On the Macroeconomic Management of Food Price Shocks in Low-income Countries†

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Abstract

Global food prices have risen sharply in recent years and have become more volatile. In this paper, I examine how these developments are transmitted to domestic food and non-food markets in low-income economies and consider the options available to policymakers concerned with managing the macroeconomic consequences of global food price shocks. I first review the simple economics of the transmission of global food price movements to food and non-food prices in low-income countries. I then use a simple dependent-economy model to illustrate the real macroeconomic and distributional effects of alternative fiscal and trade policy responses to food shocks and how these are determined by the structural characteristics of low-income economies. In the final section, I consider how food price shocks impact on the aggregate price level and, in particular, the

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implications of increased food price volatility has for the design and conduct of monetary policy in low-income economies.

JEL classification: E60, Q10

1. Introduction

The precipitate rise in global food and fuel prices between 2006 and the middle of 2008 was a shock to the world economy and to developing countries in particular. At the international level, the shock returned concerns about food security, international food policy coordination and the role of food aid to centre stage. At the national level, it re-ignited debates about policies towards agriculture and agricultural productivity, about trade policy and the role of strategic grain reserve (SGR) management and about the capacity of social safety nets to protect vulnerable populations. But it also raised questions about the role of macroeconomic policy in the face of large relative price movements which were potentially destabilising, both economically and politically. Should policy instruments, specifically monetary and fiscal instruments, be employed purposively in the face of food price shocks, and if so how? Are contemporary policy regimes in Africa suitably structured to permit effective countercyclical behaviour? Or, are information and response lags too long and too unpredictable that intervention risks exacerbating disequilibrium or otherwise stores up excessive costs for the future?

The food price shock at this time was, indeed, large, both in absolute terms and relative to the past. Between January 2006 and the peak of their cycle in mid-2008, global food prices, measured in constant US dollars, rose by around 75%, yet by April 2009 they had fallen back by almost 30%. For commodities such as maize and rice, the surge in world market prices was even more dramatic, with prices more than doubling over the same period (Figure 1).

Given the preponderance of food and fuel in their consumption and net imports, the income-effect of these price shocks on low-income countries was also large. The IMF (2008a, 2008b) estimated the cumulative balance of payments shock associated with rising food and fuel prices from early 2007 to mid-2008 to be equivalent to approximately 4.3% of pre-shock GDP for non-oil-exporting countries, with approximately one-third of this cost occurring in the second quarter of 2008 (in what turned out to be the final quarter of sharply rising prices).¹ For oil exporters, the net

¹ The impact of the price change assume a baseline counterfactual in which import volumes were unchanged but prices were held at their January 2007 values.
income effect was less dramatic, at least on average, with the mean cumulative cost over the same period estimated to be approximately 2.4% of initial GDP, but for countries at the other end of the spectrum, such as DRC and Liberia, that were highly import-dependent with high transport costs, the incremental balance of payments cost was estimated to be in excess of 8% of GDP. Across the continent, rising food and fuel prices drove inflation sharply upwards, with median inflation rising from around 6.7% in 2007 to over 10% per annum in 2008 (Figure 2).

The 2006–08 events highlighted a second factor, namely that even if the level of prices was likely to return to trend, the world economy appeared to be entering a phase of increased volatility in real food and fuel prices. As described elsewhere (e.g., Abbot and Borot de Battisti, 2011), this reflects a number of factors, including climatic conditions, changing food demand patterns in rapidly growing nations such as China and India and the effects of policies on biofuel production. An increase in the extent of leveraged trading in commodity-based securities may also have played a part. Thus, while over the very long run, there has been a trend decline in the relative volatility in the prices of primary commodities relative to manufactured goods (Jacks et al., 2009), the volatility around this

Figure 1: Global Food Prices, 2006–10. Price indices are computed in nominal US dollar terms and then deflated by the US CPI. The food price index consists of a weighted average of international prices for cereals, vegetable oils, protein meals, meats, seafood, sugar, bananas and oranges. The maize price index is for US No. 2. Yellow maize (f.o.b., Gulf of Mexico); the fuel price index is the average petroleum spot index of UK Brent, Dubai and West Texas Intermediate; and the input price index is directly computed by the IMF.
Figure 2: The Inflation Surge in Sub-Saharan Africa, 2007–08.
long-run trend decline appears to have increased, especially in recent years (Table 1). In the short run, the legacy of the recent shock has meant that stocks of food commodities are below their long-run target values, limiting the scope for price-stabilising interventions, while uncertainty continues to surround the direction of policy on biofuels. On top of this, continued climate change raises the likelihood of much greater variability in yields and hence prices, at least until investments in adaptation and mitigation take root. There are plenty of reasons, therefore, to believe that global food price shocks are likely to become more rather than less common in the future.

The question of how to manage sharp movements in commodity prices has been a central preoccupation for low-income countries for decades. From Prebisch and Singer in the 1950s, and particularly since the surge in commodity prices in the mid-1970s and early 1980s, research has sought to understand the dynamics of commodity price movements and the economics of price stabilisation, at both the international and the national level, a debate encapsulated in the authoritative work on price stabilisation by Newbery and Stiglitz (1981). These issues have, of course, been central to the modern economics of Africa, emerging in particular through the ‘trade shocks’ literature (e.g., Bevan et al., 1991; Collier and Gunning, 1999) and in debates on the role and reform of commodity boards and commodity export taxation. Given the dependence of African economies on the export of primary commodities and natural resources, this literature has tended to focus on questions of the saving and investment response to trade shocks and, in particular, to public finance income and real exchange rate implications of price volatility (e.g., Deaton and Laroque, 1992; Deaton, 1999; Deaton and Laroque, 1992; Deaton, 1999;
Cashin et al., 2004; Collier et al., 2006; AERC, 2007). What sets recent events apart, however, is that the food price shock is an import price shock which forces policymakers to focus much more sharply on questions of consumption, food security and the distributional effect of the shocks, rather than the concerns highlighted in the trade shocks literature.

Food and fuel price shocks are disproportionately important for the low-income countries of Africa, partly because food and fuel constitute an enormous share of households’ consumption baskets, and particularly those of the poor. Food alone accounts for between 40 and 60% of expenditures compared to around 10% for the OECD,\(^2\) and a large proportion of this defines the basic subsistence expenditure of households. Moreover, since food and fuel are necessities and have few substitutes, the income elasticity food consumption is low, as is the elasticity of substitution between stable and non-staple foods (and non-food consumption more generally). As a consequence, price shocks have powerful income effects which will be transmitted to the non-food economy. On the supply side, the heavy reliance on rain-fed food production and the relative difficulty of altering land use in the short run (compounded by weaknesses of land tenure) suggest a relatively low elasticity of supply in stable food production and a limited elasticity of substitution into non-traditional domestic food production. Especially in rain-fed environments, food is produced under conditions where inputs can be controlled but not yields and hence not output and prices. Trade in food (and fuel) is therefore important and hence movements in global food prices are transmitted to local food markets. Though the presence of high transport costs, combined with market imperfections, means that local markets often remain partially insulated from global markets, with the consequence that movements in global food prices are not fully transmitted to African food markets, the links are sufficiently strong that global food price volatility has first-order implications for food and non-food consumption and welfare in Africa.

Movements in global food prices matter for other reasons too. The food price shock came on the heels of an extended period where, for many countries, strong growth and a benign external environment—most obviously the ‘great moderation’ which saw world prices fall steadily over the early 2000s—meant that central banks were able to achieve a degree of price stability with little or no output cost. By mid-decade, median inflation rates in Africa were in single digits, growth was strong and external balance positions were solid (IMF, 2009). The rise in world food prices from

\(^2\) See, for example, USDA, http://www.ers.usda.gov/Data/InternationalFoodDemand/.
2006 to 2008 thus represented the first large negative terms of trade shock to hit the economy since the implementation of widespread stabilisation and liberalisation efforts of the late 1990s, and was the first time that price and output stabilisation objectives pulled the authorities in different directions. It was, in effect, the first test of the market-based macroeconomic policy regimes that had been put in place during the early 2000s.

But this history meant that, in many countries, policymakers not only had the full array of monetary and fiscal instruments at their disposal, but also they had the further option of financing the shock to avoid the short-run costs of undertaking adjustment measures. Not all countries enjoyed such favourable circumstances, of course, and a number of countries that faced the same global shock are still mired in economic or political crisis, but in what follows, I limit my attention to those cases where policymakers’ choices are not excessively constrained by competing demands being placed on the use of policy instruments.

In this paper, I discuss some of the challenges confronted by macroeconomic policymakers in the low-income countries of Africa as a result of increased volatility in world food and commodity prices. This is a huge topic and so I divide the task into four main sections. In Section 2, I define the key issues, focusing on the links between world and domestic food prices. In doing so, I highlight the distinction between the impact of global food price shocks on the real or relative price of food, on the one hand, and the impact on the average price level, on the other. I then carry this distinction through to Sections 3 and 4. In Section 3, I use a simple simulation model to illustrate how aspects of economic structure influence the impact of global food price movements on the domestic economy, particularly on production and consumption decisions, and to examine the properties of alternative fiscal policy responses. This normative analysis is then used to discuss the evidence on how countries have responded in the light of recent food price shocks. In Section 4, I turn my attention to the conduct of monetary policy in the face of this type of shock. Section 5 concludes.

2. Preliminaries

2.1 Trade and the transmission of global food prices

It only makes sense to talk of a food price shock in the context of a small open economy where domestic prices are, at least to some extent,
anchored to world prices. When food is not traded across borders, volatility in average food prices emerges principally from volatility in supply (being relatively inelastic, the demand for basic food changes only slowly over time) and, in low-income countries, this volatility may be substantial. Food production in Africa, for example, tends to be organised around smallholders working very small plots, with only limited input use. With scales economies under-exploited and the use of irrigation and new seed varieties at very low levels, agricultural productivity remains low and volatility in supply is endemic (Collier and Dercon, 2009). Monopoly power in transport and distribution services, combined with low-grade transport networks, serves only to exacerbate this underlying volatility.

Trade in food provides a mechanism for eliminating excess volatility in prices, income and food consumption. If world market conditions are less volatile than domestic conditions (which, given relative market sizes, is a reasonable assumption, at least on average), the incipient price volatility arising from shifts in domestic supply and demand conditions can be traded away at prevailing world prices, offering producers and consumers the opportunity to smooth incomes and (food) consumption with concomitant welfare gains (Jacks et al., 2009). A corollary, of course, is that prices in the domestic economy may not reflect local supply or demand conditions if these are uncorrelated with conditions in the global market. Thus, consumers and producers can find themselves facing high food prices in times of (domestic) plenty (with the net surplus being exported) and vice versa (where imports fill the gap). By extension, in periods of extreme movements in global food markets, the welfare gains from free trade in food may be sharply diminished or even reversed (arguably, it is this concern that sets many policymakers against greater trade liberalisation in agriculture).

2.2 Transport costs and the pass-through from world to domestic food prices

This is too simple a view. The relevant incentive prices—the prices at which it pays consumers to import and producers to export—are not the world market prices, but the local import and export parity prices. The import parity price is the world prices, expressed in local currency, plus the margin determined by ‘pure’ transport costs, tariffs and other taxes plus the profit margin earned by wholesalers and
By the same token, the export parity price received by exporters at the farm gate will lie below the world market price as a function of the same factors. Defining the per unit transport cost margins by $c$ and tariffs/taxes $t$, with $x$ and $m$ denoting exports and imports, respectively, the range between the export parity price and the import parity price within which domestic food prices (denoted $P_F$) can vary without triggering price-stabilising trade is given by

$$(1 - c_x)(1 - t_x)E_p^w \leq P_F \leq (1 + c_m)(1 + t_1)E_p^w,$$

where $E$ denotes the nominal exchange rate and $p_F^w$ the world price of food. It follows that the higher are these cost components, the larger the wedge between the export and import parity prices, and the greater the influence domestic market conditions will have on prices, the corollary of which is that the measured pass-through from world (food) prices to domestic food prices will be weak.

The ‘parity gap’ will clearly widen or shrink with changes in trade policies. It will also move in line with changing transport costs, reflecting the direct effect of increased fuel prices on the cost of transport, and also indirectly through the co-movement between world prices for food and fuel. The recent spike in food prices, for example, closely followed, and to a substantial degree was powered by, the surge and collapse in fuel prices. The strong co-movement of world fuel and food prices serves to exacerbate the de-linkage of domestic from world food market conditions when world food prices rise.

This pro-cyclical movement may also result from the lack of competitiveness in the trade and distribution sectors. If these sectors are competitive so that excess profits are arbitraged away, the $c$ terms in equation (1)
represent pure costs. In reality, however, transport and distribution activities are frequently dominated by monopolistic firms that will seek to prices (for transport services) as a mark up over marginal cost. Since the profit-maximising mark-up is a decreasing function of the (absolute) price elasticity of demand, then if Engel’s Law prevails and food consumption levels are close to their subsistence levels, the gap between export and import parity prices is likely to be much wider for food compared to other commodities.\(^7\)

Policy interventions geared towards addressing these microstructural factors can generate potentially large welfare gains for consumers and producers by making trade easier and less costly, although possibly at the expense of often politically powerful interests in the trade and distribution sectors—likewise, public investment in roads and ports. But these medium-term structural policy interventions may also generate complementarities with monetary policy if they help to smooth out volatility in domestic food prices, thereby easing the task of overall inflation control, assuming still that conditions in global food markets are less volatile on average than domestic ones.

Transport costs, trade policy and monopolistic transport and distribution markets thus increase the likelihood that domestic prices are insulated from global markets. However, in many cases, economies are consistent net importers or exporters, placing the domestic price hard against the relevant parity price, however high or low it may be.\(^8\) At the parity bounds, relative purchasing power parity prevails. In the case of imports, this means

\[ P_F = (1 + c_m)(1 + t_1)E P^w_F, \]  

\(^7\) In a linear expenditure system with a subsistence threshold for food, the elasticity of demand tends towards zero as consumption converges on the subsistence threshold.\(^8\) In many low-income countries, the bulk of food production is consumed by producers themselves or in their immediate neighbourhood. The net marketable surplus in food is thus an extremely small share of total food production and consumption (a fact which itself follows directly from the presence of high barriers to trade in food). One consequence is that small variations in supply conditions can quickly throw countries from being in a net surplus position to a net food-deficit position. Assuming costs are broadly symmetric for exporting and importing, domestic prices will move by twice the transport and associated cost markup as the economy moves from a net export to a net import position. As Newbery (1989) notes, it would require world market conditions to be strongly negatively correlated with domestic conditions (so that world market prices fall just as the economy moves to a net import position) to offset this high price volatility.
which says that, measured in a common currency, domestic and world prices differ by a proportion corresponding to transport costs and trade policy wedge. If this mark-up is constant over time, domestic food price inflation will be determined by the sum of exchange rate depreciation and world food price inflation:

\[ \pi_F(t) = \hat{E}(t) + \pi^w_F(t). \]  

(3)

If we assume that the cost wedge is stationary rather than constant, equation (3) would become

\[ \pi_F(t) = \hat{E}(t) + \pi^w_F(t) + \epsilon(t), \]  

(3’)

where \( \epsilon(t) \) represents the stochastic evolution in the cost wedge. Equations (3) and (3’) form the basis for the empirical analyses of the food-price pass-through, some of which we review below. The next step is to consider how food prices are transmitted to the general price level. Let the overall or ‘headline’ consumer price index be defined as a geometric weighted average of food (\( P_F \)) and non-food (\( P_N \)) prices where, for convenience, we can interpret the food sub-index as encompassing both food and fuel

\[ P = P^a_F P^{1-a}_N, \quad 0 < a < 1. \]  

(4)

Notice that we could re-write equation (4) as \( P = (P_F/P_N)^a P_N \). Differentiating the log of these two versions, the price index with respect to time allows us to express headline CPI either conventionally as a weighted average of the component inflation rates as \( \pi(t) = \alpha \pi_F(t) + (1 - \alpha) \pi_N(t) \) or as

\[ \pi(t) = \pi_N(t) + \alpha \left( \frac{P_F}{P_N} \right)(t), \]  

(5)

in other words, as the sum of core (non-food) inflation and growth in the relative prices of food (and fuel). This presentation brings out an important policy distinction when we think about the effect of food price shocks and the consequent disposition of policy instruments. Conventional wisdom would see the evolution of relative prices as lying outside the domain of monetary policy, certainly beyond the short run. Rather, the relative price of food will be determined primarily by supply and demand conditions as modified by fiscal and trade interventions (e.g., price controls, subsidies, taxes, trade restrictions). By contrast, the path for core inflation does fall within the domain of monetary policy, even if its path too is influenced by the evolution of the real food price,
for example through wage pressures emanating from reactions to rising food prices. We take this distinction up in the next two sections.

3. Real food price shocks and policy responses in the small open economy

Equation (5) decomposes the domestic inflationary process into an effect coming from the average price level and a component reflecting movements in the real food price. In this section of the paper, we focus on the latter, leaving to later the question of what happens to the average (headline) price level. From this conventional macroeconomic perspective then, the food price shock is analysed as a relative price shock. Food prices rise relative to non-food prices in the global economy and, at least initially, relative to non-food prices in the local economy. To analyse the implications of this shock for consumption, production and the distribution of income, and how standard policy interventions modify these responses, we turn to a standard model of the small open (dependent) economy.

Within this framework, a relatively small number of factors will shape outcomes. The first is, obviously, whether the economy is a net importer or a net exporter of food in aggregate. This will determine whether rising global food prices represents a positive or negative external shock on aggregate. The second is the size and expected (and actual) duration of the shock to global prices. Depending on the structural characteristics of the economy, this will determine the feasible set of policy responses and in particular the balance between ‘adjustment’ and ‘financing’, whether households or, more likely, governments can reasonably seek to smooth (aggregate) consumption through borrowing without recourse to costly expenditure-switching and -reducing measures. The scope for financing will, in turn, also be determined by ‘initial conditions’ such as the country’s reserve coverage, its public debt and fiscal position and its global creditworthiness. The third key determinant is the degree of integration of the domestic food sector with world markets, both in terms of consumption and production. As noted above, this reflects the nature of transport costs, policy measures and other factors that drive a wedge between domestic and trade parity prices. Fourth, the nature of food demand and the responsiveness of food production, in both the short-

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9 Even if the economy is a net food exporter, the domestic consumption price of food will rise, setting up obvious distributional tensions between net producers (who gain) and net consumers (who lose).
and long run, will determine the magnitude of the required adjustment and/or financing of the shock. Finally, the range of feasible policy choices will depend on domestic political economy factors and the likely distributional consequences of large movements in real food prices.

3.1 A simple real model

To understand the key inter-relations between these factors, and to provide a basis for examining the effect of fiscal policy responses, we use a simple simulation model to study the adjustment of a stylised low-income economy to a world food price shock of the kind experienced between 2006 and 2008. To keep the analysis manageable, we use a small comparative-static, trade-focused, dependent economy model based on the framework developed by Devarajan et al. (1993). We limit our attention to the short run where capital stocks are fixed, both in aggregate and in their sectoral disposition, and where the economy is a net food importer, abstracting from the possibility that the economy is operating within the price parity bounds and that movements in world prices are insufficient to trigger trade.\(^{10}\) In this model, the shock is deterministic rather than stochastic.

The model we use is described in detail in Adam and Bevan (2006)\(^{11}\) and so we only briefly comment on the principal design features here. The small country assumption means that the international terms of trade are independent of domestic policy choices and, with the exception of the exogenous food price, all other world prices are constant across all simulations. Firms in each of three sectors (food-crop agriculture, manufacturing and services) are assumed to be competitive, producing a single good under constant returns technologies. Land (in the case of food-crop agriculture) and capital stocks are fixed in each period, while labour, consisting of skilled and unskilled labour, is fixed in total supply but inter-sectorally mobile. Labour markets are competitive so that labour is employed in each sector up to the point that it is paid the value of its marginal product. There is no international trade in services but domestic firms/
households in the food and manufacturing sectors can produce for either the domestic or world market although they face costs of switching their output between the two markets. The elasticity of transformation between markets is our summary measure of the short-run flexibility of the supply side of the economy. To highlight distributional considerations, we distinguish three household types, differentiated by factor ownership, a ‘rural’ household which is involved in food-crop and cash-crop agriculture; an ‘urban unskilled’ household whose only factor of production is unskilled labour and an ‘urban-skilled’ household which supplies skilled labour to the manufacturing, services and public sectors and owns the remainder of the capital in the economy. Each household consumes food, manufactured goods and services. For food and manufactured goods, consumers can substitute between domestic and import varieties, with the degree of substitutability being governed by a standard Armington assumption. Aggregate consumption for each household type is thus defined by a constant elasticity of substitution linear expenditure system which allows for the income elasticity of demand for different goods to deviate from unity. In the simulations reported, we restrict our attention to the case where only food consumption is subject to a subsistence threshold. This implies that the marginal income elasticity of demand is less than unity for food and greater than unity for all other goods (manufactured goods and services). Crucially, although the economy as a whole is a small net importer of food (net imports are approximately 8% of total supply), rural householders are net producers and the urban households net consumers of food.

The government raises revenue through direct taxes and tariffs on imports and finances the production of public services and the construction of public infrastructure. It may also make direct transfers to households. Domestic revenues are supplemented by (exogenous) aid flows. The model is completed by a neoclassical macroeconomic closure in which total private investment is constrained by total public and private savings (including foreign savings) net of exogenous public investment. Household savings rates are exogenous. This rule, broadly consistent with conditions in the poorest countries where household savings are inelastic and where households and firms have little or no access to world capital markets, means that the shortfall (excess) of government savings relative to the cost of government capital formation, net of exogenous foreign savings, directly crowds out (crowds in) private investment.
3.1.1 Experiments

Table 2 reports solutions to this model under a number of experiments. We proceed in two stages. The first block of experiments examines how the structural characteristics of the economy influence the transmission and impact of a global price shock. Here we assume no purposive public policy response to the shock. In the second block, we limit our attention to an environment characterised by relatively low flexibility and then examine the effects of a range of fiscal policy interventions designed to mitigate the effects of the food price shock on domestic consumers. The policy interventions we consider reflect those implemented in practice. IMF (2009), for example, reports that in 2008 alone, around three-quarters of countries in Sub-Saharan Africa put in place fiscal measures to offset the effects of rising food prices. In the main, these consisted of either reductions in ad valorem taxes or tariffs on (tradable) food or direct consumer subsidies, or both. As at mid-2009, the mean fiscal cost of these interventions was estimated to be around 1.0% of GDP. Similar patterns of policy response are reported in World Bank (2008) for a broader range of countries.

In each case, we define the shock in terms of a 25% increase in the world price of agricultural commodities. Think of this as an increase in the maize price. In the model, though the economy is in a net import position, a small share of total food production, equivalent to 2% of total supply, is exported.12 We then trace the short-run comparative static effects of the food price shock.13 It is important to note that this simple comparative static framework means that we abstract from any considerations, at least on the part of private agents, of the persistence of the shock. Implicitly we assume that private agents either optimise in a purely myopic fashion or are otherwise constrained so as to rule out any inter-temporal consumption-smoothing choices. The government, on the other hand, does have the capacity to re-allocate resources inter-temporally.

We start with our benchmark case. This imagines a low-income economy in which food is a normal good but where households are initially consuming not much in excess of their threshold; their marginal income

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12 Our assumptions concerning imperfect substitutability in consumption and production between domestic and foreign varieties permit this ‘cross-hauling’.

13 We should be clear as to what ‘short run’ means here. Essentially, we mean that the interval over which consumers can adjust their consumption patterns; governments can implement fiscal policy changes and, possibly, producers can adjust inputs of mobile factors (labour).
Table 2: World Food Price Shocks: Simulation Results

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Baseline</th>
<th>1</th>
<th>2</th>
<th>2a</th>
<th>3a</th>
<th>3b</th>
<th>4a</th>
<th>4b</th>
<th>5a</th>
<th>5b</th>
<th>6</th>
<th>7</th>
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<tr>
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<td>Low</td>
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<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<td>Low</td>
<td>Low</td>
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<tr>
<td>Subsistence consumption</td>
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<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Correlation between world and local agricultural market conditions</td>
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<td>Policy intervention</td>
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<td>Domestic price of imports</td>
<td>PM</td>
<td>Food</td>
<td>1.00</td>
<td>25.0%</td>
<td>25.0%</td>
<td>25.0%</td>
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<tr>
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<td>Food</td>
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<td>25.0%</td>
<td>25.0%</td>
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<td>Import real exchange rate</td>
<td>PM/PD</td>
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<td>24.9%</td>
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<td>39.2%</td>
<td>11.3%</td>
<td>6.2%</td>
<td>–3.4%</td>
<td>23.8%</td>
<td>26.8%</td>
<td>6.1%</td>
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<td>Export real exchange rate</td>
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<td>24.9%</td>
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<td>11.3%</td>
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<tr>
<td>Net imports</td>
<td>Food</td>
<td>521</td>
<td>–15.0%</td>
<td>–60.7%</td>
<td>–52.2%</td>
<td>–21.1%</td>
<td>–8.8%</td>
<td>–7.1%</td>
<td>–0.2%</td>
<td>–14.4%</td>
<td>–16.3%</td>
<td>–3.8%</td>
</tr>
<tr>
<td>Real product wages</td>
<td>w/pd</td>
<td>Unskilled</td>
<td>1,907</td>
<td>–0.6%</td>
<td>0.0%</td>
<td>–0.3%</td>
<td>2.1%</td>
<td>–3.4%</td>
<td>–0.5%</td>
<td>0.9%</td>
<td>–0.3%</td>
<td>–0.7%</td>
</tr>
<tr>
<td>Real consumption wages</td>
<td>w/pc</td>
<td>Unskilled</td>
<td>3,749</td>
<td>–2.4%</td>
<td>–8.7%</td>
<td>–10.2%</td>
<td>4.0%</td>
<td>–9.2%</td>
<td>–1.0%</td>
<td>0.1%</td>
<td>–2.8%</td>
<td>–1.6%</td>
</tr>
<tr>
<td>Real disposable income</td>
<td>y/pc</td>
<td>Rural</td>
<td>3,632</td>
<td>1.1%</td>
<td>10.9%</td>
<td>12.9%</td>
<td>–5.6%</td>
<td>7.8%</td>
<td>0.7%</td>
<td>1.6%</td>
<td>1.8%</td>
<td>–6.8%</td>
</tr>
<tr>
<td>Total consumption</td>
<td>Food</td>
<td>2,242</td>
<td>–5.2%</td>
<td>–12.4%</td>
<td>–14.6%</td>
<td>6.7%</td>
<td>–17.1%</td>
<td>–2.6%</td>
<td>0.6%</td>
<td>0.2%</td>
<td>1.5%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Real GDP growth</td>
<td>GDP</td>
<td>Urban, skilled</td>
<td>8,036</td>
<td>–0.3%</td>
<td>–1.3%</td>
<td>–1.6%</td>
<td>2.8%</td>
<td>–3.7%</td>
<td>–0.1%</td>
<td>0.0%</td>
<td>–0.4%</td>
<td>–0.2%</td>
</tr>
<tr>
<td>Fiscal deficit after aid</td>
<td>%GDP</td>
<td>Food</td>
<td>–4.77%</td>
<td>–4.94%</td>
<td>–4.23%</td>
<td>–4.48%</td>
<td>–4.61%</td>
<td>–5.26%</td>
<td>–6.94%</td>
<td>–4.71%</td>
<td>–7.85%</td>
<td>–4.87%</td>
</tr>
<tr>
<td>Social welfare</td>
<td>GDP</td>
<td>Urban, skilled</td>
<td>31,547</td>
<td>–4.6%</td>
<td>–2.8%</td>
<td>–3.1%</td>
<td>1.5%</td>
<td>–11.4%</td>
<td>–1.3%</td>
<td>2.2%</td>
<td>2.3%</td>
<td>–6.1%</td>
</tr>
</tbody>
</table>
elasticity of demand is therefore low, consistent with the classic Engel curve for food. Moreover, though the economy is flex-price, in the strict sense that prices move to clear goods and factor markets, producers and consumers have limited capacity to substitute away from staple foods in consumption and/or towards staples in production.\textsuperscript{14} Hence, at the margin, consumers face the full force of rising world food prices, and producers cannot readily adjust production to take advantage of favourable conditions. For a net importer, therefore, adjustment to rising world food prices will typically require a depreciation in the equilibrium real exchange rate. Absent additional external financing, the economy must generate an increase in net exports to finance the now more expensive import bill. This can be achieved only through an increase in the relative price of (non-food) imports and of food and non-food exports. In other words, the economy faces a classic adjustment challenge. In our baseline simulation, we assume that supply conditions in the domestic economy are orthogonal to those driving changes in the world food market. We relax this assumption later.

3.1.2 Structural characteristics

Experiment 1 presents this core simulation. Given that the elasticity of substitution in consumption is low (strictly less than unity), food import compression is modest despite the sharp depreciation of the real exchange rate for food (a depreciation of almost 25\% leads to a fall in imports of just under 10\% of baseline imports). The incipient trade deficit therefore widens, which, with external financing fixed, requires an offsetting increase in net non-food exports and hence a depreciation of the non-food real exchange rate. Since world prices for non-food commodities are assumed constant, this requires a reduction in equilibrium real wages. Since there is substitution at the margin between domestic and imported food and unskilled labour is used intensively in agriculture, the decline in unskilled real wages is moderated, with the principal adjustment falling on real wages for skilled workers. Thus, real product wages ($w/pd$) for non-food fall by 0.6\% for unskilled labour and by 2.4\% for the skilled labour, which is used more intensively in the non-food exportable sector, manufacturing. Given the higher price of imported food, real

\textsuperscript{14} In terms of model parameterisation, this entails setting the elasticities in consumption of food and manufactures (between imports and domestic goods) equal to 0.5, with the same value applied to the elasticity of transformation in production (between supplying the export and domestic markets). The overall elasticity of substitution in consumption (between composite consumption goods is also set equal to 0.5).
consumption wages \((w/pc)\) fall by more, just under 3% for unskilled labour and just over 5% for skilled labour. These real wage movements mirror movements in real incomes \((yd/pc)\). As a result of the price shock, net producers of food—rural households on average—enjoy modest gains in real incomes, measured in terms of the consumption basket—while urban households, especially the unskilled, stand to lose. The net effect of this shock on the economy is a reduction of 4.6% in our social welfare measure.\(^{15}\)

Experiment 1 is our benchmark and represents the baseline against which alternative policy interventions will be assessed. Before considering these, however, it is useful to examine how this adjustment process is moderated if consumers and producers face lower costs of adjustment, in the sense that consumers can substitute away from high-cost imported food and producers can quickly supply domestic substitutes for imported food. This case is shown in simulation 2, where we assume a higher elasticity of substitution between world and domestic goods across all sectors, but especially food, and where, in addition, we assume that consumers are sufficiently far from their subsistence consumption level that the marginal income elasticity is close to unity. From an aggregate welfare perspective, flexibility clearly has value: our social welfare measure still falls but by less than two-thirds of the decline in the baseline case (a fall of 2.8% compared to 4.6%). What happens here is that only a very modest depreciation in the food real exchange rate is required for the economy to respond efficiently to the shock. Higher import prices for food pass through rapidly to the domestic economy (the real exchange rate for food rises by only 10% in this case compared to 25% in the baseline) but this modest real exchange rate movement is sufficient to induce consumers to switch decisively out of (the now expensive) imported food and towards domestic goods and services. Net food imports drop very sharply (consumers switch away from imports while producers switch into exports of food) and, in fact, drop so sharply that net non-food imports actually increase (with the non-food real exchange rate showing a corresponding appreciation). In this highly flexible environment, while the ease with which consumers can avoid high-priced food imports and producers can respond to higher world prices means much milder relative

\(^{15}\) The welfare measure is a weighted average of aggregate consumption by the three representative households. The households are weighted by shares in total population, and aggregate household consumption is defined by the utility function

\[ U_h = \sum \beta_i (C_i^h - \gamma_i^h)^{1/(1-\sigma)} . \]
price movements, the factor movements involved are larger and tend to exacerbate the distributional tensions noted in the baseline. The demand switch towards domestic food production means unskilled labour, used intensively in agriculture, is protected, while real product wages for skilled labour and, because of the rapid pass-through in consumer prices, real consumption wages for this group fall even more sharply than in the baseline case. The big income gains, however, accrue to owners of fixed factors, especially landowners in the rural economy.\footnote{Note that in this model, unskilled labour can move between rural and urban activities. If instead we assumed that there was segmentation between urban and rural unskilled labour markets, the distributional tensions would be magnified as urban unskilled labour would be unable to move into the rural economy.}

The problem with this experiment is that total food consumption falls very sharply, probably too sharply, even for a flexible economy. Simulation 2a therefore restores the assumption that consumers remain close to their subsistence level of food consumption. Now, food consumption is stabilised and, as a consequence, non-food consumption is no longer insulated from the shock. Importantly, this serves to peg back the previously observed (relative) welfare gain. But otherwise, this simulation replicates many of the features of the previous simulation, notably the high-price pass-through and the modest real exchange rate adjustment required to accommodate the shock. As before, the powerful distributional effects in favour of the rural economy remain in place. For net food consumers, principally the urban workers, rising food prices in this instance are exacerbated by falling real consumption wages as the demand for labour shifts to unskilled rural workers.

Experiments 3a and 3b examine the baseline outcome under the assumption that domestic supply conditions are either positively or negatively correlated with world market conditions. In experiment 3a, the rise in world food prices is accompanied by an exogenous reduction in total factor productivity in food agriculture; in experiment 3b, the correlation is reversed so that domestic supply conditions improve as world conditions deteriorate. In the pro-cyclical case, the adjustment costs fall even more heavily on net consumers (i.e., the urban households). Faced with an inelastic food demand, the reduction in domestic output means that food imports can fall by less than in the baseline, which in turns requires a correspondingly tighter squeeze on net non-food imports, which requires an even sharper contraction in real wages than before. The welfare and rural–urban distributional effects are correspondingly much more stark.
In the counter-cyclical case (experiment 3b), the simulation shows how an increase in the quantity of effective labour in agriculture eases the adjustment pressure on the domestic economy; the increased domestic food supply capacity means that the economy can afford to substitute away from imported food at lower cost, creating the space for a much smaller reduction in non-food imports. The compression in real consumption wages is substantially lower than in the baseline and, as a result, the distributional tensions between urban and rural sectors are moderated. Indeed, given the calibration values adopted here, increased total factor productivity in the rural economy, combined with the fall in real food prices in the domestic economy, shifts the real income gains in favour of urban households and especially skill-endowed households.

3.1.3 Macroeconomic policy responses

The second block of Table 2 examines a range of fiscal policy responses to the food price shock. In each case, these are applied to the benchmark case (experiment 1). As we think about policy in this case, it should be noted that interventions here are motivated not by the need to address externalities or market failures (except the absence of complete markets to allow inter-temporal smoothing in response to temporary shocks) but rather out of a concern to protect consumer welfare. Interventions are essentially standard counter-cyclical fiscal measures more or less accurately targeted on the poor or food-vulnerable. Moreover, the baseline calibration assumes various taxes, tariffs and public expenditure patterns, the structure of which is not in any sense optimised but rather they are calibrated to represent patterns of public finance prevalent in low-income countries. In principle, therefore, there exists an opportunity to re-configure the structure of taxation and expenditure. We do not do this; instead, this baseline is taken as a reflection of the reality on the ground, and the impact of policy choices is evaluated relative to it.

We assess three interventions under alternative financing arrangements. Experiment 4 considers the impact of a domestic-debt-financed tariff reduction on food sufficient to fully offset the rise in the import price of food (although the world price increases pass through to food exporters), the fiscal costs financed either by domestic debt (experiment 4a) or by donor grants (experiment 4b), while experiment 5 leaves the import price unaltered but seeks to offset the income effect of rising food prices through public transfers targeted at urban households (the net consumers of food). In variant 5a, the transfer is debt-financed, and in 5b, it is
designed to be *ex ante* debt neutral so that transfers are financed by a corresponding reduction in pre-existing income transfers to rural households. In experiment 6, donors provide increased aid (but not food aid) to finance government transfer to households, thereby substituting donor grant financing for the taxation of rural household. Finally, in experiment 7, the shock is met by the drawdown of an SGR by the authorities. In all cases, when additional foreign financing is not forthcoming, we assume that government finances any change in the budget deficit arising from the policy intervention through public debt. Public debt in this model directly crowds out private investment, although since we focus on the short-run comparative static of the model, the consequences of this crowding out are not observed. Moreover, since this is a purely real model, there is no scope for inflationary financing of the deficit.

### 3.1.4 Tariff reduction

The tariff reduction is designed to fully isolate consumers from the rise in world prices while allowing exporters the opportunity to sell at these prices. It has particularly attractive properties, at least *ex ante*, since unlike other interventions it entails the removal of a pre-existing distortion in the economy. As shown in experiment 4a, by blunting the price signal, the tariff reduction obviates any significant contraction in food imports (which fall by 3% of the baseline) and, by offsetting the price increase, eases the squeeze on real consumption wages. The corollary, of course, is that with limited substitution, the resource cost to the economy of food imports has risen by almost the full-amount world price increase so that an even greater burden is now placed on food exports, for which the tariff reduction serves as an export subsidy (relative to counterfactual), and, particularly, on net non-food exports to satisfy the external balance constraint. Thus, food exports rise by 15.4% (compared to 12.2% in the

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17 This experiment abstracts from many of the relevant issues surrounding questions of price stabilisation and (public and private) storage (Newbery, 1989). Thus, we assume that neither consumers nor producers are able to use storage for consumption-smoothing purposes (possibly because of credit constraints), which simplifies consideration of the impact of public strategic grain management on private sector behaviour. In addition, we do not seek to model the authorities’ storage and intervention decisions explicitly; rather, we assume that there is sufficient stock in the reserve to meet some specified (one-period) stabilisation objective and that the initial stock in the reserve represents the target to which the authorities will seek to return after the intervention.
baseline), while non-food net exports rise by 7.4%, almost as much as observed in the baseline. By dampening the price pass-through, the net effect of the tariff is a small increase in current-period welfare and a reduction in real rural–urban disparities. However, this is an expensive strategy entailing a significant increase in the fiscal deficit which rises from around 4.9% of GDP to 6.9%, adding an additional 2% of GDP to the debt stock which carries future (although un-modelled) consequences for the economy.

If the tariff reduction is aid-financed (with the aid flow computed to compensate government for the loss of tariff revenue at the initial level of food imports), not only is the fiscal deficit stabilised, but the adjustment burden is essentially removed; there is a mild spending effect from the aid, an appreciation in the import real exchange rate which finances a small increase in total non-food consumption and a modest rise in real wages.

3.1.5 Fiscal transfers to consumers

An alternative policy response is to allow world prices to pass through to the domestic economy, thereby not masking relative price movements, but seeking to offset the income effect of rising world prices by increasing cash transfers to net consumers. In experiment 5a, transfers are made from the budget sufficient to stabilise food consumption of urban households. Ex post, once the general equilibrium effects of this intervention have fed through, however, this intervention more or less stabilises real incomes in urban households (in fact, they rise slightly, by 0.2%, as opposed to falling by around 5% in experiment 1). In the end, total food consumption rises very marginally, although due to higher rural consumption but with higher real incomes for all households, non-food consumption rises by 2.4% over the baseline, again substantially more than in experiment 1 and in the tariff-reduction case. The net effect is a substantial gain in current period welfare, but at the cost of a sharp increase in the fiscal deficit, which rises to almost 8% of GDP compared to less than 5% in the baseline and 6.9% in experiment 4a. The key difference between this and the tariff reduction case is that the sharper depreciation of the import real exchange rate for food encourages a much sharper fall in net food imports compared to the tariff reduction case (a 14% contraction instead of a 4% reduction), which in turn eases the adjustment burden on the tradable non-food sector, where net imports contract by 3.6% compared to 7.4% in experiment 4a.
Given that rural households gain from the price increase, it is worth considering a revenue neutral policy which funds the real income stabilising transfer to net consumers by reducing (pre-existing transfers to the rural households). Essentially, this experiment is equivalent to combining the baseline price shock with an internal income distribution. On top of the pure price shock, differences in patterns of consumption mean that the income redistribution shifts demand away from food towards non-food, with adverse consequences for rural incomes, which fall by approximately 7% as opposed to rising by 1%. Given that rural household accounts for the majority of households in the economy, this shift weighs heaving on our social welfare measure which falls by 6% compared to a fall of 4.6% in experiment 1.

Experiment 6 replicates 5a except that the additional costs are financed by increased aid flows to government rather than being debt-financed. In terms of the external constraint, the foreign resource inflow works in the opposite direction to the world food price shock, easing the required external adjustment. Hence, the real exchange rate for food is less depreciated than in experiment 5a or 5b, while the non-food real exchange rate actually appreciates. Net food imports still shrink but non-food imports rise, while the conventional ‘spending effect’ of the aid inflow eases the pressure on real product wages for skilled workers (those used intensively in the services sector). Given the low income elasticity of demand for food, non-food consumption rises sharply in this case.

3.1.6 Drawing down the SGR

The final experiment imagines government operating an SGR which carries large enough stocks that it can supply the domestic market with sufficient food to stabilise food consumption at its pre-price-hike levels. The SGR sells its stocks into the domestic market at the prevailing domestic food price (which is endogenous to the quantity sold) but the reserve is replenished ton-for-ton at the prevailing world price.18 As with our previous experiments, we assume that this replenishment is a direct cost to the budget and is debt-financed. The operation of the SGR stabilises food consumption at a cost of an additional 1.1% of GDP added to the fiscal deficit,

18 Replenishment of reserve does not occur immediately, so there is no current call by the reserve on either domestic output or imports. However, government can be thought of as entering into forward purchase contracts. The fiscal consequences of replenishment but not the balance of payments consequences are therefore captured in the simulation.
a lower cost than either a tariff intervention or domestic consumption transfers. The reason is simple: by supplementing domestic food supplies, the SGR drawdown facilitates a more rapid substitution out of expensive food imports (which requires a less severe real exchange rate depreciation than the tariff or transfer case) and, given the low elasticity of demand for food, relaxes the constraint on non-food consumption. A common concern with using sales from an SGR is that it subsidises net exports and therefore fails to protect domestic consumption. This risk is certainly present if sales from the reserve drive the domestic price below the border price, but as configured here, the SGR sells grain at the prevailing market price—which is set by the relative purchasing power parity condition—so that the welfare gain is internalised.

3.1.7 Summary

The simulations reported above represent only a small sub-set of the possible configurations and policy choices of interest and only for the case where the economy is a net importer on aggregate and that there is relative purchasing power parity for food. Nonetheless, they lead to a number of key messages. The first concerns how structure influences the behaviour of the economy in response to a food price shock; the less flexible the domestic economy the larger the real exchange rate adjustment, which implies the larger the real wage adjustment, required to induce the necessary resource movement necessary to respond to rising food prices. For low-income countries, flexibility is likely to be limited, both on consumption and production sides. Second, distributional effects are potentially very important indeed, and will go a long way to determining the political feasibility of alternative policy responses, including ‘neutral’ responses. There are few unambiguous results here since the distributional consequences depend on the initial distribution of income and the nature of labour mobility, but it is reasonable to assume that urban workers, and particularly those in the manufacturing sector, will face the largest first-round adjustment costs coming from rising real food costs (which squeeze real consumption wages) and also as a result of the real exchange rate depreciation which entails a compression of real product wages. As we discuss in the next section, it is the resistance to falling real consumption wages that hands the monetary policy challenge to an inflation-targeting central bank.

Third, public policy can go a long way to mitigating latent distributional tensions. But there are important differences in how this is done; we contrasted two approaches: on the one hand, a tariff reduction, and, on the
other, a consumption transfer. Both have the same objective but they have different implications for resource allocation. In particular, a tariff reduction, by neutralising the initial relative price movement, may help avoid the pass-through of higher food prices but at the cost of shifting more of the burden of adjustment onto the non-food sector, compared to both a case where there is no policy response and where the authorities seek to cushion the income effect of rising prices through direct household transfers.

Which of these options is preferable, in practice, must ultimately depend on the relative balance of adjustment costs, the extent to which distributional tensions are magnified or defused by different policy interventions and, in the absence of bespoke targeting mechanisms, on the targeting properties of alternative measures. Policy instruments such as the tariff reductions and subsidies considered here are generally rather blunt and different instruments have different renegotiation properties (it may be harder, for example, to withdraw direct food subsidies than to unwind temporary tariff reductions).

What also emerges strongly, although unsurprisingly, is the extent to which external financing can ease the adjustment costs to a country. This is modelled here as an aid inflow but the short-run results would be identical if the authorities were to draw down official reserves. Clearly, the scope for financing or, more generally, the balance between ‘adjustment versus financing’ depends on the expected duration of the terms of trade shock: the more temporary a shock, the stronger the case for financing, if this is possible (‘finance if you can, adjust if you must’). Clearly, if global food price shocks are perceived to be persistent, attempts to limit or forestall adjustment will rapidly become unsustainable as reserves are depleted and/or borrowing limits are confronted, unless this period of financing is accompanied by significant improvements on agricultural productivity.

4. From real models to monetary management

The foregoing analysis suggests that with a relatively inflexible economic structure, efficient adjustment to a world food price shock typically

19 The strategies are not identical, of course. Reserve depletion (assuming reserves are sufficient in the first place) places replenishment costs on the authorities in the future and may in addition have impacts on perceived creditworthiness. On the other hand, higher levels of aid dependency may bring associated costs as well.
requires adjustment to the real price of food. In the model we just analysed, this shock emanates from developments in world food markets, but a similar relative price movement would be entailed if the shock were domestic in origin and the domestic food price was within the trade parity boundaries, as defined in equation (3). Recall from equation (5) that the overall headline inflation rate can be expressed as the non-food or ‘core’ inflation rate plus a term reflecting the growth in the real price of food. The question we examine in this section is how the monetary authorities should seek to reconcile the need for a relative price adjustment with pursuit of a target for headline inflation, assuming that the ultimate objective of monetary policy is to anchor the growth of the domestic price level at some low and stable rate at minimal cost in terms of output volatility. The problem is symmetric whether we are considering a positive or negative agricultural shock, but for convenience we will concentrate on a negative shock, a rise in world prices (for the net importer) or a domestic supply shock.

To achieve these two competing objectives appear to require opposite actions on the level of prices and their growth rate. Thus, the authorities need to accommodate the first-round food price increase so as not to suppress the required increase in the relative price of food (the ‘level effect’), but to do so in a manner that ensures this increase does not pass through into a generalised growth in average prices—i.e., into inflation—which would not only entail a failure to anchor general inflation but would at the same time unwind the initial relative price movement and thwart the required real adjustment. Conventional wisdom therefore suggests that the authorities will seek to bear down on ‘second-round’ inflationary pressures—i.e., the pass-through from food price increases to generalised inflation, possibly as a result of wage pressures or other mechanisms.

In practice, how this is pulled off depends on the exchange rate regime and the monetary policy regime. In a floating exchange rate, real exchange rate adjustment is typically delivered ‘up front’ as higher world food prices feed directly onto domestic food prices through the depreciation of the nominal exchange rate. But, by the same token, the authorities must face the exchange rate pass-through onto generalised domestic inflation; hence, the pressure to constrain non-food price increases is also immediate. Under a fixed exchange rate regime by contrast, the up-front inflationary impact of the initial food price increase is necessarily moderated (and there is no first-round exchange rate effect on non-food prices to be concerned about), but by the same token, the real exchange rate adjustment
will be sluggish unless domestic non-food prices are highly flexible. With sticky domestic prices, as research suggests, adjustment to terms of trade volatility under a fixed exchange rate regime may be significantly more expensive (see, e.g., Adam et al., 2001).

4.1 The evidence

The evidence on the degree of pass-through from global food price volatility to domestic food and non-food inflation is rather mixed. Early work in this literature includes Mundlak and Larson (1992), who directly estimate the pass-through in the form of equation (3), using a simple pooled sample of data for fifty-eight countries and sixty commodities for the decade 1968–78, finding a powerful one-for-one pass-through from world food prices to domestic agricultural prices, at least in the long run despite attempts on the part of domestic authorities to insulate local markets. Baffes and Gardner (2003), working with a sample of countries that had implemented reforms in agricultural pricing, found evidence of a much weaker pass-through result. This result is echoed in work by Delgado et al. (2004), in a study of Tanzania, who find that while the 3-month pass-through from world to domestic food prices is around 0.40 in reasonably ‘well integrated’ food markets in Tanzania, it is less than 0.30 in remote markets.

More recently, authors have tended to focus on the pass-through to overall or headline inflation. Habermeier et al. (2009) use panel data for forty-nine emerging markets and developing countries over the period from January 2005 to June 2008 to estimate a generalised Phillips curve of the form

$$\pi_{it} = \alpha \pi_{it-1} + x_{it}\beta + \gamma z_t + \epsilon_t,$$

where \(x\) denotes a vector of country-specific domestic inflation determinants and \(z\) a set of common global factors, including world food and fuel prices. The short-run pass-through from domestic and world inflation factors is given by the estimated values of \(\beta\) and \(\gamma\) and the long-run values by \(\beta/(1-\alpha)\) and \(\gamma/(1-\alpha)\), respectively. In contrast to the earlier work of Mundlak and Larson, they find that the pass-through of world food and fuel price inflation over this period was ‘not as powerful as commonly believed’. On the basis of the differenced-GMM estimator, they find a 10 percentage point increase in oil prices leads to only a 0.1% increase in domestic inflation on impact, rising to 0.3% in the long run (Table A3 in Habermeier et al., 2009). A similar result holds for food inflation.
These effects are somewhat higher once food inflation and oil price inflation are weighted by their share in CPI, but nonetheless they remain relatively modest, consistent with the emerging evidence on the impact of commodity price inflation (including oil prices) on OECD countries (see also Kirchene, 2008). One hypothesis advanced by the authors is that these muted pass-through effects may reflect the effect of countervailing policy measures over this period, although an alternative hypothesis—echoing, for example, Blanchard and Gali (2007) and Kilian (2009)—that changes in the conduct of monetary policy since the 1980s has seen monetary authorities, especially those pursuing inflation targeting, being more aggressive in bearing down on second-round effects (see what follows).

Adding more structure, Murgasova et al. (2008) amongst others, build the Phillips curve into a vector auto-regression (VAR) model of the general form

\[ B y_t = \Gamma y_{t-1} + \varepsilon_t, \]

where \( y_t = [ x_t \ z_t ]' \) is a vector of variables partitioned between a vector \( x_t \), which consists of external factors including world food and fuel prices, and \( z_t \), which is a vector of domestic factors including measures of inflation in the domestic economy and other factors deemed to drive inflation. These will typically include output, possibly decomposed into agricultural and non-agricultural output, money growth and movements in the exchange rate. \( B \) and \( \Gamma \) are matrices of contemporaneous and lagged polynomial coefficients, and \( \varepsilon_t \) a stochastic error vector. The small country assumption is typically invoked to treat world prices \( (x_t) \) to be exogenous so that \( B_{12} = \Gamma_{12} = 0 \). The reduced form of this VAR, denoted

\[ y_t = \prod y_{t-1} + v_t, \]

where \( \prod = B^{-1} \Gamma \) and \( v_t = B^{-1} \varepsilon_t \), is then estimated—subject to conventional identification restrictions on the parameters of \( B \)—and the (constrained) coefficients are then used to compute the cumulative impulse response of alternative measures of domestic inflation to an arbitrary shock to world food or fuel prices. The basic VAR in equation (8) will typically be estimated for a stationary representation of the data by either differencing or de-trending the vector \( y_t \) to remove any non-stationary components. An alternative representation, appropriate if the non-stationary elements of \( y_t \) are co-integrated, entails estimation of a vector
error correction model in the form
\[
\Delta y_t = \sum_i Y_i \Delta y_{t-i} + \alpha \beta' y_{t-1} + \nu_t,
\]
where, now \( \beta \) consists of the parameters of the long-run co-integrating relationships between the elements of \( y_t \) and \( \alpha \) contains the relevant adjustment coefficients.

In what is perhaps the most directly relevant work to date, Murgasova et al. (2009) use this framework to examine the pass-through from world food (and fuel) prices to domestic prices in the countries of the East African Community (EAC; Burundi, Kenya, Rwanda, Tanzania and Uganda), using monthly data from 1997 to 2008. Pass-through estimates are derived from reduced form, country-specific VAR models in which world prices are assumed to be strongly exogenous for the EAC countries.

These estimates are then used to decompose overall inflation in the EAC during the period of the global food price shock between: (i) the direct effect of world food and fuel prices on domestic food and fuel inflation; (ii) the indirect effects reflecting the role of these goods as intermediate inputs into other final goods; and (iii) the second-round effects of the world inflation shock (being the total estimated pass-through less the direct and indirect first-round effects). The residual between the sum of these identified factors and actual inflation is then attributed to ‘other’ inflationary factors.

Though there is considerable variation across the EAC countries, the pass-through from world food and fuel prices to headline inflation appears somewhat higher here than found in the larger Habermeier et al. (2009) sample, with a 10\% increase in world oil prices leading to an increase in headline inflation of 0.4 percentage points and a similar increase in world food prices leading to a 0.7\% increase in domestic inflation. Looking more closely at inflation dynamics over the period 2006–08, the authors conclude that the contribution of the direct effects of food and fuel prices is relatively modest; the contribution of the second-round effects on inflation appears to be much more important; but even then these direct and indirect effects are able to account for slightly less than half of total inflation that year. There is much in the inflation dynamics in these economies that is not well explained by a simple pass-through analysis.

Loening et al. (2009) examining inflation dynamics in Ethiopia, and O’Connell et al. (2010) doing the same for Tanzania, seek to add more structure on the VAR by exploring the role of potential co-integrating relationships in determining inflation. Rather than seeking to identify long-run co-integrating relationships from the stand point of an
unrestricted VAR, these authors impose a lot more structure on the model by specifying *ex ante* a set of long-run equilibria to which inflation is assumed to respond and then by embedding these within a short-run dynamic model. In both cases, the identified driving forces for inflation consist of domestic monetary disequilibrium (the idea that excess money growth, relative to demand, is dissipated through rising prices); the effect of domestic food price shocks operating on the supply side of the economy; and the pass-through of international prices—through the mechanism of the real exchange rate. ²⁰ Loening *et al.* (2009) suggest that there is a long-run co-integration between domestic and world food prices, defined in a common currency. Thus, the real exchange rate for food is stationary and thus consistent with long-run relative purchasing power parity, while deviations from this estimated long-run equilibrium feedback on short-run food and non-food inflation. They conclude—somewhat controversially, given strong evidence by Dercon *et al.* (2009) that staple food prices in Ethiopia are heavily insulated from movements in world prices—that the growth of food prices (and hence overall inflation) is overwhelmingly determined in the external sector, and that, in addition, there is substantial persistence in food price inflation. Whilst recent evidence supports the latter observation, such powerful pass-through effects from global food markets do not appear to be present in the data for Tanzania; however, there is strong evidence that supply-side factors do play an important role in determining the path of inflation.

### 4.2 Analysis

The consistent empirical findings that pass-through effects, of varying strength, are present and that other supply-side factors play a significant role in inflation dynamics present an important challenge for the design of monetary policy in African economies. Supply-side shocks of this kind confront policymakers with a rather different challenge than is represented in the conventional text-book story which tends to emphasise demand-side shocks. For the latter—unanticipated public expenditure or shifts in spending preferences, for example—the impact of the shock on

²⁰ Letting $e$ and $E$ denote the log of the real and nominal (effective) exchange rates and $p^*_t$ and $p_t$ world and domestic price indices, respectively, relative PPP implies a co-integrating relationship of the form: $e_t = E_t + p^*_t - p_t + \mu + \epsilon$. Deviations from this relationship, triggered, for example, by movements in world prices, should therefore induce an error-correcting movement in the nominal exchange rate and/or domestic prices.
output, or the output gap, on the one hand, and inflation, on the other, are positively correlated (excess demand increases both the output gap and inflation). For supply-side shocks, this correlation is negative. This distinction poses a major challenge for the conduct of monetary policy as it undermines one of the features that has made inflation targeting so attractive in industrialised economies. Moreover, pursuit of aggressive inflation targeting in the presence of supply-side shocks may, in fact, be counterproductive and quite unattractive for low-income countries.

The essential problem is as follows: with demand shocks moving output and inflation in the same direction, a tightening of the monetary stance designed to bring inflation back on track will simultaneously serve to eliminate excess demand. This ‘divine coincidence’—the fact that demand shocks dominate and that a policy reaction targeting inflation also targets the output gap—goes a long way to explaining the attraction of IT in industrialised countries. With supply-side shocks, however, output and inflation will move in opposite directions. One instrument is now no longer appears to be sufficient: acting to stabilise the inflationary consequences of a supply shock risks exacerbating the adverse output effects and vice versa.  

The textbook New Keynesian line of argument addresses this problem by arguing that monetary policy should avoid reacting to supply side-shocks such as world food price shocks. This is because these relative price movements are driven by real factors they represent ‘non-monetary’ sources of inflation and in this sense contribute to the flex price equilibrium in the economy (Goodfriend and King, 1997). In an environment of complete markets (where households can smooth their consumption in the face of these sources of price volatility), there is no welfare rationale to include these prices in the target index. The only source of inflationary pressure that should call forth action from the central bank arises from sticky wages or prices.

The appropriate response of (inflation targeting) policymakers, therefore, is to distinguish between ‘core’ components of inflation—those where domestic policy has leverage—and these ‘non-core’ components of inflation and to bring to bear the apparatus of inflation targeting only on the core component of inflation, reacting to movements in non-core prices only to the extent that they have second-round feedback effects on core inflation.  

21 This is because a supply-side shock which puts upward pressure on inflation will elicit a contractionary policy reaction, and if this policy reaction feeds back on output (for example, through the IS curve), the original output volatility is amplified. 

22 The argument for excluding these items from the target derives from the view that the role of monetary policy is to influence ‘sticky’ prices to bring the economy as close as possible to its notional real business cycle path (i.e., the path that would be followed
This is the analytical rationale for the strategy of accommodating the first-round effects of non-core price movements but bearing down on any second-round effects, and is why most inflation-targeting industrialised country let their headline inflation rate stray outside its target zone in the first half of 2008 as oil prices surged.

This approach may make sense in developed countries where (i) markets are reasonably complete; and (ii) non-core components account for a relatively small share of the overall CPI. In this case, focusing monetary policy on the stabilisation of core inflation goes a long way towards stabilising overall inflation without drawing the authorities into destabilising responses to supply-side shocks.

In low-income countries, however, things are rather less straightforward. First, if there are frictions so that households cannot smooth expenditures, income and consumption will be correlated so that shifts in real wages (or real incomes if they are food producers) arising from shocks to non-core prices will be correlated with aggregate demand. In this case, adopting a strategy of simply targeting sticky prices will not maximise welfare. Moreover, when non-core items typically account for over 50% of the CPI, the efficacy of targeting core inflation may be weak. In doing so, the authorities will end up targeting less than half the overall consumption basket and even if the authorities were extremely successful in stabilising core inflation, this may still co-exist with high volatility in headline inflation if the evolution of prices of non-core items is volatile. If, as seems reasonable, private agents set prices and wages not in terms of the evolution of expected core inflation—as IT theory suggests—but on actual headline inflation, the efficacy of monetary policy is likely to be undermined as inflation expectations will be less securely anchored by any given policy action. Stated slightly differently, trying to control overall inflation in these environments would require the authorities to lean much more heavily on their policy levers, with the attendant risk of greater volatility in output and interest rates.

Designing monetary regimes in these settings is now the subject of an active and exciting research programme, most of which tends to point in the same

if all prices were perfectly flexible). By this argument, prices that are, in fact, fully flexible, as is the case of imports where variations in world prices are allowed to pass through instantly to domestic prices, should be excluded from the target. Failure to exclude them would lead to placing excess weight on the policy levers. For example, seeking to lean against a positive food price shock—which would be the case if policy was geared to targeting headline inflation—would lead to an inefficiently tight squeeze on the non-food price component of the headline index, serving to ‘over-deflate’ the economy.
direction, concluding that credible and effective monetary policy regimes for
the low-income environments of Africa will inevitably place more weight on
objectives other than the narrow inflation target itself. The basic argument is
well made by Frankel et al. (2007), who demonstrate that the appeal of
inflation targeting over other policy rules—most notably a money-targeting
rule—as a means of delivering lower inflation volatility and lower output vola-
tility only holds true when demand shocks dominate. When supply shocks
dominate, strict inflation targeting continues to deliver lower inflation vola-
tility but at the cost of higher output volatility. In these circumstances, a con-
ventional money-based anchor will result in lower output volatility (although
inflation volatility will be higher) and the unambiguous welfare-based argu-
ment in favour of inflation targeting disappears.

Anand and Prasad (2010) develop a similar model to explore optimal
linear policy rules in settings where consumers are credit-rationed and
where, again, food consumption obeys Engel’s Law. They show that
while conventional inflation-targeting rules dominate when consumers
are unconstrained, with credit-constrained consumers and a high food
share in total consumption, rules that target headline (rather than core)
inflation and which at the same time place some weight on the output
gap dominate conventional IT rules that target core inflation only.

O’Connell (2011), in an AERC plenary paper examining the use of
Dynamic Stochastic General Equilibrium (DSGE) methods to evaluate
monetary policy rules, follows a similar line by developing a two-sector
model in which aggregate food demand is characterised by Engel’s Law
(i.e., an income elasticity of demand less than 1). This model is then
used to show how the introduction of food storage, in an economy that
is closed to international trade in food, can generate persistence in food
price inflation.

From a policy perspective, what sets this latter approach apart is the
specific focus on low-income countries of SSA operating under conditions
of imperfect capital market integration combined with a focus on policy
rules that reflect the reality on the ground. Thus, the authorities are
assumed to pursue monetary policy objectives through balance-sheet
instruments (reserve management and open market operations) rather
than the interest rate rules adopted in more conventional New Keynesian
models such as Habermeier et al. (2009) and Anand and Prasad (2010).
In a similar vein, Adam (2010) builds on earlier work on monetary
policy by Adam et al. (2009) and Adam and Goderis (2008) to examine
the robustness of these results in circumstances where food and fuel
price volatility draw the authorities into fiscal policy responses of the
kinds discussed in Section 3 of this paper. In all these cases, the conclusions point towards policy rules, whether interest rate or balance sheet rules, which emphasise much more attention being paid to output volatility and, in the case of Frankel et al. (2007), begin to construct a robust defence of the money-targeting rules widely used across Sub-Saharan Africa.

5. Conclusions

The spike in global food and fuel prices between 2006 and 2008 and the dislocation of trade that followed the global financial crisis brought a long period of relatively benign macroeconomic conditions to an abrupt halt. In doing so, it forced authorities around the world to reassess the reach and limits of macroeconomic management. The price spike around 2008 was relatively short-lived but there is mounting evidence that, after an extended period of relative tranquillity in global food markets, price volatility has increased and it is likely that governments will be confronted with the same policy challenges even more frequently in the future. This paper has sought to draw out some of the lessons from recent experience and research. Three main messages emerge. First, and in contrast to terms of trade shocks that hit export crops and minerals, macroeconomic management of food price shocks cannot proceed without careful attention being paid to the distributional effects of large price movements and thus to the potentially first-order fiscal costs of policy measures put in place to address these effects. Second, the prevalence and increased frequency of supply-side shocks, such as global food and fuel price shocks, have seen the enthusiasm for inflation targeting that was widespread in the early 2000s being replaced by a more sober assessment of how such regime might best be modified for the conditions of Africa. Finally, we stress the complementarity of structural and regulatory policies directed at improving the functioning of markets in food and the conduct of monetary and fiscal policies. Long-term investment in improving the functioning of domestic food markets will have the added payoff of supporting robust and coherent macroeconomic management in Africa.

References


