The Real Effects of Disruptions in Global Food Commodity Markets: Evidence for the United States*

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Abstract

We construct a novel quarterly composite global production index for the four basic staples (corn, wheat, rice and soybeans) to examine the macroeconomic consequences of supply disruptions in global food commodity markets. An unfavorable supply shock raises food commodity prices, which leads to a rise in food, energy and core inflation, as well as a persistent fall in real GDP and consumer expenditures. Households do not only reduce food consumption. In fact, there is a much greater decline in durable consumption and residential investment. Overall, the macroeconomic effects are about four to six times larger than the expected impact implied by the share of food commodities in the consumer price index and household consumption. These effects are estimated with standard vector autoregression (VAR) methods, and turn out to be robust when we use local projection methods and a series of narratively identified global food commodity market shocks.

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1 Introduction

The doubling of nominal food commodity prices between 2002 and 2011, a period which has been described as a “global food crisis”, and subsequent fall by circa 30 percent, has attracted a vast interest in understanding the economic consequences of developments in food markets.[1] Yet very little is known about the repercussions of disruptions in food commodity markets on the business cycles of advanced economies. The lack of quantitative evidence on the macroeconomic effects is surprising given that food and beverages have, for example, accounted for approximately 18 percent of US household spending between the 1960s and today.[2]

In this paper, we estimate the effects of disturbances in global food commodity markets on the US economy over the period 1963Q1-2013Q4. Quantitative evidence on the macro consequences is not only important for a better understanding of business cycle fluctuations and a prerequisite for the construction of general equilibrium models that incorporate food markets. It is also vital to examine the optimal monetary policy response to changes in food prices or the usefulness of public food security programs, such as the Federal Agricultural Improvement and Reform (FAIR) Act and the US Supplemental Nutrition Assistance Program (SNAP, formally known as the Food Stamp Program). Furthermore, it is necessary to analyze the repercussions of several policy measures that may influence the price of food, for example trade policies (e.g. export bans or restrictions on food imports) or policies to reduce CO_2 emissions (e.g. ethanol subsidies or carbon offset programs). Finally, empirical evidence on the macro effects of food market disruptions should help to assess the consequences of climate change in case that this increases the likelihood of significant weather shocks in agriculture.

[1] Two examples of newspaper articles are “The World Food Crisis” (New York Times, April 10, 2008) and “Global food crisis forecast as prices reach record highs” (The Guardian, October 25, 2010). In 2012, the NBER directed a panel of academic experts to study the economics of food price volatility (Chavas et al., 2014). See also a number of reports from policy institutions on the sources and potential consequences of the surge in food prices (e.g. Headey and Fan, 2010; Abbott et al., 2011; Trostle et al., 2011) or recent microeconomic studies that examine the welfare implications of food prices shocks for households in developing economies (e.g. Ivanic and Martin, 2008; Baquedano and Liefert, 2014; Dawe and Maltsoglou, 2014).

[2] As a benchmark, the shares of oil products (heating oil and motor fuel) and total energy expenditures have on average been respectively 3.8 and 6.4 percent over the same period, while numerous studies have analyzed the macroeconomic effects of shocks in the global crude oil market (e.g. Hamilton, 1983; Kilian, 2009; Peersman and Van Robays, 2009).

An empirical analysis of the macroeconomic effects of fluctuations in food markets is challenging because food prices likely respond substantially to both supply and demand conditions, implying that reverse causality effects from macroeconomic aggregates to food prices are also present. The unconditional correlation between changes in real global food commodity prices and US real GDP is, for instance, positive. If one is interested in a unique causal interpretation, it is thus crucial to isolate movements in food prices that are strictly exogenous. In this paper, we explore two strategies for identifying such movements.

Our baseline strategy is a joint structural VAR model for the global food commodity market and the US economy. To identify food market disturbances that are unrelated to macroeconomic conditions, we construct a novel quarterly composite global production index for the four most important staples: corn, wheat, rice and soybeans. Together, these commodities comprise approximately 75 percent of the caloric content of food production worldwide. Annual production data for these four crops are available from the Food and Agriculture Organization (FAO) for 192 countries since the early 1960s. Roberts and Schlenker (2013) aggregate the four crops on a caloric-weighted basis to construct an annual indicator of world food production. We use the same principium to construct a quarterly indicator, which is an appropriate frequency for business cycle analysis. Specifically, we combine the annual production data of each individual country with the country's planting and harvesting calendars for the four crops. Since most countries have only one relatively short harvest season for each crop, and there is a delay between planting and harvesting, we can assign two-thirds of world food production (harvest) to a quarterly production index which fulfills the criterion that the decision to produce (planting) did occur in an earlier quarter. Accordingly, in a quarterly VAR, innovations to the food production index (essentially unanticipated harvest shocks) are by construction exogenous to the macroeconomy, and the subsequent changes in real GDP, consumer prices and other macro variables can be given a causal interpretation.

The estimation results assert a considerable influence of global food market disruptions on the US economy. A one standard deviation unfavorable innovation to the global food production index raises food commodity prices by approximately 1.7 percent, which in turn leads to a 0.2 percent rise in consumer prices and a persistent fall in real GDP and personal consumption by almost 0.3 percent. These effects are about 4 to 6 times larger than the expected impact implied by the share of food commodities in total consumption expenditures, which denotes that indirect effects are prevailing. Indeed, a closer inspection of the impact on the components of consumer prices reveals that not only food prices increase, but also energy prices and core inflation. Furthermore, households do not only reduce food consumption expenditures. Specifically, there is even a much greater decline in durable consumption and residential investment. The stronger impact on durable consumption and residential investment can partly be explained by a (modest) monetary policy tightening, but suggests that also discretionary income, uncertainty and/or precautionary savings effects are at play.

As a robustness check, we use a narrative approach in the spirit of Hamilton (1983), Romer and Romer (1989, 2010), Ramey and Shapiro (1998) and Ramey (2011) to address the identification problem. The advantage of narrative methods compared to the benchmark VAR is that we can use a very large information set to identify exogenous food market shocks. More precisely, based on FAO reports, newspaper articles and several other sources, we identify 13 historical episodes in which major changes in food commodity prices were mainly driven by exogenous disturbances that had little to do with macroeconomic conditions. Examples of unambiguously unfavorable food commodity shocks were the Russian Wheat Deal (combined with a failed monsoon in South-Asia) in the summer of 1972, or the more recent Russian and Ukrainian droughts in 2010 and 2012. On the other hand, a number of unanticipated significant upward revisions in the expected harvest volume can be classified as episodes of favorable food market shocks (e.g. in 1975, 1996 and 2004). In a next step, we construct a dummy variable based on these episodes, which is then used as an instrument to estimate the consequences of global food commodity price shocks on the US economy. This is done with Jordà's (2005) local projection method. The results of this exercise turn out to be very similar and confirm the conclusions of the baseline VAR analysis. In sum, the macro effects of food market disturbances are compelling, and should be taken into account for business cycle analysis, countercyclical policies, public risk management schemes for the stabilization of food markets, as well as the assessment of climate change and policy measures that may influence food prices.

In the next section, we describe the baseline VAR model, the construction of the global food production index, and the other variables that are used for the estimations. In section

3, we present the benchmark results, a number of sensitivity checks, as well as the impact on household expenditures categories and inflation components. The narrative approach is reported in section 4. Finally, section 5 concludes.

2 VAR model for the global food market and US economy

2.1 Methodology

In order to estimate the macro consequences of disruptions in global food commodity markets, it is crucial to identify unanticipated shocks in these markets that are exogenous with respect to the macroeconomy. Our baseline strategy is a structural VAR approach in the spirit of Sims (1980), which has been a popular tool in the literature for the estimation of the effects of respectively monetary policy (e.g. Bernanke and Mihov, 1998), fiscal policy (e.g. Blanchard and Perotti, 2002), oil market (e.g. Kilian, 2009), technology (e.g. Galí, 1999) and news (e.g. Beaudry and Portier, 2006) shocks. This method allows us to capture the dynamic relationships between macroeconomic variables within a linear model, isolate structural innovations in the variables that are independent of each other, and measure the dynamic effects of these innovations on all the variables in the VAR system.

The VAR model that we use has the following reduced form representation:

$$Z_t = \alpha + A(L) Z_{t-1} + u_t \tag{1}$$

where Z_t is a vector of endogenous variables representing the global food commodity market and the US economy, α is a vector of constants and seasonal dummies, $A(L)$ is a polynomial in the lag operator L, and u_t is a vector of reduced form residuals. The frequency t of the data that we use is quarterly because, as we discuss below, this is essential for the identification of exogenous food commodity market shocks.

Since food commodity prices are determined in global markets, Z_t contains five key variables characterizing these markets: global food commodity production, real food commodity prices, global economic activity, the real price of crude oil, and the volume of seeds set aside for planting. It is evident that global food production and prices portray fluctuations in food markets. Global economic activity measures changes in global income and the business cycle that could affect the demand for food commodities.[3] The real price of crude oil captures a possible link between oil prices and food commodity prices, because biofuels can be considered as a substitute for crude oil to produce refined energy products. For example, corn is used in producing ethanol and soybeans in producing biodiesel. Furthermore, food commodity prices may be affected because oil is used in the production, processing and distribution of food commodities. The VAR also includes the volume of seeds from harvest that are set aside for planting, which should be an important determinant of future food production and harvests. Finally, the vector of endogenous variables contains a set of conventional variables representing the US macroeconomy: real GDP, real personal consumption, an index of consumer prices (CPI) and the Federal Funds rate.

2.2 Identifying exogenous food market disturbances

US and global macroeconomic variables typically have an influence on food commodity markets, implying that there is reverse causality from macro aggregates to the food market variables.[4] For example, a surge in global or US economic activity very likely leads to higher food commodity prices relatively quickly. This problem is, for instance, ignored in existing studies from policy institutions (e.g. Fed, ECB and IMF) analyzing the pass-through of changes in food commodity prices to consumer prices.[5] These studies typically impose a pricing chain assumption, i.e. innovations in food commodity prices are not contemporaneously affected by shifts in consumer prices. The motivation is that commodity prices are determined in flexible markets, whereas consumer prices respond to shocks with a delay due to the presence of frictions in final goods markets. It is, however, possible (and likely) that also innovations to real GDP have an immediate impact on food commodity prices, and a delayed effect on consumer prices. Similarly, oil shocks could simultaneously affect food commodity prices (on impact)

[3] This is also typically done in VAR models analyzing the crude oil market (e.g. Peersman and Van Robays, 2009; Kilian, 2009; Baumeister and Peersman, 2013).

[4] In essence, the reduced form residuals in equation (1) can be thought of as linear combinations of, on the one hand, the contemporaneous (within the quarter) endogenous response of a variable to innovations in the other variables, and exogenous structural shocks on the other hand.

[5] For example Furlong and Ingenito (1996), Ferrucci et al. (2010), Pedersen (2011) and Furceri et al. (2015). See also Rigobon (2010) for a similar approach.

and consumer prices (with a delay). At best, such estimates or correlations can be informative about the signaling role of food commodity prices for future inflation, but they cannot be given a causal interpretation. The same endogeneity problem applies for the analysis of the output effects of fluctuations in food prices.

To investigate the causal macroeconomic effects of disruptions in global food markets, it is hence crucial to isolate a series of exogenous shocks that are specific to global food commodity markets. In this paper, we identify unanticipated supply shocks to global food production. To achieve identification, we explore the time lag between the decision to produce (planting) and the actual production (harvest), and the fact that actual production is subject to random shocks due to, for instance, changes in weather conditions. More specifically, while the decision to produce can respond contemporaneously (within the quarter) to macroeconomic developments, this is not the case for actual production, because of the time lag between both activities. In section 2.3, we derive a quarterly global food commodity production index that explicitly fulfills this criterion. Hence, innovations to this index are exogenous food market disruptions that are uncorrelated with other structural shocks. This is identical to a Cholesky decomposition of the variance-covariance matrix $u_t u_t'$ of the VAR, in which the food production index is ordered before the other variables.

2.3 Quarterly composite global food production index

Measuring world food commodity production is not straightforward. Many distinct commodities matter for food consumption, and can be considered as close substitutes. To simplify the analysis, we follow Roberts and Schlenker (2013) by transforming the quantities of the four most important staples (corn, wheat, rice and soybeans) into caloric equivalents, which are then aggregated into a single composite index. Together, these four commodities account for about 75 percent of the caloric content of global food production, whereas also the prices and quantities of other staple food items are typically linked to these four commodities (Roberts and Schlenker, 2013).[6]

[6] Corn and soybeans have respectively the greatest and smallest shares of the four major staples. Wheat and rice are in between and have approximately equal shares. Roberts and Schlenker (2013) use the composite index of the four staples to estimate annual global supply and demand elasticities of agricultural commodities.

Annual production data for each of the four commodities are published by the FAO of the United Nations for 192 countries over the period 1961-2013 (FAO Statistics Divison, 2015). Roberts and Schlenker (2013) convert the production data, which are measured in tonnes, into edible calories using the conversion factors of Williamson and Williamson (1942). The calories are then aggregated across countries and crops. Annual production data are, however, not suitable for our analysis. In particular, the time lag between planting and actual production of a crop typically varies between 3 and 10 months, which implies that production could endogenously respond to macroeconomic developments when annual data are used. We therefore extend the Roberts and Schlenker (2013) approach to a quarterly frequency by combining the annual production data with the crop calendars of each individual country. This is feasible because the bulk of the countries have only one harvest season for each crop, which lasts for only a few months.

The harvesting and planting dates of the crop calendars are obtained from various sources: the AMIS Crop Calendar for the largest producers and exporters (Agricultural Market Information System, 2012), GIEWS Country Briefs (Global Information and Early Warning System, 2014) and the FAO Crop Calendar (FAO, 2015). These calendars are at a monthly frequency. For some very small producers, for which no crop calendar was found, the harvest and planting dates of the relevant nearest country are used. If a single harvest season is spread over two subsequent quarters (e.g. the harvest season of US rice is from August until October), we allocate the production volume to the first quarter (e.g. third quarter for US rice). We only consider harvests for which there is no overlap with the planting season at a quarterly frequency. In appendix A, we show examples of crop calendars to illustrate how we have allocated the annual production data to a specific quarter. The raw data and the entire crop calendars, including country and crop specific sources and assumptions, can be found in an online appendix (spreadsheet) of the paper. The quarterly global food production index has also been seasonally adjusted using the Census X-13 ARIMA-SEATS Seasonal Adjustment Program (method X-11). Accordingly, we have managed to assign approximately two-thirds of world annual food production to a quarterly production index. Because of the time lag between planting and harvesting of at least one quarter, innovations to food production are thus by construction predetermined or exogenous relative to the other variables included in the VAR.

A couple of remarks about the index in the context of the VAR analysis are worth mentioning. First, although this index does not capture all disturbances to global food production, the production volume covered by the index should be sufficiently meaningful to influence global food commodity markets, in particular food commodity prices, which is a prerequisite to examine the impact of exogenous food supply shocks on the US macroeconomy. Second, the identified shocks only capture unanticipated innovations to food production. More specifically, anticipated changes in food production before the start of the harvest season (e.g. bad weather conditions between planting and harvesting) should already be reflected in the other variables and innovations in the VAR (e.g. food commodity prices).[7] Third, our approach implicitly assumes that food producers cannot endogenously influence the production volume in the harvesting quarter. For example, a rise in economic activity or food commodity prices could induce farmers to raise fertilization activity in order to increase food production. Whereas some endogenous response might be present, this should however be meager relative to variation induced by e.g. weather conditions.[8]

The top panel of Figure 1 shows the time series of the (100*logs) global food commodity production index. There has been an upward trend in food production since the 1960s. However, there has also been considerable variation around the trend, with spikes of up to 10 percent, suggesting that there have been serious food production disruptions. The figure also shows an index of global food production excluding US food production, and an index of global production yields. Both indicators will be used in a sensitivity analysis of the benchmark results (section 3.4). Production yields are the ratio of food production divided by area harvested, which is also obtained from the FAO database. The upward trend in this variable is flatter than the production volume, implying that part of the food production expansion is driven by a rise of the land that is used in crop production.

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[7]Notice that an arbitrage condition ensures that changes in futures prices also shift spot prices of storable commodities (Pindyck, 1993). If there is a rise in expected food commodity prices, i.e. futures prices increase, traders will buy inventories in the spot market. Hence, spot commodity prices also increase.

[8]Notice that also the production volume of the four staples that is not covered by our index cannot endogenously respond to macroeconomic conditions within the quarter due to a standard time lag between planting and harvesting of at least 3 months.

2.4 Other variables

For the baseline estimations, we use the broad food commodity price index from the International Monetary Fund (IMF). The index is a trade-weighted average of different benchmark food prices in US dollars for cereals, vegetable oils, meat, seafood, sugar, bananas and oranges. These benchmark prices are representative for the global market and determined by the largest exporter of each commodity. The nominal price index has been deflated by US CPI. The time series is shown in the bottom panel of Figure 1. Real food commodity prices reached a peak in the 1970s, after which there has been a steady decline until the early 2000s. The trend is again positive afterwards. However, there have also been a lot of fluctuations around the long run evolution of commodity prices, with noticeable upward spikes in the second half of the 1970s, 1983, 1987-1988, 1995-1996, 2002-2004, 2007-2008, 2010 and 2012. Overall, the standard deviation of the quarter-on-quarter change in real food commodity prices is 5.7 percent.[9]

Since our production index is limited to the four major staples, we have also constructed an alternative composite cereal price index containing only the price of corn, wheat, rice and soybeans. The index, which is also shown in Figure 1, is based on the (trend) production weights of the four commodities, and will be used in another sensitivity check of the benchmark results. As can be seen in the figure, the correlation with the broad index from the IMF is very high, which is in line with the premise that prices for all food commodities tend to vary synchronously. The variation of the cereal price index has, however, been higher than the broad food prices index, with a quarterly standard deviation of 7.8 percent.

The volume of seeds from harvest that are set aside for planting is also made available by the FAO on an annual basis. We have used the same procedure to allocate the annual data to a quarterly series as described in section 2.3 for the production index. Other data are standard. As in Kilian (2009) and Baumeister and Peersman (2013), the real oil price series is the refiner acquisition cost of imported crude oil, deflated by US CPI. To proxy global economic activity, we follow Baumeister and Peersman (2013) by using the world industrial production index from the Dutch Bureau for Economic Policy Analysis, which is backcasted

[9] As a benchmark, the standard deviation of the change in real crude oil prices is 11.3 percent over the same period.

for the period before 1991 using the growth rate of industrial production from the United Nations. Finally, US macro data are obtained from the St. Louis Federal Reserve's FRED database.

3 Benchmark results

3.1 Inference

The benchmark VAR model for the global food commodity market and US economy has been estimated over the sample period 1963Q1-2013Q4. All variables are seasonally adjusted natural logarithms (multiplied by 100), except the Federal Funds rate, which is measured in percent. Estimation in (log) levels gives consistent estimates and allows for implicit cointegrating relationships in the data.[10] Based on the Akaike information criterion (AIC), we include five lags of the endogenous variables. Hansen's (1992) joint stability tests on the parameters and variance of each equation, as well as tests based on recursive estimation (CUSUM), suggest that there are no major structural breaks in the VAR model.[11] In all figures, we show the OLS point estimates of the impulse responses, together with respectively the 16th-84th and 5th-95th percentiles error bands based on 10,000 draws. These are constructed as proposed by Sims and Zha (1999).

3.2 Identified shocks and contribution to real food commodity prices

The top panel of Figure 2 shows the time series of the identified global food commodity supply shocks (red bars), as well as the historical contribution to the evolution of the level of real food commodity prices implied by the VAR model (blue line). Positive values of the

[10]See Sims et al. (1990) for inference in VAR models when some or all the variables have unit roots. In particular, they show that even when variables have stochastic trends and are cointegrated, the log levels specification gives consistent estimates. On the other hand, pretesting and imposing the unit root and cointegration relationships could lead to serious distortions when regressors almost have unit roots (Elliott, 1998). Notice that the results are robust when we estimate the VAR with a linear (and/or quadratic) time trend.

[11]Stability tests on individual parameters of the VAR equations do indicate that there is instability in the estimated variance of real crude oil and food commodity prices, as well as real GDP and personal consumption. We have therefore also estimated the VAR model for more recent sample periods (e.g. the Great Moderation period). The qualitative conclusions reported in the paper are, however, not affected. These results are available upon request.

shock series are unfavorable supply shocks, i.e. a decline in the food production index. The shocks and contribution to real food commodity prices corroborate very well with episodes that have been described as (un)favorable developments in food markets. For example, the VAR model identifies major favorable food supply shocks in the periods 1967-1972, the mid-1980s, 1992, 1994, 1996-2000 and 2004-2006. On the other hand, innovations to the global food production index have been unfavorable in the periods 1974-1977, 1983, 1988, 1996, 2000-2003 and 2006-2008. Almost all these episodes were characterized by significant falling or rising food commodity prices, and correlate with many spikes discussed in section 2.4. For example, the cumulative contribution of the identified food commodity supply shocks to the surges in food commodity prices between 2005-2007 and 2009-2011 has each time been more than 10 percentage points.

3.3 Impact of food market disruptions on the US economy

The impulse responses to a one standard deviation shock in the global food production index are shown in Figure 3. These should be interpreted as the dynamic effects of an unanticipated decline in the food production index on all the variables in the VAR, controlling for other changes in the economy that may also have an impact on the variables. The shock corresponds to a fall in the food production index by 4 percent, which returns to baseline after one quarter. The drop in food production leads to a significant temporary rise in real (nominal) food commodity prices, which reaches a peak of approximately 1.6 percent (1.7 percent) after one quarter, and a persistent fall in global economic activity. There is also a temporary decline in the volume of seeds that are set aside for planting, while the impact on the real price of oil is insignificant.

The influence of global food market disruptions on the US economy is considerable. In particular, real GDP starts to decrease after two quarters, reaching a maximum decline of 0.3 percent after five to six quarters, and gradually returns to the baseline afterwards. Although the rise in real food commodity prices lasts for only four quarters, the fall in real GDP is still significant after ten quarters. The macroeconomic consequences are thus very persistent. A similar pattern appears for the response of real personal consumption expenditures of households. The shock in global food commodity markets also leads to a surge in consumer prices, with a peak of almost 0.2 percent, while there is a moderate rise in the Federal Funds rate of 10 basis points. The magnitudes of the effects are striking. In particular, the responses of consumer prices and total consumption are about four to six times larger than the maximum direct influence that food commodities may have on the consumer price index and personal consumption. Specifically, the rise of nominal commodity prices is 1.7 percent at its peak. Given a share of food commodities in final food products of 16.7 percent, and a share of food and beverages in total household expenditures of 18 percent, the (maximum) direct effect of the rise in food commodity prices on consumer prices and total consumption is approximately 0.05 percent.[12] This suggests that indirect effects are important. In section 3.5, we analyze the indirect effects in more detail.

Another useful benchmark to assess the size of the effects is a comparison with crude oil supply shocks. Peersman and Van Robays (2009) find that a 10 percent supply-driven global crude oil price shock leads to a fall in US real GDP and personal consumption by circa 0.3 percent, whereas consumer prices increase by 0.4 percent. Other studies find even a lower impact of oil supply shocks on the US economy (e.g. Kilian, 2009). In other words, the impact of a 1.7 percent rise in food commodity prices on economic activity (consumer prices) is roughly the same as a 10 (5) percent rise in crude oil prices. This might not be surprising given the much larger share of food and beverages in total household expenditures, but is at odds with the large existing body of research on the macro consequences of oil market shocks, and no such studies for fluctuations in food commodity markets.

Finally, disturbances in food commodity markets have contributed to several post-WWII recessions. This can be seen in the bottom panel of Figure 2, which shows the cumulative contribution of the identified shocks to real GDP over time (blue line), as well as the NBER recession periods (grey bars). Although our index only captures a subset of food market disruptions, unfavorable shocks to global food production seem to have contributed to the recessions in 1974, 1982, early 1990s, 2001 and the Great Recession in 2008-2009. Also in non-recessionary periods, food commodity market shocks had a meaningful influence on economic activity. For example, favorable food supply shocks increased real GDP by roughly

[12]These shares are obtained from USDA Economic Research Service. The share of food commodities in final food products (16.7 percent) is only available for the period 1993-2013, while the share of food and beverages in total household expenditures (18 percent) corresponds with the VAR sample period.

2 percent in the period 1967-1972, 1.8 percent in the mid 1980s, 1.6 percent in 1998-2000 and 1.7 percent between 2003 and 2005. In sum, the macroeconomic repercussions of food market disturbances are important.

3.4 Sensitivity of benchmark results

The qualitative results are not sensitive to the lag order choice or sample period. Furthermore, in panel (a) of Figure 4, we show the results of the benchmark VAR model estimated with the real cereal price index instead of the broad food commodity price index. This index, which only contains the price of corn, wheat, rice and soybeans, is less representative for the global food commodity market, but corresponds more directly to the production index. For reasons of legibility, the responses of global economic activity, volume of seeds set aside for planting and real price of oil are not shown in the figure. They are very similar as in Figure 3. As can be seen in the figure, cereal prices increase more than the broad commodity price index after a decline in the production index. The maximum impact of the shock on real cereal prices is 2.7 percent, while the rise in the broad index reported in section 3.3 was 1.7 percent. The responses of all other variables are very similar to the benchmark effects. The results are thus not sensitive to the choice of the food price measure.

Although agriculture comprises less than 2 percent of the US economy, a decline in US food production could also have a direct impact on real GDP beyond the change in food commodity prices. In addition, fluctuations in US weather conditions may simultaneously affect food production and economic activity. For example, several panel studies find significant negative effects of hotter temperatures on agricultural output, but also on labor productivity and labor supply at the spatial level (Dell et al., 2014).[13] This may distort the estimations and exaggerate the role of food commodity markets for macroeconomic developments. We have therefore also re-estimated the benchmark VAR model by excluding US food production from the global food production index. Accordingly, the identified production shocks cannot have

[13]Notice that this evidence is rather found for poor countries, i.e. temperature shocks appear to have little effect in rich countries (Dell et al., 2014). Notice also that the estimated response of US real GDP (and global economic activity) only starts to decline with a delay following food market disruptions, i.e. the shocks are not reflected in economic activity on impact.

a direct effect on US real GDP.[14] The results are shown in panel (b) of Figure 4. They are again very similar to the benchmark results.

As a final sensitivity check of the benchmark VAR model, panel (c) of Figure 4 shows the results with global food production yields as a measure of food production, which also takes into account the area harvested. The results are in line with the benchmark results. The magnitude of the shock is somewhat lower, but the effects on real food commodity prices, real GDP, personal consumption and consumer prices are very similar to the benchmark results. We conclude that the benchmark results are not sensitive to the modeling choices we have made.

3.5 Pass-through to consumer prices and household expenditures

In section 3.3, we have documented that the effects of global food commodity market disturbances on consumer prices and household expenditures are four to six times larger than the maximum impact implied by the share of food commodities in the consumer price index and real personal consumption. Several indirect macroeconomic effects should thus be at play. In particular, other components of the consumer price index should also increase, while the fall in consumption cannot solely be driven by the loss in purchasing power, i.e. there is more than just a discretionary income effect of the rise in food prices on household expenditures. To better understand these effects, we extend the benchmark VAR model of section 2. More precisely, we re-estimate the benchmark VAR by adding each time an additional variable of interest. We first consider a set of price variables to investigate the pass-through to consumer prices. We then examine the effects on the components of household expenditures to learn more about the output effects.

Consumer prices A consumer price index is calculated as a weighted average of prices of different types of goods and services, which could be divided in food (18%), energy (6%) and core (76%) CPI. A rise in food commodity prices can affect these components via several channels. First, there is a direct effect on the food component of CPI. The exact pass-through

[14] Unless there is a systematic correlation of non-US food production shocks and US food production. If so, this is probably measly given the global level of our analysis.

of food commodity prices to final prices of food products should depend on competition and demand conditions in the food sector. Second, a rise in food commodity prices may augment energy prices. More specifically, food commodities are also used for the production of biofuels, which are a source of energy in the US, i.e. from home heating to vehicle fuel. Third, if energy prices rise, production costs for firms could increase. If firms pass these costs on to their selling prices, consumer prices of non-energy goods may increase as well. Finally, higher inflation (expectations) could trigger so-called second round effects that can greatly amplify and protract the effects of the shock on (core) inflation. For example, employees could demand higher nominal wages in subsequent wage bargaining rounds to maintain their purchasing power, leading to mutually reinforcing feedback effects between wages and prices.

Panel (a) of Figure 5 shows the impulse responses of respectively food, energy and core CPI. There is a strong and significant effect of a rise in food commodity prices on CPI food, with a peak of 0.3 percent after four quarters. Given a share of food commodities in final food products of 16.7 percent, and a rise of nominal food commodity prices of 1.7 percent, this implies that changes in food commodity prices are more or less fully passed on to food consumer prices. The impulse responses further reveal that a rise in food commodity prices raises energy prices, i.e. CPI energy increases by 0.3 percent on impact and 0.4 percent at its peak. The error bands around these parameters are, however, quite large and only significant on impact.[15] Finally, there is a significant rise of core CPI, which reaches a peak of 0.14 percent after seven quarters. The indirect effects via core inflation explain why the ultimate impact on consumer prices is considerably larger than the effects implied by the share of food commodities in the CPI.

Household expenditures Shocks to food commodity prices very likely do not only affect food consumption. In particular, since food is a basic necessity for life, food demand is considered to be quite inelastic. Unless households increase borrowing, higher food prices hence erode the disposable income to purchase other goods and services. There are, however,

[15] The magnitude of the impact on CPI energy is remarkably high and cannot solely stem from the use of food commodities for the production of biofuels. One potential explanation for the strong effect could be that in reality also the global price of crude oil increases after an unfavorable food market shock. As shown in Figure 3, this is not the case for the benchmark VAR results, but the error bands of the oil price response are quite large (as for CPI energy). For some VAR specifications, we find a rise of the point estimate by approximately 1 percent on impact, albeit not statistically significant.

several reasons why the decline in personal consumption and real GDP could be larger than such a discretionary income effect. For example, the tightening of monetary policy should also curtail aggregate demand, in particular durable consumption and residential investment. Furthermore, households may decide to consume less and increase their precautionary savings because of rise in uncertainty or a greater perceived likelihood of future unemployment and income loss. The shock could also lead to a changed composition of aggregate demand, such as a shift from the use of food services and accommodations to the consumption of food and beverages for off-premises consumption. Similarly, the rise in energy prices could trigger a shift from energy-intensive to energy-efficient goods. This change implies a reallocation of capital and labor across sectors, which is costly and may lead to a reduction in economic activity. Davis and Haltiwanger (2001) and Hamilton (2009) have documented this for oil shocks, but this may also be the case for food shocks.

To analyze the real effects in more detail, panel (b) of Figure 5 shows the dynamic effects on the components of household expenditures. There is a significant decline in nondurable food consumption, i.e. food and beverages for off-premises consumption, by almost 0.3 percent. The impact on the consumption of food services and accommodations is, however, insignificant. On the other hand, taking the uncertainty of the estimations into account, the impact of food commodity market shocks on the consumption of nondurable goods and services excluding food is very similar to the overall effect on consumption. In other words, households do not only reduce food consumption, but also their purchases of other nondurable goods and services. Strikingly, this is much more the case for the consumption of durable goods. In particular, we find a decline of durable consumption by 0.9 percent, which is three times larger than the overall fall in personal consumption. This result suggests that durables play an important role in the transmission of disturbances in global food commodity markets to the real economy. Similarly, given its durable nature, we also find a considerable reduction in expenditures on home improvements and residential investments, i.e. a fall by 0.8 percent. The error bands of the latter response are, however, quite large.

4 Narrative approach to identify food market disturbances

As an alternative approach, in this section we rely on historical documents to identify exogenous food market disruptions. Narrative methods to address the identification problem have a long-standing tradition in macroeconomics. They have, for example, been used by Romer and Romer (1989) to estimate the effects of monetary policy changes. By examining the minutes of the Federal Open Market Committee (FOMC) policy deliberations, they identify six episodes of large independent restrictive monetary policy shocks, which are then included as a dummy variable in an autoregressive model to estimate the macroeconomic consequences. Similarly, by reading through Business Week, Ramey and Shapiro (1998) create a dummy variable capturing major military buildups. The dummy is then embedded in a standard VAR to examine the impact of government spending shocks. Ramey (2011) extends this approach by creating a quantitative narrative series of exogenous news shocks on government spending. Romer and Romer (2010) use the narrative record, such as presidential speeches and Congressional reports, to identify major tax policy shocks. Perhaps most closely related to our application, Hamilton (1983, 2003) considers a number of historical episodes where changes in oil prices were almost solely driven by exogenous disturbances to supply that had little to do with macroeconomic conditions, e.g. due to political and military conflicts in oil-producing countries, to estimate the dynamic effects of oil market shocks.

While VARs are constrained by relatively small information sets, the advantage of a narrative approach is that it is possible to incorporate a large amount of information, including expectations. There is also no need for the identification of a structural form. On the other hand, it implies judgment of the researcher, while shocks may still contain endogenous components. It can hence be considered as a useful complementary analysis and serve as a robustness check for the VAR results based on the global food production index. In section 4.1, we describe the narrative approach to identify exogenous food commodity market shocks. Section 4.2 discusses the estimation method, while section 4.3 presents the results.

4.1 Historical episodes of major exogenous food commodity market shocks

To quantify the macroeconomic consequences of changes in food commodity prices, it is crucial to identify changes in food commodity prices that are unrelated to the state of the economy, i.e. movements where the proximate causes are disturbances in food commodity markets. We rely on FAO reports, newspaper articles (e.g. the *Financial Times* archive), disaster databases (e.g. Centre for Research on the Epidemiology of Disasters, 2015) and several other online sources (e.g. *Google news*) to identify historical episodes of such movements. The task is daunting given the global level of the analysis. There are continuously, many times even conflicting, events affecting food commodity markets somewhere in the world. We therefore only select episodes that fulfill the following criteria:

1. There has to be an event that is important enough to affect food commodity markets at the global level, such as weather shocks in a major food production region, or unanticipated news on the volume of global food production (e.g. a sizable revision of expected agricultural production by the USDA).

2. The event should have an unambiguous significant effect on global food commodity prices. A shift in commodity prices is considered to be significant if either the quarterly change in food commodity prices or accumulated change over two subsequent quarters is at least one standard deviation different from the sample mean.[16]

3. There should be no developments in the macroeconomy, alternative events or macroeconomic news that may also have a recognizable impact on food commodity prices. For example, we exclude admissible food market events if there is simultaneously a significant shift in crude oil prices (one standard deviation different from its sample mean), or in economic activity (e.g. a global or US recession). Put differently, we eliminate or minimize possible endogenous movements in food commodity prices to current or future fluctuations in the business cycle, i.e. the event in food commodity markets has to be

[16] The standard deviations of the quarterly change in food commodity prices and accumulated change over two subsequent quarters are respectively 5.7 and 9.1 percent, while the means are respectively -0.31 and -0.62 percent.

the proximate cause of the price shift.[17] All ambiguous cases are not selected as an episode.

A narrative approach to identify exogenous shocks involves judgment calls, which is a concern we acknowledge. We believe, however, that we have identified 13 episodes that could reasonably be interpreted as major exogenous food commodity market disturbances that are unrelated to the state of the economy. The results reported below are not driven by a single episode, i.e. they are very similar if we exclude (one by one) individual events from the estimations. 6 episodes are unfavorable food market disruptions, whereas we have detected 7 favorable shocks to food commodity markets. Examples of unambiguously unfavorable shocks are the Russian Wheat Deal (combined with a failed monsoon in South-Asia) in the summer of 1972, and the more recent Russian and Ukrainian droughts in 2010 and 2012. On the other hand, a number of unanticipated significant upward revisions in the expected harvest volume (e.g. in 1975, 1996 and 2004) can clearly be classified as episodes of favorable food market shocks. The dates (quarters), as well as a brief description of all global food commodity market events are reported in Table 1. The narratively identified global commodity market shocks are also depicted in panel (b) of Figure 1, together with the evolution of real cereal and food commodity prices over time. A detailed motivation for the selected quarters can be found in an online appendix of the paper. In every case, we attempt to give explanations and quotations such that other researchers can see why we classify the episodes as food commodity market disruptions. To give a sense of our approach, appendix B reproduces the most recent unfavorable shock that we have identified in 2012Q3.

4.2 Estimation method

There is obviously no one-to-one mapping between the true structural shocks and the observed changes in food commodity prices in these 13 episodes. We therefore first construct a dummy variable, which is equal to 1 for the unfavorable food market disturbances that we have identified, and -1 for favorable food market events. The idea is that this dummy variable series

[17]Crude oil is not only used in the food production process, or a close substitute for food commodities to produce energy products. A shift in crude oil prices could also signal changes in (expected) demand for commodities more generally.

is a noisy measure of the true food market shocks and can be used as an external instrument to identify exogenous changes in global food commodity prices. Mertens and Ravn (2013) show in this context that a series based on narrative evidence is robust to many types of measurement problems and a valid instrument as long as the series is contemporaneously correlated with the structural shock, and contemporaneously uncorrelated with all other structural shocks in the economy.

In a next step, we examine the dynamic effects of shocks to global food commodity prices on the US economy using Jordà's (2005) local projection method for estimating impulse responses.[18] The advantage of local projections is that it is more robust to misspecification than VARs because it does not impose implicit dynamic restrictions on the shape of the impulse responses and not all variables are required to be included in all equations. In addition, joint or point-wise analytic inference is simple, and it is easy to incorporate instrumental variables.[19]

For each variable and each horizon, we estimate the following single regression model:

$$z_{t+h} = \alpha_h + \lambda_h (L) z_{t-1} + \psi_h(L) X_{t-1} + \theta_h RFCP_t + \varepsilon_{t+h} \tag{2}$$

where z is the variable of interest at horizon h. We consider real food commodity prices and the benchmark variables representing the US economy: real GDP, real personal consumption, CPI and the Federal Funds rate. α is a vector of deterministic terms, i.e. a constant, linear and quadratic time trend, $\lambda_h (L)$ and $\psi_h (L)$ are polynomials in the lag operator ($L = 5$), and X a set of control variables. Although the control variables do not have to be the same for each regression, we include all other benchmark variables. Finally, θ_h is the estimated response of z at horizon h to a shock in real food commodity prices ($RFCP_t$) at period t. Because real food commodity prices may be partly endogenous to the US economy, we estimate equation

[18] A similar approach has been used by Ramey and Zubairy (2014) to estimate the effects of narratively identified government spending shocks.

[19] Because this method imposes fewer restrictions, the estimates are however often less precise and more erratic at longer horizons because of a loss of efficiency (Ramey, 2015). If the data generating process is adequately captured, impulse responses of VARs are in contrast optimal at all horizons. We have therefore also estimated two VAR models based on the narrative food commodity market shocks. On the one hand, we have embedded the episodes as dummy variables in a standard VAR to estimate the macro effects, an approach similar to Ramey and Shapiro (1998). On the other hand, we have used the dummy variable as an instrument to identify food commodity prices shocks within a VAR model, as proposed by Mertens and Ravn (2013). The results of both exercises are qualitatively very similar and confirm the conclusions of the local projections. These results are available upon request.

(2) with the narrative dummy and first lag of the dummy as external instruments for $RFCP_t$. The reason why we also use the first lag of the narrative dummy as an instrument is that some of the episodes encompass more than one quarter (see online appendix).

4.3 Narrative results

The estimated impulse responses to a 1 percent increase in real food commodity prices are shown in Figure 6. Since the error terms follow some form of moving-average structure, with an order that is a function of the horizon h, they are serially correlated. Accordingly, we calculate and report Newey-West standard error bands in all figures. The rise in real food commodity prices reaches a peak of 1.8 percent after three to four quarters. This corresponds to a rise in nominal food commodity prices by approximately 2.1 percent, a magnitude which is somewhat higher than the maximum impact of the food production shocks identified with the benchmark VAR model. The narratively identified shocks have also a much more persistent impact on food commodity prices. In particular, food commodity prices only return to baseline after about 12 quarters, compared to 4 quarters in the benchmark VAR. This is also reflected in more persistent effects on the US economy.

Taking into account the more persistent and slightly greater rise in food commodity prices, the macroeconomic consequences are quite similar to the VAR results reported in section 3. More specifically, real GDP and real personal consumption fall by somewhat more than 0.3 percent, whereas consumer prices increase by 0.4 percent. Relative to the benchmark VAR, the impact on consumer prices is thus stronger compared to the estimated GDP response. The Federal Funds rate rises by 20 basis points. Furthermore, the pass-through to consumer prices and household expenditures is also similar to the benchmark results. The impulse responses of the components are shown in Figure 7. We again find a significant effect on CPI food, a highly uncertain positive impact on CPI energy, and second-round effects on core CPI. In line with the VAR results, there is also a significant fall in off-premises consumption of food and beverages, non-food nondurable goods, and non-food services, while there is an insignificant impact on the consumption of food services and accommodations. Finally, the effects on durable consumption and residential investment are again considerably stronger compared to the other components of household expenditures. In sum, the results of the narratively identified food commodity market disturbances confirm the conclusions of the baseline VAR analysis. Accordingly, we can safely conclude that the repercussions of disruptions in global food commodity markets on the US economy are compelling.

5 Conclusions

> *"It is almost a truism to say that the characters of the seasons exert a very great influence on the amount and quality of our home-produce of wheat from year to year; and that upon the amount of food which the crop supplies depends very materially, though less than formerly, the general prosperity of the nation."*
>
> Lawes and Gilbert (1868).

Until the beginning of the 20th century, agricultural fluctuations were considered to be very important for the business cycles of advanced economies (e.g. Giffen, 1879), but the attention vanished as agricultural sectors in developed countries contracted. However, there have been huge swings in food prices since the start of the millennium, which reignited interest in the linkages between food price volatility and the macroeconomy. With global temperatures expected to rise substantially over the next decades, understanding these relationships will become even more important in the future.

In this paper, we have estimated the consequences of disruptions in global food commodity markets on the US economy over the past fifty years. Since food markets also respond to developments in the macroeconomy, the main challenge for doing this is the identification of exogenous shifts in food commodity prices. We have used two different approaches for identifying such movements. The baseline strategy is a joint structural VAR model for global food commodity markets and the US economy, in which food market disruptions are identified as unanticipated changes in a quarterly global food production index that we have constructed based on the planting and harvesting calendars of the four major staples (corn, wheat, rice and soybeans). As a robustness check, we relied on FAO reports, newspaper articles, disaster databases and several other sources to identify 13 historical episodes in which significant changes in food commodity prices where mainly caused by exogenous food market events.

The structural VAR analysis and the narrative approach deliver very similar results. We find a considerable impact of fluctuations in food commodity markets on the US economy. On the one hand, a rise in food commodity prices augments food, energy and core consumer prices. On the other hand, there is a persistent fall in real GDP and household expenditures. The effects are about four to six times greater than the expected impact implied by the share of food commodities in the consumer price index and household consumption. An intriguing finding is that households reduce much more durable consumption and expenditures on home improvements and residential investments than food consumption. A better understanding of the exact mechanism of these indirect effects remain complex and is an interesting topic for future research. Other avenues for future research are the analysis of cross-country differences and the question whether policies, such as public food security programs or monetary policy, could dampen the macroeconomic consequences of food market disruptions.

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Appendix A - Examples of crop calendars

Figure A1 shows some examples to illustrate how we have assigned the annual food production data to a specific quarter, based on the crop calendars (planting and harvesting seasons) of the countries.

- For several crops and countries, the allocation to a specific quarter is very obvious. Examples in Figure A1 are Kazakhstan (wheat), the Russian Federation (rice), South Africa (corn) and Argentina (soybeans). The harvest seasons clearly fall within a single quarter, whereas the planting seasons are one or more quarters beforehand.

- Whenever a single harvest season is spread over two subsequent quarters, we allocate the production volume to the first quarter. Examples are Mexico (wheat), China (corn), the United States (rice) and Brazil (soybeans). The same rule is applied to cases where two subsequent quarters are part of two subsequent years, such as the wheat harvest of Argentina (also the FAO has allocated the annual wheat harvest of Argentina to year N).

- Some countries have two planting seasons for some of the crops, for example winter and summer wheat in the Russian Federation, and spring and winter wheat in Canada. However, given that their harvest seasons still fall within a single quarter and the planting seasons are in an earlier quarter, it is easy to allocate the production to a specific quarter.

- Whenever part of the planting and harvesting seasons overlap at the quarterly frequency, e.g. Brazil (wheat) we do not allocate the production. This production is not included in the index.

- For some countries is it not possible to assign the annual production data to a specific quarter because there is more than one harvest period, or because the crops are harvested almost uniformly throughout the year. Examples in Figure A1 are Thailand (soybeans) and India (rice). This production is not included in the index.

Appendix B - Example of narratively identified global food commodity market shock: droughts around the globe in 2012Q3

Type Unfavorable food commodity market shock

Food commodity market event Due to droughts in Russia, Eastern Europe, Asia and the US, there was a signifcant decline in global cereal production. In retrospect, annual global cereal production contracted by 2.4%. In July, the USDA decreased its previous (June) estimate for US corn by 12% because of the worst Midwest drought in a quarter century. Heatwaves in southern Europe added serious concern about global food supplies later that month, as well as below-average rainfall in Australia. In August, there was news about a late monsoon affecting the rice harvest in Asia negatively. According to the International Food Policy Institute, production of food grains in the South Asia region was expected to decline by 12% compared to a year earlier. Also in August, the Russian grain harvest forecasts were reduced because of drought. In October 2012, wheat output in the Russian Federation was estimated some 30% down from 2011, in Ukraine, a decrease of about 33% was expected, while in Kazakhstan, output was reported to be just half of last year's good level. Wheat harvest indeed declined in 2012, respectively by 33%, 29%, 57% in Russia, Ukraine and Kazakhstan. The EMDAT Database of international disasters lists droughts in Ukraine (15/04/2012-31/07/2012), Russia (06/2012-09/2012) and the US (06/2012-12/2012).

We allocate the shock to 2012Q3 because this is the period when the severe scaling back of the expected harvests started, resulting in considerable price increases. Real food commodity prices increased by 7.9% in that quarter, whereas oil prices decreased by 1.6%. The same comment about the Greek debt crisis reported for the 2010Q3 shock applies for 2012Q3 (the Second Economic Adjustment Programme for Greece was approved in March 2012). There were no other events that could explain the rise in food commodity prices.

Relevant articles

Midwest drought slashes corn estimate, jolts market

Reuters. Charles Abbott, (12 July 2012).

"**The worst Midwest drought in a quarter century is doing more damage to U.S. crops than previously expected with the government on Wednesday slashing its estimate for what was supposed to be a record harvest.** The U.S. Department of Agriculture said the **corn crop will average just 146 bushels an acre, down 20 bushels from its June estimate and a much more dramatic drop than analysts had projected**. **The report initially reignited a near-record rally in grain prices** that could eventually hit consumer grocery bills in North America, although the impact could be more immediate for the world's poor if the drought persists. T**he severe scaling back of the harvest has sent corn and soybean prices up by more than a third over the past month**, as extreme heat and dry conditions stunt growth in the world's largest grower and exporter."

Available at:

http://www.reuters.com/article/2012/07/12/us-usa-crops-idUSBRE86A0LL20120712

Europe Heat Wave Wilting Corn Adds to U.S. Drought

BloombergBusiness. Rudy Ruitenberg, (24 July 2012).

"**Heat waves in southern Europe are withering the corn crop and reducing yields in a region that accounts for 16 percent of global exports at a time when U.S. drought already drove prices to a record**.

Temperatures in a band running from eastern Italy across the Black Sea region into Ukraine reached 35 degrees Celsius (95 degrees Fahrenheit) or more this month, about 5 degrees above normal, U.S. government data show. Corn, now in the pollination phase that creates kernels, risks damage above 32 degrees, said Cedric Weber, the head of market analysis at Bourges, France-based Offre et Demande Agricole, which advises farmers on sales.

The heat wave in Europe is adding to concern about global food supplies as U.S. farmers face the worst drought since 1956, India delays sowing because of a late monsoon and Australian crops endure below-average rainfall. Soybeans and corn rose to all-time highs yesterday and wheat surged 42 percent since June 1. The United Nations says food prices will probably rebound after falling the most in three years in the second quarter."
Available at: http://www.bloomberg.com/news/articles/2012-07-23/europe-heat-wave-wilting-corn-adds-to-u-s-drought-commodities

Rice Harvest in India Set to Drop as Drought Curbs Sowing

BloombergBusiness. Prabhudatta Mishra, (16 August, 2012).

"Rice production in India, the world's second-biggest grower, is poised to slump from a record as the worst monsoon since 2009 reduces planting, potentially lowering exports and boosting global prices.

The monsoon-sown harvest may be between 5 million metric tons and 7 million tons below a record 91.5 million tons a year earlier, said P.K. Joshi, director for the South Asia region at the Washington-based International Food Policy Research Institute. **Production of food grains, including corn and lentils, may slide as much as 12 percent from 129.9 million tons a year earlier**, he said.

Rice has rallied 6.3 percent in Chicago since the end of May on prospects for a lower Indian crop and export curbs, adding to global food costs that the United Nations estimates jumped 6.2 percent in July. **Corn and soybeans have soared to records as the worst U.S. drought in half a century killed crops**. **Global rice production this year will be smaller than previously forecast**, according to the UN's Food & Agriculture Organization."

Available at: http://www.bloomberg.com/news/articles/2012-08-15/rice-harvest-in-india-set-to-decline-as-drought-curbs-planting

Russia harvest forecasts cut as drought hits crop in east

Reuters. Polina Devitt, (20 August 2012).

"**Two leading Russian agricultural analysts cut their forecasts for Russia's grain harvest on Monday** after harvest data from two drought-stricken eastern growing regions reduced the outlook for the overall crop.

SovEcon narrowed their grain forecast to 71-72.5 million metric tons (78.3- 79.9 million tons) from a previous 70-74 million tonnes after the start of harvesting campaign in Urals and Siberia regions showed weak crop prospects. It has also cut wheat harvest forecast to 39-41 million tonnes from earlier 40.5-42.5 million tonnes.

The Institute for Agricultural Market Studies (IKAR) has cut its 2012 grain crop forecast to 73 million tonnes from a previously expected 75.4 million tonnes, its chief executive, Dmitry Rylko, said. It has not yet estimated wheat harvest. 'I see the possibility of further downgrading,' Rylko said."

Available at: http://www.reuters.com/article/2012/08/20/us-grain-russia-harvest-idUSBRE87J0BE20120820

Crop Prospects and Food Situation No.3 October 2012

Food and Agriculture Organisation, (2012). Rome: FAO.

"**FAO's latest forecast for world cereal production in 2012 has been revised downward slightly (0.4 percent) since the previous update in September**, to 2 286 million tonnes. The latest adjustment mostly reflects a smaller maize crop in central and southeastern parts of Europe, where yields are turning out lower than earlier expectations following prolonged dry conditions. At the current forecast level, world cereal production in 2012 would be 2.6 percent down from the previous year's record crop but close to the second largest in 2008. The overall decrease comprises a 5.2 percent reduction in wheat production, and a 2.3 percent reduction for coarse grains, while the global rice crop is seen to remain virtually unchanged. **Severe droughts this year in the United States and across a large part of Europe and into central Asia have been the main cause of the reduced wheat and coarse grains crops**.

[...]

FAO's latest forecast for global wheat production in 2012 stands at 663 million tonnes, 5.2 percent below last year's level, but close to the average of the past five years. This level is considerably below expectations earlier in the year, largely reflecting the impact of the severe drought that set-in across eastern Europe and central Asia, but also on account of downward revisions for the key southern hemisphere producing countries where weather and policy factors in some cases have reduced prospects for the 2012 crop yet to be harvested.

Most of the decline in global wheat production, compared to last year, reflects the negative effects of drought in the major producing CIS countries in Europe and Asia. Wheat output in the Russian Federation is estimated some 30 percent down from 2011, in Ukraine, latest information points to a decrease of about 33 percent, while in Kazakhstan, output is reported to be just half of last year's good level. In other parts of Europe, wheat output also declined, particularly in some central and southeastern countries on the edge of the drought-affected zone. The aggregate output of the EU countries is estimated to be down by 2.6 percent. In the other Asian subregions, record crops have been gathered in the key producers in the Far East, namely, China and India, while in the Near East, results have been mixed: good crops were gathered in Afghanistan and the Islamic Republic of Iran but outputs were down elsewhere, reflecting dry conditions and/or the negative impact of civil disturbances. The 2012 harvest results were also mixed in North Africa, where production recovered in Algeria but was sharply reduced in Morocco due to dry conditions. In the United States, this year's wheat production is estimated to have increased by 13.4 percent to an above-average level of 61.7 million tonnes. In Canada, output is expected to be above average and almost 7 percent higher than in 2011.

In South America, the subregion's aggregate wheat production is forecast at about 21 million tonnes, 12 percent down from the previous year and below average. The expected reduction reflects a general decline in the area planted in response to changes in marketing policy and **due to dry weather at sowing time in June and July**. In Oceania, prospects for the wheat crop in Australia are mixed, reflecting varied winter rainfall and moisture conditions: overall output is forecast down by about 24 percent from last year's record crop due to lower yields expected in some major producing areas affected by dry conditions."

Available at: http://www.fao.org/docrep/016/al992e/al992e00.pdf#page=30

Table 1 - Narrative food commodity market shocks

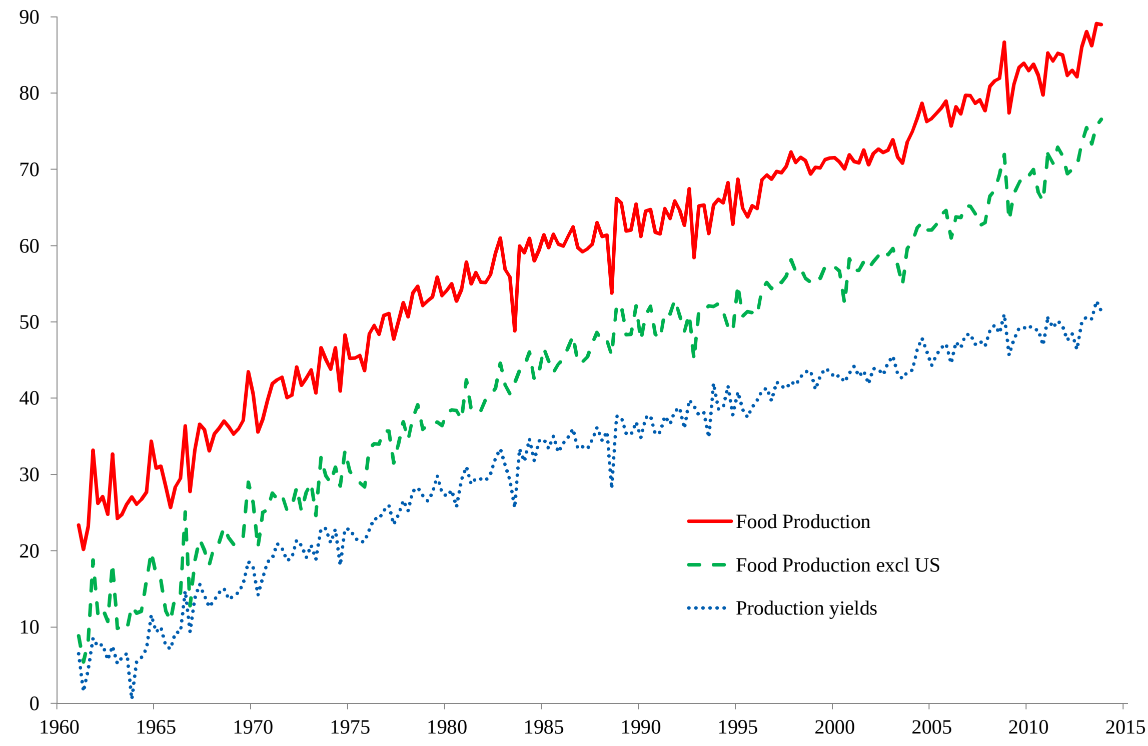
Date	Type	(cumulative) change in food commodity prices impact	after 1Q	Food commodity market event
1972Q3	Unfavorable	1.4%	18.3%	Wheat production in the USSR declined by 13% due to disastrous weather conditions. This resulted in unexpectedly large purchases of an unprecedented scale by the Soviet Union on the world market. At the same time, the global agricultural sector was severely affected by monsoon failure in most of southeast Asia during summer, followed by extremely dry weather throughout autumn and early winter. Rice production decreased in Cambodia, India, Malaysia and Thailand by respectively 29%, 9%, 13% and 10%.
1975Q2	Favorable	-10.9%	-9.9%	In April 1975, the USDA predicted a large increase in world grain production, indicating an easing of the tight supply-demand balance of the previous two years. Furthermore, in May 1975, the USDA increased its US wheat production estimate for 1975 because of favorable May field conditions. A record wheat harvest was expected. In retrospect, US wheat production increased by 19.4% relative to the previous year.
1975Q4	Favorable	-4.7%	-10.7%	In September 1975, there were expectations of a record rice crop because of a favorable monsoon season. As a consequence, rice prices started to decrease from October 1975 onwards. Real cereal prices fell by 19% over two subsequent quarters. Ex post, 1975 proved indeed to be a very favorable rice year for India, Japan and Thailand, with an acceleration of production yields relatively to 1974 by respectively 23%, 7% and 14%.
1977Q3	Favorable	-20.9%	-12.9%	Several favorable and/or increased food production forecasts were published throughout July and August: predictions of record US corn crops (July 1977), increased forecasts of world wheat and feed grains production (July 1977), news on record Soviet wheat harvest (August 1977), and predictions of record US soybeans crops (August 1977).
1977Q4	Unfavorable	8.0%	15.6%	Despite expectations of record harvests in the previous quarter, global grain production turned out to be below trend in 1977 as a result of unfavorable weather conditions in the major producing areas. In November 1977, the Financial Times announced that the Sovjet crop would be roughly 10% below the latest estimate predicted by the USDA. In addition, the International Wheat Council lowered its estimate of world wheat output by 2%-3%. In retrospect, Soviet wheat production decreased 5% compared to the previous year. Chinese wheat production declined 18% and in the US wheat production shrunk 5%.
1984Q3	Favorable	-10.4%	-14.1%	In July 1984, the USDA improved its June estimate for US wheat production, and predicted record grain production worldwide. Much of this increase was a consequence of the North American recovery from the sharp decline of 1983. Western Europe also had exceptionally good harvests of cereals. In retrospect, US maize production rose considerably, i.e. 84%. Furtermore, wheat production increased in China, India and France by respectively 8%, 33% and 6%. Overall, global cereal production increased by 11.4% in 1984, which was the largest annual rise since the 1960s.
1988Q4	Favorable	-4.5%	-9.4%	In December 1988, it was announced by the International Wheat Council that worldwide wheat production was expected to rise considerably in 1989, amongst others because of a reduction in the requirement for US set-aside of arable land, from 27.5% to only 10% of the wheat acreage in the next year, which was a farm policy response to the 1988 drought in the US (The Disaster Relief Act of 1988). In response to drought-shortened crop inventories, the 1989 version of the farm bill was expected to encourage larger crop planting. Wheat production in 1989 increased indeed in all large wheat producing countries (China 6%; France 10%; India 17%; US 12%; USSR 11%). Ex post, annual global cereal production increased by more than 10% in 1989.
1995Q3	Unfavorable	6.6%	7.8%	In 1995Q3, there were large downward revisions of 1995 world cereal production. This was especially the case for wheat and coarse grains production in the US (poor weather conditions, predominantly hot and dry weather during early September) and the Commonwealth of Independent States, and for wheat production in Argentina and China. In Central America, a below-normal coarse grain crop was in prospect in Mexico due to a combination of reduced plantings and dry weather in parts. In retrospect, wheat production declined in the US and Russia by 6%, and in Argentina by 16%. Mexican maize production stagnated in 1995, but US maize production decreased by 26%. Annual global production of the four major staples ultimately declined by 2.6% in 1995.
1996Q3	Favorable	-4.5%	-12.5%	The FAO issued a provisional favorable forecast for world 1996 cereal output (6.5% up from the previous year). The largest increase was expected in coarse grains output, mostly in the developed countries. Additionally, wheat output was forecast to increase significantly, and rice production to rise marginally. In September 1996, the International Grains Council increased its forecast (compared to a month earlier) for 1996-97 global wheat production in response to a confirmation of favorable harvests in the Northern Hemisphere and excellent prospects in the Southern Hemisphere.

2002Q3	Unfavorable	9.4%	10.7%	The FAO's July forecast pointed to a global cereal output which is considerably less than the previous forecast in May. It would be the smallest wheat crop since 1995. The downward revision was mostly a result of a deterioration of production prospects for several of the major wheat crops around the globe because of adverse weather in the northern hemisphere or for planting in the southern hemisphere. The forecast for global coarse grain output was also revised downwards since the last report mainly because of dry weather conditions in the Russian Federation. In September, the Austrialian Bureau of Agricultural and Resource Economics announced that drought will slash the country's winter grain production. Austrialia is one of the big five wheat exporters. In retrospect, US wheat production decreased by 18% in 2002 and Australian wheat production by 60%. The downward revision resulted in an increase in real food commodity prices in 2002Q3 by 9.4%.
2004Q3	Favorable	-6.9%	-10.9%	Favorable weather conditions triggered expectations of significant higher cereal production in Europe, China, Brazil and the US. In July 2004, the International Grains Council announced an expected rise in the global volume of coarse grain. In september 2004, the FAO's raised its forecast for world cereal output since the previous report in June. Annual global cereal production increased by more than 9% in 2004.
2010Q3	Unfavorable	8.6%	22.1%	The 2010 cereal output in the Republic of Moldova, Russian Federation, Kazakhstan and Ukraine was seriously affected by adverse weather conditions. Russian Federation, Kazakhstan and Ukraine (all three amongst the world's top-10 wheat exporters) suffered the worst heatwave and drought in more than a century, while the Republic of Moldova was struck by floods and hail storms. In the Russian Federation, the most severely affected by adverse conditions, the 2010 cereal crop was 33% smaller than the previous year. In Ukraine the wheat harvest decreased 19%. Accordingly, in July 2010, wheat prices have seen the biggest one-month jump in more than three decades, i.e. a rise of nearly 50% since late June. In September, wheat prices were even 60% to 80% higher due to a decision by the Russian Federation to ban exports.
2012Q3	Unfavorable	7.9%	6.9%	Due to droughts in Russia, Eastern Europe, Asia and the US, there was a signifcant decline in global cereal production. In retrospect, annual global cereal production contracted by 2.4%. In July, the USDA decreased its previous (June) estimate for US corn by 12% because of the worst Midwest drought in a quarter century. Heatwaves in southern Europe added serious concern about global food supplies later that month, as well as below-average rainfall in Australia. In August, there was news about a late monsoon affecting the rice harvest in Asia negatively. According to the International Food Policy Institute, production of food grains in the South Asia region was expected to decline by 12% compared to a year earlier. Also in August, the Russian grain harvest forecasts were reduced because of drought. In October 2012, wheat output in the Russian Federation was estimated some 30% down from 2011, in Ukraine, a decrease of about 33% was expected, while in Kazakhstan, output was reported to be just half of last year's good level. Wheat harvest indeed declined in 2012, respectively by 33%, 29%, 57% in Russia, Ukraine and Kazakhstan.

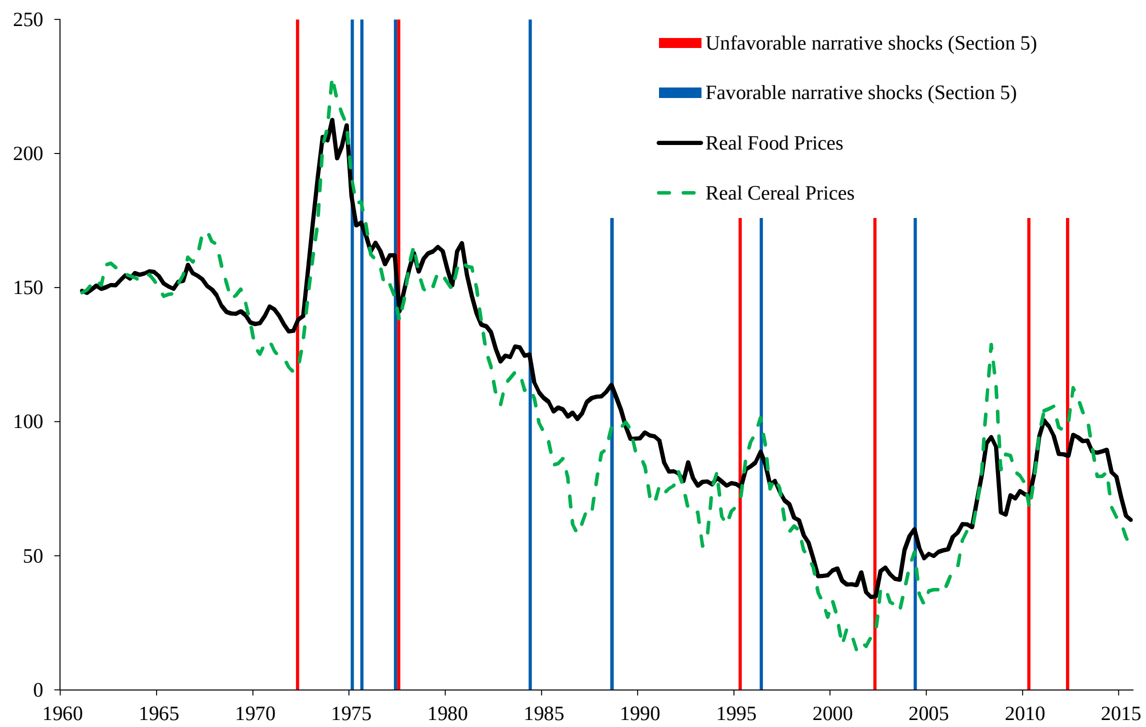
Noot: a detailed motivation and description of the episodes can be found in the online appendix of the paper

Figure 1 - Global Food Market Variables

(a) Global Food Production Index



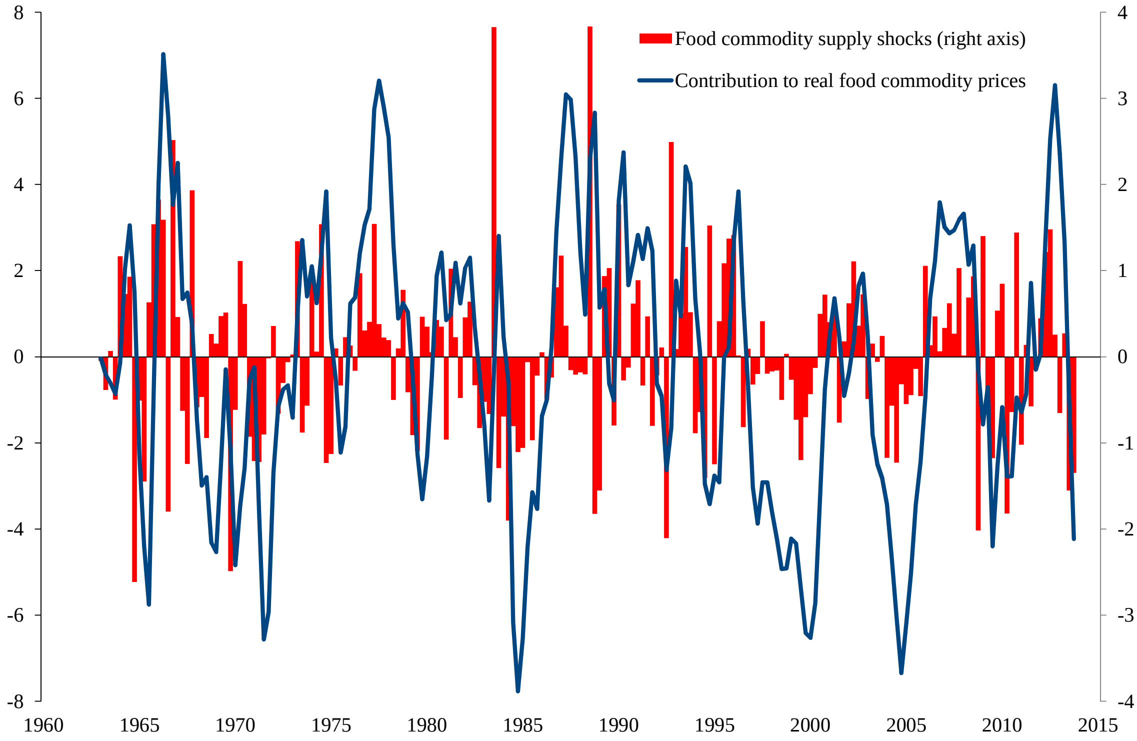
(b) Real Food Commodity Prices



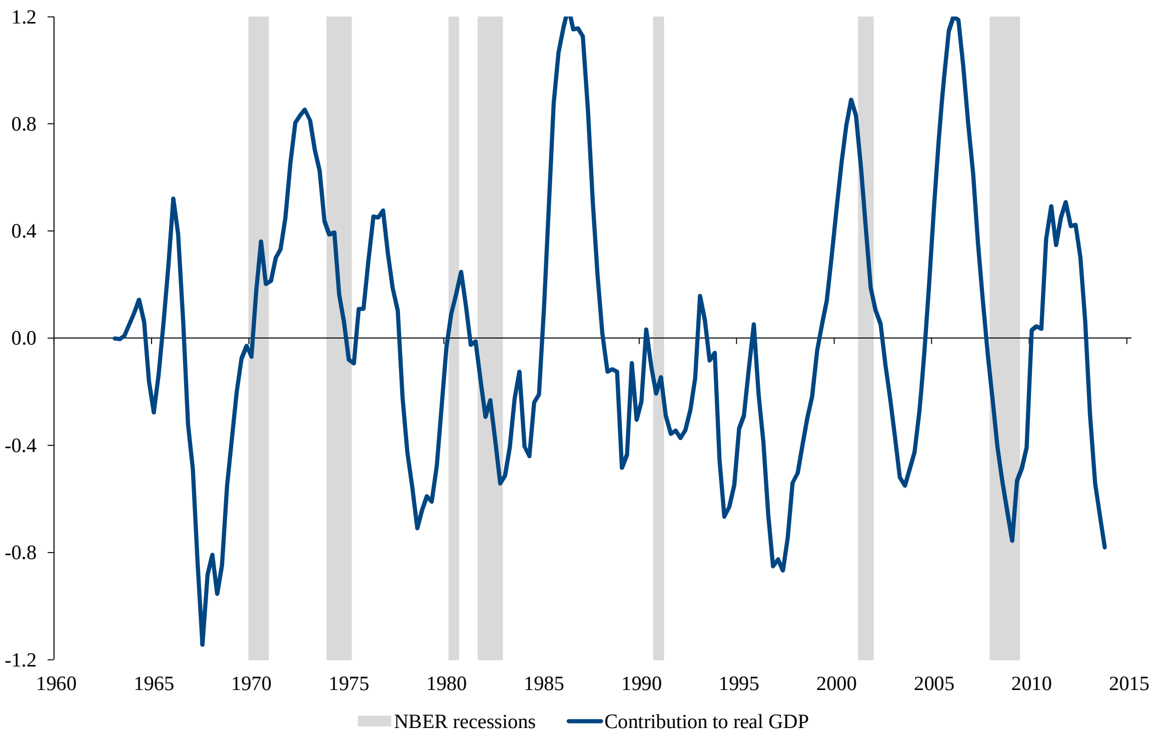
Note: All variables in figures are measured as 100*log of index, production yields in panel (a) are ratio of food production divided by area harvested. The production (real cereal prices) index aggregates the production (prices) of corn, wheat, rice and soybeans on a caloric-weighted basis.

Figure 2 - Time series of shocks and contribution to real commodity food prices and US real GDP

(a) Global food supply shocks and cumulative contribution to real food commodity prices

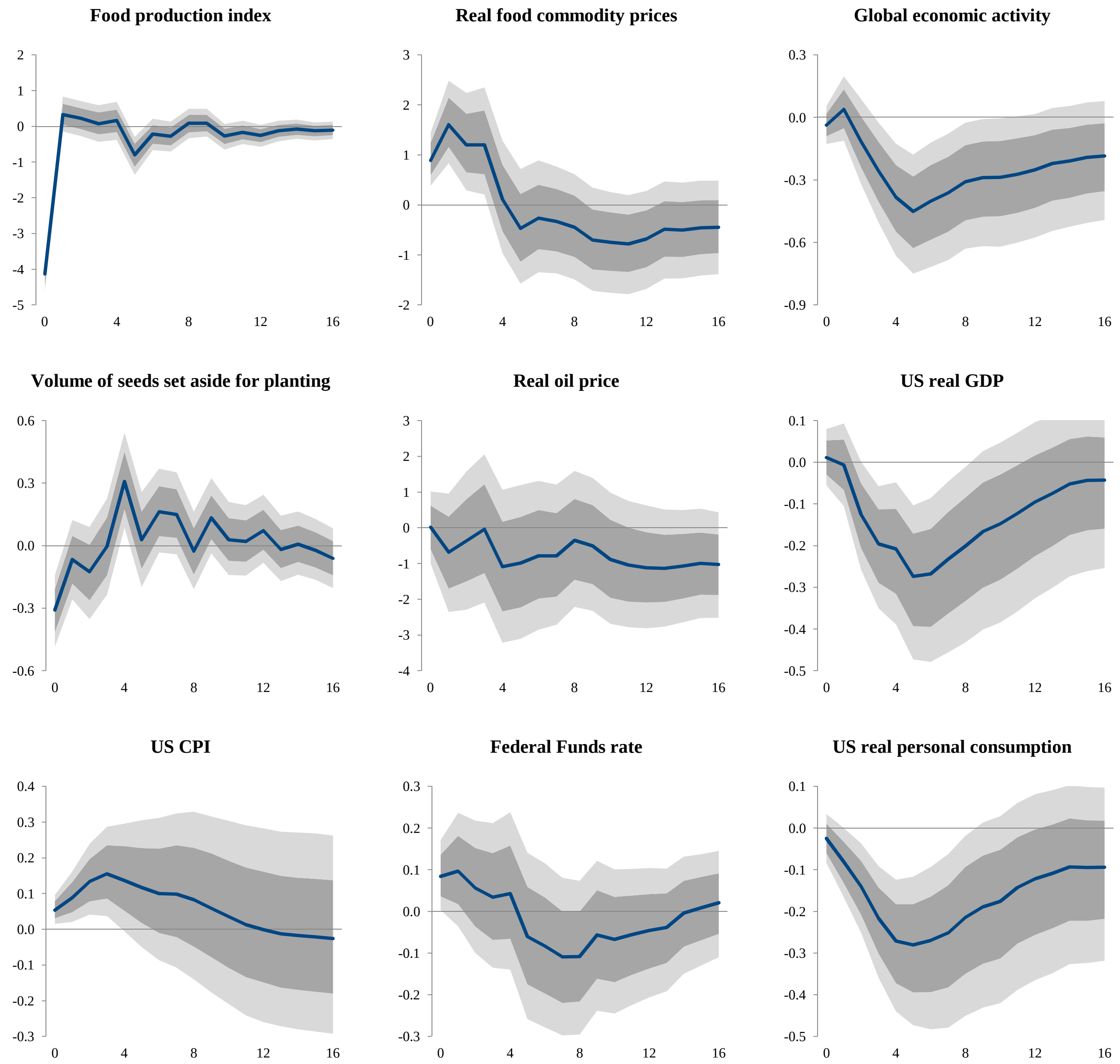


(b) Cumulative contribution to US real GDP and NBER recessions



Note: Quarterly structural shocks and historical contributions to real food commodity prices (real GDP) implied by the benchmark VAR model. Positive values correspond to a decline in food production. Contributions are in percent, shocks in standard deviations.

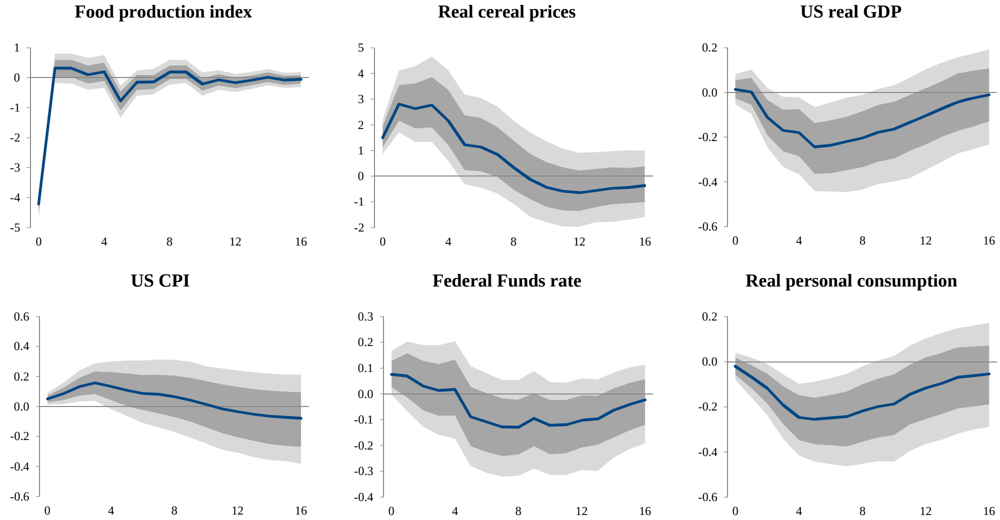
Figure 3 - Impulse responses to global food commodity supply shocks: benchmark VAR results



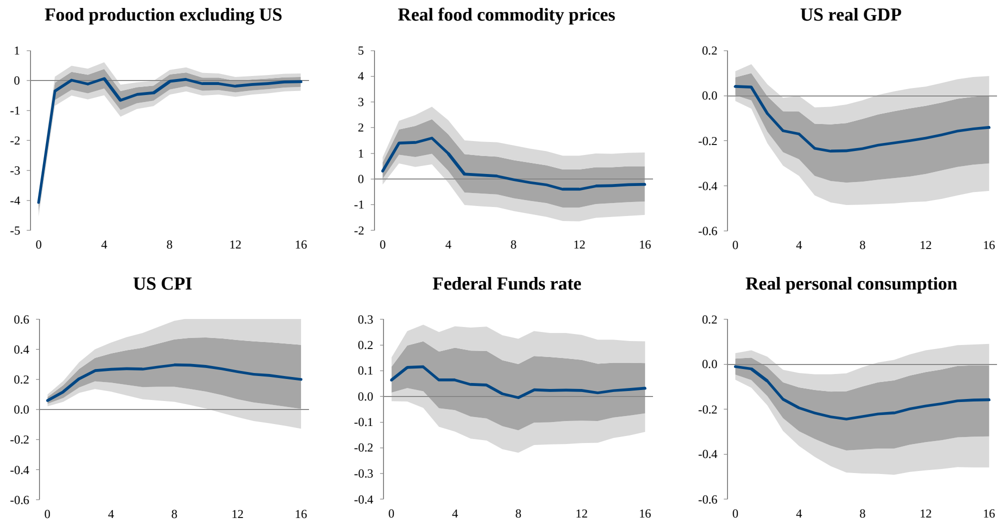
Note: sample period is 1963Q1-2013Q4, horizon is quarterly — 16th and 84th percentiles — 5th and 95th percentiles

Figure 4 - Impulse responses to global food commodity supply shocks: sensitivity analysis

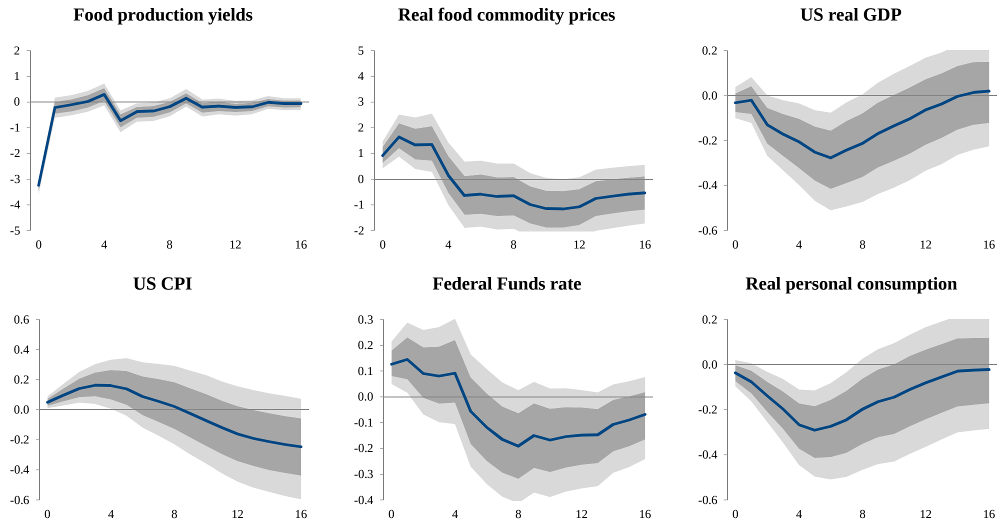
(a) VAR with real cereal prices



(b) VAR with global food production, excluding US food production



(c) VAR with global food production yields

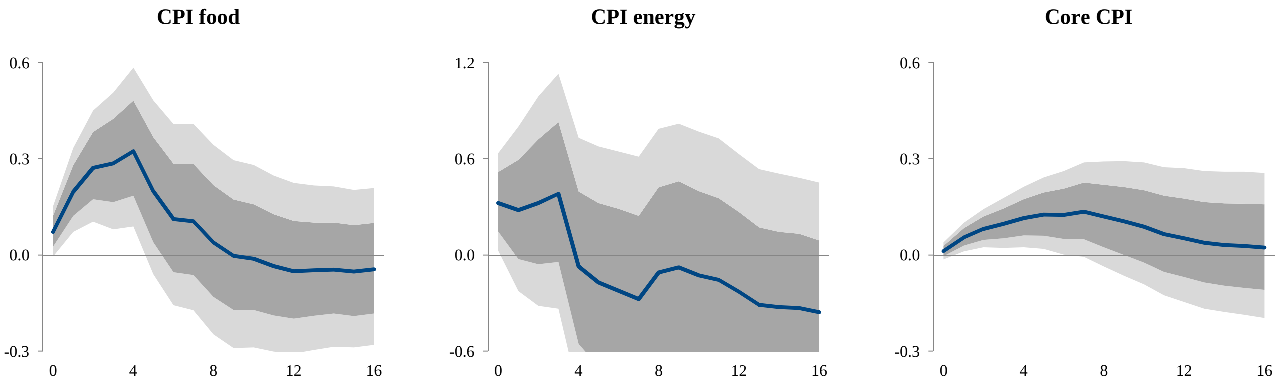


16th and 84th percentiles 5th and 95th percentiles

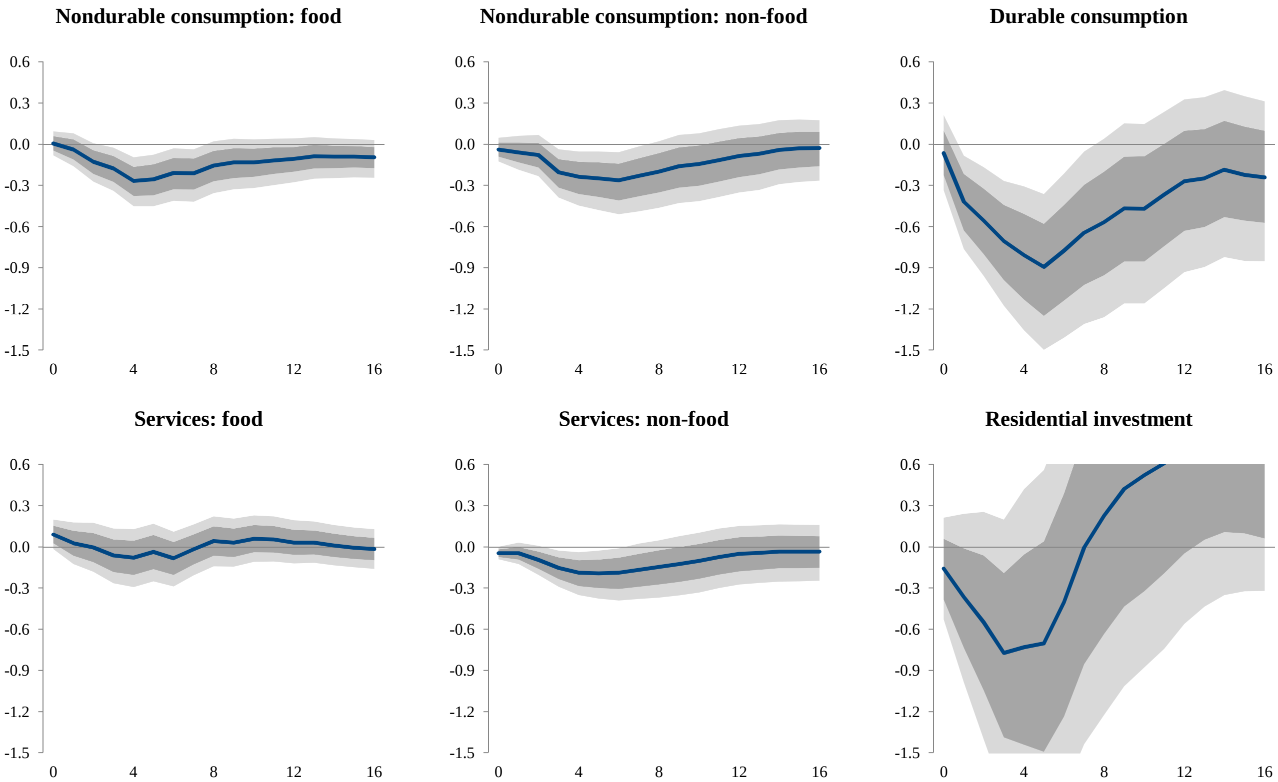
Note: sample period is 1963Q1-2013Q4, horizon is quarterly.
For reasons of legibility, the responses of global economic activity, volume of seeds set aside for planting and real oil price are not shown.

Figure 5 - Impact of food commodity supply shocks on CPI and expenditures components: extended VAR

(a) Impact on consumer prices components



(b) Impact on household expenditures

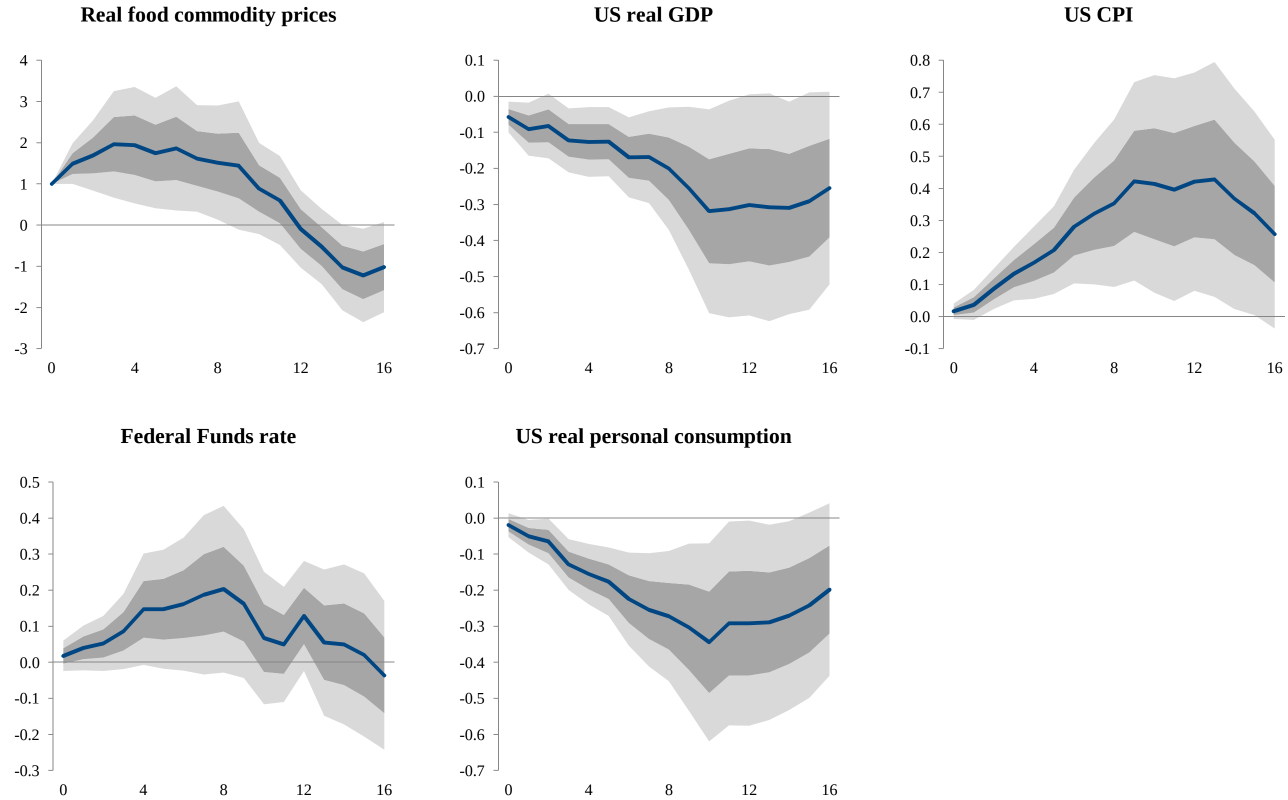


Note: sample period is 1963Q1-2013Q4, horizon is quarterly

16th and 84th percentiles

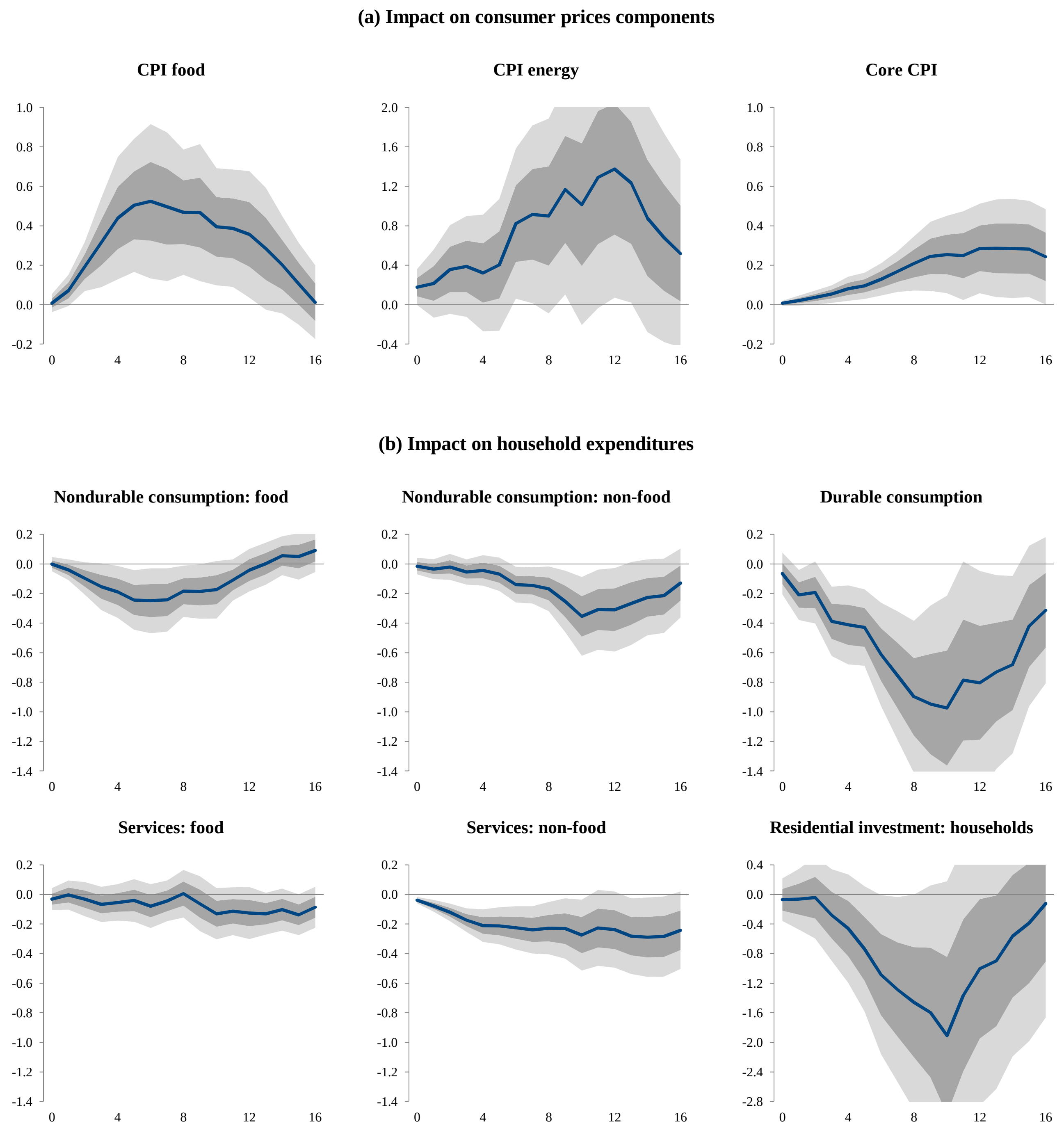
5th and 95th percentiles

Figure 6 - Impulse responses to narrative food commodity supply shocks: local projections



Note: local projections, Newey-West standard errors, quarterly horizon — one-standard error bands — two-standard error bands

Figure 7 - Impulse responses to narrative food commodity supply shocks: CPI and expenditures components



Note: local projections, Newey-West standard errors, quarterly horizon — one-standard error bands — two-standard error bands

Figure A1 - Examples of crop calendars