LIVERPOOL MACROECONOMIC RESEARCH LIMITED

Quarterly Economic Bulletin

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Cardiff Business School
Ysgol Busnes Caerdydd

Julian Hodge Institute of Applied Macroeconomics

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Contents

The Julian Hodge Institute of Applied Macroeconomics

The Julian Hodge Institute of Applied Macroeconomics was launched in autumn 1999 in a new collaboration between the Cardiff Business School of Cardiff University and Julian Hodge Bank. The aim of the Institute is to carry out research into the behaviour of the UK economy, and to study in particular its relationship with the other economies of Europe. This research has been given added urgency by the ongoing discussions about the UK's adoption of the Euro in place of the Pound. The new Institute has aimed to develop research relevant to this important debate.

The Institute embraces the original Liverpool Research Group in Macroeconomics, which is now based at Cardiff Business School and is pursuing a research programme involving the estimation and use of macroeconomic models for forecasting and policy analysis. It is grateful for financial support to the Jane Hodge Foundation, the Economic and Social Research Council, Esmee Fairbairn Charitable Trust, the Wincott Foundation and Cardiff Business School.

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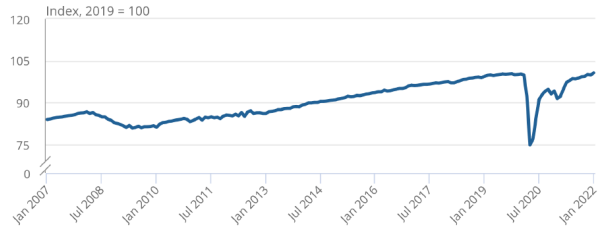
THE RECOVERY CONTINUES AND THERE IS NO NEED TO RAISE TAXES

Patrick Minford

The latest monthly GDP estimates for January confirm that the economy is still recovering well. December's figure for growth was a slight fall due to the mini-lockdown measures; but in January the economy bounced back with 0.8% growth The economy is now 0.8% above its pre-Covid level.

Figure 1: UK gross domestic product (GDP) is estimated to have grown by 0.8% in January 2022, and is now 0.8% above its pre-coronavirus (COVID-19) level

Monthly index, January 2007 to January 2022, UK



Source: Source: Office for National Statistics - GDP monthly estimate

The PMIs from Markit are also strong in February:

Related	Last	Reference
Manufacturing PMI	58.0	Feb 2022
Services PMI	60.5	Feb 2022
Composite PMI	59.9	Feb 2022

All this suggests that the recovery is continuing strongly into 2022.

The latest Covid scare over the Omicron variant should not derail it. The government is now determined to 'live with Covid' and this includes new variants that will continue to pop up. Plainly there is a concern that it will spread fast, reinfecting people who had earlier variants. But it does seem that the vaccinations should protect against serious disease and hence hospitalisation, via the strengthening of T-cells, to which the omicron variant is as vulnerable as previous ones. If so then the government will not react with economy-damaging lockdown measures and one must hope, will also reopen travel.

If Omicron spreads faster than previous variants but is no more deadly or perhaps less deadly, as the evidence now suggests, it would conform to the evolution of previous viruses with which we have had to live, including previous coronaviruses that now produce the common cold.

Table 1: Summary of Forecast

	2018	2019	2020	2021	2022	2023	2024
GDP Growth[1]	1.3	1.4	-9.9	7.5	5.6	2.2	2.8
Inflation CPI	2.4	1.7	1.0	2.5	7.0	4.3	3.2
Wage Growth	3.0	3.5	1.6	5.8	6.7	4.6	4.3
Survey Unemployment	4.1	3.8	4.5	4.5	4.9	3.6	2.8
Exchange Rate[2]	78.6	78.3	78.2	81.5	77.3	76.7	76.3
3 Month Interest Rate	0.4	0.8	0.2	0.1	1.5	2.4	2.9
5 Year Interest Rate	1.0	0.6	0.1	0.4	1.9	3.5	3.0
Current Balance (£bn)	-82.9	-89.1	-57.6	-63.8	-37.2	-24.9	-17.6
PSBR (£bn)	39.3	49.1	317.2	169.5	55.0	31.9	23.5

[1]Expenditure estimate at factor cost
[2]Sterling effective exchange rate, Bank of England Index (2005 = 100)

Policy confusion

Meanwhile in fiscal policy confusion reigns. The Chancellor proclaimed in his Budget that he would like to cut taxes, even while he was then busy raising them. As we pointed out at the time, this stance was illogical and self-contradictory. Optimal tax policy should be constant over time as it is damaging to raise tax early for today's businesses, in order to lower them more for tomorrow's; welfare is greatest if the tax rate is 'smoothed' over time and borrowing is used to achieve that.

The latest news from Nos 10 and 11 Downing Street is that both Rishi Sunak and Boris Johnson would like to cut taxes in the next few years- https://www.thetimes.co.uk/article/rishi-sunaks-plan-to-slash-taxes-c30wd5kzx. The problem is that they have not clarified how they would square this with the short termist rules on the PSBR being imposed by the Treasury and its ally the OBR, given that there are strong pressures to spend on public services and infrastructure. We have argued consistently that these rules make no sense; the only issue is long term solvency and that is enhanced by the better growth taxcuts will bring.

As the economy recovers fully into 2022, tax revenues will rise and benefit payments will fall, both sharply; accordingly the PSBR will fall in spite of spending pressures. We must hope this leads to a less short termist approach, with greater confidence to go for a bold tax-cutting agenda for growth. This agenda would be good not just for growth but also for levelling-up; our projections show that taxcuts will be a bigger tonic to the North than to the South, so helping to close the gap and level up the UK. Our latest forecasts suggest a good background for it.

The implications of the recovery for tax revenues and benefit payments are that the PSBR will fall sharply in the coming financial year 2022/23 to around 2% of GDP, without any need for higher taxes. Subsequently it will go on falling to zero in a couple of years. This is after allowing for the likely rise in interest rates and in inflation (on index-linked bonds). All this implies that the debt ratio to GDP will fall steadily. Longer term projections imply it will get to around 50% by the mid-2030s, a target for complete long term safety- Table 1.

Table 1: Basic Forecast- Public Finances without tax increases

	Nom PSBR	Nom GDP	Nom Pub Spend	Spend/ GDP	PSBR/ GDP	Nom Debt	Debt Interest	Debt/ GDP	Net Taxes	Net Tax Rate
2019/20	49.1	2196.3	472.2	21.5	2.2	1621.0	48.1	73.8	471.2	21.5
2020/21	317.2	2006.2	481.1	24.0	15.8	1938.2	39.8	96.6	203.7	10.2
2021/22	169.9	2311.2	517.8	22.4	7.4	2108.1	42.6	91.2	390.5	16.9
2022/23	55.0	2579.1	562.0	21.8	2.1	2163.1	41.1	83.9	548.1	21.3
2023/24	31.9	2732.3	592.9	21.7	1.2	2195.0	42.9	80.3	603.9	22.1
2024/25	23.5	2903.4	646.8	22.3	0.8	2218.5	44.1	76.4	667.4	23.0
2025/26	3.8	3019.5	679.8	22.5	0.1	2222.3	45.2	73.6	721.2	23.9
2026/27	0.2	3140.3	734.4	23.4	0.0	2222.5	46.3	70.8	780.5	24.9
2027/28	0.2	3265.9	797.0	24.4	0.0	2222.7	47.3	68.1	844.2	25.9
2028/29	0.0	3396.6	864.8	25.5	0.0	2222.7	48.3	65.4	913.0	26.9
2029/30	0.0	3532.4	938.3	26.6	0.0	2222.7	49.2	62.9	987.5	28.0
2030/31	0.0	3673.7	1018.0	27.7	0.0	2222.7	50.1	60.5	1068.1	29.1
2031/32	0.0	3820.7	1104.4	28.9	0.0	2222.7	50.9	58.2	1155.3	30.3
2032/33	0.0	3973.5	1197.9	30.1	0.0	2222.7	51.7	55.9	1249.5	31.5
2033/34	0.0	4132.4	1299.1	31.4	0.0	2222.7	52.4	53.8	1351.5	32.7
2034/35	0.0	4297.7	1408.6	32.8	0.0	2222.7	53.2	51.7	1461.8	34.0

But we must not forget the other side of this policy coin: that policy must sustain and encourage growth. In truth projected growth of 2% is low and we can do better. Higher growth in turn will bring down the debt ratio, so in effect paying for those policies.

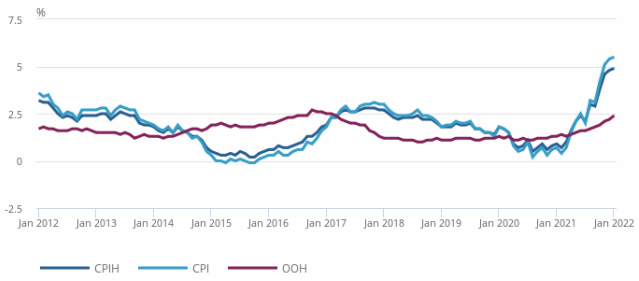
Furthermore, to boost growth a policy agenda of actually cutting taxes is not just viable but desirable. By raising growth it will pay for itself long term- as our projections in previous Bulletins have shown. Unfortunately the Treasury has turned a deaf ear to these points and continues to press for tax rises. However, though these are intended to bring down debt faster they may simply succeed in derailing growth and in so doing actually push debt up.

Where is inflation headed?

The latest inflation data looks ominous, with the YOY rate reaching 5.1%.

Figure 1: Annual CPIH inflation rate highest since May 1992

CPIH, OOH component and CPI 12-month inflation rates for the last 10 years, UK, January 2012 to January 2022

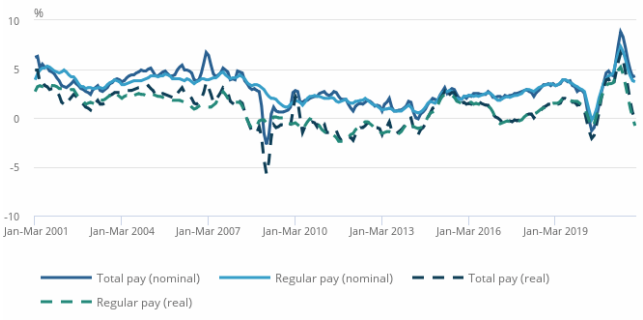


Source: Office for National Statistics – Consumer price inflation

The CPIH includes owner-occupiers' housing costs (OOH), a new addition. Wages are rising around 4%- implying that they are falling in real terms. The question is whether they will grow faster in coming months, in response to the higher inflation we are seeing. To gauge this, we need to estimate what inflation workers will expect, as they will aim to get an appropriate real pay gain in the light of economic conditions. This may not need to be much above the 2% where it was pre-Covid in 2019. There has been a recent labour shortage in key industries but with workers still coming off furlough, the labour market as a whole looks roughly in balance.

Figure 2: Annual growth in total pay was 4.3% and regular pay was 3.7% in October to December 2021

Average weekly earnings annual growth rates in Great Britain, seasonally adjusted, January to March 2001 to October to December 2021



Much has been made of the huge increases in the money supply during the pandemic. However, these were the result of massive QE in support of fiscal expansion to offset Covid effects on output; they are now being tapered off, with interest rates rising in the UK and expected to rise in the US. In the EU they will probably not rise but QE is being tapered. The central banks of all three areas are committed to

bringing inflation down to 2%. In this they will be helped by a downwards backlash in commodity prices which have surged in the Covid recovery process. The nearest parallel to the recent pandemic commodity surge is the period after WW1 in the 1918 flu pandemic- see chart below. Real commodity prices came back to their pre-war levels in 1920.

Commodity prices-past 150 yrs

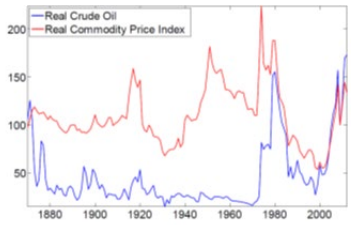


Figure 2: Commodities

Commodity Price Index (Sterling)
(Economist, 2015 = 100)

Other input prices have followed commodity prices upwards- including shipping rates and computer chips. It is likely that during 2022 they will fall as demand normalises and capacity increases in the usual commodity cycle. This will sharply moderate inflation, allowing central banks to hit their targets in 2023. Workers will anticipate this and these expectations will keep pay increases down.

Hence our forecast for inflation and interest rates are fairly moderate, as shown in our latest forecast tables for the world below. This outlook is disappointing from a policy viewpoint as it reveals that interest rates are still stuck close to the zero bound. It would be better if fiscal policy was more expansionary, driving inflation and interest rates upwards more solidly. However, the signs are that fiscal retrenchment is now taking over. The UK situation is shown below, according to our calculations. As can be seen, UK fiscal policy is turning negative, in response to the Treasury concerns we discussed in the last Bulletin. This is inappropriate, given the need to keep tax rates down to support growth.

	2020	2021	2022
Trend growth in GDP	2.0	2.0	2.0
Actual growth-Covid	-9.0	7.5	5.8
Covid effect	-11.4	5.5	3.8
PSBR £bn	104	-50	-35
PSBR outturn	307	180	58
Fiscal ex-Covid	203	230	93
% of GDP	8.9	10.0	4.0
Fiscal demand impact	8.9	1.1	-6.0

What is going on in trade?

If we turn to trade, we find that since pre-Covid trade of all sorts, both exports and imports, fell off sharply in 2020 during Covid and hardly recovered in 2021. By area, trade with the EU went on falling in 2021; with the non-EU exports went on falling but imports bounced back.

Here is the trade data over the past fifteen years. In all our main trade partners there was the well-known Covid collapse and bounce-back, which was broadly matched by our trade. However, as can be seen, the bounceback in our esports to all areas was largely aborted, as were our imports from the EU. Only our imports from the non-EU bounced back convincingly.

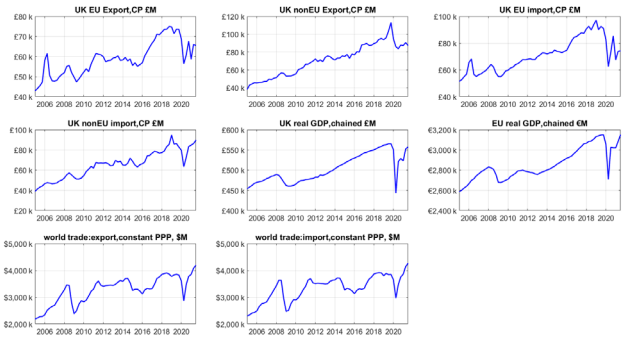


Table of trade movements (%)- 2020-21

Current prices-total, goods and services	2020	2021
Exports of G +S	-14	-2
Imports of G+S	-17	7
Volume- total, goods and services		
Exports of G +S	-14	-1
Imports of G+S	-16	3
Volume-goods, by area		
Exports to EU	-10	-6
Imports from EU	-12	-7
Exports to non-EU	-18	-
Imports from non-EU	-13	16

Source: ONS trade statistics, December 2021

How can we account for these movements? It appears there has been substantial short run disruption to trade from Brexit. This is not surprising; when border arrangements are changed, paperwork and other border requirements have to be adjusted and in the short run this is disruptive, as firms adjust to the new needs. This will apply both to EU trade and to non-EU exports (which switch from being EU exports to being UK exports); the only border arrangements that will not change are for non-EU imports. This last has been the only trade that has bounced back in 2021, suggesting that only Covid was involved with them. We have done a more sophisticated exercise statistically, relating these trade figures over the past fifteen years to their relevant drivers, as well as to the recent effects of Covid and Brexit; the conclusion is the same. The Covid dummy is insignificant as its effects re captured in the GDP and world import figures. The 'dummy' for Brexit is however significantly negative for all trade except imports from non-EU.

Of course this was the disruption that Remain advocates warned would happen and should be avoided. However, the Leave camp never denied that there would be such short run disruption. Its argument was that this would be ironed out over time: trade is a repetitive process and once the new formalities are mastered, trade should resume its old levels, given that there is an FTA with the EU and all the FTAs between the EU and non-EU are in the process of being rolled over to the UK. The Leave case was built on the long term gains, including, besides the remodelling of regulation, those from free trade while retaining free trade with the EU. Over the longer term as more FTAs are signed with non-EU countries, creating widening free trade outside the EU, we will see trade switching towards the non-EU and away from the EU; import prices will also come down, creating more competition in the home market and driving up home productivity- the main source of the gains from free trade.

Here are the regressions:

Dependent Variable	**Definition**	**Source**
Export EU	Exports trade goods & services EU, current price, SA	ONS
Export non-EU	Exports trade goods & services Non. EU, current price, SA	ONS
Import EU	Imports trade goods & services EU SA	ONS
Import non-EU	Imports trade goods & services Non. EU SA	ONS
Independent Variable		
RXR	Effective Exchange rate index	BoE
UK GDP	GDP, CVM, SA	ONS
EU GDP	Millions of Chained 2010 Euros, Seasonally Adjusted	Eurostat
World import	Import trade in goods & services, constant price & PPPs	OECD
Brexit	Dummy: from Q1 2020 as constant -1	-
COVID	Dummy: from Q1 2020 as 0, -1, 0.5, 0.2, 0.1, 0.2	-

$$\ln(Export\ EU) = C + \beta_1 \ln(RXR) + \beta_2 \ln(EU\ GDP) + \beta_3 COVID + \beta_4 Brexit$$

$$\ln(Export\ nonEU) = C + \beta_1 \ln(RXR) + \beta_2 \ln(World\ import) + \beta_3 COVID + \beta_4 Brexit$$

$$\ln(Import\ EU) = C + \beta_1 \ln(UK\ GDP) + \beta_2 \ln(RXR) + \beta_3 COVID + \beta_4 Brexit$$

$$\ln(Import\ nonEU) = C + \beta_1 \ln(UK\ GDP) + \beta_2 \ln(RXR) + \beta_3 COVID + \beta_4 Brexit$$

Table 1 chained volume measure, goods only, OLS estimate results, 2005Q1 to 2021Q3,

	Export EU	Export non-EU	Import EU	Import non-EU
RXR	0.477*	-0.375*	-0.037	-0.223*
	(0.115)	(0.133)	(0.093)	(0.116)
EU GDP	0.831*			
	(0.226)			
World imports		0.635*		
		(0.090)		
UK GDP			-0.126	1.192*
			(0.137)	(0.106)

COVID	-0.007	-0.144	-0.044	0.032
	(0.070)	(0.069)	(0.047)	(0.046)
Brexit	0.107*	0.059*	0.133*	-0.005
	(0.033)	(0.036)	(0.027)	(0.021)

Note: *significant at the 5% level; Constant is included in the regression

Table 2 Current prices/deflator measure, goods and services, OLS estimate results, 2005Q1 to 2021Q3

	Export EU	Export non-EU	Import EU	Import non-EU
RXR	-0.111	-0.745*	-0.061	-0.650*
	(0.097)	(0.096)	(0.076)	(0.078)
EU GDP	0.988*			
	(0.226)			
World imports		0.699*		
		(0.084)		
UK GDP			1.313*	1.164*
			(0.137)	(0.115)
COVID	0.034	-0.067	-0.002	0.049
	(0.059)	(0.072)	(0.048)	(0.049)
Brexit	0.157*	0.049	0.185*	0.041
	(0.028)	(0.034)	(0.022)	(0.022)

Note: *significant at the 5% level; Constant is included in the regression

The Chancellor's Mais Lecture-Wrong on the Thatcher parallels

In his generally excellent Mais lecture on Wednesday Feb 24th the Chancellor set out his vision for the UK economy. He aims for freeing up markets, improving regulation, and cutting taxes to incentivise investment, training and R&D. So far so good. But he argues that in the short term it is right to raise taxes to reduce debt. He says that Mrs. Thatcher's government did this before cutting taxes later and cites this as a supportive precedent.

But the situation in 1981 when the Thatcher government raised taxes was entirely different. Inflation was running close to 20% and interest rates were around 15%. There was a lack of credibility over the ability of monetary policy to control inflation. There was a particular worry that the government would print money to avoid borrowing. The tough budget of 1981 was necessary to create confidence in the control of inflation, so reducing inflation expectations and with them actual inflation; and so to allow interest rates to fall and permit recovery. As a result recovery was strong in 1982 and inflation fell sharply.

Today interest rates are close to zero and there is no credibility problem for the Bank in controlling inflation; its problem until recently has mostly been too little inflation, while today's inflation comes from commodity supply bottlenecks due to the Covid cycle. Now by raising rates moderately it will have a strong dampening impact on inflation; if rates go even as high as 2%, the impact will be strongly deflationary. As for government borrowing, it can be done very cheaply with long rates at just over 1%, negative in real terms. There is no pressure on the government to cut its debt ratio; its solvency is assured, gilts are seen as a highly safe asset. Nor is there any need for borrowing to fall to buttress Bank anti-inflation credibility, as that is, as we have just seen, extremely strong.

There is therefore no parallel between the fiscal policy needs of 1981 and those of today. Then fiscal policy needed to tighten to underpin anti-inflation policy. Today fiscal policy needs to permit taxes to stay down to underpin growth, and monetary policy is easily capable of the necessary tightening to restrain inflation. Indeed if fiscal policy promotes growth it will allow the Bank to raise interest rates further into more normal ranges, getting us well away from the dangerous zero interest rate region.

The need to adapt the net zero strategy for the UK's energy security needs

With the Ukraine crisis it has become clear that the UK faces an energy security problem that dominates the outlook. The cost of gas has risen sharply and is likely to rise further. Yet the transition to net zero requires that the UK's energy needs be filled by gas, to avoid the use of coal in supplementing the inputs from renewables.

Already it is clear that the cost of moving fast to net zero was excessive, as the following diagram from the Nordhaus DICE model shows. The currently planned rapid move to net zero has costs shown on the bottom line- where the temperature rise by the end of the century (2100) is kept to 3.9 degrees F. The cost-minimising strategy aims at 6.75 degF- much slower and relying much more on adaptation.

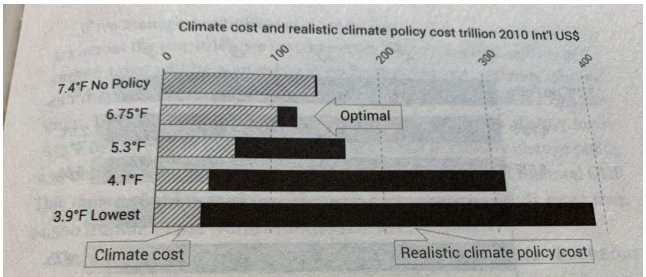


FIGURE 11.6 *Total global climate damage costs and total realistic climate change policy costs over the next five hundred years for different temperature rises by 2100, using Nordhaus's DICE model. Optimal policy (with the lowest total cost) indicated.*[18]

Source: Bjorn Lomborg False Alarm, p. 163

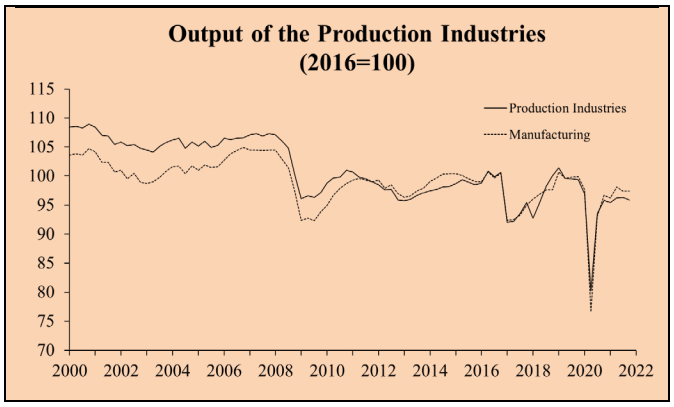
As part of this slower move, the share of gas in the transition should rise. The UK can contribute to this both in boosting its North Sea production and in pushing forward with the fracking programme in northern England where the Bowman shale reservoir greatly exceeds the supplies in the USA. At the very high prospective prices for gas fracking can create a very large GDP gain, though the size is uncertain with the current moratorium on fracking holding up any updating of possible production plans; being located in the North it will also contribute to levelling-up.

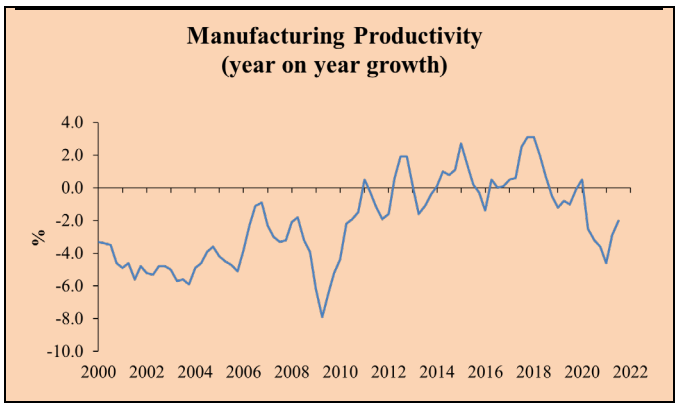
On the issue of just how much fracking can contribute to GDP, there are differing assessments. The LSE's Grantham Research Institute on Climate change and the Environment has the following: "A review published in March 2020 by Warwick Business School of a range of 'resource estimates' and production forecasts produced by the industry organisation UK Onshore Oil and Gas calculated that UK fracking might produce between 90 and 330 billion cubic metres (bcm) of natural gas between 2020 and 2050. Using future demand figures from National Grid, they calculated that could represent between 17 and 22 per cent of projected cumulative UK consumption over that period. However, the review made clear the high levels of uncertainty around all these numbers and the fact that we have no estimates of 'proven reserve' estimates on which to base commercial development". A more positive assessment from Chris Faulkner, CEO of Breitling Gas was this in the Guardian in 2013: "a British Geological Survey estimate suggests there are around 40tn cubic metres of shale gas in northern England alone. If only 10% of the UK's shale reserves were tapped, the nation could be powered for the next half century." With household energy consumption currently running at about 1.5% of GDP, and about to double with rising energy prices, the possible GDP contribution to GDP could therefore be as much as 3-4% of GDP for the next 50 years.

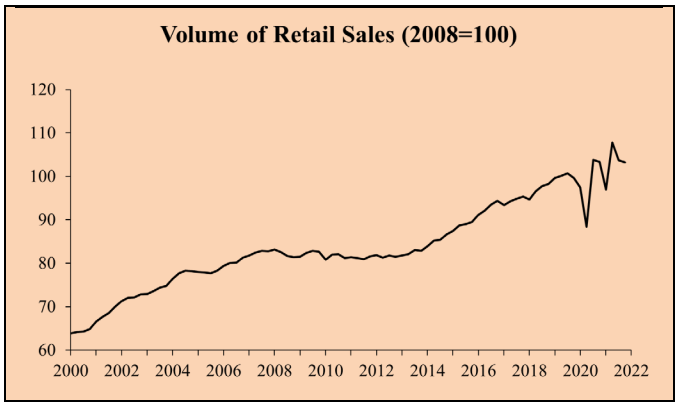
THE UK ECONOMY

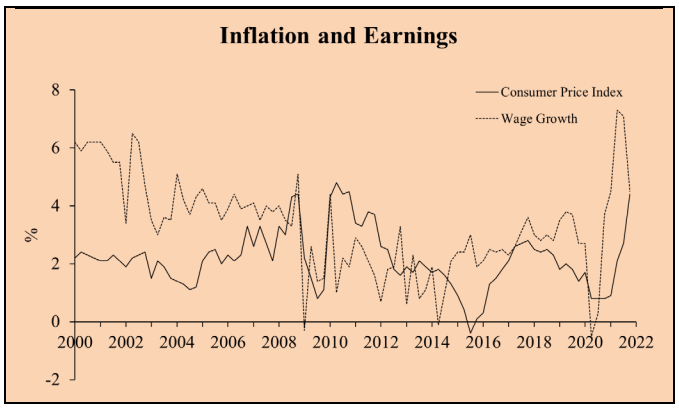
Vo Phuong Mai Le

The economic recovery has lost some momentum as inflation has surged. Economic activity rose 1% in Q4 2021, following a 1% increase in the previous quarter. This growth was driven by expansion in the construction (1% after -1.4% in Q3) and services (1.2% after 1.3% in Q4) sectors, but production output fell 0.4% (after 0.1% in Q3). On the expenditure side, the growth is driven mainly by private consumption (1.2% compared to 2.9% in Q3) and fixed investment (2.2%, after -0.2% in Q3). Net trade added 1.6 percentage points to Q4's growth, after contracting 12.2 percentage points in Q3, as strong foreign demand boosted exports growth to 4.9% (up from -4.7% in Q3), while imports demand declined 1.5% (after a 3.6% rise in Q3)









Labour market, costs and prices

Labour market conditions remained robust. According to the Office of National Statistics, in Q4 the employment rate was 75.5%, up from 75.4% in the previous quarter. At the same time, the unemployment rate was 4.1% compared to 4.3% in Q3. The number of vacancies rose to a record of 1,298,400, up by 513,700 from the pre-Covid January to March 2020 level. Due to tight labour market conditions, average weekly earnings including bonuses continued to rise (4.3% yoy in December, up from 4.1% in November). However, there are signs that the market has stabilised. The average weekly earnings growth rates have been steadily coming down from their peak of 8.8% in June 2021, and the vacancies growth rate has also continued to slow down.

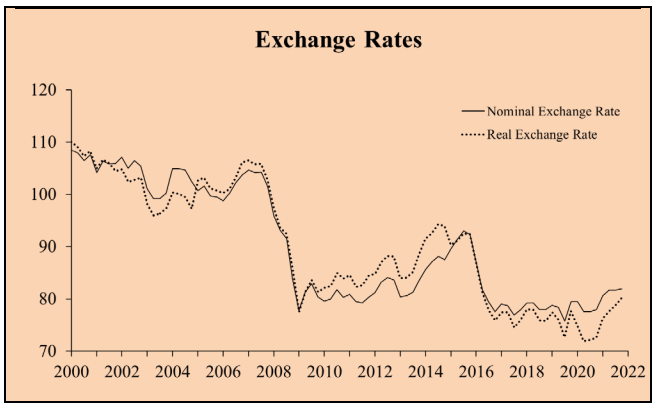
Annual CPI inflation has increased steadily. It rose 5.5% in January 2022, following December's 5.4%. It is the highest inflation rate since March 1992. High inflation is sustained by persistently high prices in transport (11.3%. after 11.9% in December), furniture household equipment and maintenance (8.4% after 7.3% in December), and housing and utility (7.1% following December's 6.9%). Core inflation also has been rising continuously, 4.4% in January from 4.2% in December. The annual inflation rate is above the target rate of 2% and is expected to rise further in the coming months. Energy, material and food prices are expected to rise further due to the Russian-Ukrainian conflict and the reset of utility price caps in April 2022, which will put further upward pressures on inflation.

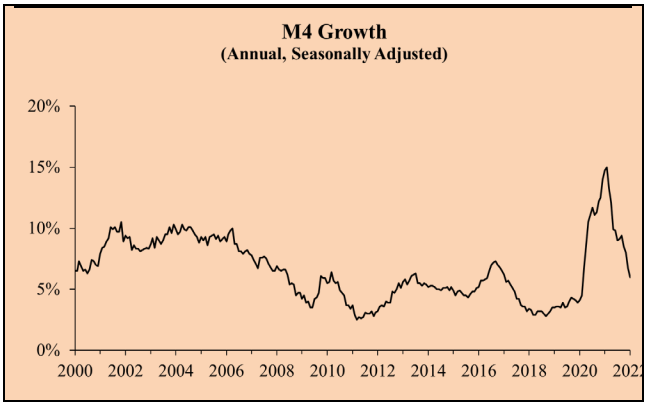
Fiscal and Monetary Developments

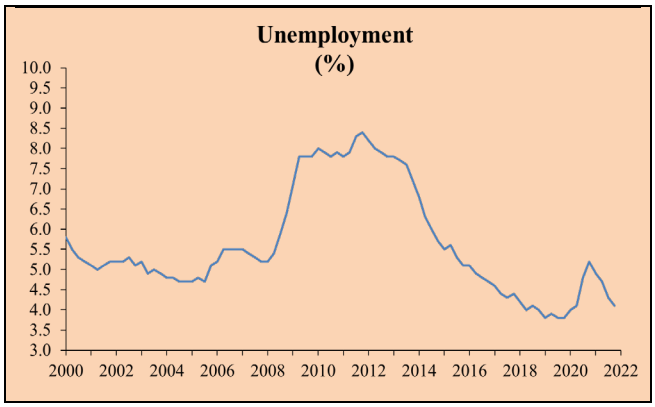
The economic perspective for Q1 2022 is optimistic according to up-to-date data and surveys. Improvements in supply chains and the easing of Covid restrictions will drive growth across most sectors. The Markit/CIPS Composite Purchasing Managers Index (PMI) rose to 60.2 in February, up from 54.2 in January. Within this, the manufacturing PMI rose to a three-month high of 58.0 in February, up from 57.3 in January and services output (its PMI Business Activity Index was 60.5, compared to 54.1 in January) rose at the fastest pace since June 2021. According to the Lloyds Bank

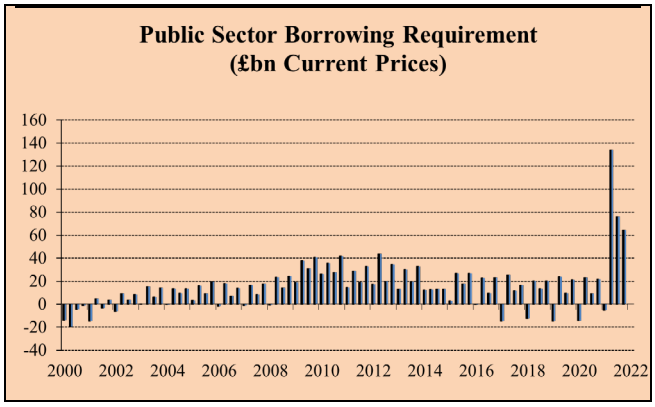
Business Barometer, business confidence was at its highest level in 5 months reaching 44% in February (up from 39% in January), and above its long-term average of 28%, indicating continued rises in business optimism.

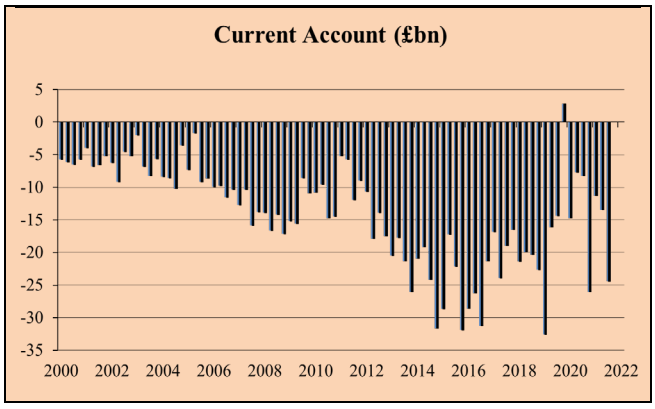
In the light of this inflation and activity data, at the February meeting the Bank of England decided to tighten its monetary policy stances. They decided to raise Bank rate from 0.25% to 0.5% to stabilise inflation and to reduce the stock of corporate bond purchases, winding the programme up by the end of 2023.











UK FORECAST DETAIL

Prices, Wages, Interest Rates and Exchange Rate Forecast (Seasonally Adjusted)

	Inflation %[1] (CPI)	Short Dated (5 Year) Interest Rates	3 Month Int. Rates	Nominal Exchange Rate (2005=100) [2]	Real Exchange Rate[3]	Real 3 Month Int. Rates %[4]	Inflation (RPIX)	Real Short Dated Rate of Interest[5]
2019	1.7	0.6	0.8	78.3	73.8	-0.7	2.6	-0.5
2020	1.0	0.1	0.2	78.2	72.9	-1.3	1.5	-1.4
2021	2.5	0.4	0.1	81.5	78.2	-5.6	4.0	-5.3
2022	7.0	1.9	1.5	77.3	77.6	-4.0	8.7	-3.5
2023	4.3	3.5	2.4	76.7	78.9	-1.1	5.7	0.0
2024	3.2	3.0	2.9	76.3	80.0	0.5	4.3	0.6
2019:1	1.8	0.9	0.9	79.0	75.4	-0.8	2.5	-0.8
2019:2	2.0	0.7	0.8	78.6	74.0	-0.7	3.0	-0.6
2019:3	1.8	0.4	0.8	76.0	70.7	-0.8	2.6	-0.4
2019:4	1.4	0.5	0.8	79.6	75.0	-0.5	2.2	-0.2
2020:1	1.7	0.4	0.6	79.5	74.9	-0.2	2.6	-0.4
2020:2	0.8	0.0	0.1	77.6	71.9	-1.0	1.2	-1.1
2020:3	0.8	-0.1	0.1	77.6	72.2	-1.5	1.1	-1.7
2020:4	0.8	0.0	0.1	78.0	72.6	-2.7	1.1	-2.7
2021:1	0.9	0.2	0.1	80.6	76.2	-3.9	1.4	-3.8
2021:2	2.1	0.4	0.1	81.7	77.6	-5.2	3.4	-4.9
2021:3	2.7	0.3	0.1	81.7	78.7	-6.3	4.5	-6.1
2021:4	4.4	0.6	0.1	81.9	80.2	-6.9	6.7	-6.4
2022:1	6.9	0.7	0.3	77.8	77.4	-6.2	9.0	-5.8
2022:2	7.1	1.7	1.7	77.7	77.3	-4.2	8.7	-4.2
2022:3	7.0	2.2	1.8	76.9	77.3	-3.3	8.5	-2.9
2022:4	7.0	3.0	2.0	76.9	78.4	-2.3	8.5	-1.3
2023:1	5.0	3.0	2.0	77.0	78.7	-1.9	6.4	-0.9
2023:2	4.4	3.5	2.2	76.9	78.7	-1.4	6.0	-0.1
2023:3	4.0	3.5	2.5	76.5	78.7	-0.9	5.5	0.1
2023:4	3.8	4.0	3.0	76.4	79.7	-0.2	5.0	0.8
2024:1	3.5	3.0	2.5	76.4	80.0	-0.3	4.6	0.2
2024:2	3.2	3.0	3.0	76.5	79.7	0.5	4.4	0.5
2024:3	3.0	3.0	3.0	76.2	79.7	0.8	4.2	0.8
2024:4	3.0	3.0	3.0	76.1	80.7	1.0	3.9	1.0

[1] Consumer's Expenditure Deflator
[2] Sterling Effective Exchange Rate Bank of England
[3] Ratio of UK to other OECD consumer prices adjusted for nominal exchange rate
[4] Treasury Bill Rate less one year forecast of inflation
[5] Short Dated 5 Year Interest Rate less average of predicted 5 year ahead inflation rate

Labour Market and Supply Factors (Seasonally Adjusted)

	Average Earnings (1990=100)[1]	Wage Growth[2]	Survey Unemployment Percent	Millions	Real Wage Rate[3] (1990=100)
2019	275.7	3.5	3.8	1.0	148.8
2020	279.1	1.6	4.5	1.3	149.7
2021	296.1	5.8	4.5	1.3	154.5
2022	314.8	6.7	4.9	1.5	154.0
2023	328.4	4.3	3.6	1.0	154.0
2024	341.1	4.1	2.8	0.7	155.4
2019:1	273.4	3.4	3.8	1.0	148.1
2019:2	273.5	4.0	3.9	1.0	147.9
2019:3	278.1	3.7	3.8	1.0	149.7
2019:4	277.9	2.7	3.8	1.0	149.6
2020:1	279.7	2.7	4.0	1.1	150.0
2020:2	270.1	-0.2	4.1	1.2	145.9
2020:3	278.6	0.2	4.8	1.4	149.0
2020:4	288.2	3.7	5.2	1.6	154.0
2021:1	292.1	4.5	4.9	1.4	155.3
2021:2	289.7	7.3	4.7	1.3	153.4
2021:3	298.4	7.1	4.3	1.3	155.5
2021:4	301.1	4.5	4.1	1.4	153.6
2022:1	311.7	6.7	5.0	1.5	155.0
2022:2	309.3	6.8	5.0	1.5	152.9
2022:3	318.3	6.7	5.0	1.5	155.0
2022:4	319.9	6.7	4.7	1.4	153.1
2023:1	326.2	4.5	4.2	1.2	154.5
2023:2	322.9	4.4	3.6	1.0	152.9
2023:3	331.9	4.3	3.4	0.9	155.4
2023:4	332.6	4.6	3.2	0.9	153.3
2024:1	339.6	4.1	2.9	0.8	157.4
2024:2	335.7	3.9	2.8	0.7	154.8
2024:3	345.9	4.2	2.8	0.7	157.3
2024:4	346.3	4.0	2.8	0.7	155.0

[1] Whole Economy
[2] Average Earnings
[3] Wage rate deflated by CPI

Estimates and Projections of the Gross Domestic Product[1] (£ Million 1990 Prices)

	Expenditure Index	£ Million '90 prices	Non-Durable Consumption[2]	Private Sector Gross Investment Expenditure[3]	Public Authority Expenditure[4]	Net Exports[5]	AFC
2019	167.8	803514.3	475369.3	308458.5	209136.4	-70959.7	118490.2
2020	152.0	728097.3	427575.8	258732.0	199232.3	-33095.4	124347.4
2021	163.3	782161.7	452309.6	292118.7	208538.0	-36908.1	133896.5
2022	172.3	825357.2	479861.8	289024.0	218557.2	-23886.6	138199.2
2023	176.1	843295.7	494513.6	282408.2	225319.4	-18612.0	140333.5
2024	181.0	866882.8	509517.7	285194.7	232155.8	-15890.3	144095.1
2019/18	1.4		0.3	3.1	3.0		-0.1
2020/19	-9.4		-10.1	-16.2	-4.8		4.9
2021/20	7.5		6.8	15.8	5.2		7.7
2022/21	5.6		6.2	-0.3	4.8		3.2
2023/22	2.2		3.1	1.2	3.1		1.5
2024/23	2.8		3.0	1.7	3.0		2.7
2019:1	167.5	200481.1	119045.5	83717.3	53429.6	-27900.7	27810.6
2019:2	167.1	200009.6	118526.3	74816.9	51617.9	-19203.6	25747.9
2019:3	168.3	201443.7	118808.6	71008.4	51891.0	-12473.8	27790.5
2019:4	168.4	201579.9	118988.8	78916.0	52197.9	-11381.7	37141.1
2020:1	163.4	195632.5	118032.8	72147.1	51656.8	-11632.2	34572.0
2020:2	131.6	157502.4	91565.8	47009.3	43743.5	429.6	25245.8
2020:3	155.3	185971.2	109964.7	64749.1	50846.1	-8204.0	31384.7
2020:4	157.9	188991.2	108012.5	74826.5	52985.9	-13688.8	33144.9
2021:1	155.5	186205.9	106678.2	68183.6	51087.4	-7838.9	31904.4
2021:2	163.9	196217.8	112089.9	66707.0	51382.2	-672.0	33289.3
2021:3	166.4	199176.5	116084.7	78828.1	52892.3	-14394.2	34234.4
2021:4	167.5	200561.5	117456.8	78400.1	53176.1	-14003.1	34468.4
2022:1	169.2	202535.5	118569.8	73860.3	53932.3	-9285.7	34541.2
2022:2	172.2	206121.1	119522.6	69230.1	54465.4	-2829.4	34267.6
2022:3	173.5	207696.3	120433.1	73370.9	54873.9	-6098.3	34883.3
2022:4	174.6	209004.2	121336.4	72562.6	55285.5	-5673.1	34507.2
2023:1	174.9	209452.2	122246.4	77513.4	55700.2	-11225.1	34782.7
2023:2	175.8	210455.1	123162.6	68889.8	56117.6	-2732.1	34982.8
2023:3	176.5	211349.8	124087.0	68248.6	56538.8	-2249.0	35275.6
2023:4	177.1	212038.5	125017.6	67756.4	56962.8	-2405.7	35292.6
2024:1	178.5	213757.9	125955.3	75531.6	57390.1	-9648.0	35471.1
2024:2	180.2	215707.1	126900.0	69270.6	57820.5	-2453.1	35830.9
2024:3	181.8	217699.5	127851.8	69660.3	58254.2	-1824.1	36242.7
2024:4	183.5	219718.3	128810.6	70732.2	58691.1	-1965.2	36550.4

[1] GDP at factor cost. Expenditure measure; seasonally adjusted
[2] Consumers expenditure less expenditure on durables and housing
[3] Private gross domestic capital formation plus household expenditure on durables and clothing plus private sector stock building
[4] General government current and capital expenditure including stock building
[5] Exports of goods and services less imports of goods and services

Financial Forecast

	PSBR/GDP %1	GDP1 (£bn)	PSBR (£bn) Financial Year	Current Account (£ bn)
2019	2.2	2196.3	49.1	-89.1
2020	15.8	2006.2	317.2	-57.6
2021	7.4	2311.2	169.9	-63.8
2022	2.1	2579.1	55.0	-37.9
2023	1.2	2732.3	31.9	-25.5
2024	0.8	2903.4	23.5	-18.1
2020:1	-2.7	537.8	-14.4	-38.6
2020:2	4.4	534.5	23.3	-24.9
2020:3	1.7	544.9	9.2	-16.4
2020:4	3.8	567.5	21.6	-9.2
2021:1	-0.9	549.4	-5.0	-18.7
2021:2	30.6	437.6	133.8	-11.9
2021:3	14.6	519.2	76.0	-12.3
2021:4	12.2	525.7	64.3	-14.8
2022:1	5.7	605.7	34.2	-15.0
2022:2	2.1	625.2	13.2	-19.3
2022:3	2.3	638.1	14.5	-6.9
2022:4	2.1	654.1	13.7	3.3
2023:1	2.1	661.8	13.6	-20.0
2023:2	1.2	666.9	8.2	-19.5
2023:3	1.3	676.9	8.6	2.4
2023:4	1.0	689.2	7.2	11.7
2024:1	1.1	699.3	7.9	-16.7
2024:2	1.0	705.9	7.1	-19.1
2024:3	0.9	717.8	6.8	4.1
2024:4	0.7	735.6	5.0	13.5

1GDP at market prices (Financial Year)

Public Finance Forecast

	Nom PSBR (£bn)	**Nom GDP (£bn)**	**Nom Pub Spend (£bn)**	**PSBR/GDP %[1]**	**Spend/GDP %**	**Nom Debt (£bn)**	**Debt Interest (£bn)**	**Debt/GDP %**	**Net Taxes (£bn)**	**Net Tax Rate%**
2019/20	49.1	2196.3	472.2	2.2	21.5	1621.0	48.1	73.8	471.2	21.5
2020/21	317.2	2006.2	481.1	15.8	24.0	1938.2	39.8	96.6	203.7	10.2
2021/22	169.9	2311.2	517.8	7.4	22.4	2108.1	42.6	91.2	390.5	16.9
2022/23	55.0	2579.1	562.0	2.1	21.8	2163.1	41.1	83.9	548.1	21.3
2023/24	31.9	2732.3	592.9	1.2	21.7	2195.0	42.9	80.3	603.9	22.1
2024/25	23.5	2903.4	646.8	0.8	22.3	2218.5	44.1	76.4	667.4	23.0
2025/26	3.8	3019.5	679.8	0.1	22.5	2222.3	45.2	73.6	721.2	23.9
2026/27	0.2	3140.3	734.4	0.0	23.4	2222.5	46.3	70.8	780.5	24.9
2027/28	0.2	3265.9	797.0	0.0	24.4	2222.7	47.3	68.1	844.2	25.9
2028/29	0.0	3396.6	864.8	0.0	25.5	2222.7	48.3	65.4	913.0	26.9
2029/30	0.0	3532.4	938.3	0.0	26.6	2222.7	49.2	62.9	987.5	28.0
2030/31	0.0	3673.7	1018.0	0.0	27.7	2222.7	50.1	60.5	1068.1	29.1
2031/32	0.0	3820.7	1104.4	0.0	28.9	2222.7	50.9	58.2	1155.3	30.3
2032/33	0.0	3973.5	1197.9	0.0	30.1	2222.7	51.7	55.9	1249.5	31.5
2033/34	0.0	4132.4	1299.1	0.0	31.4	2222.7	52.4	53.8	1351.5	32.7
2034/35	0.0	4297.7	1408.6	0.0	32.8	2222.7	53.2	51.7	1461.8	34.0

[1]GDP at market prices (Financial Year)

THE WORLD ECONOMY

US

The economic recovery accelerated in Q4- its pace is the fastest since Q3 2020. Real GDP rose 1.7% from 0.6% in Q3. The growth was driven by stronger domestic demand: private consumption rose 0.78% (compared to 0.5% in Q3) and gross private domestic investment rose 8.3% (up from 3.1% in Q3). Net trade made a marginal negative contribution to growth (-0.017 percentage points, up from a subtraction of 0.3% in Q3), as exports recovered sharply (6.1%, after -1.3% in Q3) and imports surged (4.4%, following 1.2% in Q3).

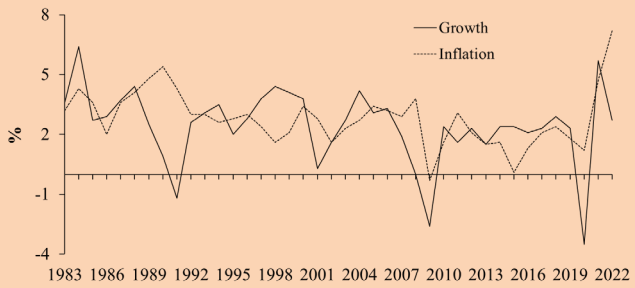
The labour market continued to tighten in January. Total non-farm payrolls increased by 467,000, following December's 510,000. The unemployment rate rose slightly to 4.0% from 3.9% in December. However, the labour force participation rate increased to 62.2% (from 61.9% in December), the highest since March 2020. The tightness has resulted in strong annual wage growth, 5.0% in December from September's 4.6%.

Consumer Price Inflation continued to rise, well beyond its target of 2%. The annual rate of CPI growth was 7.5% in January (up from December's 7.0%), the highest since February 1982. The increase was mainly due to persistently rising energy costs (27%, after December's 29.3%) and food (7%, after 6.3% in December). Excluding food and energy, core inflation rose to 6.0%, up from 5.5% in December.

According to the latest surveys, economic activity continued to grow in Q1 2022. The US Composite Output Index was 56.0 (up from 51.1 in January); strong growth was observed in both manufacturing (Markit PMI of 57.5, up from 55.5 in January) and services (Markit PMI of 56.7, up from 51.2 in January) sectors. High inflation keeps weighing on the consumer confidence level (110.5, compared to 111.1 in January), but it remained above the threshold of 100, indicating continued consumer optimism.

Despite rising inflation and improvements in economic conditions, in the January meeting the Federal Reserve voted to maintain the federal funds rate at 0 to 0.25%. However, they are expected to raise this target range soon. Regarding their unconventional policies, they decided to continue to reduce the monthly pace of net asset purchases, bringing them to an end in early March. To ensure smooth market functioning and accommodative financial conditions, they decided to increase holdings of Treasury securities by at least $20 billion per month and agency mortgage-backed securities by at least $10 billion per month.

U.S.: Annual Growth Rates of Real GNP and Consumer Prices

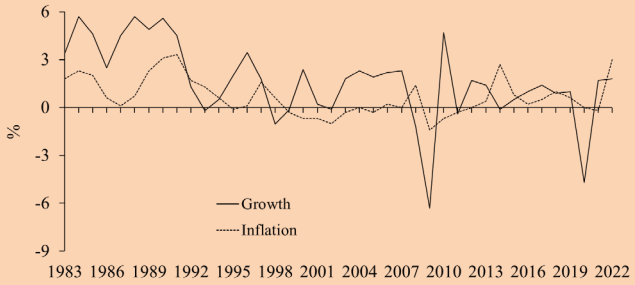


US

	2018	2019	2020	2021	2022	2023
Real GDP Growth (% p.a.)	3.0	2.2	–3.5	5.7	3.7	1.5
Inflation (% p.a.)	2.4	1.8	1.2	4.7	7.2	2.6
Real Short Int. Rate	0.6	0.3	–4.6	–7.1	-1.0	-0.3
Nominal Short Int. Rate	2.4	1.5	0.4	0.1	1.6	2.3
Real Long Int. Rate	0.9	0.7	-3.8	-5.6	0.4	0.7
Nominal Long Int. Rate	2.7	1.9	0.9	1.6	3.0	3.3
Real Ex. Rate (2000=100)[1]	93.5	96.3	97.6	95.5	98.5	97.0
Nominal Ex. Rate[2]	112.01	115.73	117.78	113.13	111.49	112.10

[1]The real exchange rate is the domestic price level relative to the foreign price level converted into domestic currency. A rise in the index implies an appreciation of the real exchange rate.
[2] The series for the USA is a nominal broad U.S dollar index (2006=100)

Japan: Annual Growth Rates of Real GNP and Consumer Prices



Japan

	2018	2019	2020	2021	2022	2023
Real GDP Growth (% p.a.)	0.6	0.0	–4.7	1.7	2.8	0.8
Inflation (% p.a.)	1.0	0.5	0.0	–0.2	3.0	0.7
Real Short Int. Rate	–0.4	0.1	0.3	-2.9	0.4	0.4
Nominal Short Int. Rate	0.1	0.1	0.1	0.1	1.1	1.1
Real Long Int. Rate	–0.5	0.0	0.2	–2.9	0.4	0.4
Nominal Long Int. Rate	0.0	0.0	0.0	0.1	1.1	1.1
Real Ex. Rate (2000=100)[1]	57.8	59.4	60.6	54.8	52.1	51.5
Nominal Ex. Rate	112.10	110.40	109.02	106.78	115.10	114.80

[1]The real exchange rate is the domestic price level relative to the foreign price level converted into domestic currency. A rise in the index implies an appreciation of the real exchange rate.

Japan

The economy rebounded in Q4 due to easing of Covid restrictions. Real GDP grew 1.35%, after contracting 0.7% in the previous quarter. The recovery reflected a strong rebound in private consumption (rising 2.8%, after -0.9% in Q3) and a smaller drop in fixed investment (-0.6%,

following -2.3% in Q3). A positive contribution came again from the external sector. Net trade added 0.2 percentage points to growth (up from 0.1 percentage points in Q3), as exports demand increased (1%, compared to -0.3% in Q3) and imports contracted further (-0.3%, after -0.9% in Q3).

Looking ahead, recent surveys indicate a difficult Q1. The Jibun Bank Composite PMI fell deeper into contractionary territory in February (44.6, down from 49.9 in January), pointing to a further deterioration in private sector activity. Within this, the services sector contracted with a PMI of 42.7 (following 47.6 in January), while the manufacturing sector's expansion decelerated (with five-month low PMI of 52.9, compare with 55.4 in January).

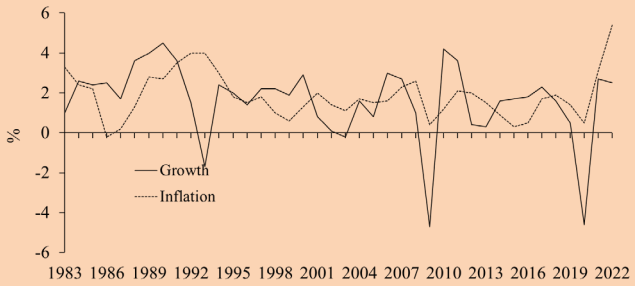
Annual CPI inflation rose 0.5% in January, down from 0.8% in the previous month. This was driven by moderation in housing, culture and recreation, and miscellaneous. The main upward pressure came from fuel, light and water charges (12.7%, up from 11.2% in January) and food inflation remaining at a 16-month high at 2.1%. Core inflation, excluding energy and food, was 0.3% in January, down from December's 0.4%. In the January meeting the Bank of Japan decided to maintain its monetary policies. It will continue with monetary easing until its CPI inflation target of 2% is met.

Germany

Renewed Covid restrictions in Q4 hampered the economic recovery. Real GDP decreased 0.3%, down from an expansion of 1.7% in Q3. The negative contribution came from a fall in private consumption (-1.8%, down from 6.0% in Q3). Positive contributions came from rebounds in government spending (1%, up from -2.8% in Q3) and fixed investment (0.5%, after -2.9% in Q3). Net trade added 0.2 percentage points to the Q4's growth (following 0.1% in Q3), as both exports (4.8% in Q4 after flattening in Q3) and import (5.1% after decreasing 0.1% in Q3) recovered strongly.

Recent surveys have indicated a return of economic expansion in Q1 2022. The Markit Composite PMI reached a six-month high level of 56.2 in February, up from 53.8 in January. The improvement came from a stronger improvement in the services sector (the Services PMI was 56.6, compared to 52.2 in January) and continuous expansion in the manufacturing sector (the manufacturing PMI was 58.5, following 59.8 in January). Despite this promising information, the recent immediate sanctions against Russia will inevitably make a negative contribution to Q1 growth through the higher cost of energy, commodities and food as well as disruptions to exports, although the size of the impact is uncertain.

Germany: Annual Growth Rates of Real GNP and Consumer Prices

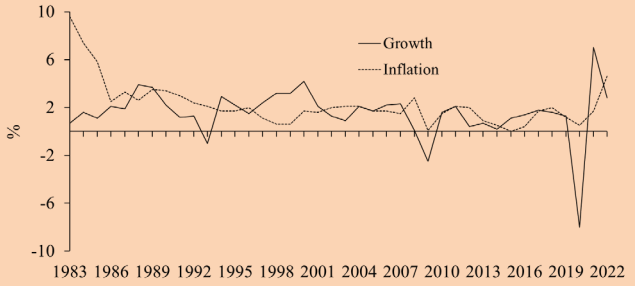


German

	2018	2019	2020	2021	2022	2023
Real GDP Growth (% p.a.)	1.3	0.6	–4.6	2.7	3.5	1.7
Inflation (% p.a.)	1.8	1.4	0.5	3.1	5.4	1.9
Real Short Int. Rate	–1.7	–0.9	–3.6	–6.0	–1.4	–1.3
Nominal Short Int. Rate	–0.3	–0.4	–0.5	–0.6	0.5	0.6
Real Long Int. Rate	–1.2	–0.7	–3.7	–5.6	–0.9	–0.7
Nominal Long Int. Rate	0.2	–0.2	–0.6	–0.2	1.0	1.2
Real Ex. Rate (2000=100)[1]	96.5	94.8	95.8	96.6	94.3	93.8
Nominal Ex. Rate	0.85	0.89	0.88	0.85	0.88	0.88

[1]The real exchange rate is the domestic price level relative to the foreign price level converted into domestic currency. A rise in the index implies an appreciation of the real exchange rate.

France: Annual Growth Rates of Real GNP and Consumer Prices



France

	2018	2019	2020	2021	2022	2023
Real GDP Growth (% p.a.)	1.8	1.8	–8.0	7.0	3.8	1.1
Inflation (% p.a.)	1.9	1.3	0.5	1.7	4.6	1.5
Real Short Int. Rate	–1.6	–0.9	–2.2	–5.1	–1.0	–0.9
Nominal Short Int. Rate	–0.3	–0.4	–0.5	–0.6	0.5	0.6
Real Long Int. Rate	–1.2	–0.8	–1.5	–4.3	0.0	0.1
Nominal Long Int. Rate	0.1	–0.3	0.2	0.3	1.5	1.6
Real Ex. Rate (2000=100)[1]	97.4	95.6	96.4	95.7	93.2	93.1
Nominal Ex. Rate[2]	0.85	0.89	0.88	0.85	0.88	0.88

[1]The real exchange rate is the domestic price level relative to the foreign price level converted into domestic currency. A rise in the index implies an appreciation of the real exchange rate.

France

The economic recovery lost some momentum in Q4. Real GDP rose 0.7%, after rising 3.2% in the previous quarter. The slowdown was due to weaker domestic demand because

of tight Omicron restrictions. While a sharp deceleration was observed in private consumption (0.5% in Q4, after a 5.6% rise in Q3) and government spending (0.3%, from 2.7% in Q3), fixed investment grew 0.5% (up from 0.1% in Q3). In addition, net trade subtracted 0.2 percentage points from the quarter's growth (following +0.2 percentage points in Q3), as imports demand (3.6%, compared to 0.8% in Q3) accelerated faster than exports (3.2% compared to 1.7% in Q3).

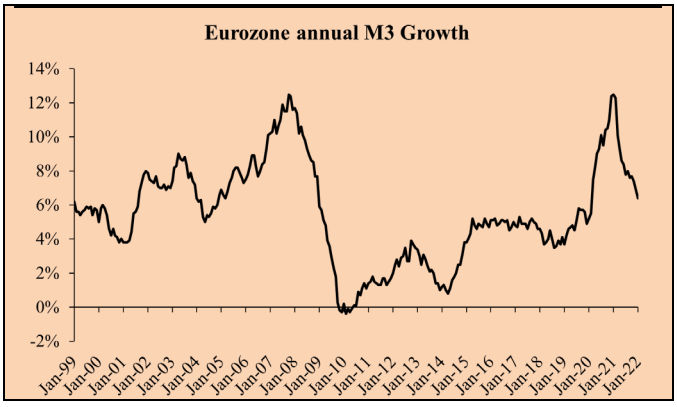
Labour market conditions improved in Q4. The unemployment rate was 7.4%, down from 8.0% in Q3. The employment rate edged up to 67.8%, from Q3's 67.6.

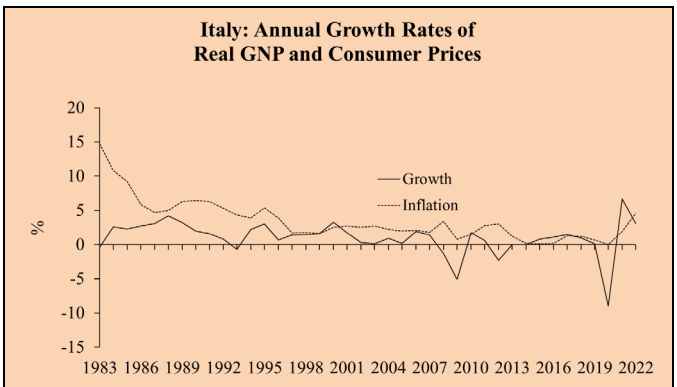
There are signs of returning recovery momentum in Q1, as in February the private sector had its strongest expansion since June 2021. The Flash Composite Output Index was 57.4, up from 52.7 in January. This acceleration is observed across both services (Services activity Index of 57.9, after 53.1 in January) and manufacturing (Manufacturing PMI at 57.6, up from 55.5 in January).

Italy

The economic recovery in Q4 slowed down to its slowest rate since Q1 2021. Real GDP rose 0.6%, down from 2.6% in Q3. This deceleration was driven by weaker private consumption (0.2%, after 2.2% in Q3), while gross fixed investment formation accelerated (2.8%, following 1.6% in Q3). Net trade contributed negatively to the quarterly growth, as imports demand increased (4.2%, after 2.1% in Q3) while exports growth stalled (0% in Q4 compared to 3.4% in Q3).

The recent data points to an economic expansion in Q1. Business confidence rose in February (108.2, from January's 105.2), showing private sector optimism. The services sector rebounded in February. The Markit Services PMI recovered from a fall of 48.5 in January to 52.8 in February. Manufacturing continued its growth. The Markit Manufacturing PMI was 58.3 in February, unchanged from January.





Italy

	2018	2019	2020	2021	2022	2023
Real GDP Growth (% p.a.)	0.9	0.3	–9.0	6.7	4.1	1.3
Inflation (% p.a.)	1.2	0.6	-0.1	1.9	4.6	1.3
Real Short Int. Rate	–0.9	–0.3	–2.4	–5.2	–0.8	–0.7
Nominal Short Int. Rate	–0.3	–0.4	–0.5	–0.6	0.5	0.6
Real Long Int. Rate	2.2	1.4	–1.4	–3.4	1.2	1.6
Nominal Long Int. Rate	2.8	1.4	0.5	0.9	2.5	2.9
Real Ex. Rate (2000=100)[1]	102.8	100.4	100.9	100.5	100.0	99.5
Nominal Ex. Rate[2]	0.85	0.89	0.88	0.85	0.88	0.88

[1]The real exchange rate is the domestic price level relative to the foreign price level converted into domestic currency. A rise in the index implies an appreciation of the real exchange rate.

Euro-zone monetary policy

The annual Harmonized Index of Consumer Price inflation rate has been rising steadily. It was 5.1% in January, up from 5.0% in December 2021. The main drivers of this rise were energy inflation (28.6%, compared to 25.9% in December) and food, alcohol and tobacco (3.6%, after 3.2% in December). Core HICP, without energy and food, rose 2.3%, down from 2.6% in December.

Given the economic recovery and inflation conditions, at the February meeting while the European Central Bank did not change its monetary policy stance, it gave some indications that it will announce steps to start normalising monetary policy at the March meeting. However, all these were prior to the Russian-Ukrainian conflict which will impact negatively on the economic outlook for euro zone countries and may well cause the ECB to react dramatically differently to what it suggested in the February meeting.

WORLD FORECAST DETAIL

Growth Of Real GNP

	2018	2019	2020	2021	2022	2023
U.S.A.	3.0	2.2	–3.5	5.7	3.7	1.5
U.K.	1.3	1.4	–9.4	7.5	5.6	2.2
Japan	0.6	0.0	–4.7	1.7	2.8	0.8
Germany	1.3	0.6	–4.6	2.7	3.5	1.7
France	1.8	1.8	–8.0	7.0	3.8	1.1
Italy	0.9	0.3	–9.0	6.7	4.1	1.3

Growth Of Consumer Prices

	2018	2019	2020	2021	2022	2023
U.S.A.	2.4	1.8	1.2	4.7	7.2	2.6
U.K.	2.5	1.8	1.0	2.5	7.0	4.3
Japan	1.0	0.5	0.0	–0.2	3.0	0.7
Germany	1.8	1.4	0.5	3.1	5.4	1.9
France	1.9	1.3	0.5	1.7	4.6	1.5
Italy	1.2	0.6	-0.1	1.9	4.6	1.3

Real Short-Term Interest Rates

	2018	2019	2020	2021	2022	2023
U.S.A.	0.6	0.3	–4.6	–7.1	-1.0	-0.3
U.K.	–1.4	–0.2	–2.3	–6.9	–2.8	–1.9
Japan	–0.4	0.1	0.3	-2.9	0.4	0.4
Germany	–1.7	–0.9	–3.6	–6.0	–1.4	–1.3
France	–1.6	–0.9	–2.2	–5.1	–1.0	–0.9
Italy	–0.9	–0.3	–2.4	–5.2	–0.8	–0.7

Nominal Short-Term Interest Rates

	2018	2019	2020	2021	2022	2023
U.S.A.	2.4	1.5	0.4	0.1	1.6	2.3
U.K.	0.4	0.8	0.2	0.1	1.5	2.4
Japan	0.1	0.1	0.1	0.1	1.1	1.1
Germany	–0.3	–0.4	–0.5	–0.6	0.5	0.6
France	–0.3	–0.4	–0.5	–0.6	0.5	0.6
Italy	–0.3	–0.4	–0.5	–0.6	0.5	0.6

Real Long-Term Interest Rates

	2018	2019	2020	2021	2022	2023
U.S.A.	0.9	0.7	-3.8	-5.6	0.4	0.7
U.K.	–0.8	–0.4	–2.4	–6.6	–2.4	–0.8
Japan	–0.5	0.0	0.2	–2.9	0.4	0.4
Germany	–1.2	–0.7	–3.7	–5.6	–0.9	–0.7
France	–1.2	–0.8	–1.5	–4.3	0.0	0.1
Italy	2.2	1.4	–1.4	–3.4	1.2	1.6

Nominal Long-Term Interest Rates

	2018	2019	2020	2021	2022	2023
U.S.A.	2.7	1.9	0.9	1.6	3.0	3.3
U.K.	1.0	0.6	0.1	0.4	1.9	3.5
Japan	0.0	0.0	0.0	0.1	1.1	1.1
Germany	0.2	–0.2	–0.6	–0.2	1.0	1.2
France	0.1	–0.3	0.2	0.3	1.5	1.6
Italy	2.8	1.4	0.5	0.9	2.5	2.9

Index Of Real Exchange Rate (2000=100)[1]

	2018	2019	2020	2021	2022	2023
U.S.A.	93.5	96.3	97.6	95.5	98.5	97.0
U.K.	77.4	78.6	78.3	78.2	77.6	78.9
Japan	57.8	59.4	60.6	54.8	52.1	51.5
Germany	96.5	94.8	95.8	96.6	94.3	93.8
France	97.4	95.6	96.4	95.7	93.2	93.1
Italy	102.8	100.4	100.9	100.5	100.0	99.5

[1] The real exchange rate is the domestic price level relative to the foreign price level converted into domestic currency. A rise in the index implies an appreciation in the real exchange rate.

Nominal Exchange Rate (Number of Units of Local Currency To $1)

	2018	2019	2020	2021	2022	2023
U.S.A.[1]	112.01	115.73	117.78	113.13	111.49	112.10
U.K.	1.34	1.28	1.28	1.38	1.35	1.35
Japan	112.10	110.40	109.02	106.78	115.10	114.80
Eurozone	0.85	0.89	0.88	0.85	0.88	0.88

[1] The series for the USA is a nominal broad U.S dollar index (2006=100); the series for the UK is $ per £

* Forecasts based on the Liverpool World Model

EMERGING MARKETS

Anupam Rastogi

India

GLobal events seem to be getting ahead of us. Writing is on the wall that the world economic order has changed. Economic development built on liberal values, encouraged by world trade, has given way to an 'Autarkic Order.' Political alignments have changed, and so would be economic priorities.

Prime Minister Narendra Modi's party looks set to retain power in four out of five provincial elections. The most important is Uttar Pradesh which is a crucial state. The perception that he would continue beyond 2024 is strengthening and winning in Uttar Pradesh show that handling of Covid-19 and reaching out to poor people during that time is paying a handsome dividend to the party. Indian voters remain loyal to the prime minister, and his popularity remains intact ahead of general elections in 2024.

India's responses to the Ukraine crisis were dictated by its dependence on Russia for arms and, now, providing a backstop to China's expansion on the world stage. It skilfully balanced its interests in the Sino-Ukraine conflict. On the broader geopolitical realm is its position vis-à-vis the U.S. and China. This would become clear as it pushes its financial infrastructure, the revival of barter trade with Russia, and the development of defence industries capable of exporting arms.

Nevertheless, India is not insulated from the economic fallout of this conflict. The flare-up in crude oil, metals, and food grain prices will translate into a trade shock. The impact of high oil prices is already seen in February's widening trade deficit. This was mainly because of weak exports and a surge in imports of oil and gold. An increase of $10/bbl in the price of crude oil raises India's current account deficit by $10 billion (about 0.3% of GDP), a decline in GDP growth by 0.1%, and an increase in inflation by 0.1%. The current account deficit, up to 2.5%, does not harm the INR, but beyond that, it has to take a hit on its currency. With foreign exchange reserves of USD632 billion and expected bumper wheat production, India seems to keep its economy on the growth path.

The government estimates an 8.9% growth for the year to March 31st of 2022. We maintain our 7.5 and 6.4% GDP growth forecast for the next two fiscal years. The impact of the third wave on the Indian economy turned out to be far less severe than the previous two waves. But, an increase in crude prices would impact growth and inflation in the coming months. A neutral La Nina during the initial phase of the four-month monsoon season this year that starts from June could mean there would be one less reason to worry about the prospects of the monsoon and GDP growth this year. A more accurate weather prediction of El Nino will be made around late May or early June.

India: BSE Sensex

India's fiscal deficit is expected to hit 6.9% of gross domestic product, or $210.12 billion, this financial year and 6.4% next year as the government continues to try to spend its way out of the pandemic-induced downturn.

The RBI's 4.5% inflation projection for fiscal 2023 might prove a bit optimistic even if the disruptions from the Ukraine crisis fade quickly. The retail inflation rate currently stands at 6.01%. We expect inflation to breach the central bank's inflation target and come out to be 6.5%. For fiscal 2024, we forecast inflation to be 6%.

The Reserve Bank of India's rate-setting panel has continued with its accommodative stance and holds interest rates as it takes a dovish view on inflation. Tightening of monetary policy is expected only later this year as the altered geopolitical situation solidifies.

Higher crude prices have a negative influence on the current account deficit. India recorded a six-fold increase in defence exports between 2017 and 2021, growing from 15.2 billion rupees to 84.4 billion rupees. India may make barter trade with Russia for its food and chemical needs. India's arms imports have dropped by over 30%. Overall, the impact of the Ukraine crisis on CAD will be muted.

Indian markets are somewhat isolated from the crisis. Indian equities moved in tandem with the broader E.M. pack, with modest selling in January that intensified in February amid rising geopolitical tensions. The INR is expected to depreciate at a measured pace on the central bank's currency support.

	20–21	**21–22**	**22–23**	**23-24**	**24-25**
GDP (%p.a.)	-6.9	8.9	7.5	6.4	6.5
WPI (%p.a.)	5.5	6.0	6.5	6.0	5.5
Current A/c(US$ bill.)	35.0	-35.0	-30.0	-30.0	-30.0
Rs./$(nom.)	75.0	74.5	77.0	79.0	80.0

China

China's role in the new world order will be very different from the one envisaged by President Xi Jinping a few months ago. Ties between Russia and China, taken as a "marriage of convenience," will reshape global politics. The weakening of the Sino-Russian relationship crafted in 1972 to neutralize Soviet power was anchored on the policy that national sovereignty and territorial integrity are paramount. This is also known as the One China policy. The approach is credited with reducing the likelihood that Beijing would seek to recapture the self-governed island of Taiwan by military force: Even though the Shanghai Communiqué was more of an agreement to disagree, it provided the foundation for China's economic growth in the last five decades without questioning its national sovereignty and territorial integrity. President Xi Jinping feels that successive U.S. administration's actions have eroded the U.S. commitment to the One China policy.

China strongly feels that the U.S. is building a Pacific version of NATO. Foreign Minister Wang Yi is on record that the "real goal" of the U.S.'s Indo-Pacific strategy was to form Asia's answer to the North Atlantic Treaty Organization while describing ties between China and Russia as "rock solid."

China has set an economic growth target for the year of around 5.5%, the lowest level in more than a quarter-century of economic planning, reflecting heightened domestic and global uncertainties in a pivotal political year for leader Xi Jinping. Inflation risks will push the People's Bank of China to support the nation's collapsing housing market by allowing looser lending. President Xi has an incentive to ensure stability because in the twice-a-decade party leadership reshuffle later this year, he's expected to seek a precedent-defying third term in power. The plenum will be held in late October or early November.

The lower GDP target indicates policy makers' concerns about the impact of government-engineered slowdowns in the property and technology sectors and rising geopolitical uncertainty with the chaos in Ukraine. Domestic consumption will slow down as China's government has committed to boosting military spending by 7.1% to 1.45 trillion yuan ($230 billion) in 2022, up from the previous year's 6.8% increase and marking its most significant increase in three years.

China's factory-gate inflation eased, and consumer price growth slowed slightly. The producer-price index rose 9.1% in January from a year earlier, down from December's 10.3%. Softening coal and steel prices helped the index lower. China's PPI inflation is likely to be 8.2% in the first quarter before falling to 5.1%, 2.9%, and 0.5% in the remaining quarters for 2022.

The People's Bank of China kept the One-year loan prime rate at 3.7%, while the five-year rate was 4.6%, both on par with the prior month. We expect Beijing to trim its benchmark loan rates again this year to provide more extensive economic support, which faces increased downward pressure from a property slump and sluggish domestic demand.

China: SSE Composite Index

China's exports rose in January–February as global demand revived while imports also gained despite a downturn in the economy. Exports grew by 16.3% over a year earlier to $545 billion in the two months. Imports advanced 15.5% to $429 billion. Chinese authorities combine trade data for the first two months to screen out fluctuations due to the Lunar New Year holiday, which falls at different times each year in January or February. However, Chinese manufacturers fear that if the yuan further appreciates to 6.25 against the U.S. dollar, their exports will be less competitive.

The yuan is stable as global markets roll from Russia's attack on targets across Ukraine. While major stock markets took a hit, and currencies from the euro to the Korean won declined, the yuan is still hovering near a four-year high after Russian leader Vladimir Putin ordered an operation to demilitarize Ukraine. The yuan has been trading like a safe haven currency during the Ukraine crisis.

It seems that the central bank does not want to see the dollar-yuan falling below the 6.3 level. But, the yuan's appreciation could continue on the back of continued trade surplus, portfolio inflows, and safe haven perception of the yuan.

	20	**21**	**22**	**23**	**24**
GDP (%p.a.)	2.2	8.1	5.2	5.0	4.5
Inflation (%p.a.)	2.5	1.8	2.0	2.0	1.5
Trade Balance(US$ bill.)	60.0	80.0	60.0	52.0	45.0
Rmb/$(nom.)	6.7	6.4	6.3	6.3	6.2

South Korea

South Koreans elected Yoon Suk-yeol, a conservative, as new President on March 9th. He has pledged to get tougher on North Korea and develop closer ties with the U.S. We expect South Korea to remain away from the Sino-Russia nexus. Enhanced expenditure on the military is inevitable,

but in the coming few years, South Korea will continue to grow until semi-conductor chip factories come on stream in the U.S., Europe, China, and India.

Inflation is likely to worsen as the crisis in Ukraine threatens to disrupt supply chains. The Bank of Korea's three interest-rate increases have failed to make a dent in price gains, and we expect it will hike again in the coming months. South Korea's inflation accelerated in February. The consumer prices index increased 3.7% from a year earlier compared to a 3.6% increase in the earlier month. We forecast inflation to be 3.2% in 2022 due to the rise in fuel prices leading to the rise in transportation and utility costs.

South Korea's central bank held its base rate steady in the last week of February after making three increases in the past six months. It signalled tighter policy and forecasted stronger inflation. The Bank of Korea left its benchmark seven-day repurchase rate unchanged at 1.25%.

South Korean exports in February expanded 20.6% from a year earlier and faster than the 15.2% gain in January. It also marked the 16th straight month of expansion. Imports jumped 35.5% and continued to outpace exports on higher energy prices, creating a trade deficit of ~$5 billion in January. However, the outlook for the trade balance and exports is clouded. Due to supply chains disruptions, the impact on South Korea is blurred due to the availability of Russian crude oil available at a heavy discount in the oil market. For the whole of 2021, the country's current account surplus reached $88.3 billion, which was higher than the previous year's $75.9 billion.

The South Korean won depreciated more than 3.5%. The currency will fluctuate due to the volatility in world trade.

	20	21	22	23	24
GDP (%p.a.)	-0.9	4.0	3.0	2.5	2.3
Inflation (%p.a.)	0.5	2.5	3.2	2.5	2.0
Current A/c(US$ bill.)	70.0	91.0	80.0	40.0	35.0
Won/$(nom.)	1070	1150	1250	1300	1310

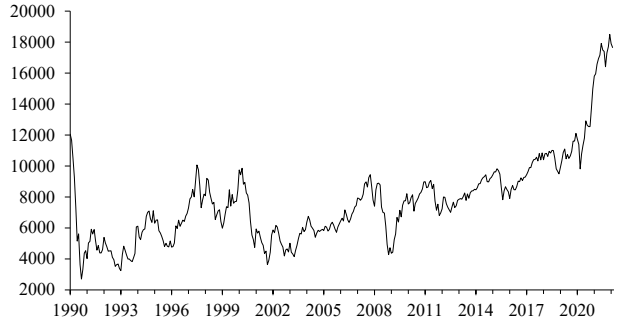
Taiwan

This investment letter of February commented, "The U.S. and NATO response to the Ukraine-Russia crisis has given an indirect assurance to Taiwan. It has given a clear signal to China that any misadventure in the Taiwan strait will be met with the military might of near and far democratic nations." We stand by our commentary except that the onset of the cold war and subsequent setback to globalization will harm Taiwan in the long term because its prosperity depends on free trade. It benefited enormously in the last five decades as world trade expanded. However, markets outside Europe, such as Taiwan, will do well in the short term as it is considered a safe haven. Moreover, the government has hinted that it will "extend a hand" if any "irrational" movements in the currency and stock markets.

Taiwan's government has raised its GDP growth forecast to 4.42% in 2022, citing strong exports and increased investments. The 2021 growth forecast is revised to 6.5%, from a previous estimate of 6.3%. Foreign business groups

Korea: Composite Index

Taiwan: Weighted TAIEX Price Index



are very optimistic about the growth of Taiwan and the government's COVID-19 response. Taiwan's economy is underpinned by stable export demand and increasing global demand for 5G, automotive electronics, high-end computing, and other internet products. Demand for Taiwanese products will remain strong in the next 3–4 years.

Consumer inflation, however, is projected to be 2.76% and 2.33% in 2022Q1 and Q2, respectively, which is higher than the government's 2% inflation target. Consumer inflation rose 2.8% in January, the sixth straight month of 2%-plus increases. Strong salary growth and large annual bonuses after a stellar year for corporate revenues are expected to keep consumption elevated.

High prices are likely to force Taiwan's policymakers to follow the lead of the U.S. Federal Reserve and other major central banks in raising rates this year. Borrowing costs have been at a record low of 1.125% since early 2020. The value of the Taiwan dollar vis-à-vis the U.S. dollar remains a primary concern for the central bank after it rose to its strongest level since 1997 January. The monetary authority may embrace the increase as a helpful tool in its battle against consumer prices. The central bank has said it would maintain ample forex reserves to ensure that domestic financial markets remain stable and guard against any sudden withdrawal of funds out of the country by foreign institutional investors. The country's forex reserves as of the end of January stood at US$548.9 billion — the fifth-largest forex reserves holder in the world.

The Taiwan dollar is at NTS28 per U.S. dollar. The currency is relatively stable compared to major peers, and policymakers will maintain a flexible exchange rate policy.

	20	21	22	23	24
GDP (%p.a.)	3.1	6.5	4.4	3.2	2.8
Inflation (%p.a.)	-1.0	2.6	2.2	1.8	1.6
Current A/c(US$ bill.)	71.0	90.0	100.0	65.0	60.0
NT$/$(nom.)	29.0	27.5	27.2	27.0	27.0

Brazil

Brazil's economy expanded 4.6% in 2021, after a sharp contraction of 3.9% in 2020. The three main sectors, namely, primary, secondary, and tertiary, grew -0.2, 4.5, and 4.7%, respectively. In 2021, the severe drought led to the contraction of the agricultural sector. Household consumption rose by 3.6%, while government consumption grew by 2%. Investment recovered from 2020 to rise 17.2%, while imports expanded 12.4% and exports increased 5.8%. In 2021Q4, the economy got out of a technical recession, lifted by higher raw material prices and services that provided some relief to a country afflicted by soaring inflation and interest rates going into an election year.

Brazil will go to elections in October, and opinion polls widely show President Jair Bolsonaro trailing front-runner former President Luiz Inacio Lula da Silva. President Bolsonaro has once again expanded cash transfers to the poor. The war in Ukraine is likely to keep raw material prices high, and Brazil will benefit from the same. We forecast the economy to expand by 1% this year and 2% in 2023.

Brazil's inflation rate is slowing and may end up the year within the central bank's range as the incentives given during the pandemic are withdrawn. A year ago, Brazil embarked on an aggressive interest rate tightening cycle, increasing borrowing costs from a record-low 2% to 10.75% in an attempt to tame incipient inflationary pressures. Inflation appears to be levelling off.

The Real has become one of the most attractive assets in the region, and BRL can keep its gains in the short term even though Lula is likely to return to power after this year's election. The market believes that Lula is moving to the centre of the political spectrum, and he will pick a centrist to run as his vice-president to signal his move to the centre.

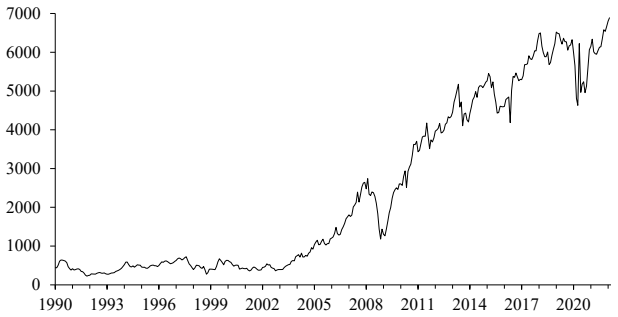
The Real is continuously strengthening, and its year-to-date gain is more than 11.4%. In the ongoing Ukraine conflict, Brazil is expected to do well, and it will be considered a safe haven for investors.

	20	21	22	23	24
GDP (%p.a.)	-3.9	4.6	1.0	2.0	2.0
Inflation (%p.a.)	4.5	8.5	4.5	4.0	4.0
Current A/c(US$ bill.)	-7.6	-10.0	-10.0	-12.0	-20.0
Real/$(nom.)	5.5	5.3	4.8	4.9	4.9

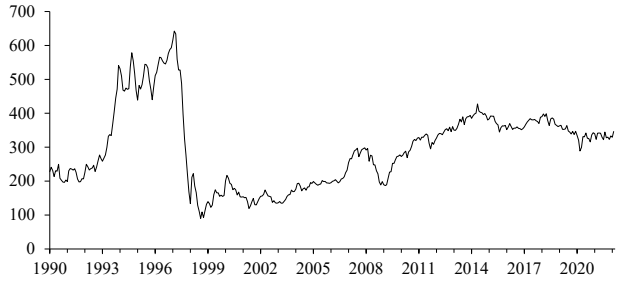
Other Emerging Markets

Hong Kong: FT-Actuaries

Indonesia: Jakarta Composite

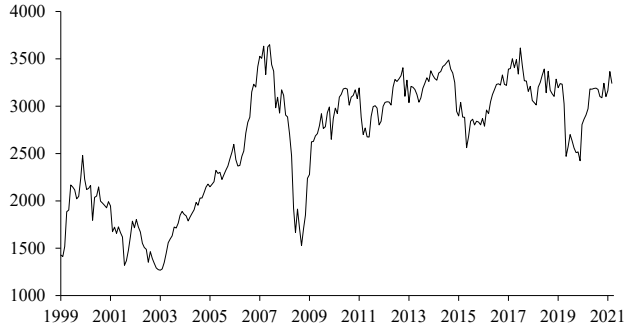


Malaysia: FT-Actuaries (US$ Index)



Thailand: Composite Index

Singapore: Straits Times Index

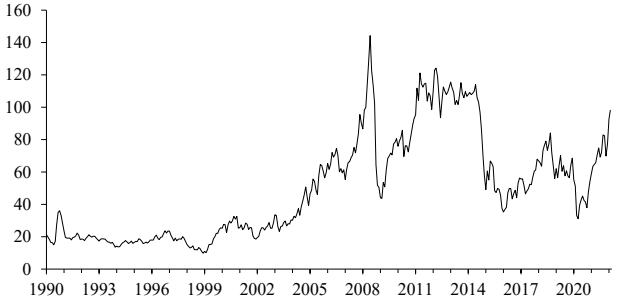


Philippines: Manila Composite

COMMODITY MARKETS

Commodity Price Index (Dollar)
(Economist, 2015 = 100)

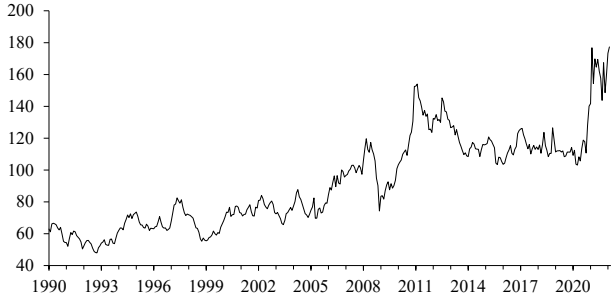
Oil Price: North Sea Brent (in Dollars)



Commodity Price Index (Sterling)
(Economist, 2015 = 100)

Gold Price (in Dollars)

Commodity Price Index (Euro)
(Economist, 2015 = 100)



REVISITING UK COVID BEHAVIOUR OVER FOUR WAVES

David Meenagh
Patrick Minford

Abstract

We extend our estimates in Meenagh and Minford (2020) for a UK model of Covid to the four waves of infection seen to date. Because we now have reliable sampling-based series for infection, we estimate the model on infections, not deaths. We are also able to estimate hospitalisation/infection and death/infection ratios; and we relate these to vaccinations and the overall infection rate, proxying immunity.

Behaviour changes in the third-fourth wave, reflecting the vaccine roll-out; the degree of immunity also rises sharply, while personal willingness to isolate increases. The vaccine penetration itself has of a direct effect on the virus progress, absent in previous waves. we find the falling death and hospitalisation rates per infection are significantly related to the rise in immunity due to past infection.

Introduction

In a previous paper, we set out a structural model of optimising households and biologically-optimised virus behaviour, together with relevant policy interventions, to explain how the Covid virus would spread in the UK and Sweden. We chose Sweden because its policy regime was crucially different and our focus was on how far the UK's more interventionist approach created different results for infections and deaths. In this paper our aim is to study how the four different waves of virus infection the UK has experienced have differed over time. Evolutionary biology suggests that viruses evolve to become more transmissible and also less damaging to health, implying a lower fatality rate, because both these developments should increase their survival chances. If this is the case, we should find that across the four UK waves, the rate of transmission has increased and the death rate per case has fallen independently of the progress in vaccination, which was rolled out rapidly before and during the third wave. We already have evidence from ONS-estimated cases that transmissibility has increased: in the second wave this evidence indicated that the 'Kent variant' dominant in the second wave was 50% more transmissible than the original (first wave) virus; and that the D-variant dominant in the third wave was 50--60% more transmissible again than the Kent variant. However, evidence on the fatality rate has been harder to find, partly because NHS-estimated case numbers have been affected by the extent of testing. In this paper we have used ONS-estimates of infections which based not on those taking tests but on a fixed sampling basis; we have then combined these from their starting point in May 2020 with the NHS data before that, combined with ZOE data on self-reported symptoms, in order to create a full data set across all four waves. This early data records those falling ill rather than those taking tests and it should therefore be free of testing bias. In this paper we have drawn on a full set of data, as well as estimating both structural and reduced form models; our aim has been to come up with more reliable estimates of these virus features, as well as the effects of vaccination and other interventions.

We proceed as follows. First, we set out a new consistent series for those infected by Covid, derived from the ONS weekly sample surveys and interpolated to give daily estimates using the ZOE daily survey of those showing symptoms. Though the latter is a voluntary survey and so not calibrated efficiently to the UK population, it is regularly recalibrated to reflect the ONS sample results and so can be used as a supplementary guide to higher frequency infection. Furthermore, we can use it in its recalibrated form to backtrack the ONS data to the earliest periods of infection before the ONS sample began. This new data gives us a reliable series for infections from the start of the pandemic, with three 'waves' of infection to examine.

Second, we estimate our model on these three waves of infection, to get estimates of the effects of lockdown, immunity spread and social reaction in line with our first paper. The difference is that we are now using infections data not data on Covid deaths, which before was the only reliable data available. We look for any effects of rising vaccination too on the infection process. As in our earlier paper we use indirect inference, using the logistic function estimates as our auxiliary model.

Third, we estimate relationships in all three waves between infections and hospitalisation and deaths. These are simple lagged 'engineering' relationships, in which we look for a simple lag of around three weeks from infection to deaths, and of a few days from infection to hospitalisation. We expect to see progress across the three waves in terms of falling hospitalisation and death rates, as the disease encounters increasing immunity, better health care, and especially rising vaccination rates.

The Model - a non-technical account

A full technical description of the model can be found in Meenagh and Minford (2020). Here we describe its workings in a non-mathematical way. The two main agents in the model are the virus, whose evolutionary nature is assumed to maximise its chances of survival. The key parameters working against this are γ measuring the population's basic resistance to infection and μ measuring government interventions such as lockdown that prevent infection. In addition the virus meets household evasion efforts ξ_t as optimised by households in their own strategy for dealing with the virus. Vaccination also comes directly into the model by obstructing infection.

The household behaviour in the model assumes that household utility is reduced by infection but also by the personal inconvenience of avoiding infection by self-

isolation activity, ξ_t. As this increases, the personal costs of not participating socially and economically rise directly with the extent of isolation, and rise indirectly the more uninfected people there are, as this lowers the personal risk of infection from participating, which raises the net costs of self-isolating (the economic costs net of the gain in lower infection risk). These net costs react to the accumulation of infected people with the parameter ϕ; as this rises they respond more strongly to rising infection- implying that with increasing infection, they self-isolate more vigorously. Households maximise this utility with respect to ξ_t subject to the virus' behaviour set out above, so they take account of the virus' behaviour.

Results

	Wave 1	Wave 2	Waves 3-4
γ	74.8847	68.9229	85.5612
μ	3.3705	3.5940	5.3381
α	−9.3384	−5.1107	−8.4966
ϕ	0.1457	0.3192	0.9270
χ	0.6424	0.1947	0.7610
Wald	0.2972	8.9507	10.6825
P-value	0.9639	0.0827	0.0574

Table 1: Structural Model Parameter Estimates for the Three Waves

		Actual	Lower 2.5%	Upper 2.5%	Mean	IN/OUT
Wave 1	a	8.8239	0.2840	33.4295	9.8216	IN
	b	65.2579	41.3138	135.0159	73.5042	IN
	c	4464493.4789	2164690.1735	16852446.2495	6608217.7604	IN
Wave 2	a	31.1942	3.0204	51.5670	13.6528	IN
	b	172.3836	39.1620	148.4174	70.8923	OUT
	c	18625762.1456	7610184.5821	20037886.5767	16071419.0855	IN
Wave 3	a	34.5802	2.1590	38.8036	8.3632	IN
	b	141.2116	29.2303	104.9454	48.7938	OUT
	c	19821214.5578	4626993.9865	20072732.2153	14350683.6932	IN

Table 2: Auxiliary Model Parameter Bounds for all Waves

Comments on results:

We find that Waves 1 and 2 have virtually the same parameters. In both the lockdown factor, μ, is a large multiple of the personal response factor, ϕ, reflecting large lockdown interventions in both. With the third-fourth wave the estimates change sharply, reflecting the vaccine roll-out. γ, the degree of immunity rises sharply; μ also rises as resistance to the virus increases with higher penetration, due to so many being vaccinated. Also ϕ rises with people responding much more to increased penetration, being made more confident by the vaccine. The vaccine penetration itself has of course a direct effect (through the parameter χ) on the virus' progress, absent in previous waves.

The three Waves differ in the overall numbers infected:

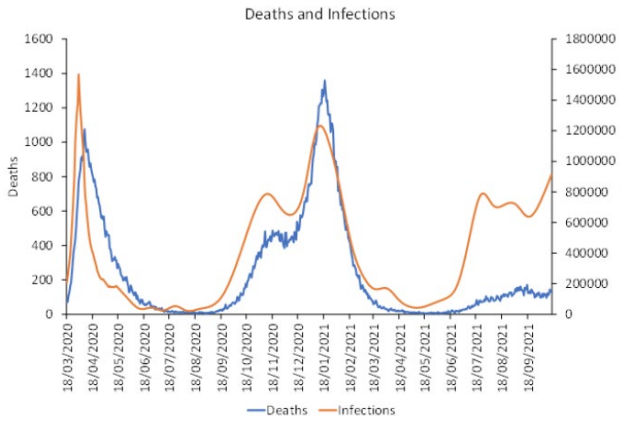
	Actual c	Model Mean c	Model Steady-state	Data
Wave 1	4.5	6.6	4.7	4.7
Wave 2	18.6	16.1	18.2	18.2
Wave 3	19.8	14.4	17.3	17.3

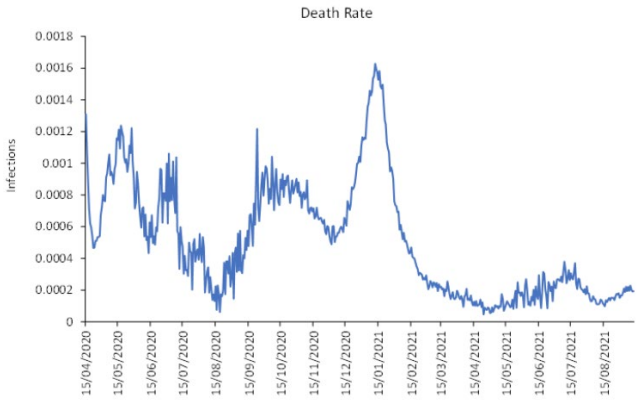
Table 3: Table of Results for Total Infected (millions)

We can see here that the logistic c value is reasonably matched by the model mean, while the steady state of the model is constrained in estimation (via the constant) to equal the data total. It is striking how many fewer were infected in the first wave than in the second two, where about four and a half times as many were infected in total.

Deaths however were about equal in total in the first two waves: this underlines how high the initial death rate was and how much it fell in the second wave (by a factor of 4). The death rate fell steadily across all waves, falling to a far lower rate from the third wave with vaccination.

Figure 1: Deaths and Infections



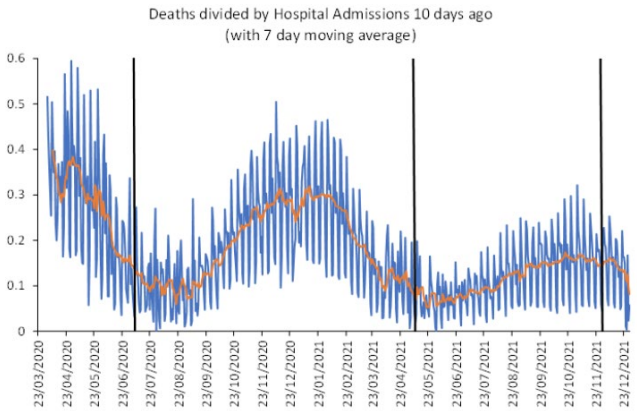


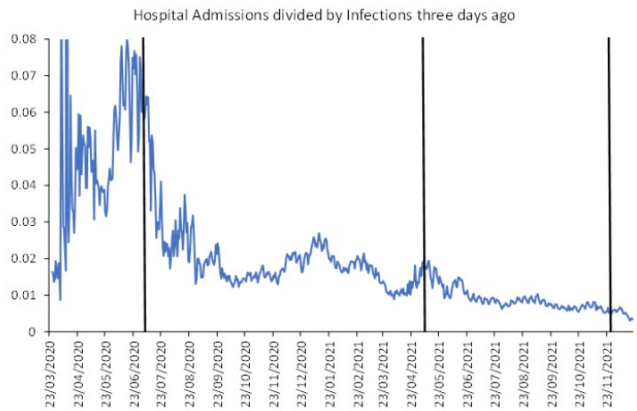
Analysing trends in the hospitalisation and death rates:

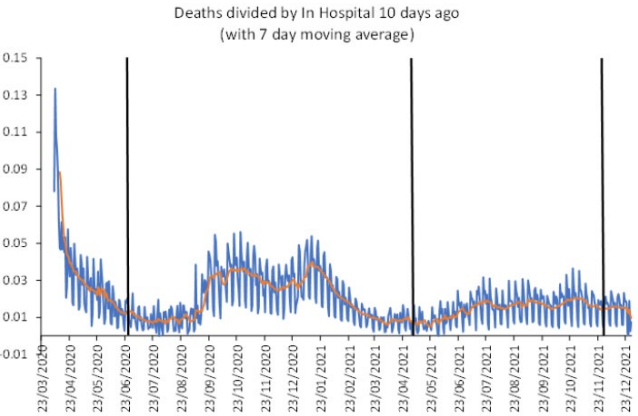
The key question as we move forward into Wave 4 is how the hospitalisation and death rates will evolve. If these are disengaged from the infection rate, then it becomes possible to continue 'living with Covid'. If however they remain high enough to precipitate excessive numbers of hospitalisations and deaths, then further lockdown interventions will be forced back into the agenda.

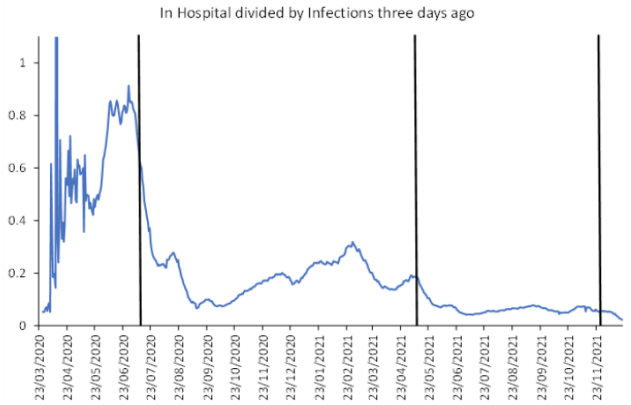
We examine this by regressing hospitalisation/cases on the double-vaccination rate and a time trend (for other factors such as the virus' virulence and rising immunity). We then do the same for deaths/lagged hospitalisations; here the trend will also pick up the effect of the better treatments that have emerged. For the Wave 4 numbers we may also find an effect of the rising booster rate.

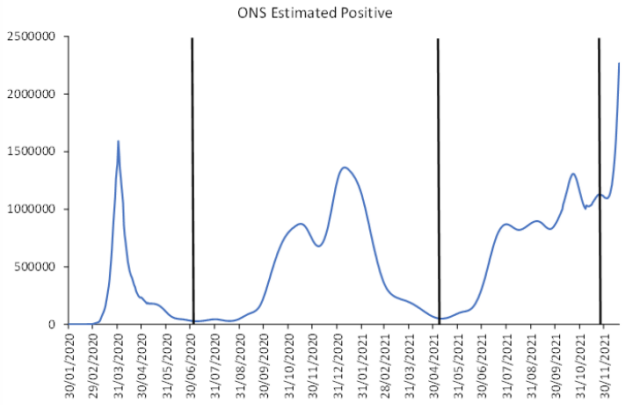
Figure 2: Data on Infections, Hospitalisation and Deaths over the 3 Waves





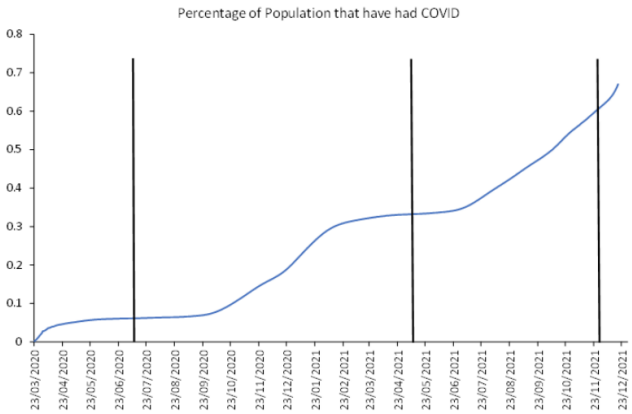






To discover what might be driving the trends in the virus' behaviour we took the detailed UK data on estimated cases, hospitalisations and deaths and regressed the hospitalisation ratio to lagged infections and the deaths ratio to lagged hospitalisations to determine the roles of vaccines and immunity on the evolving figures. We would expect that vaccines would have a steady effect but that immunity would have an increasing effect as the virus aged. We found that there are cointegrating relationships to both the hospitalisation (i.e. those in hospital) ratio to infections and the death ratio to hospitalisations from the vaccination rate and the overall past total infection rate, proxying the resulting immunity. We find also a clear Error-correcting equation relating the change in these series to the current shocks to vaccination (negative) to current infections (positive) and the lagged deviation from trend (negative). However, these regressions suggest that vaccinations, when the various vaccine elements are weighted together to create a meaningful vaccine variable, were less important than immunity (proxied by the cumulative total/population of those infected, PCINF) in reducing the trends in hospital/cases and in deaths/those in hospital. The VACC weighted variable is insignificant in both cointegrating regressions while PCINF is significant and rightly signed in both. Nevertheless, plainly these two trend variables are highly correlated, making firm conclusions about these relationships difficult.

Figure 3: Vaccinations and Infections



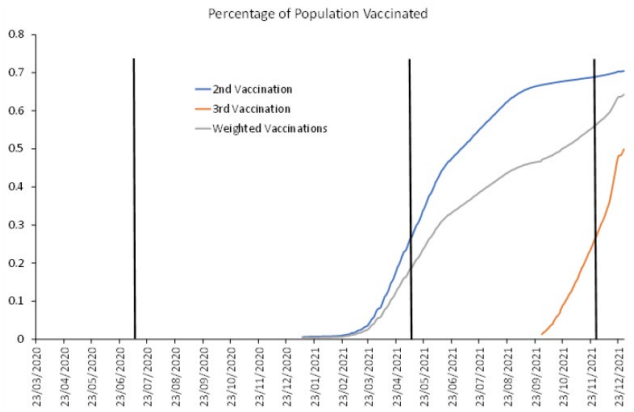


Table 4: Trends in the Virus Behaviour- hospital cases/infections (IH13) and deaths/hospital cases(DIH10)

	IHI3	DIH10
Long Run Relationship		
Constant	0.387331***	0.025383***
VACC_Weighted	−0.048444	0.002388
PCINF	−0.639231***	−0.023662***
ECM Regression		
Constant	0.017141	−0.002265***
D(VACC_WEIGHTED)	−3.593752	−0.717900**
D(PCINF)	−13.17548	2.803055***
Long Run Residual(-1)	−0.482439***	−0.393575***
Cointegrating ADF p-value	0.003666	0.023863

IHI3=(In Hospital)/Infections(-3), DIH10=Deaths/(In Hospital(-10))
***p<0.01, **p<0.05, *p<0.10

These regressions suggest that vaccinations were less important than immunity in reducing the trends in hospital totals and deaths. The *VACC* weighted variable is insignificant in both cointegrating regressions while *PCINF* is significant and rightly signed in both.

Conclusion

In this paper we extend our estimates in Meenagh and Minford (2020) for a UK model of Covid to the four waves of infection seen to date. Because we now have reliable sampling-based series for infection, we estimate the model on infections, not deaths. We are also able to estimate hospitalisation/infection and death/infection ratios; and we relate these to vaccinations and the overall infection rate, proxying immunity.

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References

Meenagh, D. and Minford, P. (2021) 'A structural model of coronavirus behaviour for testing on data behaviour', Applied Economics, Volume 53:30, pages 3515-3534 (DOI: 10.1080/00036846.2021.1883531)