



Climate, Fossil Fuels and UK Food Prices

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Executive summary

Food price inflation has been-and continues to be-a major concern for UK policymakers as high food prices - together with high energy and fuel costs - were a significant feature of the cost-of-living crisis that has impacted on UK households particularly those on low incomes.

Although there are many drivers of consumer food prices, the cost of energy inputs and extreme weather were shown to account for the lion-share of the rise in food prices experienced in the UK in 2022.

Over the past year, developments in global and domestic energy markets have changed, thus ameliorating one of the main pressures on UK food prices. In 2023, we anticipate falling energy prices to act as a brake on food price growth. However, extreme weather continues to be an important driver with global temperatures in 2023 exceeding previous records. This rise in global temperatures – with resultant droughts, flooding, lower yields – directly affects global agricultural production. Our updated estimates show that the decline in energy costs have contributed to reducing the pressure on consumer food prices but this effect has been offset by the impact of rising global temperatures.

Taken together, these two factors have accounted for a 2.6 percentage point cent rise in UK food prices, translating to a £97 annual increase in the average household spending on food in 2023. However, falling energy prices obscures the impact of rising temperatures; in the absence of the decline in energy costs, UK food prices would have increased by by £192 or 5.2 per cent, slightly higher than the contribution to UK food price levels in 2022. Estimates suggest that climate change induced extreme weather is likely to account for around one-third of the food inflation experienced in 2023.

Combining the impact of energy costs and climate change across 2022 and 2023, these two factors have increased household food bills by an average of £605, with climate costs alone accounting for 60% of this increase, or £361 for each household.

Although our focus is on the UK and updating the estimates from our previous analysis, this report highlights that the issue of food price inflation is a global concern impacting on both developed and emerging economies. We highlight recent research that addresses the links between extreme weather and price stability more generally, with the main pathway linking climate change and macroeconomic stability being via the effects of extreme weather on food prices.

This not only reflects the importance of food in consumer spending but its role in forming expectations that feed into wage bargaining (so called 'second-round' effects). With the projected adverse effects on global agriculture from what is predicted to be a strong El Niño (warm phase of global temperature) in 2023 and 2024 compounding the underlying trend in global temperatures, the nexus between energy, extreme weather and domestic and global food prices will be of heightened concern to policymakers in both developed and emerging economies for some time to come.

Introduction

Food prices continue to be a major concern for policymakers, economists and the general public. This is particularly so in the UK where food price inflation peaked at 19.2% in March 2023, the highest rate in nearly half a century. Food price inflation is not solely a UK problem; it has gone global, with most developed and emerging economies experiencing high levels of food inflation.

Although key input prices for agriculture and energy have fallen from the peaks experienced in 2022, pressures on consumer food prices persist. In the UK, a depreciating exchange rate last year and lags in the cost pass through owing to fixed-price contracts combined with higher wage demands and heightened trade costs to reinforce inflationary pressures in 2023. However, while many factors both domestic and global determine food prices in specific countries, all countries will be impacted by extreme weather which will temper the impact of the recent decline in world agricultural and energy prices.

Recent data show that global temperatures in the summer of 2023 broke all-time records which will inevitably put pressure on both global and domestic food prices going forward, compounding supply chain issues. The direct impact of extreme weather is also exacerbated by responses of some countries to protect domestic consumers from world events (such as the recent ban on rice exports imposed by the Indian government) fuelling further the impact on already tight markets. The pressures of extreme weather are likely to persist into 2024, not least due to the emergence of a strong El Niño (the warm phase of a tropical Pacific weather cycle) that looks likely to impact on global weather patterns and thus food production and energy use over the coming year.

In the UK, consumer food prices remain high and continue to grow albeit that food inflation (the rate of change of consumer food prices between now and the same time last year) has eased in recent months. The recent decline in the rate of UK food inflation has occurred against the background of the 'perfect storm' of high global agricultural and energy prices arising due to Russia's invasion of Ukraine coupled with extreme weather events that gave rise to UK food inflation in 2022 close to 11 per cent.

In our previous report that decomposed the relative contribution of energy and extreme weather impacts on UK consumer food prices (Lloyd et al., 2022), estimates indicated that energy prices accounted for around 59 per cent of the predicted rise in UK food prices with global temperatures accounting for 41 per cent of the change. With both drivers putting upward pressure on UK food prices, their combined effect was estimated to contribute £407 to an average household food bill in 2022.

In this 2023 report, we provide new estimates of the potential impact of these factors on food prices in the UK. Based on recent trends in energy and global temperatures over the last year, the effect of energy as a driver of UK food inflation has reversed while the effect of extreme weather has increased. Our estimates suggest that falling energy prices will pass through into food prices depressing the rate of food inflation by 2.6 percentage points, other things remaining constant. However, the continued rise of global temperatures adds 5.2 percentage points to food inflation, more than offsetting the reduction of energy costs. Combined, food prices rise 2.7 percentage points, equivalent to a £97 increase in the average household food budget. Assuming that food inflation averages around 15 percent over the year, the modelling suggests that climate change will have contributed around one-third of the food inflation experienced in 2023.

More broadly, the significance of climate change and extreme weather on national economies is drawing the attention of central banks across many countries as their impact percolates through to price stability more generally. In this report, we place the UK experience in the global context and highlight emerging research on climate and extreme weather on price stability more generally, the key feature of this research being the link between extreme weather, food prices and general inflation. While this sets the background for our estimates of global energy and temperature increases on the UK, this emerging research underpins that the links between extreme weather and macroeconomic price stability will be an increasing concern to policymakers and stakeholders, not just in the UK but across most developed and emerging economies well into 2024.



The global context

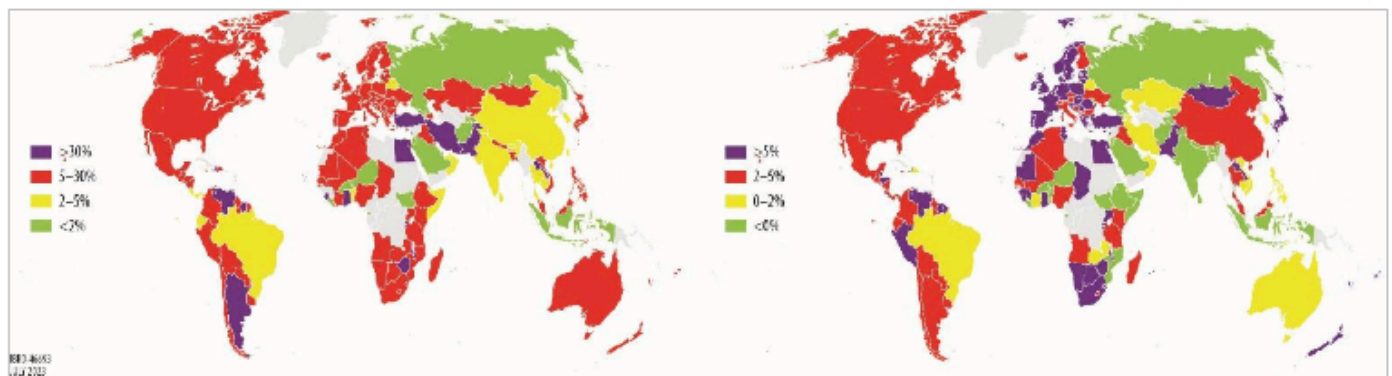
Food inflation around the world

Food inflation continues to be a concern in many countries. Based on research from the World Bank, Figure 1 shows a global food inflation 'heat map' indicating that food inflation is not the preserve of a small number of countries. The panel on the left-hand side reports the rate of food inflation in July 2023, so compares prices at July 2023 with those in July 2022. While some countries (shaded purple) have experienced rates of food inflation of more than 30 per cent, the most common experience is food inflation between 5 and 30 per cent (coloured red). This incidence of high inflation occurs across all continents though major BRIC countries (Brazil, Russia, India and China) appear immune to this experience. Other countries face significant challenges: food inflation in Turkey is over 50 per cent; in Egypt over 60%; Argentina over 100 per cent; and in Venezuela, food inflation exceeds 400 per cent.

High food inflation causes significant concerns for policymakers: across all countries, rising food prices are regressive, in that they have the greatest impact on the poorest and most vulnerable sections of society. As a result, rising food prices are a major driving force of food insecurity. They are also a key determinant underpinning workers' expectations in wage bargaining and through it, general future inflation. In many emerging economies, high food inflation is further leveraged by the high share of food costs in total household expenditure, presenting significant challenges for macroeconomic policy. For this reason, food inflation plays a more important role in the rate of general inflation in these countries, thereby impacting on the economy more broadly.

The right-hand side of Figure 1 shows real food inflation which is defined as food inflation minus general inflation. This heat map compares food price inflation with other products and thus indicates the extent to which the rise in food prices is 'mis-aligned' with other prices in an economy. In many countries, including most of Europe, North America and Africa, food prices appear to behave very differently from prices in the rest of the economy, giving rise to concerns about how food inflation may affect price stability more generally in the future. In other countries, food inflation is already a key feature of the macroeconomy where the difference between food and general inflation is low. For example, Argentina has food price inflation in excess of 100 per cent, not markedly different from the rate for consumer prices more generally.

Figure 1: Food Inflation Around the World: 2023



Source: International Monetary Fund, Haver Analytics, and Trading Economics.

Note: Food inflation for each country is based on the latest month from March 2023 to June 2023 for which the food component of the Consumer Price Index (CPI) and overall CPI data are available. Real food inflation is defined as food inflation minus overall inflation.

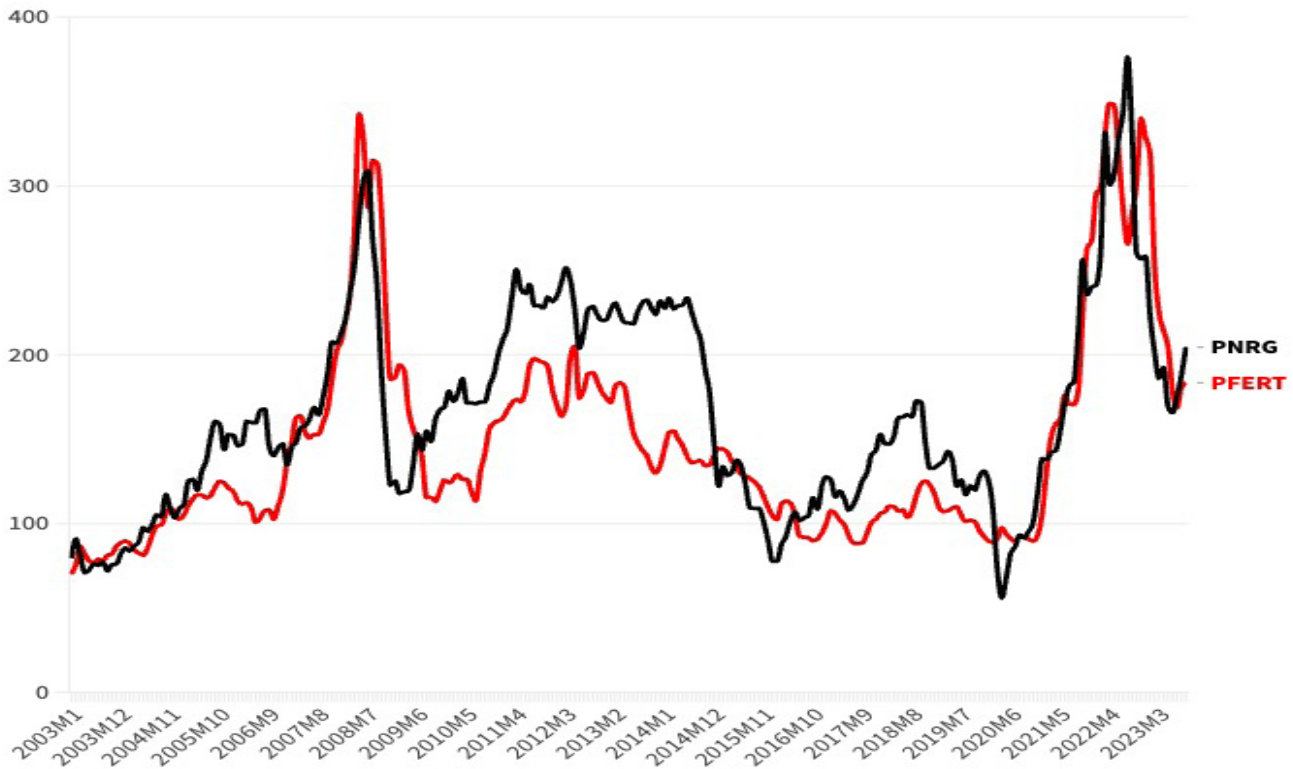
Source: Food Security Update, World Bank, July 2023

World agricultural and energy prices

As we have highlighted, for any country, food inflation will be driven by a combination of country-specific and global factors. Domestic drivers will relate to labour costs, the characteristics of food supply chains, the relative importance of domestic agriculture as well as macroeconomic (e.g. exchange rate) and trade (e.g. tariff) policies. Global factors also matter with the relevance of these global drivers of domestic food inflation increasing with the openness of each national economy to international markets. These global factors are reflected in world price indices and are determined by the complex interaction between geopolitical factors, energy costs, demand and extreme weather across all regions of the world.

Figure 2 reports global energy and fertiliser prices with the relevant energy costs for the food sector relating not only to oil but also to natural gas. Energy and fertiliser prices - as well as non-energy commodity prices - peaked in 2022 resulting from Russia's invasion of Ukraine but have since dropped back thus easing immediate cost pressures on food and agricultural production in many countries. That said, there remains continued uncertainty about energy prices in the future relating not only to the geopolitical impact of Russia's invasion of Ukraine and the Black Sea Initiative but also to future responses of other oil-supplying countries, principally OPEC.

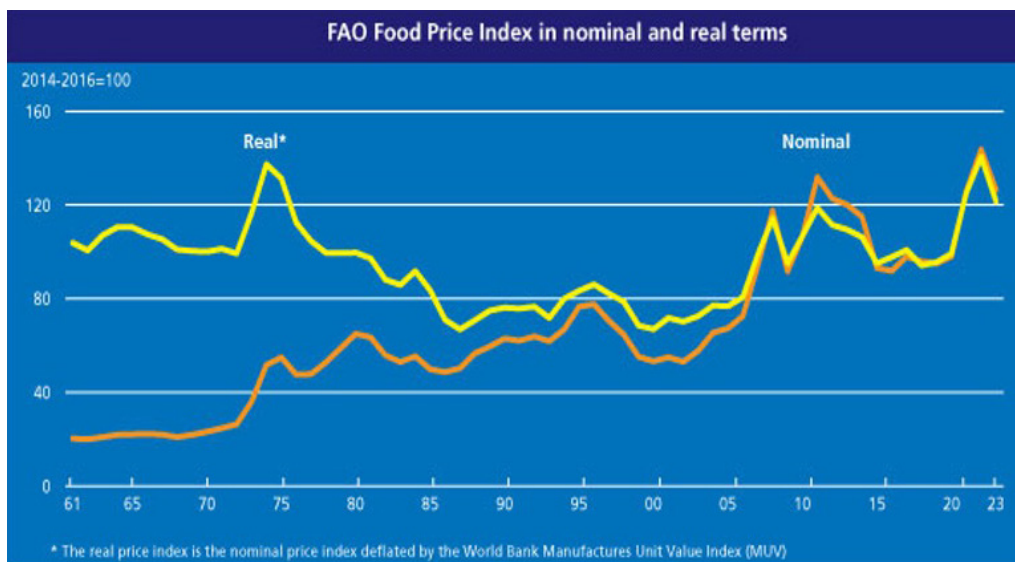
Figure 2: World Energy and Fertiliser Prices, 2003-2023 (July)



Source: IMF. Commodity Prices. Accessed 27th July, 2023

Coupled with agricultural supply responses, lower energy costs have contributed to world agricultural prices falling from the record peaks that were experienced in 2022. The FAO Food Price Index - as reported in Figure 3 - has declined in 2023: for the first half of 2023, the FAO Food Price Index is 12 per cent lower than the 2022 average. Despite the recent decline from the 2022 peak, in both nominal and real terms, world agricultural and food prices remain at high levels and exceed prices experienced during the global food crises of 2007-08 and 2011.

Figure 3: World Agricultural and Food Price



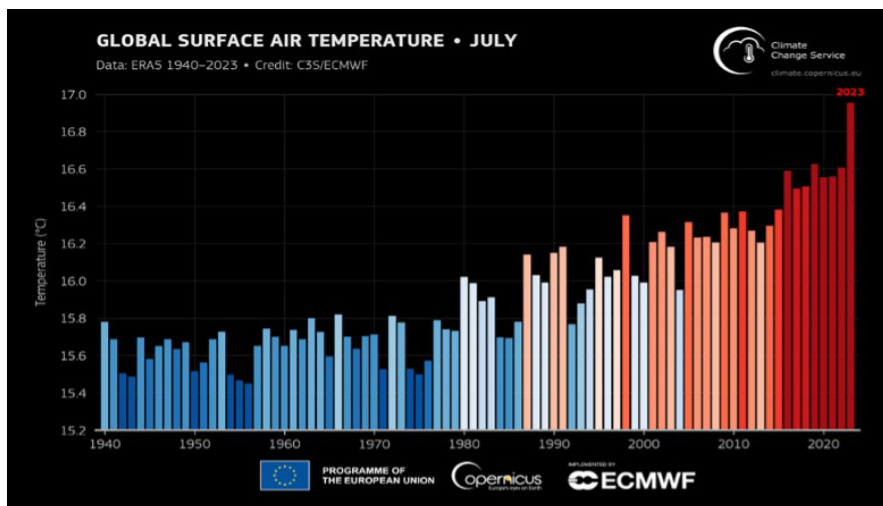
Source: UN FAO, Food Price Index. Accessed 27th July, 2023

Global temperatures

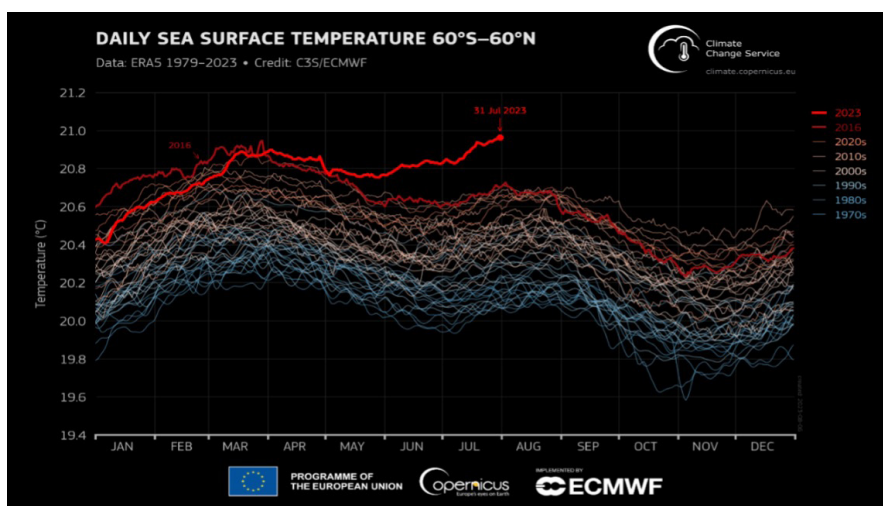
Although world energy and agricultural prices have receded from the levels experienced in 2022, global temperatures continue to rise at an alarming rate. Sourced from the EU's Copernicus programme, Figure 4(a) presents data on the rise in global temperatures since 1940. Most apparent from these data is the continual rise in global temperatures and, most notably, the unprecedented temperature for 2023 which looks set to break all-time records by quite some margin, and even more so, if the drift in the monthly data shown in Figure 4 (b) persists.

The recent experience of global temperatures has brought widespread reports of droughts, wildfires, flooding and so on. As we report below, these extreme temperatures have widespread economic effects. There are many channels via which extreme temperatures affect economic activity (for example, through labour productivity) but the most obvious direct channel is via the impact on agricultural and food production.

Figure 4: Global Temperatures



Source: EU Copernicus Programme, Press Release, 8th August 2023



Source: EU Copernicus Programme, Press Release, 8th August 2023

Latest data at <https://climate.copernicus.eu/2023-track-be-hottest-year-ever-whats-next>

Recent research on extreme weather and price stability

The links between climate change and the macroeconomy is drawing increasing attention from policymakers. As Christine Lagarde, the chair of the European Central Bank has noted: climate change has “macroeconomic and financial implications and [has] consequences for our primary objective of price stability” (Lagarde, 2021).

There are several pathways via which climate change and extreme weather events can impact the macroeconomy and price stability. One of the most direct is the effect that extreme weather exerts on agricultural production and its resulting impact on food inflation. Establishing the existence and strengths of these linkages has been the focus of recent economic research.

The study by Cashin et al. (2017) was one of the first to address the complex interaction between weather patterns (associated with El Niño), world agriculture and energy prices and the macroeconomy covering both developed and emerging countries. Extreme weather patterns have a significant impact on global agricultural prices not just via the direct disturbances to global production but also because the impact of extreme weather on energy markets increases costs for food production more generally (see the 2022 report for details). Taken together, the impact of El Niño on global agricultural and energy markets has significant consequences for macroeconomic performance particularly in emerging economies.

Faccia et al. (2021) focus on the impact of extreme temperatures on price stability across developed and emerging economies. They distinguish between food inflation, non-food inflation and consumer price indices more generally. Their analysis shows that extreme temperatures affect consumer inflation more generally but the main route relating to this impact is via food (rather than non-food) prices. While these impacts arise in both developed and emerging economies, the extent of the impact is particularly strong in the latter.

Peersman (2022) focuses on the impact of extreme weather on inflation across Euro countries. He focuses on two pathways linking weather events to the macro-economy. First, anomalous weather patterns result in a supply shock to global agriculture which results in food inflation across all Eurozone countries. But the consequence of these direct weather-related events is that the food inflation impact drives up the demand for higher wages which therefore contributes to higher levels of headline inflation. These so-called 'second round' effects are an important source of inflation persistence and highlight the importance of shocks to food prices in forming inflationary expectations. Depending on the characteristics of labour markets in Eurozone countries, this headline inflationary impact can vary but the central message is that extreme weather events have a pronounced impact on price stability more generally.

The magnitude of the impact of extreme temperatures on food inflation and other price stability metrics has been investigated by Kotz et al. (2022). With data covering 121 countries,

their results confirm the importance of the extreme temperature-food inflation channel for price stability more generally. Using state-of-the-art climate models, they also explore the impact of future warming scenarios on price stability: the impact of increasing temperatures is predicted to increase significantly with particularly strong effects arising from the food inflation channel. Although the food inflationary impact is forecast to be considerable across emerging countries, developed economies are not immune from the impact of these future warming scenarios.

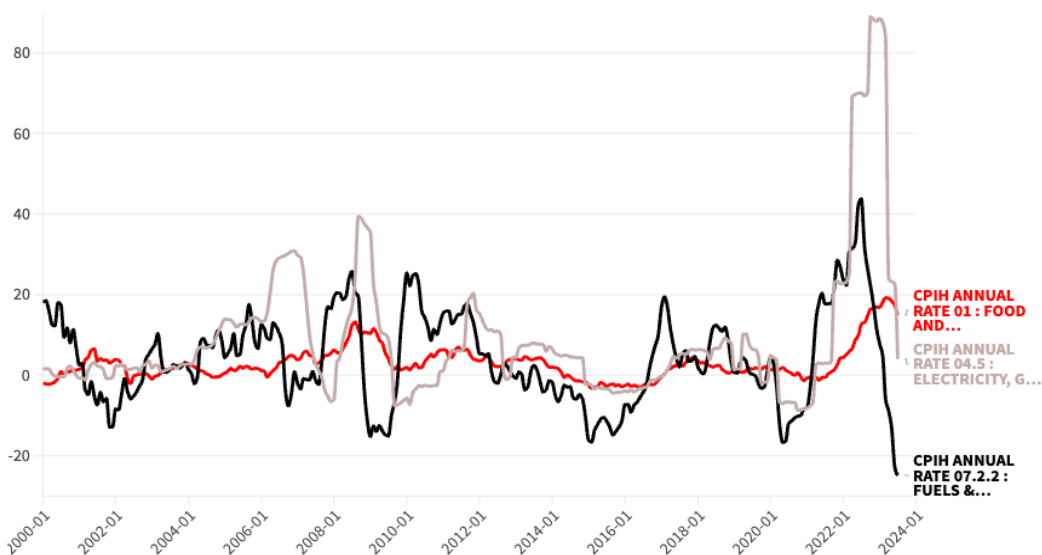
In summary, the impact of extreme weather and rising global temperatures is emerging as a central issue for policymakers across both developed and emerging economies. Recent research identifies that the impact on domestic food prices is the main channel via which extreme temperatures will influence price stability more generally. With global temperatures expected to continue to rise, these impacts can be expected to be of increasing concern.

The recent UK experience

Over the past two years, there has been considerable concern on the cost-of-living crisis in the UK relating to the impact of consumers - particularly lower income households - from rising fuel, energy and food costs. The impact of fuel and energy has been a direct consequence of Russia's invasion of Ukraine and the exposure of the UK economy to events on global markets. Developments in energy markets have also had implications for world agricultural and food markets compounding supply disturbances due to rising temperatures. These factors have all contributed to rising food inflation in the UK.

In recent months, energy and fuel price inflation in the UK has, at least for the time-being, largely abated. This is evident from Figure 5 which presents annualised inflation measures for fuel, energy and food prices. The significant spikes in energy and fuel inflation for 2022 is apparent from the data with inflation in these sectors exceeding food inflation by a considerable margin. But while fuel and energy costs have fallen substantially in the first half of 2023, high levels of food inflation have nevertheless persisted.

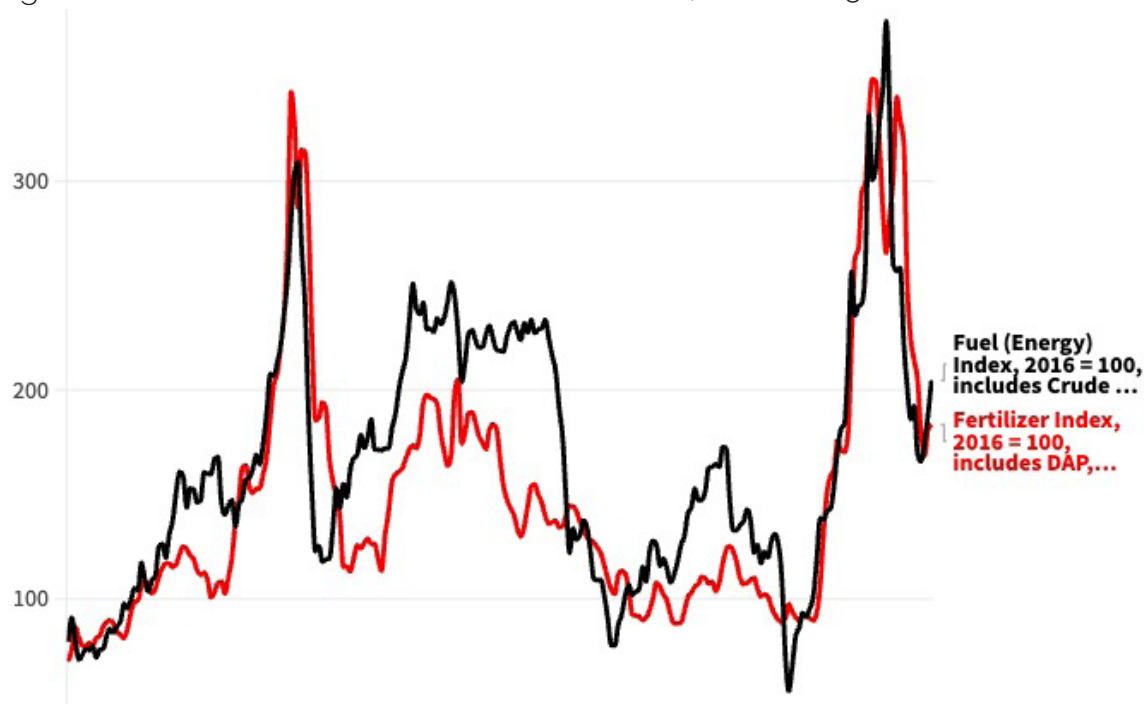
Figure 5: Annualised Inflation for Fuel, Energy and Food, 2000-2023



Despite softer energy prices, food prices continue to grow, albeit at a suppressed rate, owing to the emergence of other factors, such as higher wage costs, continued supply chain disruptions and exchange rates (the recent fall in Sterling has increased the cost of imports). In addition, while firms will attempt to rebuild margins lost in the past year (operating margins having fallen in 2022-23), a recent report by the Competition and Markets Authority found no systematic evidence to support that the view that the high rate of food inflation in 2023 was driven at an aggregate level by weak or ineffective competition, so-called 'greedflation' (Competition and Markets Authority, 2023).

Food inflation in the UK has remained at relatively high levels and this persistence has attracted on-going attention across the media and policymakers. Figure 6 indicates that food inflation has continued to exceed general inflation; though in recent months the food inflationary impacts are showing signs of easing, food inflation continues to differ from the experience of price stability across the UK economy. Focussing on this issue, the August report of the Monetary Policy Committee of the Bank of England (Bank of England, 2023) concluded that while food inflation had peaked, it was likely to remain high, falling to around 10 per cent by the end of year.

Figure 6: Annualised Inflation: General and Food, 2000-2023



Source: ONS

In our previous report, we identified that energy costs and rising global temperatures together were largely responsible for the levels of UK food prices experienced in 2022, with the impact of energy prices being the most significant factor. Although high energy costs can continue to impact on food prices due to lags in price adjustment that can contribute to persistence in price levels even when the immediate impact of cost shocks have dissipated, with the recent

declines in UK energy costs, casual inspection suggests that the role of energy costs in driving UK food prices will have likely diminished. In contrast, the effect of extreme weather continues to drive food prices upward, as we elaborate below.

Energy and global temperature impact on UK food prices: 2023

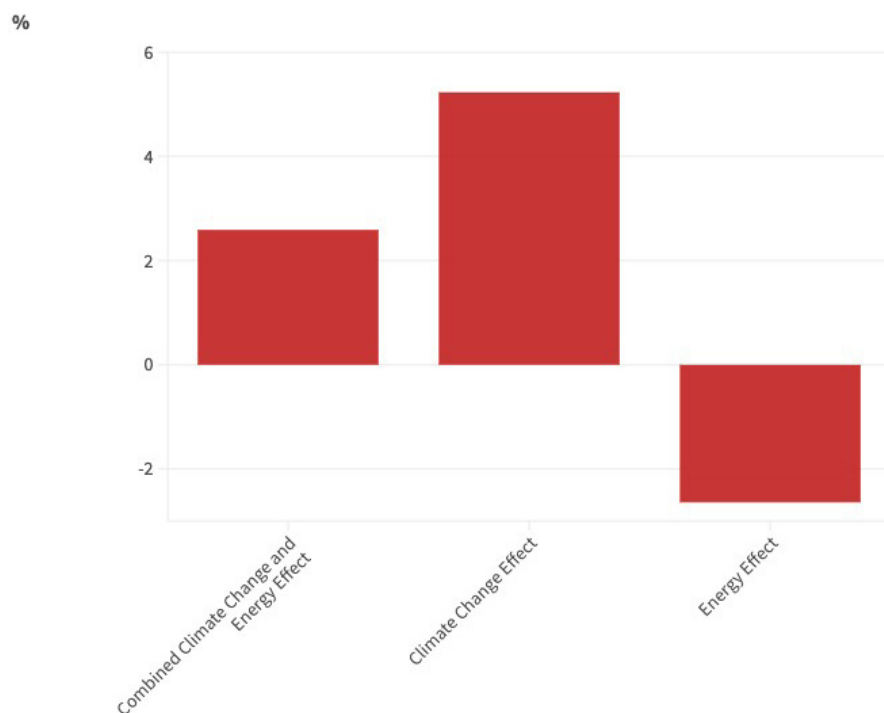
In this section, we update our estimates of the impact of energy and global temperatures on UK consumer food prices for 2023. The methodology we apply is detailed in our 2022 report (Lloyd et al., op. cit.) and reproduced here in the Appendix. In essence, it involves employing estimates of the links between drivers of food prices - both global and domestic - on prices at the consumer level in the UK. Specifically, to evaluate the impact of energy costs and rising temperatures on retail food prices, we identify from recent research the main mechanisms via which energy and rising temperatures affect the drivers of consumer food prices. For example, for energy costs, we account not only for the impact of oil on the UK food supply chain, but also the costs of fertilisers on agriculture and natural gas on food chain costs. To assess the impact of rising temperatures on UK food prices, we factor in to our estimates the linkages between extreme weather, oil prices and the prices of agricultural commodities on both domestic and international markets. We acknowledge that these estimates carry some degree of uncertainty but nevertheless provide insight into the relative role of these drivers on UK food prices.

Estimates for 2023

Our estimates (based on data up to July 2023) indicate that the combined effect of energy costs and global temperatures on UK food prices in 2023 will be to increase average consumer food prices over the year by 2.7 percentage points. This equates to an increase of £2.8 billion in the nation's food bill or an average increase of £97 per household.

These combined figures mask contrasting effects from the cost of energy and climate change. While the contribution of the extreme weather experienced in 2023 continues to inflate food prices, as we have noted above, energy prices have fallen significantly from the peaks experienced in 2022, thereby dampening the combined effect rate of food inflation in 2023. The breakdown, shown in Figure 7, reveals that climate change is predicted to add 5.3 percentage points to food inflation (equivalent to an increase of £5.5bn in the food bill or £192 per household) in 2023, whereas the fall in energy prices worked to offset inflation by 2.6 percentage points, (equivalent to a reduction of £2.7bn in the food bill or £95 per household) over the same period. The net effect of these opposing changes is to increase food prices in 2023 by 2.7 percentage points (equivalent to £2.8bn in total or £97 per household) as reported above.

Figure 7: The Breakdown of Climate Change and Energy Costs in 2023 to Food Inflation



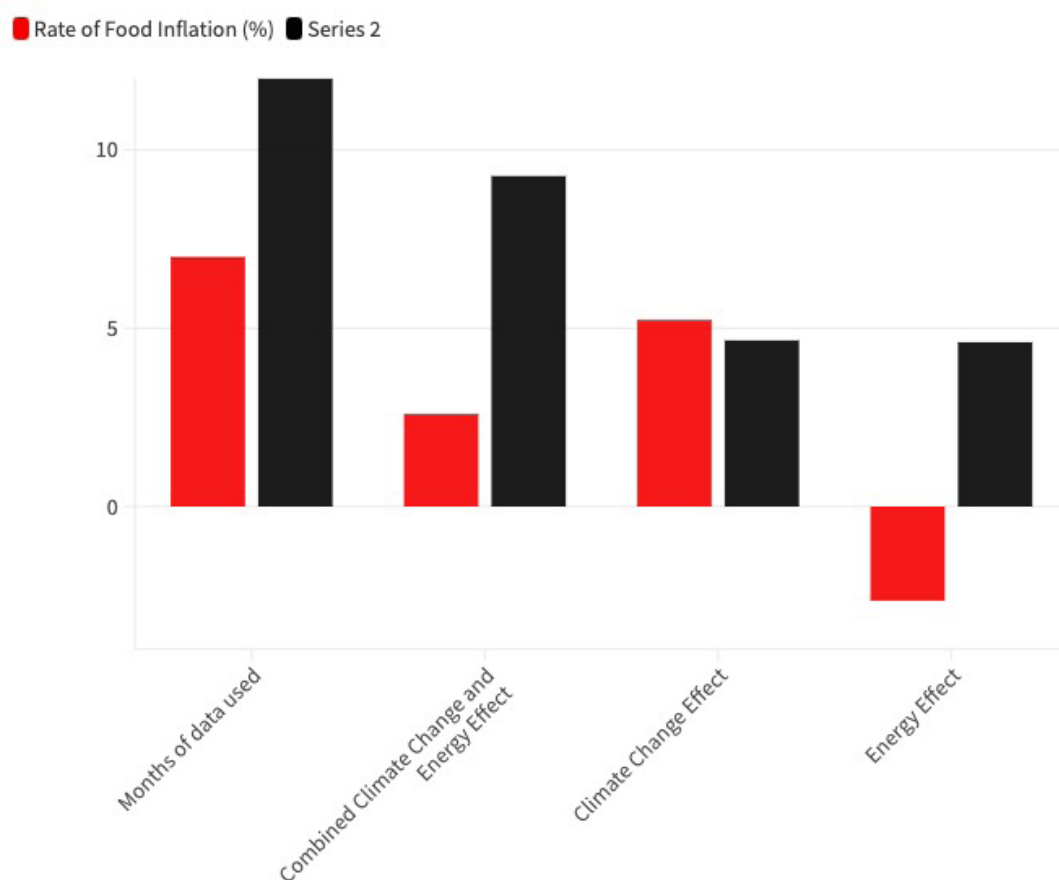
In sum, the positive effect of climate change has been partially offset by the reduction in energy costs in 2023. However, with global temperatures in 2023 exceeding previous records, the impact of climate change dominates. Assuming that food inflation averages out at around 15 per cent in 2023, our estimates indicate that around one-third of the increase (the 5.3 percentage points reported above) will be attributable to the extreme weather induced by climate change both at home and around the globe.

Comparing 2023 with 2022

To put these figures into some perspective, Figure 8 shows the breakdown of climate change and energy costs effect on food inflation reported in Figure 7 for both 2022 and 2023. The comparison highlights three important features.

1. The combined effect of weather and energy costs was considerably higher in 2022 than 2023 reflecting that in 2022 both factors acted to push up food inflation;
2. In contrast, the fall in the cost of energy during 2023 from its 2022 peak offset the effect of the record-breaking temperatures witnessed in 2023, but only partially leaving the net effect of these two factors positive over the year;
3. Whereas the effect of energy prices fluctuates year-to-year, climate change exerts a more persistent effect on food prices.

Figure 8: Relative Contribution of Energy Costs and Global Temperatures on UK Food Price Inflation in 2022 and 2023



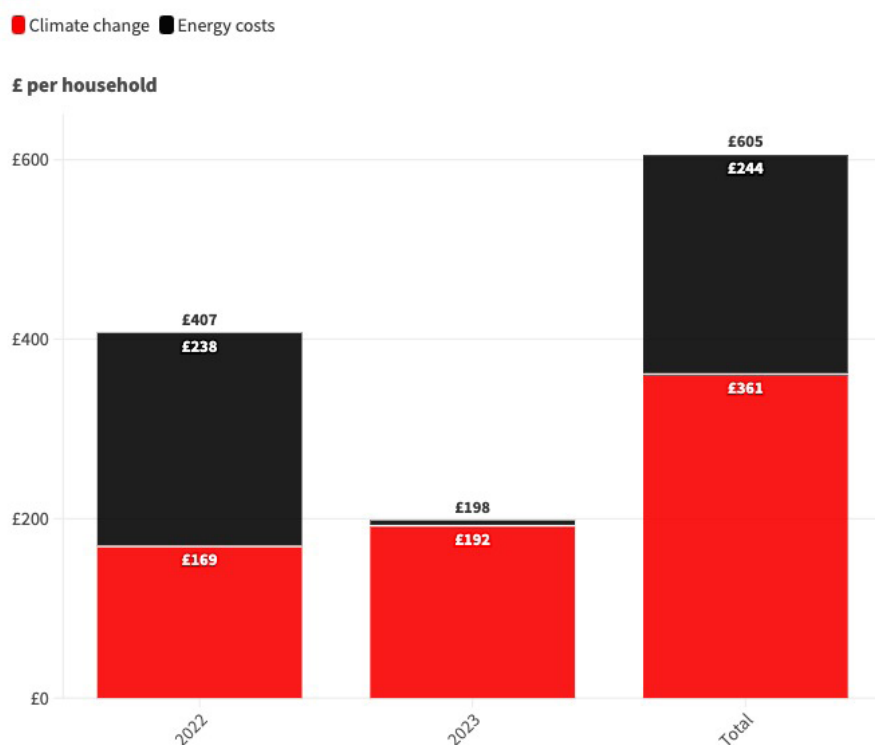
The cost-of-living crisis

As this and our 2022 report has shown, climate change and energy costs have been key drivers in the burst of inflation experienced in the UK since 2021. With this in mind, another way to look at the effects is to calculate how much more British households have paid for food in 2022 and 2023 due to these factors compared to 2021. Doing so gives a better idea of the costs borne by consumers over the cost-of-living crisis period as whole, since it recognises that while energy prices have fallen from their peak in 2022 (which reduces the year-on-year combined costs reported above) they are still higher than they were in 2021. Our estimates suggest that the nation's food bill has risen some £17 billion, contributing significantly to the cost-of-living crisis. To put this total figure into some perspective, Figure 9 shows the breakdown for the average household attributable to each factor and in each year.

Results show that food bills are estimated to be £605 higher than they were in 2001 as a result of the effects of climate change and energy costs. Of this additional burden, £361 (60%) is due to the effect of climate change and £244 (40%) is due to higher energy bills. The figure also highlights the differences in the relative contribution of the two factors during the crisis alluded

to previously with energy costs dominating in 2022, climate change in 2023. The figure also emphasises the steady growth in climate change costs over the period in contrast to energy costs which fluctuate year-on-year with the price of oil and other fuels.

Figure 9: Increases in the Food Bill of Climate Change and Energy (£ per Household) during the Cost of Living Crisis (£ per Household, compared to 2021)



Conclusion

Across both developed and emerging economies, food price inflation poses a significant challenge to policymakers. While there are many drivers of consumer food prices, both extreme weather and developments on global energy markets play significant roles. Energy markets are characterised by volatility driven by both political and economic events. Rising global temperatures also affect domestic and world agricultural markets, but also indirectly energy markets. Research has focussed recently on the effect of climate change and extreme weather on price stability more generally and the macroeconomic consequences; as we have noted, the impact on food prices is one of the most direct routes via which extreme weather impacts on national economies.

Our estimates suggest that rising global temperatures have played a significant role in maintaining UK food inflation at a high level and that this effect is stronger in 2023 compared to our previous estimates for 2022, despite the combined effect of climate change and

energy prices being lower. Accounting for the difference is the fall in energy costs from its 2022 peak, although even this was not sufficient to compensate for the effect of rising global temperatures.

While the estimates reported here should be interpreted with some degree of caution, they nevertheless point to the increasing concerns of climate change and extreme weather on economic outcomes. Based on evidence, the rise in global temperatures for food prices and the economy more generally will be an on-going and increasing concern, the consequences of which are unlikely to abate in the short-term with the potential disruptions to global agriculture arising from El Niño in coming months.

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Appendix: underlying model and methodology

Key to understanding the impact of climate change and energy price shocks on consumer food prices is the mechanism and extent to which price shocks are passed through to consumers. In this appendix, we sketch the transmission pathways through which climate shocks and fossil fuel prices affect consumer prices of food in the UK.

Our focus is on estimating the joint impact of these pass-through effects directly on UK food prices. Recent international research reported in the main text provides estimates of specific links in the overall chain. By combining these separate pass-through effects, we can assess the impact of climate change and global fossil fuel shocks on UK food prices and consumer expenditure on food, which we do so under a number of different scenarios. While this provides a tractable framework for analysis, the transmission pathways we identify do not represent a complete description of all the effects and interactions, and these limitations need to be borne in mind.

There are, of course, other factors that can drive the price of food (such as wages, exchange rates and marketing strategies) and these factors may offset or reinforce the effects of fossil fuels and climate change and have not been controlled for in the calculations produced in this report. At certain periods of time, they could potentially be the dominant driver of retail prices. Furthermore, we assume that climate change primarily has an impact on the supply of food rather than demand. Demand responses are likely to mollify the supply side shocks, as consumers hunt for bargains more actively and generally trade down (i.e. purchase lower price versions of the same product). Moreover, the impact of fossil fuel costs and climate change work through the food system over time. Given that the estimates in the underlying models we draw to produce our results were based on data prior to recent events, the timing and magnitude of the effects through the food chain may differ. As a result, the results we provide should be interpreted as a useful guide to the likely effects based on the best available data rather than the outcome of a formal econometric exercise.

Global Temperature Shocks

Drawing on recent international research, we identify three channels of transmission through which climate change impacts on consumer food prices:

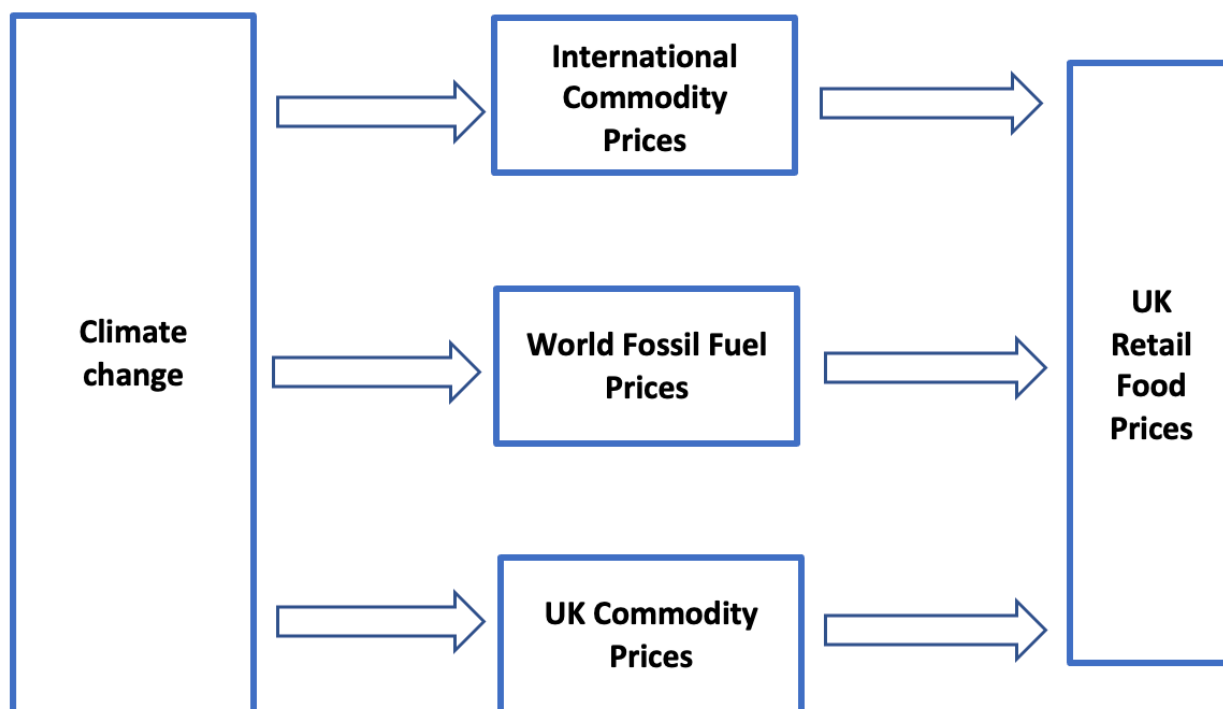
- international commodity prices
- domestic prices of farm products and
- the price of energy.

The transmission pathways are sketched in Figure A1. Each of the arrows represents a path of transmission. The mechanisms underlying the quantitative impacts are briefly set out below.

To begin, we use the global land-ocean temperature index produced by the National Oceanic and Atmospheric Administration in the US, as our global indicator of climate change. These data measure the difference in annual average global temperatures from a (1951-80) baseline and thus capture both the rising trend in global temperature and annual anomalies (i.e. extremes of temperature).

As discussed in the main text of the 2022 report, global warming and the extreme weather events that are associated with it, cause supply disruption, yield variability and thus higher prices on both world and domestic agricultural markets (Faccia et al., 2021). In turn, these higher commodity prices feed into the price of retail food as shown by the horizontal arrows in the figure. Applying these climate shocks to the estimates of Cashin et al. (2017) delivers the effects of climate shocks on world and domestic prices, which we have assumed are the same. Cashin et al., (2017) also finds a statistically significant link between climate change and the demand for energy as, for example, farmers increase their use of irrigation and mechanisation, while at the same time more refrigeration and air conditioning is needed. The effects compound the demand for fossil fuels to replace hydroelectricity. To reflect this additional channel of transmission, there are arrows leading from climate change to fossil fuel prices.

Appendix Figure A1: The Transmission of Global Weather Shocks on UK Retail Food Prices



To assess the effect of these factors on UK retail food prices, we employ the coefficients provided in Davidson et al. (2021) which measure the effects of world commodity prices, domestic commodity prices and manufacturing input costs. Three features are noteworthy here. First, international prices are adjusted to reflect UK dependency on imports; Second; international price shocks are fully reflected in domestic prices; third energy prices are adjusted to reflect its importance in manufacturing input costs using estimate reported in Green and Zhang (2013).

Combining the effects, we find that for every 0.2°C increase in annual average global temperature UK consumer retail prices increase by one percentage point, approximately 80% of which is due to changes in agricultural (world and national) prices, and 20% due to the indirect effect of higher energy prices.

Energy Shocks

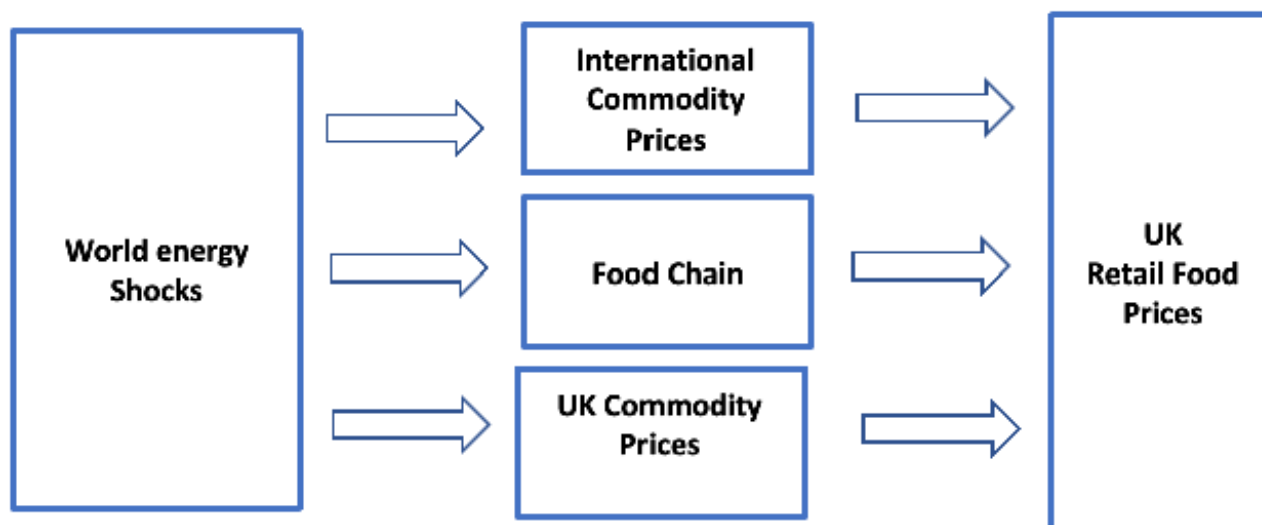
We use the Energy price index produced by the International Monetary Fund, as our measure of energy shocks. This index is broadly based, including the price of crude oil, coal and propane gas traded on world markets.

Being an important input into agricultural production for fuel and fertilizer, the price of oil and gas affects the prices of all commercially grown commodities as well as affecting costs throughout the food chain, owing to the energy intensive nature of activities such as processing, distribution and retailing of food (Baffes, 2009). High oil prices may also divert biofuel feedstocks from food supply adding upward pressure to food prices (Taghizadeh-Hesary et al., 2019) and strengthening the link between food and fuel markets.

As set out in Figure A2, the transmission channels for international energy shocks into UK food prices are via:

- international commodity markets
- food chain (processing, distribution and retailing)
- UK agricultural sector

Appendix Figure A2: The Transmission of Global Weather Shocks on UK Retail Food Prices



To quantify the effect of energy price shocks on UK food prices we first assess the impact of energy prices on agricultural prices. To do this we use the World Bank estimate calculated by Baffes (2007) which we apply to both international and UK commodity prices. These effects are then fed into the coefficients estimated by Davidson et al. (2021) reported above to quantify the effect of energy shocks arising from agriculture on consumer food prices.

As energy is an important cost in the food chain, which itself affects the price of food purchased by consumers, we apply the IMF energy prices changes to the coefficient estimated by Davidson et al. (2021) considering the importance of energy in manufacturing costs (Green and Zhang 2013).

Combining these effects, we find that a 10% increase in world fossil fuel prices is associated with a 0.7 percentage point increase in retail food prices, approximately 80% of which is because in agriculture, via competition with biofuels and higher input costs and the remaining 20% due to higher food chain costs.

Additional References

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