Explaining UK Food Price Inflation

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Abstract

Retail food price inflation in the UK peaked at nearly 14% in the summer of 2008, a level much higher than had been seen in the previous 10 years and, since then, food price inflation has continued to lead general inflation. An obvious factor driving domestic retail food prices is world commodity prices, but other factors matter too. In this paper, we model UK food price inflation and explore a range of potential drivers including world food prices, exchange rates, manufacturing costs, oil prices and wages. Over the period 1990-2010, we show that the major drivers of UK food price inflation are world raw food prices and the exchange rate; less important are manufacturing costs, unemployment and earnings. Oil prices matter too but indirectly via their effect on world agricultural commodity prices. We also show that the effect on domestic retail food price inflation depends on the duration of the shocks arising on world commodity markets.

JEL Classification: E31; Q02

Keywords: inflation, food prices, price transmission, VAR models

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1. Introduction

In the past few years, policy makers and commentators have paid considerable attention to retail food price inflation which has tended to exceed general inflation across many countries. In the UK, retail food price inflation reached around 14 per cent in mid-2008 which compares to non-food price inflation of 2 per cent for the same period. More recently (July 2011), data from the Office for National Statistics shows that while general inflation was recorded at 4.2 per cent, retail food price inflation was reported at 6.9 per cent. This increase in domestic retail food price inflation came against the background of the 'spike' in world agricultural commodity prices that had seen increases of almost 80 per cent between early 2006 and mid-2008 before dropping back sharply in 2009. By early 2011, world agricultural commodity prices had again increased with the recorded price levels exceeding the 'spike' of 2007-2008, with this expected to re-fuel domestic retail food price inflation. While the link between world agricultural commodity prices and domestic food prices seems obvious, it is important to note that raw commodities are not the same as the commodities bought at the retail level, the latter involving a wider range of inputs and marketing services that are embodied in retail food prices; recent data from the Department of Food, Environment and Rural Affairs (DEFRA) suggests that the share of raw agricultural prices in total value added of retail food prices is approximately 30 per cent. This suggests that factors in addition to world commodity prices will have an impact on domestic retail food prices, and that it is the size of their price changes and their weighting in food inflation that matter.

A further consideration in determining the impact of world commodity prices on retail food price inflation (or indeed any other factor) is the duration of the 'spike'. Commodity prices are typically characterised by long-periods of relatively low and stable prices interrupted by 'short' price spikes (Deaton and Laroque (1992) and Williams and Wright (1991)). Given that a 'spike' can vary in duration and allowing for lags in the transmission of changes occurring in world markets to feed through to the retail sector, the effect of shocks in world prices will depend on the persistence of the shock. For example, close examination of the commodity price 'spike' in the late 2000s indicates that world prices started their upswing in spring 2006 and reached their peak in spring 2008 before falling back sharply in 2009. For any given lag structure, the effect on monthly inflation will involve the accumulated effect of previous price shocks, the magnitude of this effect being contingent on the dynamics of the specific commodity price 'spike'. Given world commodity prices typically display relatively short but not necessarily single-period shocks before returning to lower levels (Deaton and Laroque (*op. cit.*)), the net effect of commodity price shocks will be lower than those implied by the estimated long-run elasticities.

The focus of recent papers in the area of food pricing has been on explaining the 2008 commodity price spike (see, for example, Sumner (2009), Trostle (2008), HMG (2009), Wright (2011) and Baffes and Haniotis (2010)). The emphasis is given to price movements at the world level rather than on domestic consumer food prices and thus on the raw rather than the processed commodity. The current paper extends the literature by examining not only the pattern of retail food price changes in the UK but also exploring the link between world raw food prices and domestic retail prices, As far as we are aware, there has been no research to date that has directly addressed the issue of food price inflation in the UK.

In this paper, we employ a 6 variable cointegrated vector autoregressive (C-VAR) model to explain retail food price inflation in the UK between 1990 and 2010. The econometric framework is attractive for this purpose: not only does it capture important inter-relationships and dynamics in the system but readily facilitates simulation through impulse response analysis. We account for two possible dimensions between events on world markets and UK retail food prices. The first relates to the price transmission effect i.e. raw commodity price changes through to changes in retail food prices. The second relates to the world oil price; while oil prices can have an impact directly on domestic food prices as a cost variable in the production and distribution of food at the retail level, they can also have an indirect effect via the link between oil prices and world agricultural prices. This indirect effect reflects the closer linkages between world oil and agricultural prices resulting from the growth in global ethanol production, particularly due to US biofuel mandates, which has been seen as one of the main determinants of world agricultural prices in recent years (Baffes and Haniotis (2010) and Wright (2011)). Hertel and Beckman (2011) provide a recent discussion of the links between energy and commodity markets that have recently emerged.

Given recent events on world commodity markets coupled with the high levels of food price inflation in the UK, the specific contribution of this paper is to explore the determinants of retail food price inflation accounting for a range of factors that may drive it. The results show that the factors that primarily determine UK retail food price inflation are world agricultural prices and the sterling exchange rate, with other manufacturing cost variables, such as labour costs, and demand factors being less important. In a mature market economy like the UK, it is perhaps unsurprising that these results suggest supply side factors dominate demand side factors given aggregate income and price elasticities of demand are quite low. Oil prices matter too, but this effect is primarily indirect via the impact of oil prices on world agricultural prices, the latter change being subsequently passed through on to domestic retail prices. We also show that the effect of world agricultural prices on retail food price inflation depends on the duration of the spike; a 10% increase in world agricultural prices lasting for one month will increase retail food inflation by 0.28% while the same shock lasting for 18 months will increase food price inflation by 2.42% differences that the more usual *ceteris paribus* measures of 'long run' elasticity cannot capture.

The paper is organised as follows. In Section 2, we provide background on UK retail food price inflation over the 1988-2010 period and comment briefly on developments on world commodity markets that relate to the domestic food price effects. In this context, we also discuss the range of likely determinants of retail food prices. In Section 3, we outline the econometric methodology and report the key insights from the estimated model. In Section 4, we use impulse response functions to highlight the role of the underlying determinants of UK food price inflation and report results relating to the duration of shocks that would impact on the rate of food price inflation. In Section 5, we summarise and conclude.

2. UK Consumer Food Price Inflation

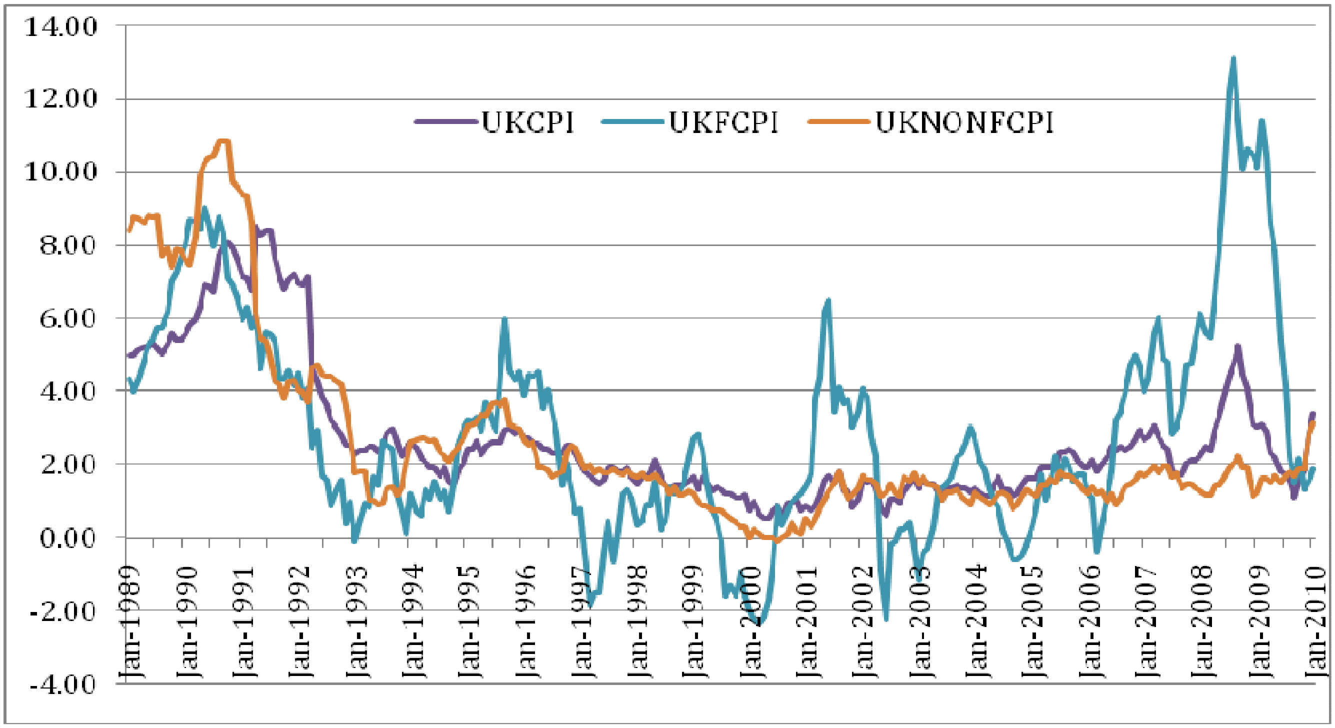
Over the last 20 years, UK food price inflation has tended to be more volatile than overall inflation and non-food inflation as shown in Figure 1 below. Indeed, there are periods where food inflation is negative, something not observed in the other series. Equally, there are significant peaks in food price inflation in July 1995 and mid-2001 as well as the outlier spike in prices in 2008-9. The evidence would suggest that food price inflation behaves differently to non-food price inflation and, given Food and Non-Alcoholic Beverages make up just over 10% of the total Consumer Price Index, understanding the drivers of food price inflation becomes an important part of unpicking the causes of general inflation not least because the effects of food price inflation are felt differently by consumers across different income levels.

Considerable attention has been paid to developments on world commodity markets, the rise in retail food price inflation in 2007 and 2008 as shown in Figure 1 being correlated with the commodity price spike[1]. There are two aspects to this link: the horizontal dimension which relates world commodity prices to producer level prices (i.e. farm-gate prices) and the vertical dimension which relates raw commodities prices to retail food prices. These horizontal and vertical dimensions are shown in Figure 2. The data show that the changes in world commodity prices are more substantive than retail food prices, though there is an apparently closer link between world agricultural prices and domestic producer (i.e. farm-gate) prices; while the data indicate a relatively close correlation between domestic producer prices and world commodity prices, the correlation appears weaker between retail food prices and developments in world markets[2]. This does not imply that there is no link but the data show clearly that volatility in world agricultural prices does not correspond closely to the volatility observed in domestic retail food prices. Furthermore, even when world prices started to fall back from their peak in late 2008, domestic retail food prices were still rising which suggests lagged adjustment to developments on world agricultural prices over previous months.

[1] We do not aim to document the causes of the commodity price spike that has been discussed extensively elsewhere see, for example, Sumner (2009) or HMG (2009).

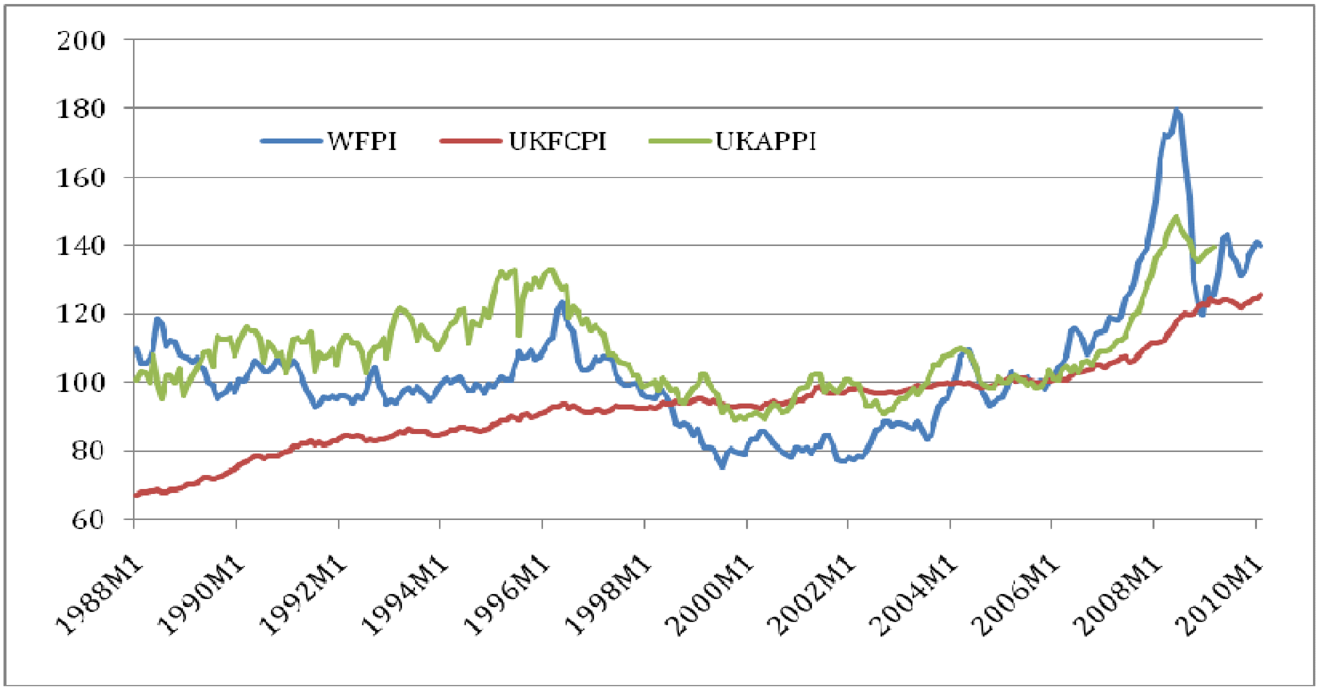
[2] It is also worth noting that the experience of retail food prices in face of the commodity price spike was considerably different across members of the EU where the link between world food prices and domestic prices appears to be much weaker (Ferrucci *et al*., 2010). See also Bukeviciute *et al*. (2009) who document the experience of food price transmission across EU member states following the 2007/2008 commodity price spike.

Figure 1: Annual Inflation for All Goods, Food and Non-food CPI 1989(1)-2010(1) (%)



Source: (ONS)

Figure 2: Indices of World Food Prices and UK Retail and Domestic Producer Prices (2005=100)

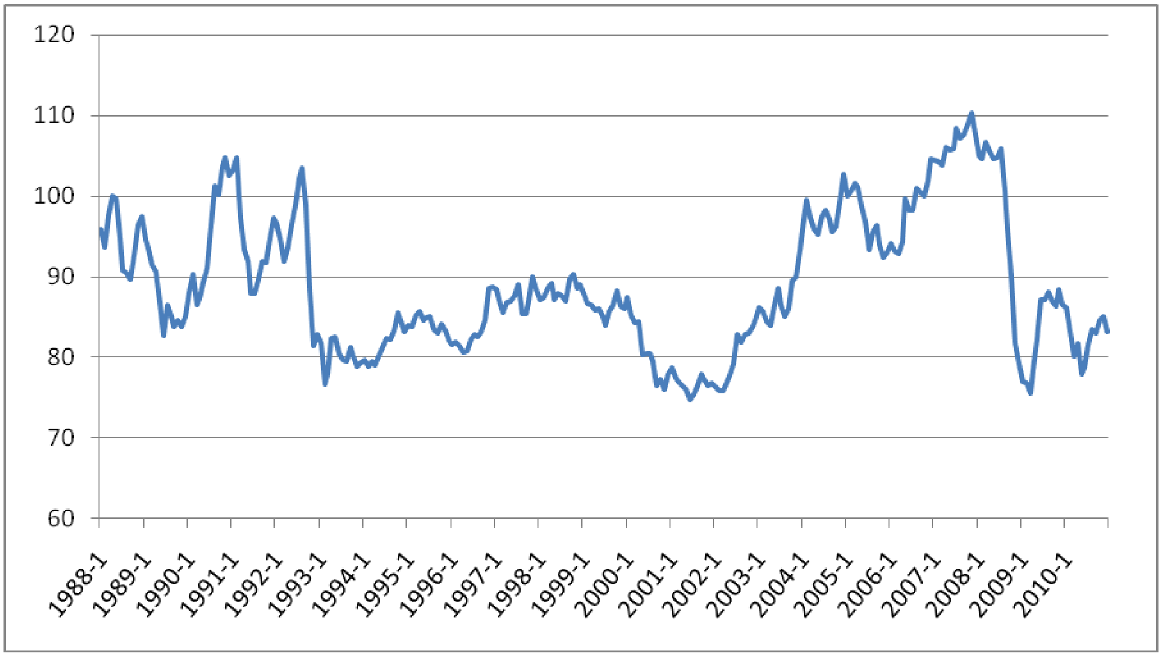


Source: IMF, ONS and DEFRA

These two aspects to the transmission process have received some coverage in the literature. The first is 'horizontal' price transmission that relates to world prices to the corresponding domestic producer prices for the 'same' commodity. Examples of empirical research relating to horizontal price transmission include Ardeni (1989), Barrett (2001) and FAO (2003) and *a priori* there can be many reasons why we would not expect complete horizontal price transmission. At the sectoral level, horizontal transmission will be determined by trade or domestic agricultural price support policies that may break the link between what happens on world markets to domestic markets for the same commodity. From a macroeconomic perspective, the change in the exchange rate vis-à-vis the US dollar may result in a lower or higher price increase in commodity prices when translated into domestic currency terms (given that most internationally traded commodities are priced in US dollars). Clearly, movements in the sterling:dollar exchange rate may offset or exacerbate the effect of dollar denominated prices of agricultural commodities on world markets. Figure 3 provides an indication of how the US dollar/sterling exchange rate has moved over time. Note that, in early 2008, sterling fell against the dollar implying that, even if world commodity prices had remained unchanged, the UK import price for commodities procured on world markets would have increased.

Vertical price transmission relates to changes in the raw commodity through to the corresponding retail price will depend on a broader range of factors that reflects the characteristics of the food processing and retail sectors. As noted above, raw agricultural commodities tend to account for a relatively small proportion of total value-added of the food product sold at the retail level. Other manufacturing costs will therefore be important in determining retail food prices. Perhaps most obviously is factor intensity of food manufacturing which tends to be relatively labour intensive. The extent of competition in the food processing and retailing sectors can also determine commodity pass-through. Recent studies that have focussed on commodity cost pass-through include Lloyd *et al.* (2006), Vavra and Goodwin (2005) and Nakamura and Zerom (2010) among others. Focussing more directly on the commodity price changes and food inflation across a wide range of countries, IMF (2008) noted that international to domestic price transmission was less than domestic price transmission into general inflation. In emerging economies, about one half of domestic price shocks are reflected in core inflation, while for advanced economies, the corresponding estimate is less than one quarter (IMF, 2008). Ferruci *et al.* (2010) focus on food price pass-through in the Euro area and showed that world commodity prices are a poor approximation for the cost pressures faced by Euro-area food producers since the Common Agricultural Policy breaks the link between what happens on world markets with what happens domestically.

Figure 3: US$:£ Exchange Rate 1988(1) – 2010(12)



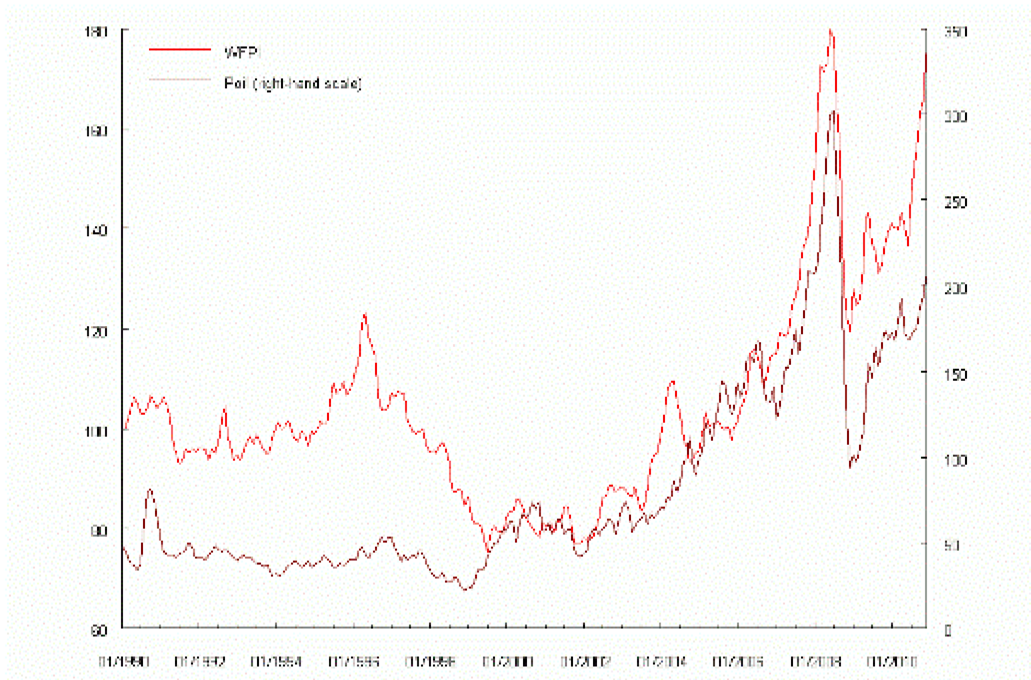
Source: IMF Financial Statistics

It is clear that there is an inter-relationship between the prices of the world's major traded commodities and key to explaining this is the price of oil. Its role in explaining the pattern of food price inflation is however perhaps more complex than with other commodities and issues arise with respect to dealing with the price of oil on food price inflation. On the one hand, there is a potential direct link given that oil is both an input into production and a cost of transportation too. However, the impact of oil as a determinant of inflation may be relatively weak. Recent studies show (Blanchard and Gali (2007) for the US, Shioji and Uchino (2009) for Japan, De Gregorio *et al.* (2007) for a selection of OECD countries) that the links between oil and the macro-economy are now considerably weaker since the 1970s and that this is true for a large number of countries, a feature arising from reduced reliance on oil as opposed to other forms of energy.

On the other hand, there is a potentially important indirect link between oil prices and retail food price inflation which relates to the linkages between energy markets and world commodity prices via biofuels. In recent years, the rise in the world price of oil, coupled with the biofuel mandates pursued by the US resulted in large amounts of land being diverted to crops that could be converted into energy, the diversion in land use contributing to the spike in world agricultural prices. Around 2000, about 5 per cent of US cropland allocated to maize went to renewable energy; by 2010, this share was just under 40 per cent. Globally, between 2000 and 2007, ethanol production tripled. Since the viability of ethanol production depends on oil prices (as well as policy initiatives such as the US government mandates), there is the possibility of a closer link between oil prices and world agricultural prices, The relationship between world oil prices and world food prices is shown in Figure 4. The data suggest a limited relationship between oil prices and world commodity prices prior to 2000; after 2000, and reflecting the increase in ethanol production, there is stronger evidence of a relationship between oil and commodity prices. Although taken over the full sample period, there does not appear to be a close link between energy prices and raw agricultural commodity prices (which is confirmed in the econometric model), we nevertheless allow for the possibility of a structural break following 1999 reflecting the increase in land devoted to ethanol production. In summary, even if oil prices do not have a strong direct effect on retail food price inflation via increasing manufacturing or transportation costs, they may nevertheless still matter in that, by impacting on land use, world agricultural prices rise which, in turn, impacts on retail food prices via the vertical price transmission effect[3].

[3] Hertel and Beckman (2010), and Wright (2011) summarise the issues relating to biofuels and world commodity markets. See also Esmaeili and Shokoohi (2011).

Figure 4: World Oil and Agricultural Prices, 1990-2010



Source: IMF Financial Statistics

Finally, we need to consider demand side factors that could influence food price inflation. Demand shifters are often proxied by measures of income, other prices or tastes. For a number of reasons including limited data frequency for our purposes, we have to employ a proxy variable to try and capture demand effects and to that end we use the unemployment rate. The use of the unemployment rate is not ideal but the choice of macro-economic variables as a proxy for demand was limited by the monthly frequency of the data.

3. Empirical Methods

The non-stationary behaviour that characterises the food price index and its drivers discussed in the previous section gives rise to the possibility of cointegrated long-run relationships. While the vertical price transmission relationship between raw commodity and retail food prices is the most likely candidate, we do not rule out the possibility of other horizontal relationships among commodity prices.[4] To allow for the potential existence of these long run linkages coupled with

[4] Using conventional (ADF) test procedures we find the food price index and the drivers identified in section 3 are integrated of order one, [i.e. I(1)] confirming the view of casual inspection.

the potentially dynamic nature of the adjustment process, we develop an econometric model in a co-integrated vector autoregressive (C-VAR) framework. This has an underlying form given by,

$$\mathbf{x}_t = \mathbf{\Phi}_1\mathbf{x}_{t-1} + \mathbf{\Phi}_2\mathbf{x}_{t-2} + \ldots + \mathbf{\Phi}_p\mathbf{x}_{t-p} + \mathbf{\Psi D}_t + \boldsymbol{\varepsilon}_t \qquad (1)$$

where lag length (p) is determined empirically using conventional model selection criteria and $\mathbf{x}_t$ is a vector of jointly determined I(1) variables containing the UK retail food price index (r_t) and a set of potential drivers, as discussed in Section 2. Specifically, these are the natural logs of: the domestic producer and world commodity prices (d_t and w_t respectively) the latter being priced in US dollars; the dollar price of oil (o_t) ; the $:£ exchange rate ($e_t$); the supply shifter, which we proxy with UK labour costs (l_t) reflecting the labour intensity of food processing and retailing; and the rate of unemployment (u_t) which we use as a demand proxy.[5] Deterministic terms (constants, trends, seasonals and dummies) are contained in the vector $\mathbf{D}_t$ and $\boldsymbol{\varepsilon}_t$ is a vector of disturbances, assumed to be serially independent with zero mean and finite covariance matrix, $\mathbf{\Sigma}$.

While (1) captures the dynamic correlations between the variables succinctly, the VAR is difficult to interpret economically. Where the variables form cointegrated relationships, then (1) is more conveniently expressed in its vector error correction (VEC) form,

$$\Delta\mathbf{x}_t = \boldsymbol{\alpha\beta}'\mathbf{x}_{t-1} + \sum_{i=1}^{p-1}\mathbf{\Gamma}_i\Delta\mathbf{x}_{t-i} + \mathbf{\Psi D}_t + \boldsymbol{\varepsilon}_t \qquad (2)$$

where the cointegrated relationships are explicitly parameterised by the matrix $\boldsymbol{\beta}$, coefficients of which provide estimates of the usual (long-run) response elasticities, given that the variables are expressed in natural logs. Trace and Maximal Eigenvalue statistics are used to assess the number of cointegrating relationships among the data. Equation (2) also defines a matrix of error correction coefficients $\boldsymbol{\alpha}$, elements of which load deviations from equilibrium (*i.e.* $\boldsymbol{\beta}'\mathbf{x}_{t-1}$) into $\Delta\mathbf{x}_t$ for correction, thereby quantifying the speed at which each variable adjusts to maintain equilibrium. Coefficients in $\mathbf{\Gamma}_i$ estimate the short-run effect of shocks to the variables on $\Delta\mathbf{x}_t$ and thereby allow the short and long-run responses to differ. Given our interest in the

[5] Data definitions and sources are provided in the Appendix.

dynamics of food prices as well as the long-run impact of changes in the drivers in $\mathbf{x}_t$, we use impulse response analysis to provide dynamic simulations of the effects of shocks of known size and duration in each driver on UK food prices. While based on the parameters estimated in (2), impulse response functions take into account the knock-on and feed-back effects that may exist between the variables and, in doing so, provide contrast to the long-run elasticities of $\boldsymbol{\beta}$ which, being *ceteris paribus* in nature, explicitly ignore such interactions. Plots of the impulse response function over time provide a graphical illustration of the period-by-period simulation, describing both the adjustment path and long-run effect on the food price index in response to the shock.

Given the monthly frequency of our data, the VEC representation expresses the variables as month-on-month growth rates. Owing to the isomorphism (Hendry, 1995, p.287) between (1) and (2), the VEC model may be equivalently expressed in log-levels (as in (1)) by algebraic manipulation. This is useful when we wish to evaluate the dynamic impact of shocks on the level of food prices. However, since this holds for any linear transformation of (2), we also re-arrange the VEC model in terms of the annualised rates of growth (the proportional changes over 12 months) given that the annualised rate of food inflation is a commonly used metric of price changes.

4. Results

Our empirical VEC model contains seven equations (in $\Delta r_t, \Delta p_t, \Delta w_t, \Delta e_t, \Delta o_t, \Delta l_t$ and Δu_t) which we estimate using the least generalised variance estimator available in *Time Series Modelling 4.31* (Davidson, 2010) with 245 monthly observations spanning the sample period 1990-8 to 2010-12.[6] Owing to the trends that are apparent in the data, we allow for the possibility of drift in the VEC specification. Results (see Table 1) for the model with six lags point to the presence of two cointegrating relationships and drift at conventional levels of significance.[7] Examination of the estimated matrix of cointegrating coefficients $\boldsymbol{\beta}$ suggests that

[6] The least generalised variance estimator is equivalent to Gaussian maximum likelihood. All data and summary output is available upon request.

[7] Diagnostic checks for autocorrelation, heteroscedasticty, ARCH and functional form support model adequacy at conventional levels of significance, although evidence of non-normality in some equations suggests that additional caution is warranted in conducting inference. Subsequent testing for the most obvious causes of non-linearity price behaviour could not identify the precise cause and nature of the non-normality.

the two co-integrating relationships correspond to a (vertical) price transmission relationship and a second (horizontal) relationship between the international market prices of oil and food commodities.

Table 1: Cointegration Test Statistics [*p* values]

Eigenvalues in the reduced rank regression, with drift, lag length 6:
0.174 0.156 0.113 0.078 0.028 0.018 0.002

	Johansen tests of H_0: rank = r				Trend test given rank = *r*.	
r	Maximal Eigenvalue		Trace		χ^2(n-r)	
0	46.88	[<0.05]	149.61	[<0.01]	57.28	[0.000]
1	41.44	[<0.05]	102.73	[<0.025]	20.14	[0.003]
2	29.27	[<0.2]	61.28	[<0.2]	16.93	[0.005]
3	19.97	[<0.5]	32.01	[<0.2]	14.04	[0.007]
4	7.04	[<1]	12.05	[<1]	14.04	[0.003]
5	4.63	[<1]	5.01	[<1]	5.65	[0.059]
6	0.38	[<1]	0.38	[<1]	3.32	[0.069]

While the results indicate two stable cointegrating relations, we wish to allow for the closer ties between oil and food commodities in the post-US biofuel mandate era (as discussed in Section 2) and so let the second cointegrating relation change at this time. The results of this modified specification are summarised in Table 2. They show that the elasticities are signed in accordance with intuition, inelastic in magnitude and statistically significant at or around conventional levels. The first of the two cointegrating relationships, the price transmission relation, links the domestic food price index with world food commodity prices, augmented by the $:£ exchange rate and the supply and demand shifters (the rate of unemployment and labour costs respectively).[8] In this relationship, the elasticity of retail food prices with respect to world food commodity prices - the long run price transmission elasticity – is the largest and suggests that, other drivers held fixed, a 10% increase in agricultural prices on the world market is associated with a 6.34% increase in retail food prices in the long run. Price transmission between commodity and retail markets is thus not one-for-one, reflecting among other factors, the more stable influence of non-agricultural components in retail food prices. The results also point to

[8] The index of domestic producer prices was found to contribute little to the long run relation (over and above that exerted by international commodity prices) and is thus excluded from it, although it remains in the model owing to its important influence on the food price index in the short run.

the important role played by exchange rates in domestic food prices: a 10% appreciation (depreciation) in the value of Sterling against the dollar being associated with a long-run 5.10% fall (rise) in retail food prices, *ceteris paribus*. The supply and demand shifters that augment the price transmission relationship have somewhat smaller effects on food prices, and suggest that 10% increases in demand (unemployment) and supply (labour costs) shifters lead to *ceteris paribus* long-run effects on food prices of -1.59% and 2.33% respectively.

Table 2: Long Run Elasticities

Elasticity of food prices with respect to:		
	World food commodity prices	6.34 [0.001]
	Exchange rate	-5.10 [0.002]
	Labour costs	2.33 [0.06]
	Unemployment rate	-1.59 [0.15]
Elasticity of world food commodity prices with respect to:		
	Oil prices pre-1999(3)	5.53 [0.000]
	Oil Prices post-1999(3)	6.51 [0.011]

The second cointegrating relation represents the links between the price of oil and food commodities on international markets. Estimates suggest that in the biofuels era a 10% increase in oil prices has been associated with a 6.51% *ceteris paribus* increase in world agricultural commodity prices. The somewhat smaller increase (5.53%) prior to that date suggests that commodity prices have indeed become more sensitive to energy prices in recent years.[9] While relationships between international commodity prices are not our principal focus, incorporating

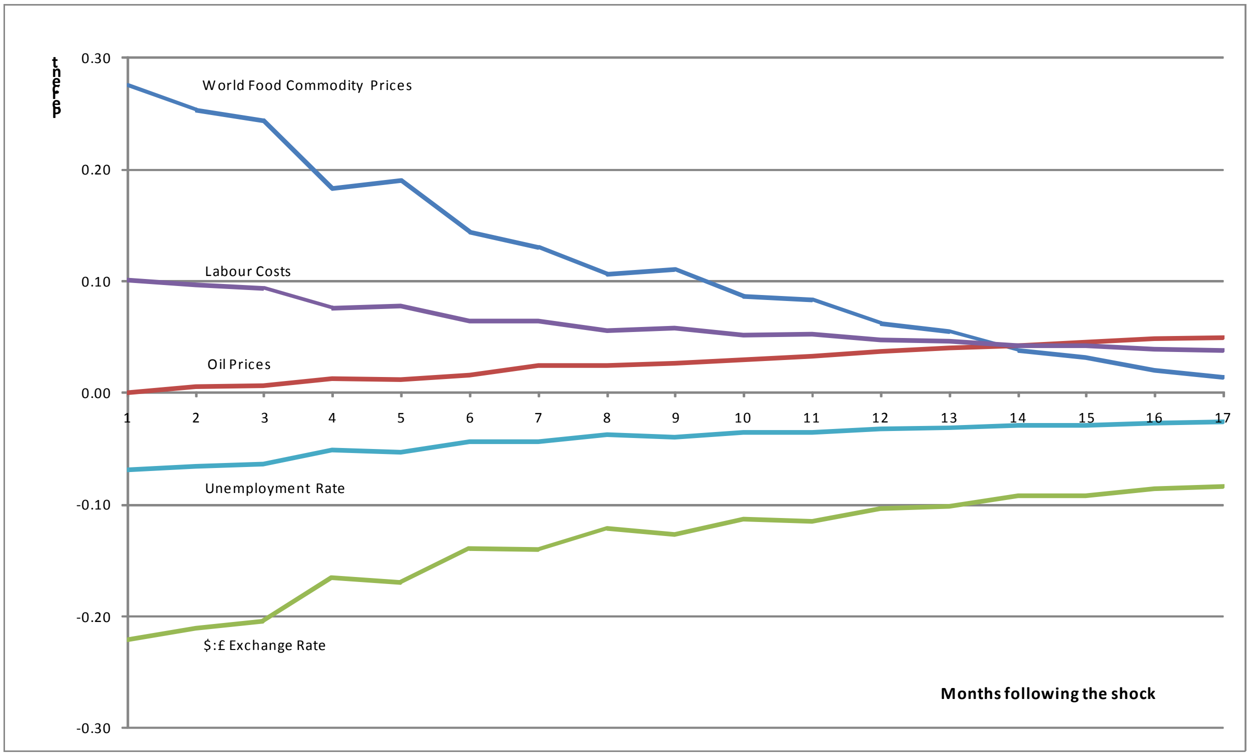
[9] Experimentation suggest that the precise date of the structural change around this time has little effect on the estimates and their statistical significance. The 1999-3 breakpoint to chosen on the basis of model selection criteria, principally the SBC.

them in a second cointegrating relation does mean we are able to quantify the impact of oil prices on domestic food inflation. We address this issue using impulse response analysis in the following section and merely note here that chain linking the long-run elasticities implies that a 10% change in oil prices leads to a (6.51×0.634=) 4.1% increase in food prices. As with the other drivers, the response of food prices to oil price shocks is inelastic and, according to the estimates in Table 2, not dissimilar in magnitude to the impact of changes in the exchange rate.

4.1 The Duration of Shocks and Response Dynamics

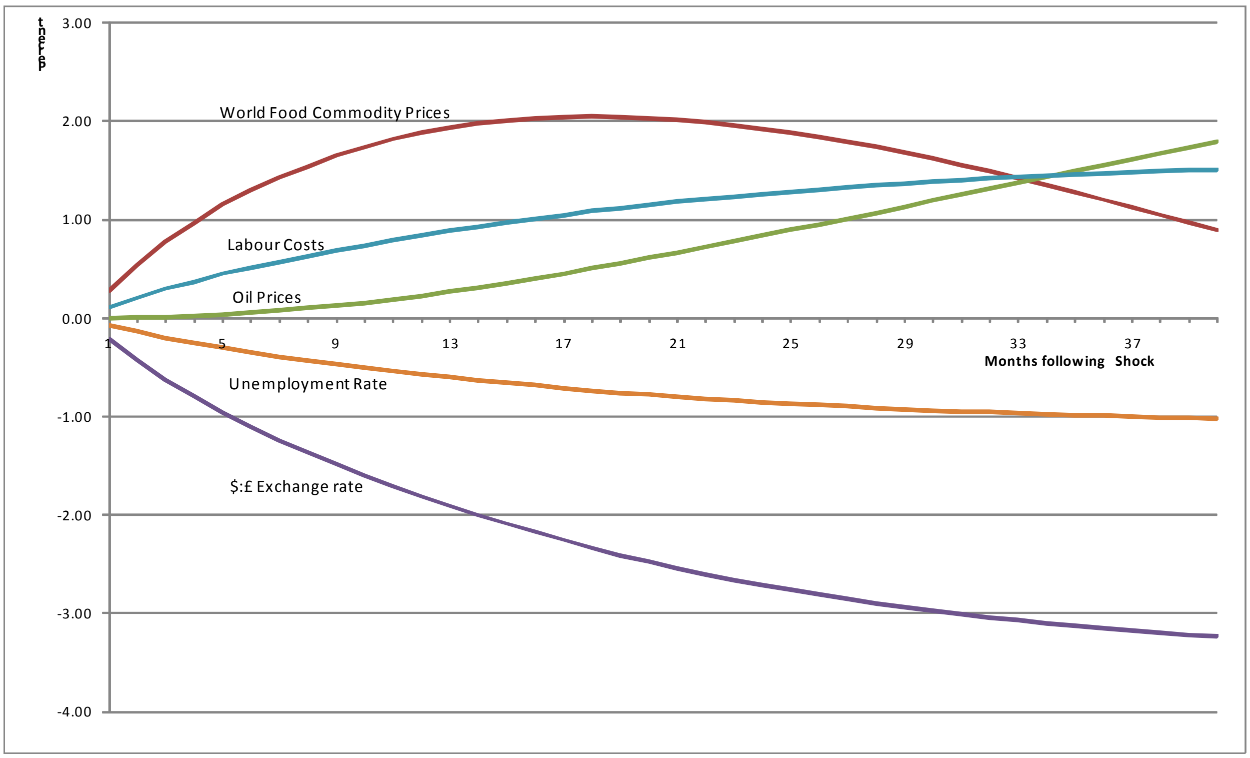
To obtain a more complete picture of the dynamic effects of changes to the drivers we undertake an impulse response analysis and trace the effect of shocks of a specific size and duration on UK food prices. Figure 5 illustrates the dynamic effect of a 10% one-period shock or 'blip' in each driver on the food price index in the 18 months after the shock (the effects being expressed as a percentage of predicted food price level in the absence of the shock). Each impulse response function measures a separate experiment (i.e. a 10% shock to each driver) so they are plotted together merely for convenience. As can be seen, shocks to world food commodity prices and exchange rates have the largest quantitative impact on food prices with the maximum impact occurring in the month following the shock. Specifically, a one-period 10% increase in world food commodity prices is estimated to increase food prices by almost 0.3% in the month immediately following the shock, an impact that diminishes to 0.06% a year after the shock. The effect of exchange rate shocks is quantitatively similar albeit opposite in sign; a one-month 10% appreciation in Sterling depresses food prices by an estimated 0.22% in the month following the shock and by 0.1% one year later. One-period shocks to labour costs and unemployment produce similar patterns but with quantitatively smaller impacts. Interestingly, the pattern of food prices in response to oil price shocks is quite different to those following shocks to the other drivers. Oil price shocks appear to have negligible effects on food prices in the short run, building momentum only slowly over time, 'peaking' some two and half years following the shock (not shown). This slow-burn effect is in stark contrast to the dynamics of other shocks whose effects tend to dissipate over time. While little should be read into the precise timing of the peak, the fact that the effect unwinds over such a long time scale might reflect more of a biofuels explanation (in which oil prices affect cropping patterns) than a costs-based story of oil price shocks.

Figure 5: The Percentage Change in Food Prices Following One Period 10% Shocks



Subject to the usual caveats regarding non-marginal changes, the effect of larger shocks can be inferred from the graph simply by multiplying by the appropriate scalar. For example, a 50% increase in world food commodities prices for one-month shifts the impulse response function by a factor of five, increasing food prices by nearly (5×0.28=) 1.5% in the month following the shock and by 0.3% a year later. While not inconsequential, the effect of such a large shock seems small. Furthermore, similarly modest effects result following shocks to the exchange rate, and even more so for the other drivers. However, the puzzle is more apparent than real since these seemingly modest effects merely reflect the short-lived (one-period) duration of the shocks. To illustrate we repeat the experiments, this time simulating the effect of a permanent 10% increase in each of the drivers on the food price level (Figure 6). In each simulation, the shock shifts the driver to a new level that is permanently 10% higher, with the result that effects last for longer and are considerably larger in magnitude. For example, a permanent 10% shock in world commodity prices leads to an initial 0.3% increase (replicating the result of a temporary shock) which then continues to grow, peaking at around 2.0% some 18 months later. Hence, the effect of a 10% commodity price shock differs by a factor of (2.0/0.3=) seven depending on its duration. Similarly amplified effects are predicted when permanent shocks to the other drivers are simulated.

Figure 6: The Percentage Change in Food Prices Following Permanent 10% Shocks



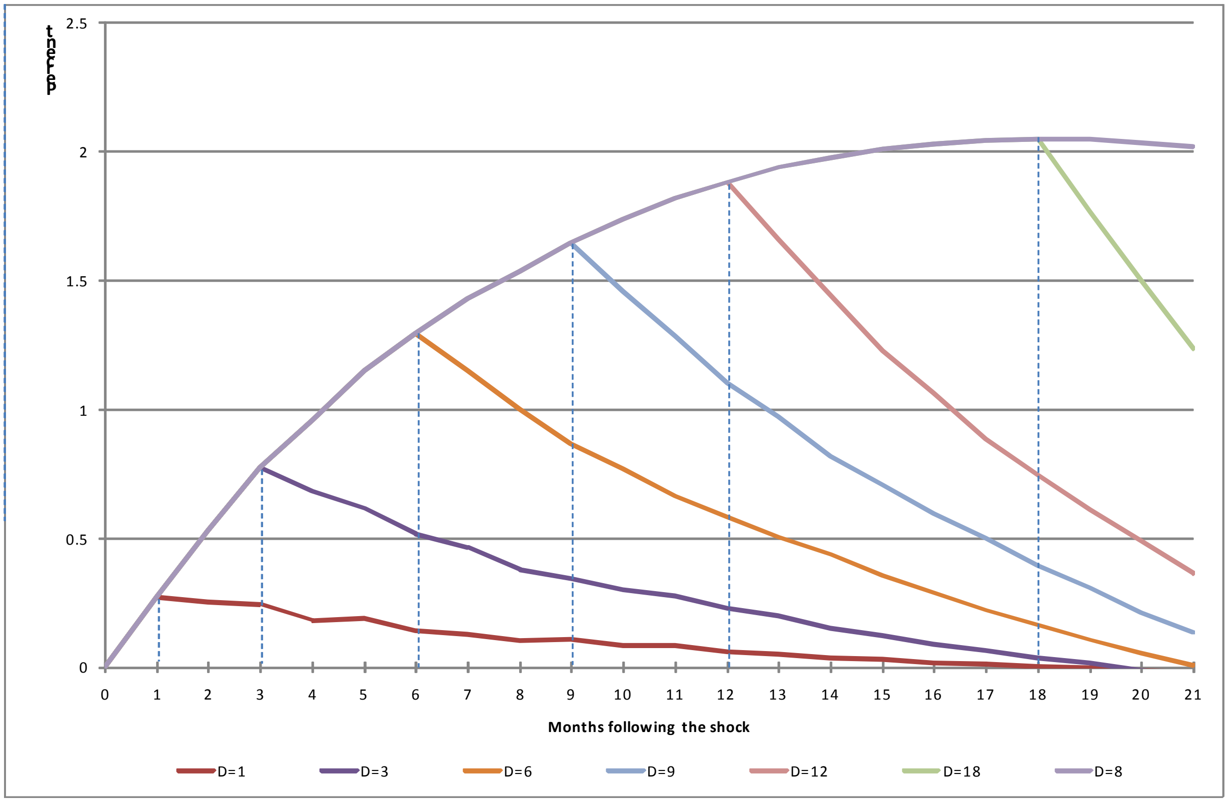
Of course, the one-period and permanent simulations portrayed in Figures 5 and 6 are polar cases, with permanent shocks representing something of a worst-case scenario. To gauge the impact of some more empirically relevant intermediate cases, consider Table 3 which offers a summary along with the long-run elasticities for comparison. As expected, the effects on food prices grow as the duration of the shock lengthens. Shocks of 9 months are more akin to a permanent change than one-off shocks, suggesting that a typical commodity price spike (the 2008 spike lasted around 15 months) is likely to induce a response towards the top end of the magnitudes estimated. Sizeable though these are, they are lower than the long-run elasticity, the more commonly used metric. The extent to which estimates of the permanent shock differ from the corresponding long-run elasticity depends on the importance and nature of the interactions among the variables in the system (which are incorporated in the impulse response analysis and ignored by the elasticities). Results suggest that these interactions tend dampen the effect of the shocks on food prices, particularly so for world commodity price shocks, where the predicted maximum impact on food prices (2.05%) is less than one-third implied by the (*ceteris paribus*) long run elasticity (6.34%). As a result, a (say) 50% increase in world food commodity prices is predicted to raise food prices to a peak that is (5×2.72=) 14% above their un-shocked level, considerably less than the (5×6.33=) 32% implied by the long-run elasticities. Comparisons for the other drivers show less of a contrast, suggesting that the net effect of interactions within the system are les important. As noted above, food prices tend to behave differently to oil price shocks, a feature that is also borne out in Table 3 where the interactions have a tendency to compound the *ceteris paribus* response rather than weaken it, a feature that may well reflect more structural ramifications of shifts in the price of oil.

Table 3: Peak Impacts on UK Food CPI of 10% Shocks by Duration

	Duration of the Shock (months)							Long-run Elasticity
	1	3	6	9	12	18	Permanent	
Commodity Prices	0.27	0.77	1.15	1.64	1.88	2.05	2.05	6.34
Exchange rate	-0.22	-0.63	-1.11	-1.49	-1.81	-2.33	-3.81	-5.10
Oil Prices	0.06	0.18	0.36	0.53	0.71	1.06	5.10	4.10
Labour Costs	0.10	0.29	0.51	0.69	0.84	1.09	1.70	2.33
Unemployment Rate	-0.04	-0.14	-0.35	-0.47	-0.57	-0.73	-1.15	-1.59

What is also apparent from Figures 5 and 6 is that the dynamic response of food prices (as well as the long run impact) is determined by the duration of the shock. To give a more complete picture of these dynamics, Figure 7 presents the predicted effect on food prices in response to a 10% shock in world food commodity prices of various durations, with D=1 and D=∞ representing the impulse response functions of one-period and permanent shocks to world food commodity prices in Figures 5 and 6. Clearly, the size and persistence of the effect on food prices increases with duration of the shock; the impact developing during the period in which the shock persists and declines thereafter as the shock becomes more distant. This dictates that the maximum effect on food prices does not occur at some fixed lag length, say five months after the shock, but varies with the duration of the shock; short-lived shocks creating peaks in food prices that are more immediate than with long-lasting shocks.

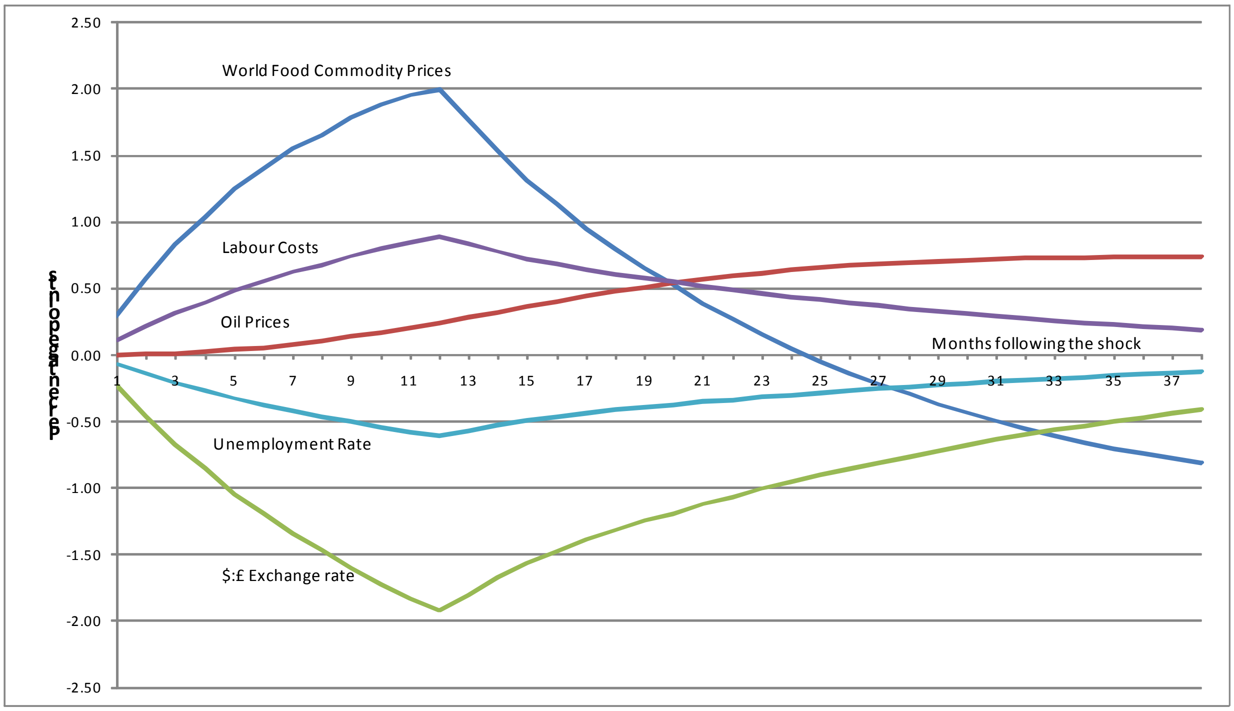
Figure 7: Percentage Effect on UK Food CPI of a 10% Shock to World Food Commodity Prices by Duration of the Shock



4.2 The Effect of Shocks on Food Price Inflation

As discussed in Section 3, food price inflation is typically measured in terms of its annualised rate, and so it seems useful to cast the results of the impulse response analysis in these terms. As before, the response of (annualised) food inflation to shocks is determined by both the magnitude and duration of the shock. Figure 8 displays the dynamic impacts of permanent 10% shocks to each driver, paralleling the effects portrayed in Figure 6. Each impulse response function plots the predicted difference in the rate of food inflation between the 'with' and 'without' shock scenarios, and since it is the effect on the annualised rate of inflation that is measured on the vertical axis, the units of measurement are percentage points. Notice that results for the first 12 months are similar to those shown in Figure 6, but thereafter differ as the effect of the shock becomes embodied in the base price level from which the annualised rates of inflation are calculated.[10] While the simulations assume permanent (i.e. worst case) shocks of 10%, it is easy to see how persistent shocks of large magnitude might induce double-digit food inflation, a topic we briefly turn to now.

Figure 8: The Change in Food Price Inflation Following Permanent 10% Shocks



A key application of the annualised inflation representation of the model is forecasting. While valuable for policy evaluation in real time, we do not present such forecasts here. We can however use the model to infer the sort of shock required to induce a specific level of food price inflation. Of particular interest is the most recent burst in UK food inflation which peaked in the summer of 2008 at nearly 14%, having been at historically low levels for many years. Since the commodity price spike was the principal culprit, we shall frame the analysis in terms of commodity prices, acknowledging that the on-off nature of the shocks we simulate only approximate the more complex dynamics of the commodity price shocks observed in practice.

[10]. Hence the estimated responses in the months after this point - and thus the peaks observed at 12 months itself - are determined by the arithmetic of the annualised inflation calculations rather than the dynamics of the underlying model.

Table 4 summarises the magnitude of the shock to the world food commodity price index required to reproduce a 2008-type spike in UK food inflation.[11] According to the model estimates, the commodity price index would need to rise 476% if the shock were to last just one month, compared to 70% if the shock lasted an entire year. Intermediate durations of 3, 6 and 9 months suggest shocks of 169%, 100% and 79%, considerably larger than the 22% implied by the long run elasticity which, as explained above, ignores the interactions between the variables in the model. Large though the shocks are, the magnitudes for the more long-lived of them are empirically plausible; the actual shock to world food prices in 2008/9 being around 60% in magnitude.

Table 4: Magnitude of Commodity Price Shocks (%) required to reproduce the 2008/9 Spike in food inflation by duration of the shock

	Duration of the Shock (months)					Long-run Elasticity
	1	3	6	9	12	
Commodity Prices	476	169	100	79	70	22

5. Conclusions

Retail food price inflation in the UK over recent years has exceeded non-food price inflation reaching a peak of round 14 per cent in 2008. More generally, food price inflation has been more volatile than non-food price inflation. The obvious inference to draw is that retail food price inflation is driven by world commodity prices, the high levels of retail food price inflation reflecting the spike in world commodity prices in 2007-2008. However, world commodity prices are not the only factor that might drive retail food prices. Using a 6 variable vector autoregressive model, we have shown that there are a range of factors that determine retail food prices. Even though world commodity prices play a dominant role, the exchange rate, manufacturing labour costs and oil prices also matter. The latter is of interest insofar as the impact on retail food price inflation is indirect, reflecting the growing link between world energy and agricultural markets in recent years, in large part a consequence of the bio-fuel mandates

[11] For the purposes of this exercise, the simulations are based on the annualised rate of food inflation of 14%.

pursued by the US government. In addition, given the underlying characteristics of commodity price behaviour on world markets (i.e. relatively low prices punctuated by spikes), the impact of world commodity prices on retail food price inflation will depend on the duration of the shock. Given the expectation that world commodity prices are likely to be higher and more volatile in the future, understanding the dynamics of commodity price (and other) shocks on domestic retail prices is an important issue for macroeconomic policy.

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Appendix

Definition	Source
UK Consumer Price Index (all items).	Office for National Statistics (ONS)
UK Consumer Food Price Index.	OECD, OECD Statistics. http://stats.oecd.org/index.aspx
UK Retail Price Index (all items).	Office for National Statistics (ONS)
World Food Price Index	IMF Primary Commodity Prices: http://www.imf.org/external/np/res/commod/index.asp
$:£ Exchange rate	IMF Financial Statistics
Agricultural Producer price index (UKAPPI).	UK DEFRA
Manufacturing Input costs index.	Office for National Statistics (ONS)
Average Earnings index for the whole economy s.a.	Office for National Statistics (ONS)
Oil Price ; UK Brent, light blend 38 API, fob U.K.	IMF Primary Commodity Prices: http://www.imf.org/external/np/res/commod/index.asp
Unemployed: UK (Thousands) s.a.	Office for National Statistics (ONS)