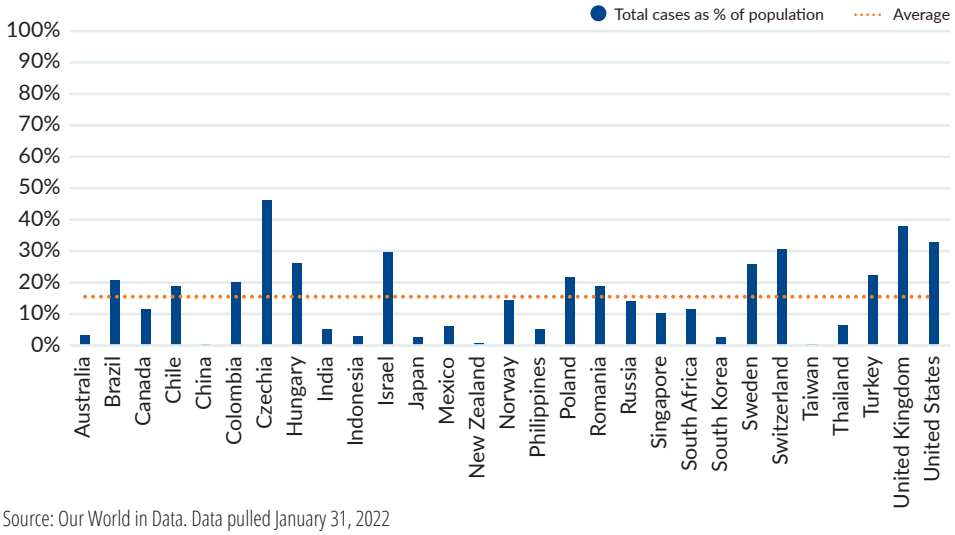
Singapore

86% of Singapore's population is fully vaccinated, which is the highest vaccination rate in the study.

South Africa

26% of South Africa's population is vaccinated, the lowest vaccination rate in the study.

FIGURE 3.3: **COVID-19 CASES AS % OF POPULATION (AS OF DECEMBER 31, 2021)**



Source: Our World in Data. Data pulled January 31, 2022

Sweden

In spite of Sweden's high vaccination rate (73%), the country's lockdown resistance may have led to their above average total deaths per million (1,507) and % of population infection rate, which can be seen in Figures 3.1 and 3.3.

Switzerland

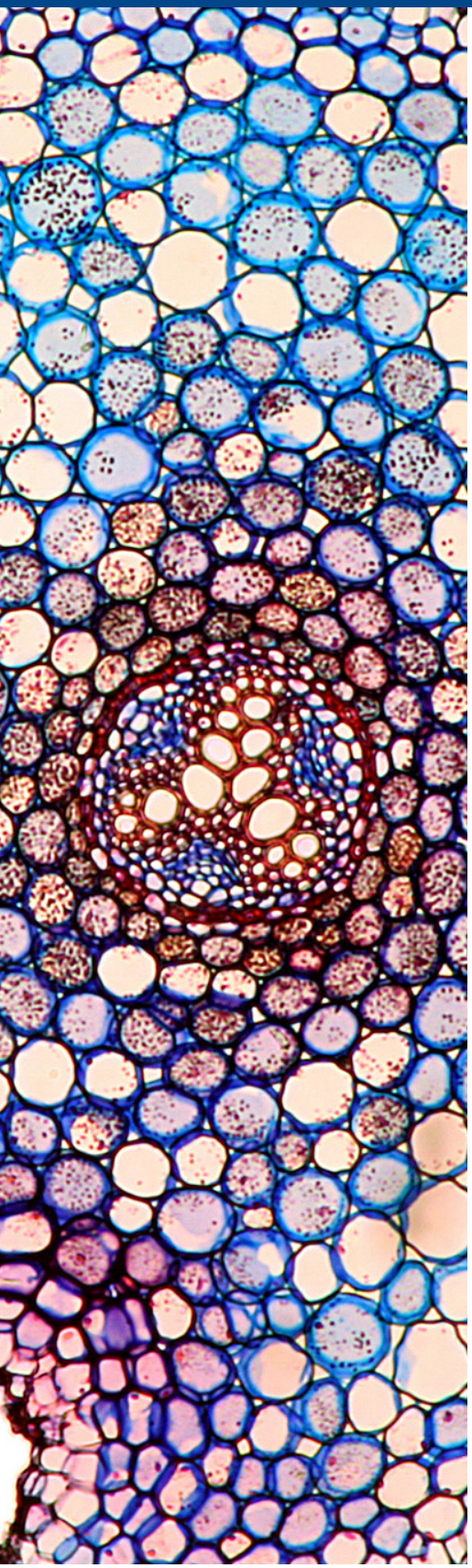
COVID-19 has infected 15.3% of Switzerland's population, one of the highest infection rates in the study.

United Kingdom

In spite of a 70% vaccination rate plus a 50% boosted population rate, COVID-19 has infected 19.0% of the U.K.'s population – 190,089 cases per million, the 2nd highest infection rate in our study.

United States

The United States has the highest 21 day moving average of new cases at 233,858 as of December 31, 2021.



4. COVID-19 and FX

The relationship between macroeconomic indicators and foreign exchange rates has been researched in multiple academic studies. Bernard Njindan Iyke[6] found that fundamental macroeconomic indicators like foreign interest rates, government spending, terms of trade, and net assets can have a direct impact on exchange rates. Robert J. Hodrick[7] also found that unanticipated macroeconomic events, like exogenous swings in the conditional variances of income growth and fiscal/monetary policy, influenced exchange rates through changes to the risk premia.

As shown in Section 2, the current pandemic has adversely affected the services industry and constrained global supply chains. In particular, accommodation/food services have been most impacted, while on the supply side, manufacturing and industrial production have been the most sensitive industries to COVID-19 cycles. Each country's dependence on these industries dictated the effects to GDP and recovery rates thus far.

Given COVID-19's level of disruption to everyday economic activity, it is anticipated that there should be a link between COVID-19 variables (infection rates, death rates, excess mortality) and foreign exchange rates. Indeed, this has been the topic of academic research throughout the pandemic. Iyke showed in another study that COVID-19 outbreaks had predictive power over exchange rate volatility. Although the sample was from December 2019 – August 2020, the study found that the level of COVID-19 infections negatively predicted exchange rate volatility for USDCHF, USDCNY, USDILS, USDJPY, and USDPEN over a 1-day horizon. The study also looked at a 5-day horizon and found that infections negatively predicted USDCHF, USDEUR, USDINR, USDPLN and USKSEK returns and positively predicted USDGBP and GBPUSD returns. For volatility over a 5-day horizon, the study found that infections positively predicted USDCAD and USDEUR while negatively predicting USDSEK and USDGBP.

While this study showed that COVID-19 infections did, indeed, contain predictive information, it remains to be seen how this relationship has evolved throughout the rest of 2020 and into 2021, especially with the emergence of vaccines and the divergence in vaccination rates between advanced economies and emerging economies.

6. Iyke, Bernard Njindan, "Macro determinants of the real exchange rate in a small open small island economy: Evidence from mauritius via bma." Buletin Ekonomi Moneter dan Perbankan 21.1 (2018): 57-80.
7. Hodrick, Robert J., "Risk, uncertainty, and exchange rates." Journal of Monetary economics 23.3 (1989): 433-459.

Our current study looked at the relationship between the level of infections, deaths, and excess mortality on exchange rates for the following currency pairs: USDSEK, USDCHF, USDTWD, USDGBP, USDAUD, USDCAD, USDCLP, USDCNH, USDXEU, USDIDR, USDJPY, USDNOK, USDPHP, USDPLN, USDRON, USDRUB, USDZAR, USDKRW, USDTHB, USDTRY, USDBRL, USDCOP, USDCZK, USDHUF, USDINR, USDILS, USDMXN and USDNZD.

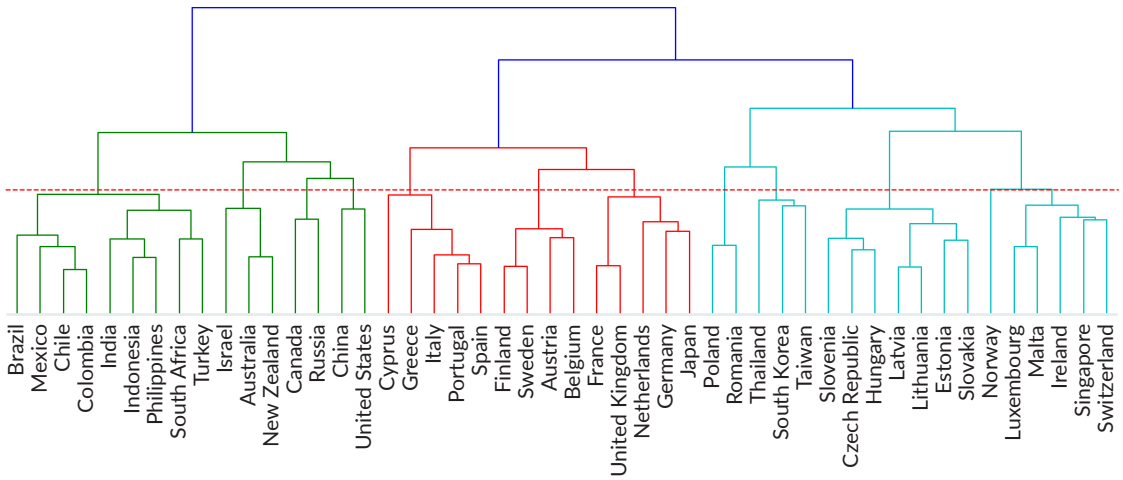
Assuming the USD as the base currency, it was anticipated that the level of COVID-19 infections, deaths and excess mortality would be negatively correlated to the exchange rate. In other words, the hypothesis was that each acceleration in COVID-19 infections within each cycle in country *n* would correspond to a depreciation in that country's currency.

Plotting the COVID-19 variables against the individual spot rates, this relationship was confirmed for the following pairs: USDPHP, USDPLN, USDRON, USDRUB, USDZAR, USDKRW, USDTHB, USDTRY, USDBRL, USDCOP, USDCZK, USDHUF, USDINR, USDILS, USDMXN and USDNZD.

In particular, USDRON, USDRUB, USDZAR, USDCZK, USDTRY and USDHUF had the strongest relationships out of all the pairs. It is no surprise that these currency pairs appeared to be more sensitive to COVID-19 infections as they are all emerging economies and their vaccination rates are not as high relative to the advanced economies

Looking at all the currency pairs that showed a negative correlation to the level of new cases, many of these pairs were clustered together according to both demographic and GDP data. This is illustrated in our demographic hierarchical clustering model (Figure 4.1). Brazil, Mexico, Colombia, Philippines, South Africa and Turkey were all clustered together. Similarly, Israel, Australia, New Zealand and Russia were also clustered together. Lastly, Poland, Romania, Thailand, and South Korea also created a cluster.

FIGURE 4.1: **HIERARCHICAL CLUSTERING USING COUNTRIES' DEMOGRAPHIC DATA**

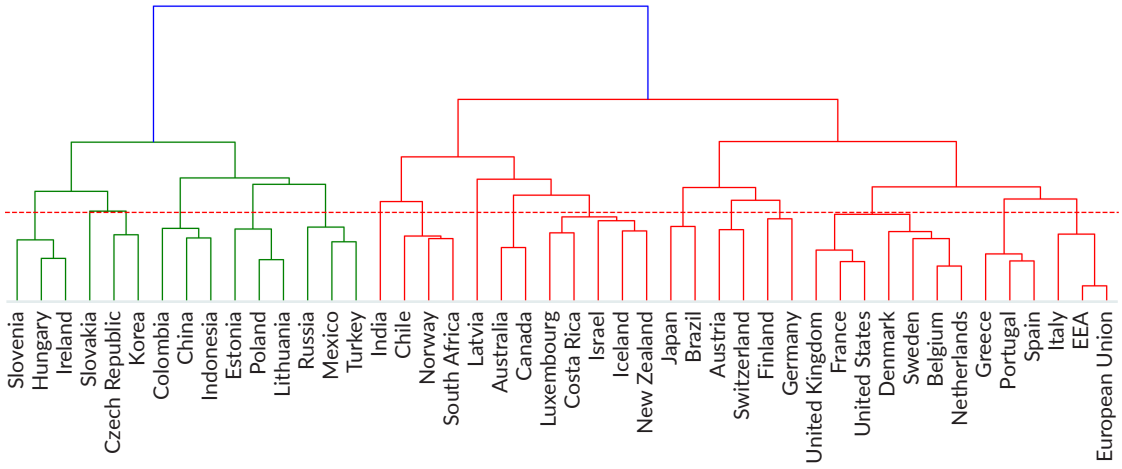


Source: Mesirow

Looking to GDP data (Figure 4.2), Russia, Mexico and Turkey created a cluster, South Korea and the Czech Republic formed another cluster, and Israel and New Zealand also formed a cluster.

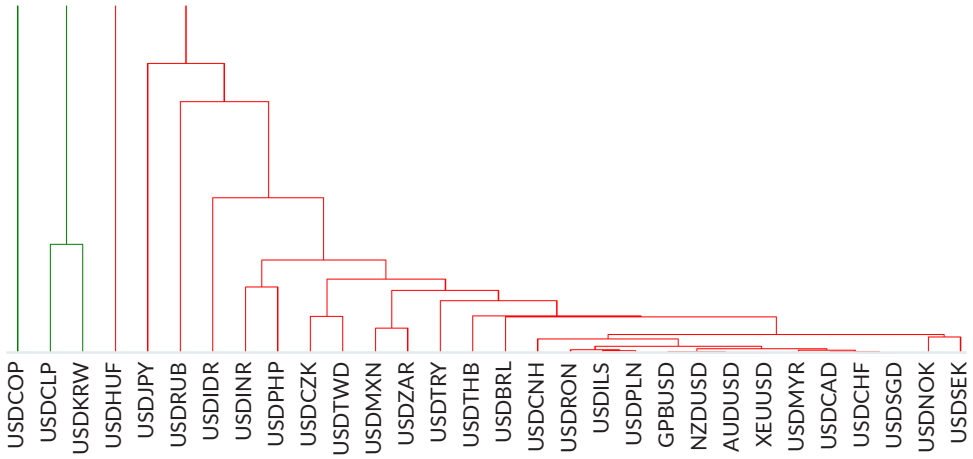
In terms of the other countries that did not exhibit a negative correlation between COVID-19 data and their exchange rates, one reason that the relationship may not exist is due to central bank intervention and macroprudential policies.

FIGURE 4.2: **HIERARCHICAL CLUSTERING USING COUNTRIES' SECTORIZED GDP DATA**

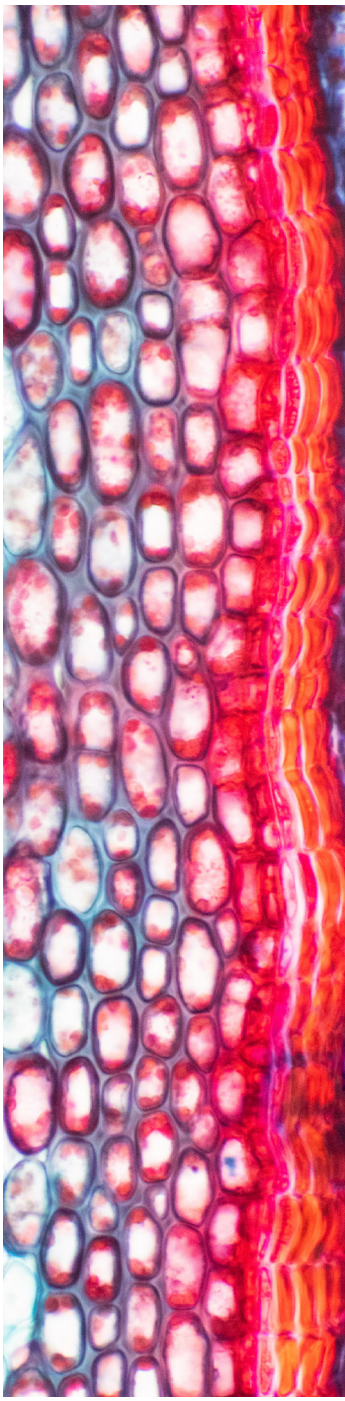


Source: Mesirow

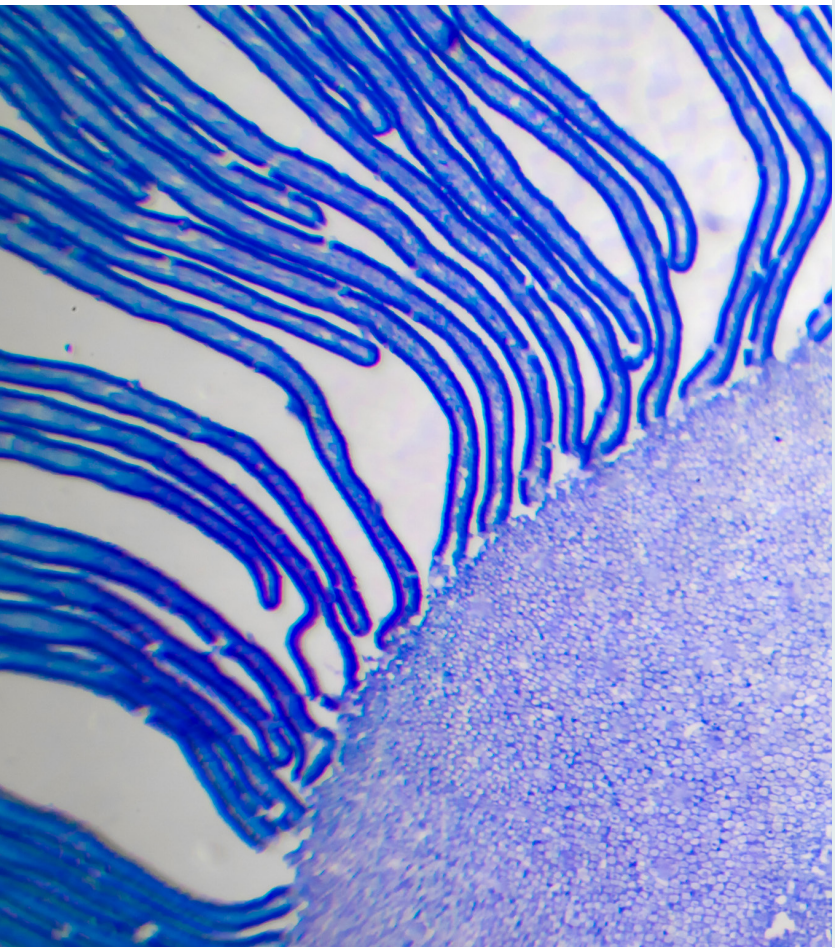
FIGURE 4.3: **HIERARCHICAL CLUSTERING USING COUNTRIES' FX DATA**



Source: Mesirow



The Federal Reserve has set up swap lines with all G7 central banks and with the Swiss National Bank. These swap lines were set up to ensure these central banks had enough liquidity to withstand the flight to safety (USD) that occurred at the onset of the pandemic, which may have impacted each currency's behavior. Given the severity of the pandemic, many central banks globally deployed all tools in their toolkits to stabilize financial markets and protect their currencies.



Handling a country's missing COVID-19 data

One way to complete missing or unreliable COVID-19 indicators for a country can be to use the data from other countries with similar economic or demographic characteristics. A data-driven approach to implement this solution is to utilize a hierarchical clustering algorithm (see Figures 4.1 – 4.3).

In general, clustering algorithms categorize the input data into various classes. As they do not rely on labelled samples, they are also known as unsupervised classification techniques. One of their key parameters is the number of output clusters. Generally, this is either explicitly given to the algorithm (by considering some prior knowledge about the problem at hand) or is implicitly inferred from the feature space. Hierarchical clustering incorporates the second approach. It first assumes each sample forms a cluster. Then, the cross-correlations between all samples are calculated. Depending on their adjacency, samples form new clusters. Each new cluster is then treated as a new sample point. This process of detecting closer samples (to form sub-clusters) and merging them to create new clusters repeats until we are only left with one cluster, comprising all the input samples.

This step-by-step calculation of correlations and merging of clusters are usually visualized as a tree diagram known as a dendrogram. By assigning a cut-off level over its branches, we can find the clustering results. We can also count the number of intersections between the cut-off line and the branches of the dendrogram as a rough estimate of the number of clusters. Therefore, this method finds clusters in the input data, without setting the number of clusters as a priori assumption. Instead, it facilitates estimating the number of clusters from the dendrogram results.

5. Predictive model

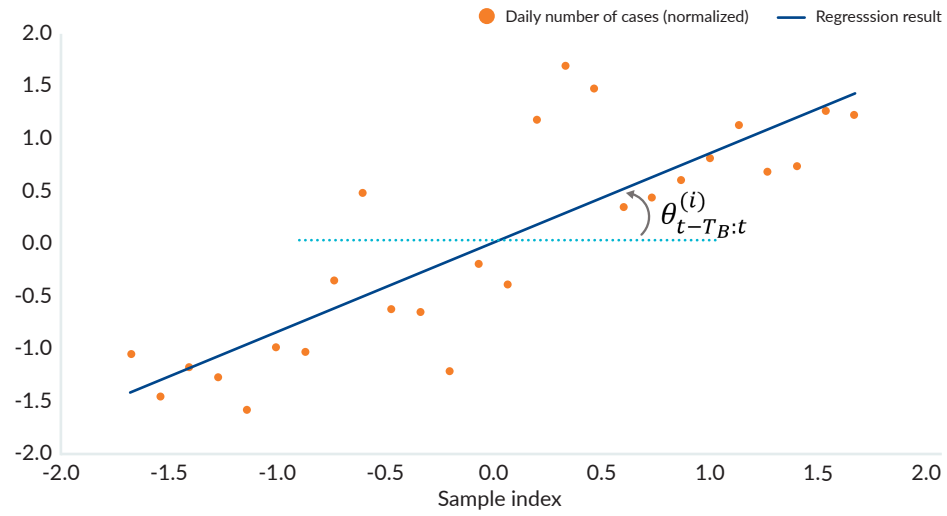
Considering the economic data and our analysis in the previous sections, we establish the following hypothesis, which constitutes the basis of our predictive model design:

There is a negative correlation between a country's COVID indicators and its currency strength.

If this assumption is true, a predictive mechanism applied to a country's COVID indicators can be used to generate signals to short its currency against the USD as soon as the COVID situation is about to worsen. One of the most obvious and widely available data to describe a country's COVID status is its number of daily new cases. Our modelling starts with first performing a linear regression over $C^{(i)}_{t\text{-}T_B:t}$, which is the number of new cases during the last T_B days in the country i.

The regression results in a line, which makes the $\theta^{(i)}_{t\text{-}T_B:t}$ angle with the horizontal axis, as shown in Figure 5.1. This angle $\theta^{(i)}_{t\text{-}T_B:t}$ is used by our predictive model to generate trading signals (z-score normalization has been applied to both axes).

FIGURE 5.1: **LINEAR REGRESSION APPLIED TO A COUNTRY'S RECENT COVID DATA**



Source: Mesirow

The sign of $\theta^{(i)}_{t\text{-}T_B:t}$ is determined by the slope of the regression line: if the slope is positive, $\theta^{(i)}_{t\text{-}T_B:t}$ has a positive sign, otherwise its sign is negative. The absolute value of $\theta^{(i)}_{t\text{-}T_B:t}$ indicates the rise or fall rate of the new cases. If our above assumption about the currency strength vs. the COVID status is true, $\theta^{(i)}_{t\text{-}T_B:t}$ can be quite informative to establish a predictive model. The closer $\theta^{(i)}_{t\text{-}T_B:t}$ is to 90°, the more rapid country i's currency could potentially fall against the USD. Therefore, at any given time t, if $\theta^{(i)}_{t\text{-}T_B:t}$ is greater than a threshold θ_T, we calculate $\theta^{(i)}_{t\text{-}T_B:t}/(\pi/2)$ and use it as a signal to generate a short position,

Equation 1

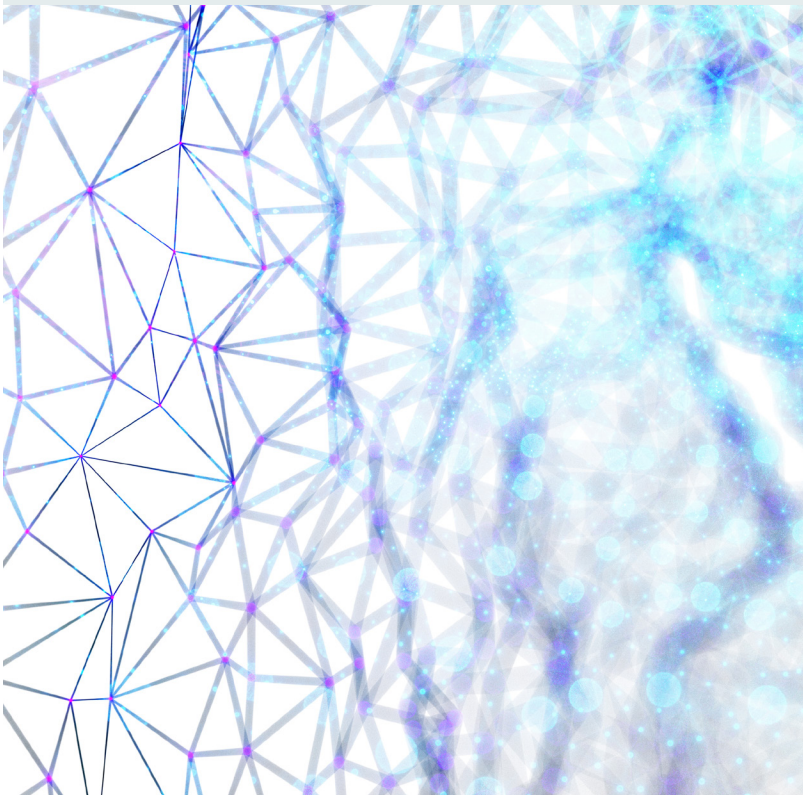
$$s^{(i)}_{t:t+T_F} = \begin{cases} -2 \times \theta^{(i)}_{t\text{-}T_B:t}/_{\pi} & \text{if } \theta^{(i)}_{t\text{-}T_B:t} > \theta_T \\ 0 & \text{if } \theta^{(i)}_{t\text{-}T_B:t} \leq \theta_T \end{cases},$$

where $s^{(i)}_{t:t+T_F}$ is the generated signal for currency i at time t, traded during the next T_F days.

It should be mentioned that although this strategy is mainly designed to predict the currency's depreciation against the USD, potentially, due to severe COVID conditions in the corresponding country (and this is why we have used a negative sign to indicate a short signal), it still allows longing the currency when $\theta^{(i)}_{t\text{-}T_B:t}$ is negative. We will further explain this in the next section.

Use of other COVID-19 indicators

As explained, our proposed predictive modelling technique uses the new daily cases as an input. This was mainly due to its ease of availability for several currency pairs in our portfolio. As the level of vaccinations continues to rise in various countries, the antibody rate increases, and the population gradually becomes more robust against the virus, the new daily cases data may become less correlated with the country's currency. Therefore, other COVID-19 indicators (antibody rate, number of excess deaths or vaccination rate, etc.) could become more useful and used as input for the predictive model. The main difficulty, however, is to gather this data for all countries, which is not so straightforward for emerging economies.



6. Backtest and experimental results

We evaluate the model over the period of July 2020 to end of August 2021, assuming July 2020 to April 2021 as the validation, and the final four months (May, June, July, and August 2021) as the out-of-sample period. T_B, T_F and θ_T are the hyper-parameters of the proposed predictive model, which are optimized using the data from the validation period.

We incorporate a hierarchical procedure to perform the optimization. At every stage, we assume only one parameter to be variable and the other two as constant. Starting with T_B, and assuming T_F and θ_T are 4 days and 0°, respectively, we calculate the 2021 year-to-date (YTD) information ratio (IR), when T_B is varied from 5 to 60 days. The YTD IR is calculated until the end of validation period in 2021 (end of April 2021).

As can be seen in Figure 6.1, the model performance peaks at around 25 days and then steadily declines for larger values for T_B. This decline can be because long look-back window lengths fail to detect immediate trend changes in the COVID data. On the other hand, selecting too small values for T_B can result in only a few numbers of samples, which prevents the linear regression from accurately modeling the COVID status in the country and, therefore, hinders the predictive performance.

In Figure 6.1 we can see the effect of increasing the look-back window size (T_B) over the predictive model performance (here we have assumed T_F=4 days and θ_T=0°).

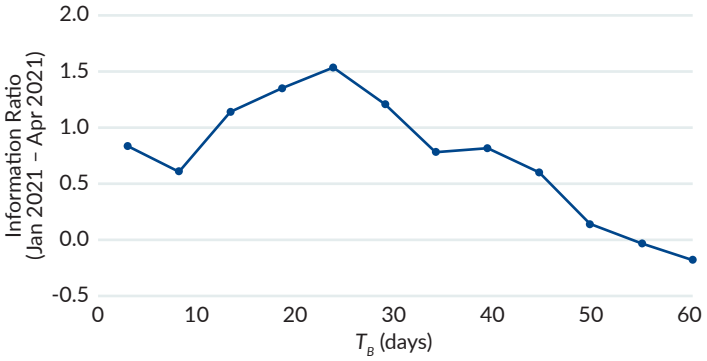
Assuming T_B=25 days, we now repeat the same process for θ_T. The results are shown in Figure 6.2. When θ_T is varied from -20 to 50 degrees, the performance peaks around -10 degrees. The YTD Information Ratio, however, declines for large values for θ_T, because at these values, the resulting signals become too sparse, and generates lower returns with higher risk. It is interesting to observe that an optimal θ_T has had a negative value. This shows that, given T_B=25, the model also facilitates longing the currency against the USD, by allowing $\theta^{(i)}_{t-T_B:t}$ to be negative in Equation 1. This is a sensible choice as the decline of the new cases at a very small rate, could be a sign of the currency recovery and, potentially, its appreciation against the USD.

Using the optimal value of 25 days for T_B from 6.1, here, we evaluate the effects of varying θ_T on the model performance, assuming T_F=4 days.

Finally, assuming T_B=25 and $\theta_T \cong$-10°, we perform the same analysis for T_F (6.3). T_F indicates for how many following days, we are going to keep the generated positions. As illustrated in Figure 6.3, while T_F peaks at 4 days, keeping the position for periods longer than 8 days (T_F>8 days) deteriorates the model performance. One reason for this could be the currency's recovery due to the government's intervention by providing incentives. For smaller values for T_F, however, the model shows significantly higher performance.

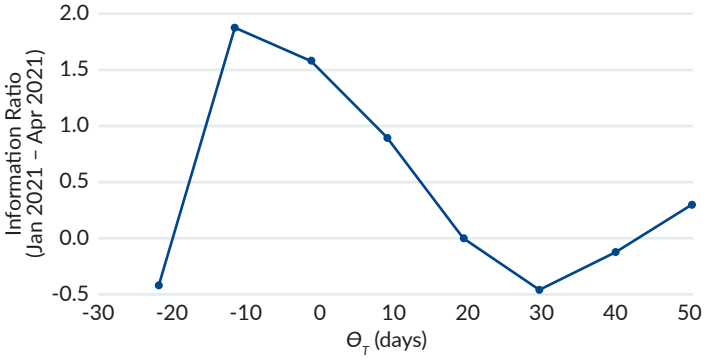
Using the optimal values of T_B=25 and θ_T=10° from 6.1 and Figure 6.2, we now investigate the model performance over various values for T_F.

FIGURE 6.1: MODEL OPTIMIZATION, STEP 1



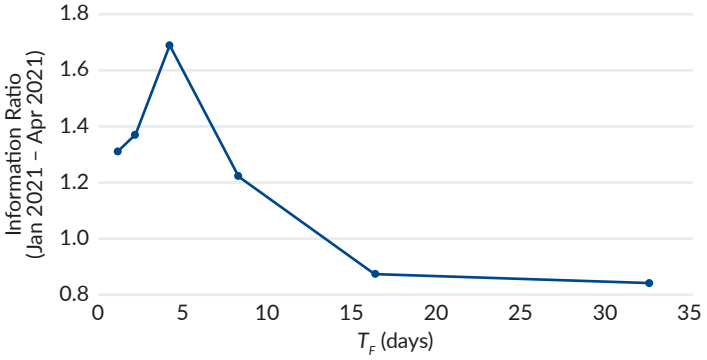
Source: Mesirow

FIGURE 6.2: MODEL OPTIMIZATION, STEP 2



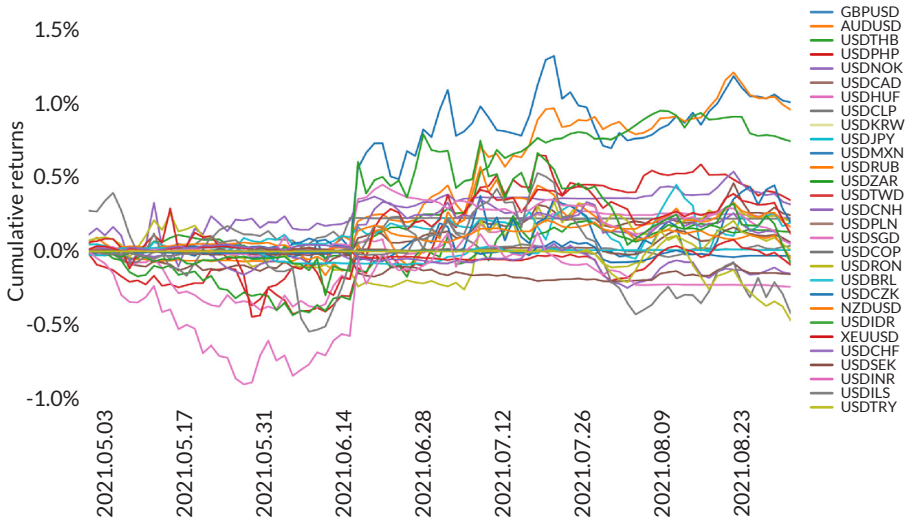
Source: Mesirow

FIGURE 6.3: MODEL OPTIMIZATION, STEP 3



Source: Mesirow

FIGURE 6.4: **CUMULATIVE RETURNS PER CURRENCY PAIR OVER THE OUT-OF-SAMPLE PERIOD (MAY 2021 – AUGUST 2021)**



Source: Mesirow

FIGURE 6.5: **CUMULATIVE TOTAL RETURNS OVER THE OUT-OF-SAMPLE PERIOD (MAY 2021 – AUGUST 2021)**

Source: Mesirow

Using the computed optimal values for T_B=25 (days), θ_{-T}=-10° and T_F=4 (days),[12] we now can evaluate the performance of the predictive model over the out-of-sample period (beginning of May 2021 to the end of August 2021).

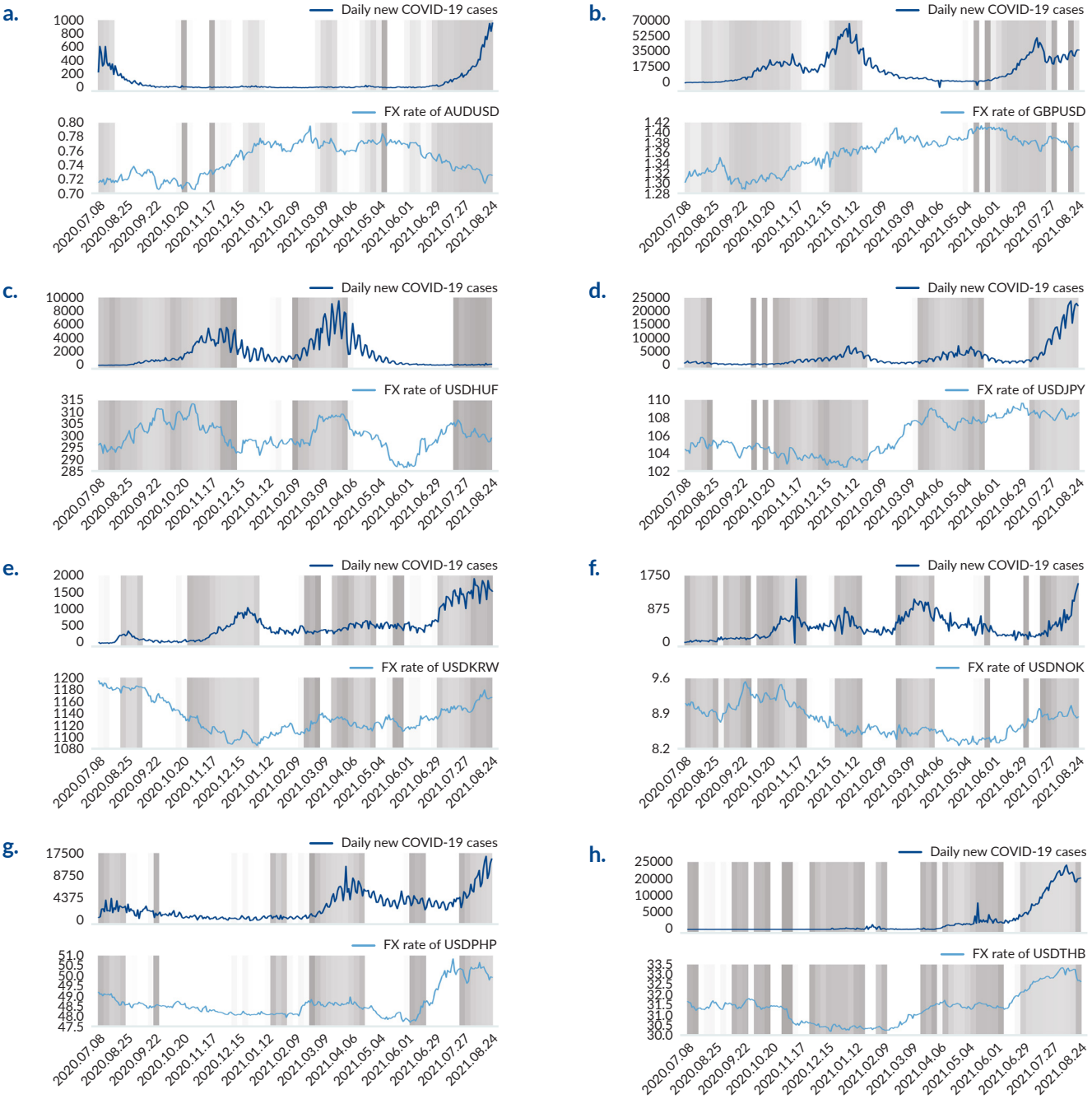
Figure 6.4 and Figure 6.5 show the per currency and total portfolio returns over the out-of-sample period, respectively. GBPUSD, AUDUSD, USDTHB, USDPHP and USDNOK have the top 5 total out-of-sample returns, while USDTRY, USDILS, USDINR, USDSEK and USDCHF are the five worst performing currencies. The total cumulative returns during the out-of-sample period is 3.35% with 0.84 standard deviation, resulting in 4.01 information ratio. The monthly returns are also detailed in the table below.

TABLE 6.1: **MONTHLY RETURNS DURING THE OUT-OF-SAMPLE PERIOD (MAY 2021 – AUGUST 2021)**

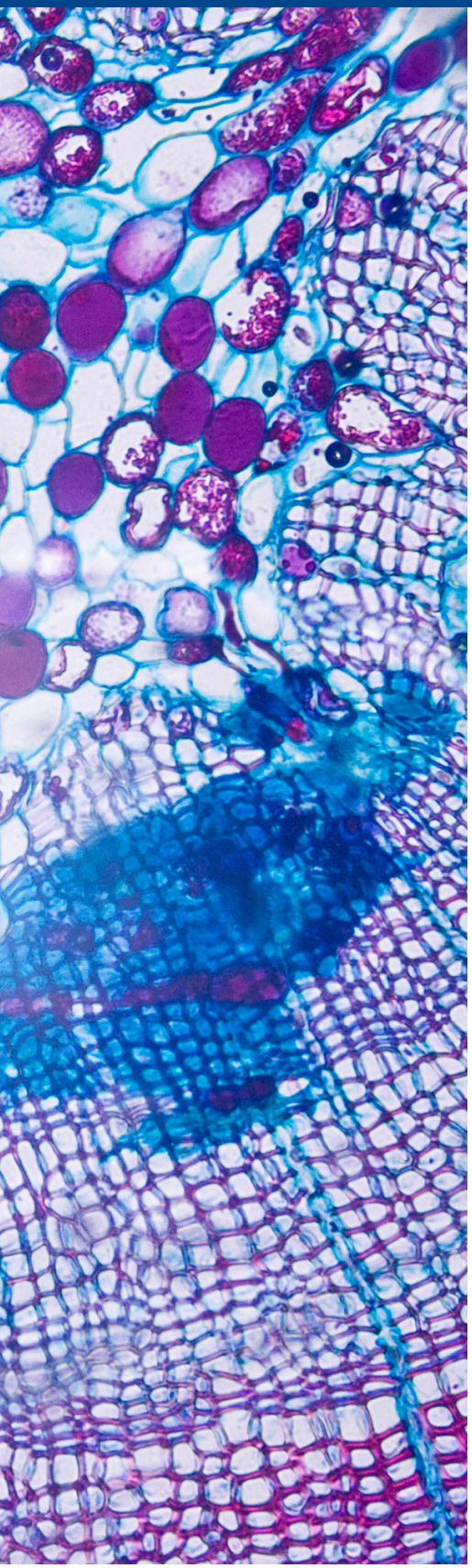
May 2021	June 2021	July 2021	August 2021	Total out-of-sample returns
-2.40%	5.95%	0.41%	-0.61%	3.35%

The instances when the strategy generates short signals over the whole period of validation and out-of-sample are shown in Figure 6.6-a to -h, for AUDUSD, GBPUSD, USDHUF, USDJPY, USDKRW, USDNOK, USDPHP and USDTHB currency pairs: The larger the absolute value of the generated signal, the lighter the intensity of the gray vertical bar.

FIGURE 6.6: **MODEL SIGNAL GENERATION**



Source: Mesirow



7. Conclusion

An extensive analysis of the economic impact of the COVID-19 pandemic was provided. After describing the current state of the world and the effects of the pandemic on the several currencies, we proposed a predictive model that utilized COVID-19 indicators to generate FX trading signals.

Over a portfolio of 28 currency pairs, the model applied a simple linear regression to the number of daily new COVID-19 cases in each country to, mainly, short the currencies against the USD. After optimizing the model's hyper-parameters over the validation data, this model resulted in 3.35% positive returns over the out-of-sample period.

One of the challenges of writing a paper during a pandemic is that the situation is constantly evolving and, sure enough, during the review stage for this paper a new variant of concern, Omicron, came to light. Omicron has around 50 mutations, including around thirty in the area of the genome that encodes the spike protein of the virus, a much higher number than previous variants.

The mutations in the spike protein are particularly worrying as the spike protein is targeted by vaccines and changes there increase the risk that the new variant will be able to evade immune responses, either from vaccines or natural immunity acquired after infection. Analysis of the mutations also made clear that the Omicron variant is more transmissible than the Delta variant, which is already more transmissible than the original Covid strain.

The website nextstrain.org provides graphical analysis of a large global database of virus sequencing data. The sequence data for the Omicron variant indicate that it evolved from a mid-2020 covid strain. One hypothesis is that an immunosuppressed individual suffered a long term chronic covid infection, allowing the virus within the individual to acquire a large number of mutations, before escaping back into the general population. If the individual was vaccinated, this would apply selective pressure on the virus to evade vaccine antibodies.

After first being identified in sequencing data in Botswana, Hong Kong, and South Africa's Guateng province towards the end of November 2021, the Omicron variant has been detected all around the world. The new variant causes an anomalous result in polymerase chain reaction (PCR) tests, termed S-gene dropout, and this has allowed the spread of the new variant to be tracked more easily than relying solely on sequencing data.

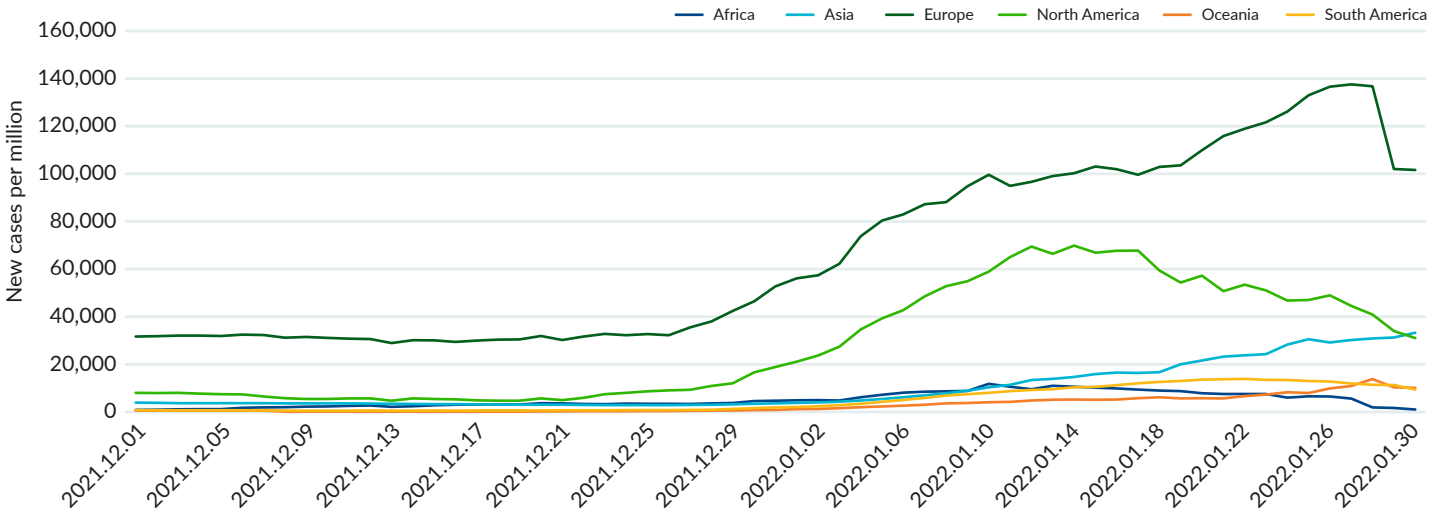
The Omicron variant has led to a rapid growth in the number of cases among individuals who have either been vaccinated or had a prior Covid infection and December 2021 and January 2021 saw a spike in new cases around the world (Figure 8.1).

The emergence of Omicron has served as a timely reminder that the pandemic will not be over, and the risk of new variants of concern will remain, until all countries have vaccinated their citizens and it has highlighted the issue of vaccine inequality between rich and poor countries.

The analysis presented in this paper provides a framework for analysis of how a new wave of infections will affect countries. We can expect countries with higher levels of vaccination and effective booster programs to experience a lower proportion of severe cases and hospitalizations in a new wave of infections, reducing the pressure on their health services and reducing the need for lockdowns and other mitigation measures that have a detrimental impact on economic activity. Conversely, countries with low vaccination levels are likely to fare worse, although it is still uncertain to what extent immunity from prior covid infections, which are often higher in countries with low vaccination rates, provides protection against the omicron strain.

There is now two years of accumulated knowledge and experience of how covid spreads, how to treat it and how to make vaccines that work against it. While a new variant with a high risk of reinfection is obviously concerning, countries are in a much better state of preparedness than at the start of 2020, and we should expect the impact on economic activity from a new wave of infections to be less severe.

FIGURE 8.1: **NEW CASES PER MILLION (DECEMBER 1, 2021 – JANUARY 31, 2021)**



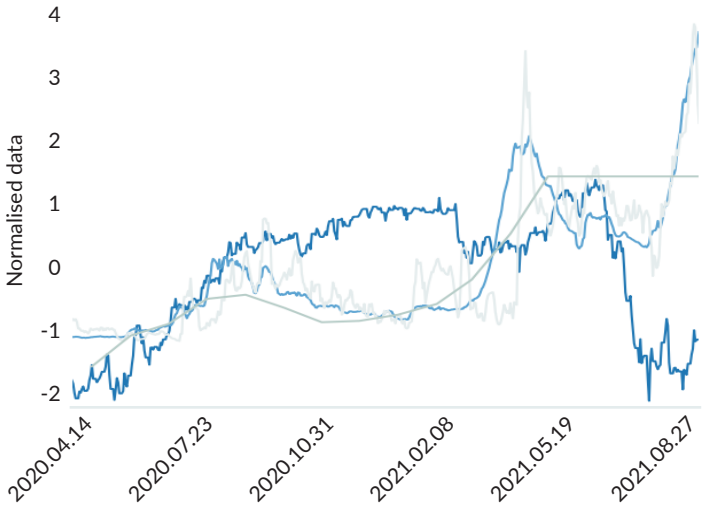
Source: Our World in Data

Appendix

FX Rates and COVID

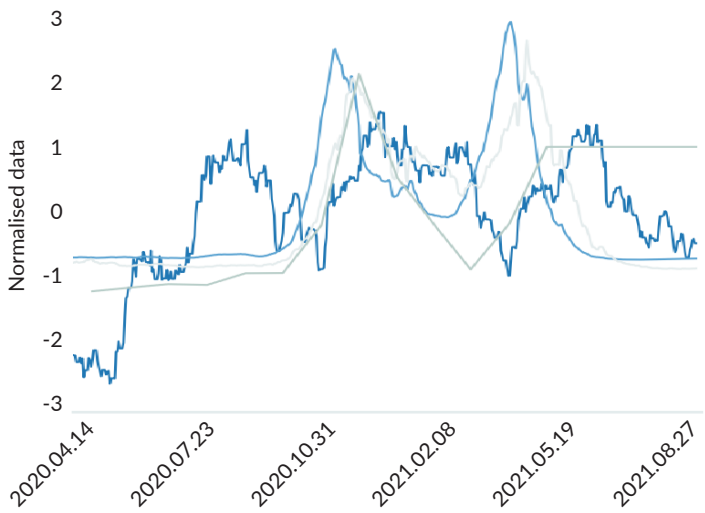
Normalised — Normalised new cases 7-days moving average — Normalised new death 7-days moving average — Normalised exccess mortality monthly

PHILIPPINES | PHPUSD



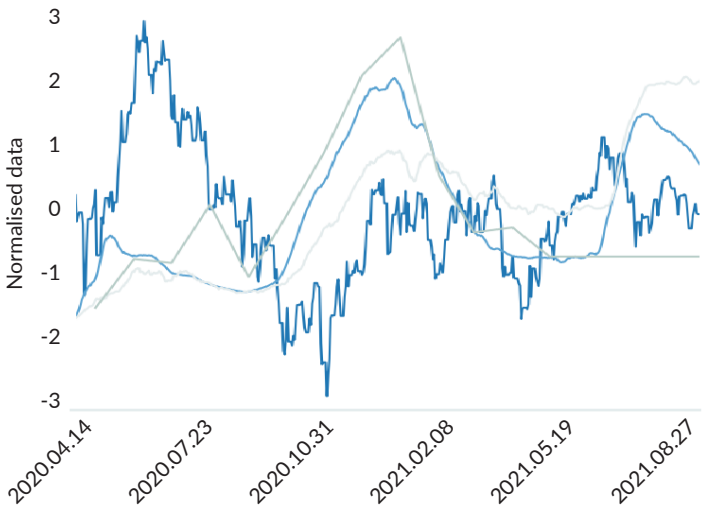
Source: Mesirow

POLAND | PLNUSD



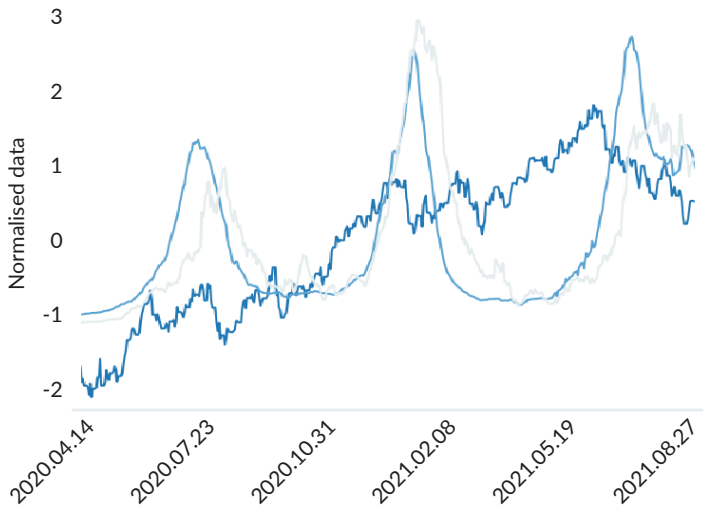
Source: Mesirow

RUSSIA | RUBUSD



Source: Mesirow

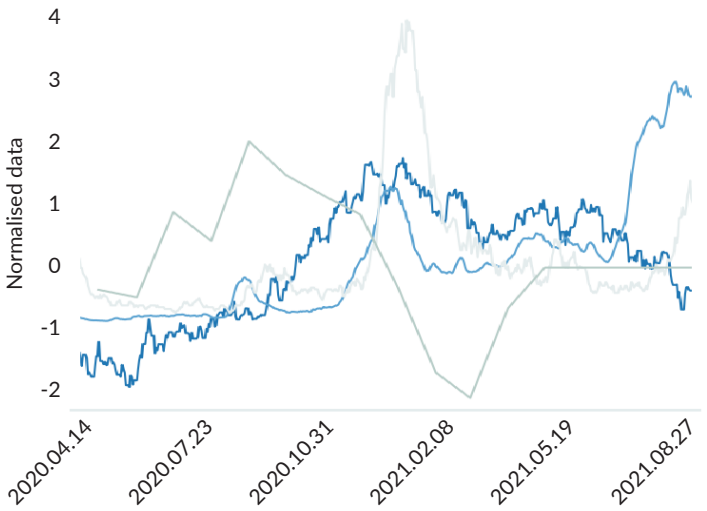
SOUTH AFRICA | ZARUSD



Source: Mesirow

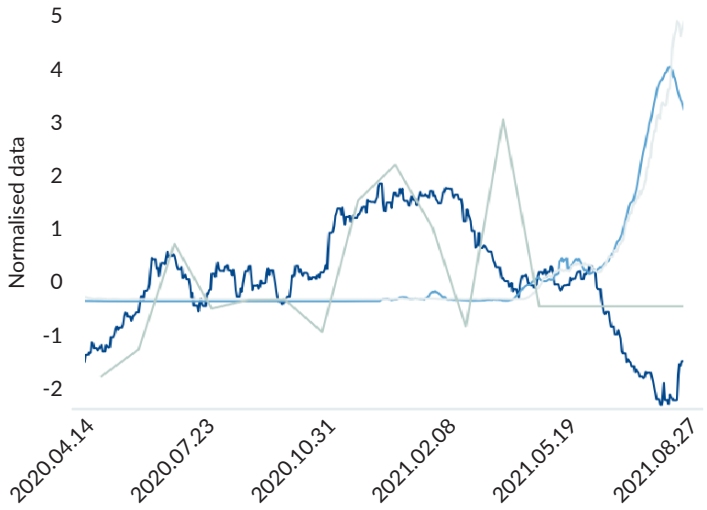
Normalised — Normalised new cases 7-days moving average — Normalised new death 7-days moving average — Normalised exccess mortality monthly

SOUTH KOREA | KRWUSD



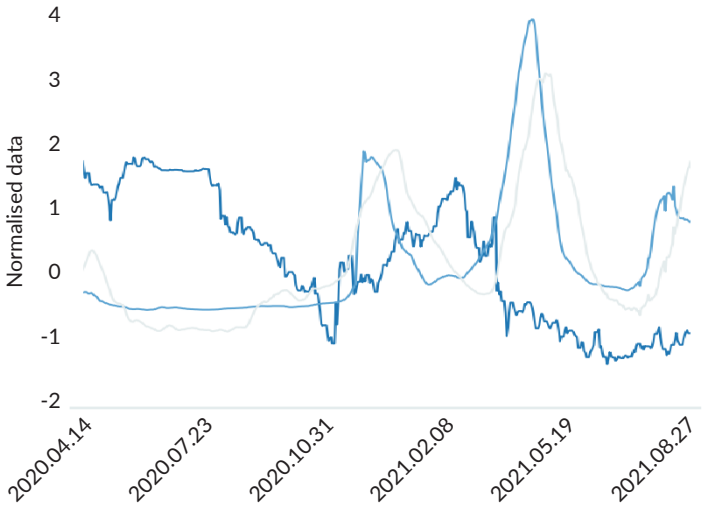
Source: Mesirow

THAILAND | THBUSD



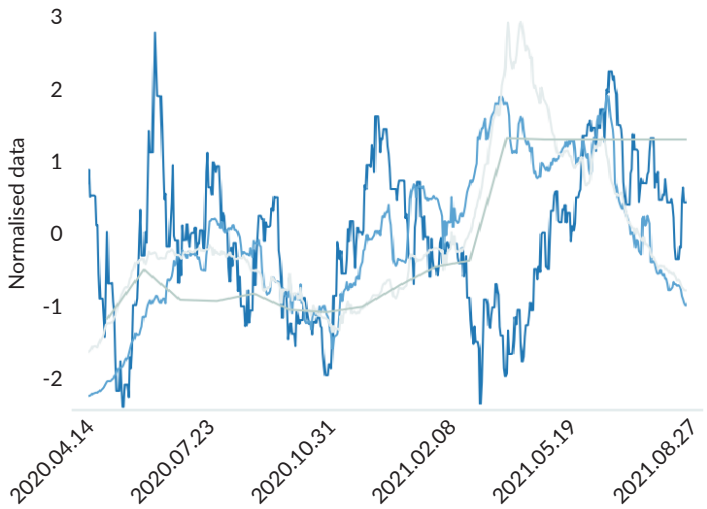
Source: Mesirow

TURKEY | TRYUSD



Source: Mesirow

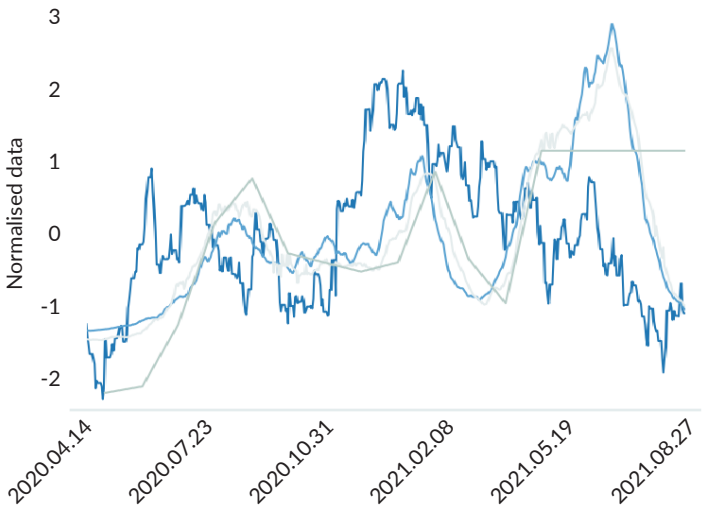
BRAZIL | BRLUSD



Source: Mesirow

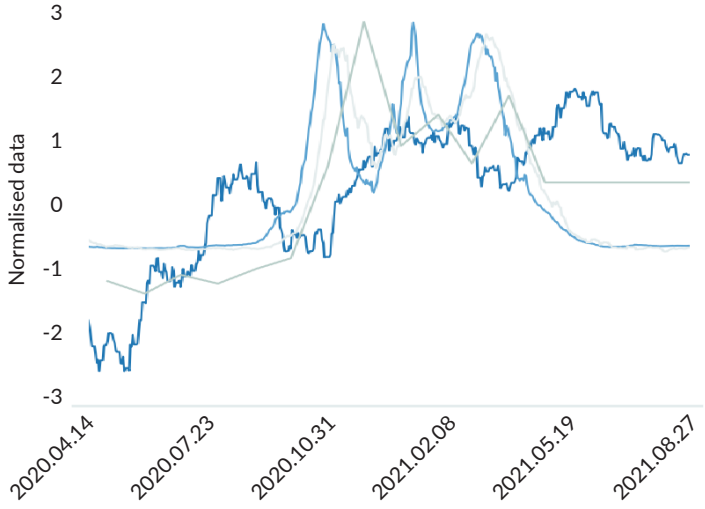
Normalised — Normalised new cases 7-days moving average — Normalised new death 7-days moving average — Normalised exccess mortality monthly

COLOMBIA | COPUSD



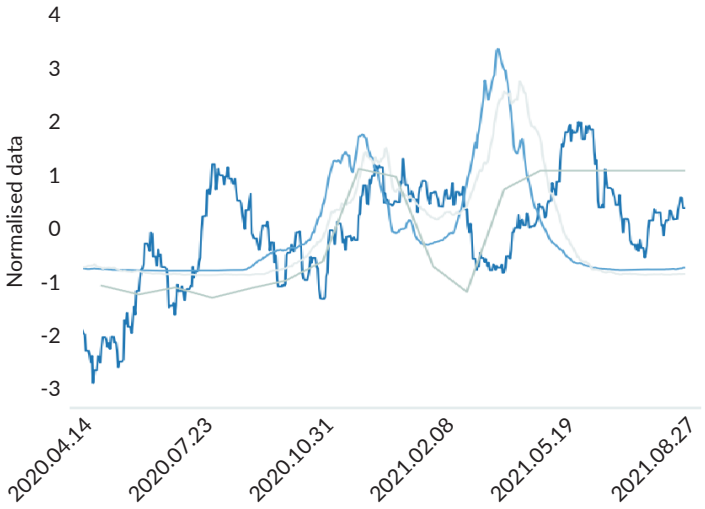
Source: Mesirow

CZECH REPUBLIC | CZKUSD



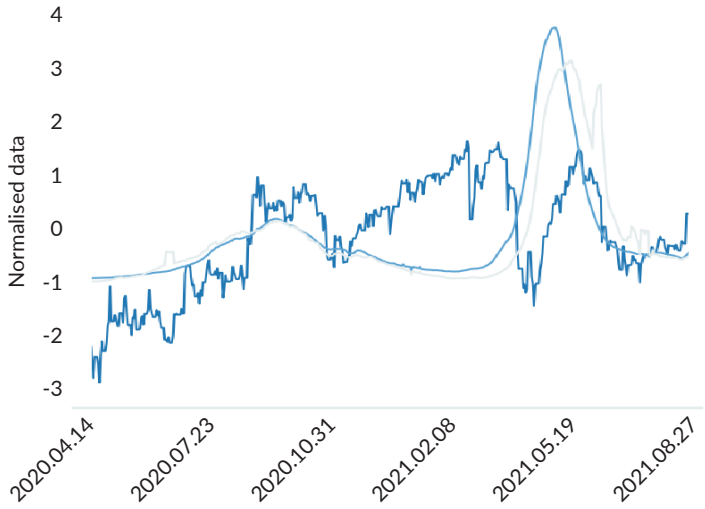
Source: Mesirow

HUNGARY | HUFUSD



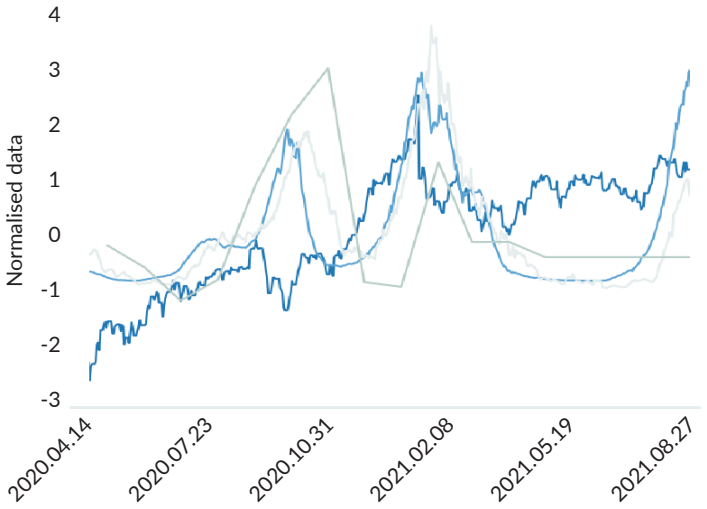
Source: Mesirow

INDIA | INRUSD



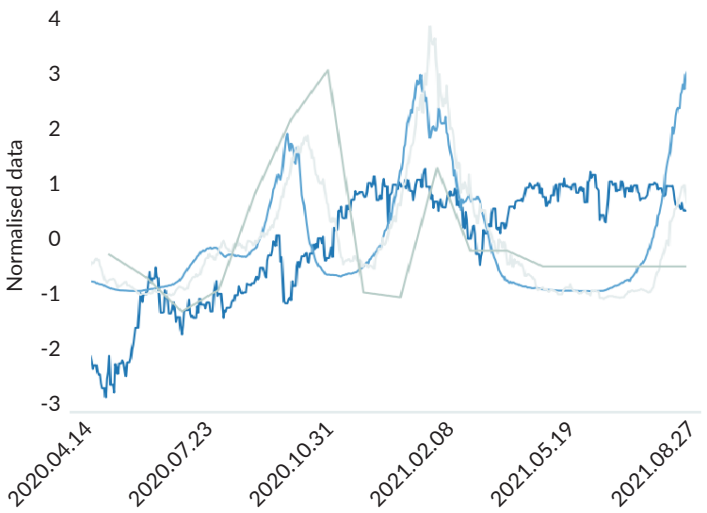
Source: Mesirow

ISRAEL | ILSUSD



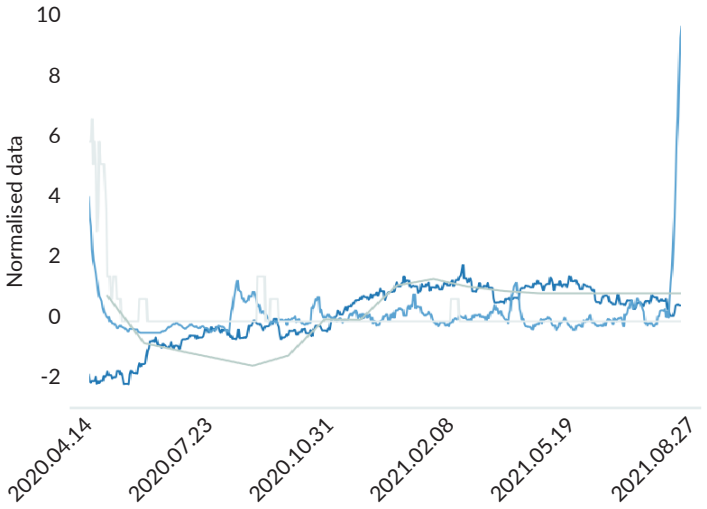
Source: Mesirow

MEXICO | MXNUSD



Source: Mesirow

NEW ZEALAND | NZDUSD



Source: Mesirow

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