

## What Drives Commodity Price Booms and Busts?\*

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### Abstract

What drives commodity price booms and busts? We provide evidence on the dynamic effects of commodity demand shocks, commodity supply shocks, and inventory or other commodity-specific demand shocks on real commodity prices. In particular, we analyze a new data set of price and production levels for 12 agricultural, metal, and soft commodities from 1870 to 2013. We establish that commodity demand shocks strongly dominate commodity supply shocks in driving prices over a broad set of commodities and over a broad period of time. While commodity demand shocks have gained importance over time, commodity supply shocks have become less relevant.

**JEL classification:** E30, Q31, Q33, N50

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## 1. Introduction

Understanding the drivers of commodity price booms and busts is of first-order importance for the global economy. A significant portion of incomes and welfare of both commodity-consuming and commodity-producing nations hinges upon these prices (Bernanke, 2006; IMF, 2012). They also vitally affect the distribution of incomes within particular nations as the ownership of natural resources varies widely. What is more, the long-run drivers of commodity prices also have serious implications for the formation and persistence of both growth-enhancing and growth-detracting institutions (van der Ploeg, 2011). But for all this, outside spectators—whether they are academics, the general public, the investment community, or policy-makers—remain seriously divided in assigning the importance of the various forces in the determination of commodity price booms and busts.

The recent history of commodity prices is indicative of this situation. From multi-decade lows in the late 1990s, real commodity prices rose for the next 10 years, culminating in the price spike of 2008 when they stood over three times their level in 1998 (Jacks, 2013). All along the way, observers battled it out, variously pointing to the respective roles of fundamentals versus speculation in driving real commodity prices to such heights (Irwin *et al.*, 2009). Recent developments in the opposite direction—with real commodity prices having shed roughly 50% of their value in the past three years—have likewise generated much heat, but not so much light. Yet regardless of any particular commenter's take on the ultimate driver of commodity price booms and busts, none have doubted the question's importance.

At the same time, a fairly large academic literature has developed which follows the work of Kilian (2009) in evaluating the sources of crude oil price dynamics. Here, structural vector autoregressive models are used to decompose changes in real crude oil prices into different types

of shocks. Identification is made possible by assigning short-run (or sign) restrictions based on assumptions primarily—but not exclusively—related to inelastic short-run demand and supply curves. The upshot of much of this work has been a reversal in our understanding of the short-run determinants of commodity prices. That is, while an earlier literature implicated supply shocks as a chief source of fluctuations in crude oil prices (see e.g. Hamilton, 2008), this more recent literature finds that demand shocks are the major source of fluctuations in prices for crude oil (Kilian, 2009; Kilian and Murphy, 2014; Baumeister and Hamilton, 2015).<sup>1</sup>

Our contribution to this literature comes in being the first in providing evidence on the drivers of real commodity prices over a broader set of commodities and over a broader span of time.<sup>2</sup> To this end, we assemble a new data set on the level of prices and production for 12 commodities, spanning the categories of agricultural, metal, and soft commodities from 1870 to 2013. In marked contrast to the literature on crude oil prices which generally uses monthly data over multiple years or a few decades, we use annual data over the past century and a half. This context makes it hard for us to rationalize a steep—that is, an inelastic—short-run supply curve which is one of the basic identifying assumptions of SVARs based on short-run restrictions (see e.g. Kilian, 2009), or to impose bounds on the short run price elasticity of supply, as used in models with sign restrictions (e.g. Kilian and Murphy, 2014).

Instead, we build on Stuermer’s (2016) identification scheme which is based on the idea that booms in real commodity prices induced by increases in global demand for commodities set in motion two processes: investment in new productive capacity and productivity-enhancing

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<sup>1</sup> See Carter *et al.* (2011) for a detailed summary of theories on fluctuations in commodity markets.

<sup>2</sup> Erten and Ocampo (2013) extract so called “Commodity Super Cycles” from various commodity price indices over the time period 1865 to 2010 and attribute them to changes in global real GDP. Our paper goes beyond this as we are able to identify the contribution of different commodity demand and supply shocks and to quantify the persistence of their effects on the real price of commodities. This is made possible by our new data-set on commodity production and by relying on a different methodology.

technological innovation. We hereby specify three orthogonal shocks to real commodity prices based on long-run restrictions, namely a commodity demand shock, a commodity supply shock, and an inventory or other commodity-specific demand shock. We emphasize that these shocks are specifically related to commodity markets and are not to be confused with the aggregate demand and aggregate supply shocks used in much of the macroeconomic literature.

In particular, we allow commodity demand shocks, representing an unexpected expansion in global GDP, e.g. periods of rapid industrialization, to have long-run effects not only on global GDP itself but also on the production of individual commodities. The idea is that, for example, an increase in price due to a shift in commodity demand for all commodities triggers technological advances and investment in new production capacities (e.g. new discoveries of mineral deposits, expansion of arable land). In contrast, we assume that commodity supply shocks, which we interpret as a disruption in the physical production of a particular commodity through natural disasters, cartel action or strikes, for example, only affect world real GDP temporarily. This is also consistent with robust evidence that oil supply shocks have only short-lived effects on U.S. real GDP (Kilian, 2009). Finally, we label the residual term, capturing all remaining uncorrelated shocks, as an inventory or other commodity-specific demand shock. This term is assumed to have no long-run effects on either global GDP or a commodity's global production. At its heart, this shock can be interpreted as capturing unexpected changes in inventory demand due to underlying changes in expectations. In combination, this identification scheme allows us to leave all short-run relationships unrestricted.

Based on the structural VAR, we derive historical decompositions for each of the relevant commodities. The historical decomposition shows the contribution of each shock in driving booms and busts in each real commodity price series over time. It serves to quantify the

independent contribution of the three shocks to the deviation of each commodity price from its base projection after accounting for long-run trends in real commodity prices.

Our results indicate that commodity demand shocks strongly dominate commodity supply shocks as drivers of commodity price booms and busts over a broad set of commodities and over a broad period of time. The average share of commodity demand shocks in explaining prices is 35 percent, while the share of commodity supply shocks is 20 percent. The most important shocks are inventory or other commodity-specific demand shocks, which drive on average 46 percent of prices. Commodity demand shocks and inventory or other commodity-specific demand shocks affect prices up to 10 years, while commodity supply shocks affect prices for only up to 5 years.

Additionally, we find that the quantitative contribution of commodity demand shocks to prices varies across the different commodities, with the largest contribution to metal commodities (38 percent on average) and to lesser extent to agricultural (32 percent) and soft commodities (34 percent). At the same time, commodity demand shocks exhibit a common pattern with respect to their timing across all commodity markets. Inventory or other commodity-specific demand shocks have stronger effects on commodity price booms and busts for agricultural and soft commodities than for metals. Commodity supply shocks play some role in explaining fluctuations for particular commodities, but in the main, their influence on real commodity prices is limited in its impact in nature. Finally, we find evidence that the importance of commodity supply shocks has decreased over time, while commodity demand shocks have become more important.

The rest of the paper proceeds as follows. Section 2 sets out the underlying data while Section 3 outlines the methodology related to structural vector auto-regressions. Section 4

provides the results on the contribution of various shocks on commodity price dynamics. Section 5 concludes.

## **2. New Data on Long-Run Real Prices and Production**

The data used in this study represent the end result of a number of selection criteria. First, real prices were drawn for all consistently-defined commodities with at least 5 billion U.S. dollars of production in 2011 (for further discussion, see Jacks, 2013). The individual real price series are expressed in U.S. dollars and deflated by the U.S. Consumer Price Index underlying Officer (2012), supplemented by updates taken from the U.S. Bureau of Labor Statistics.

Next, these prices were matched with production data for those commodities for which there is evidence of a high degree of homogeneity in the traded product (or at least, in its reference price), evidence of an integrated world market, and no evidence of significant, sharp structural changes in their marketing or global use over time.<sup>3</sup> All told, this paper then considers the evidence on 12 individual commodity price series (barley, coffee, copper, corn, cotton, cottonseed, lead, rice, rye, sugar, tin, and zinc) which are drawn from three product categories—agricultural, metals, and soft commodities. Finally, global real GDP data is based on Maddison (2010) and extensions from Stuermer (2016).

Figure 1 documents the evolution of global real GDP in percentage terms from 1870 to 2013 while Figures 2 through 4 document the evolution of real commodity prices and production for the same years. Appendix I details the sources for the individual series.

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<sup>3</sup> This last requirement precludes a consideration of natural gas and petroleum in light of the radical changes in the industrial organization of these sectors and in their use throughout the 20<sup>th</sup> century (Yergin, 1991).

### 3. Structural Vector Autoregression

We follow Kilian (2009) and subsequent authors in applying a structural vector autoregressive model to decompose changes in commodity prices into different types of shocks. In marked contrast to this literature which generally uses monthly data over decades, we use annual data over the past 145 years. This context makes it hard for us to rationalize an inelastic that is, steep supply curve, which is one of the basic identifying assumptions of SVARs based on short-run (or sign) restrictions. Instead, we build on Stuermer's (2016) identification scheme which allows us to specify three orthogonal shocks to real commodity prices based on long-run restrictions, namely a commodity demand shock, a commodity supply shock, and an inventory or other commodity-specific demand shock.

#### *A. Identification*

The identification scheme is based on the idea that increases in real commodity prices induced by increases in global demand for commodities set in motion two processes: investment in new productive capacity and productivity-enhancing technological innovation. This idea has gained considerable traction in the resource economics literature of late. For example, Anderson *et al.* (2014) show how global shocks to the demand for crude oil have induced new drilling in the United States in the last few years. Likewise, Stuermer and Schwerhoff (2013, 2015) provide stylized facts on R&D in the extractive sector and construct a growth model with a non-renewable resource stock which may be periodically augmented due to R&D investment in extraction technologies. A somewhat analogous argument has been made by earlier contributions to the literature on growth models and natural resources (Aghion and Howitt, 1998; Groth, 2007). This work basically argues that increases in factor productivity drive up total output of an

economy and, thereby, productivity in the use of natural resources. Stuermer (2016) is the first to build on these insights for the purpose of identifying different shocks to commodity prices based on long-run restrictions.

We use these restrictions in the same way to identify three mutually uncorrelated shocks to real commodity prices. First, we allow commodity demand shocks to have persistent effects on both global GDP and global production of the respective commodity. This is consistent with the logic outlined above in which unexpected changes in global GDP endogenously affect the extensive and intensive margins of commodity production in the long run.

Furthermore, we assume that a commodity supply shock may potentially have long-run effects on global production of the respective commodity, but no long-run effects on global GDP. Thus, we interpret this shock as capturing unexpected disruptions in global production of a commodity due to cartel action, inter- or intra-state conflict, labor action, weather, or the like. These events are allowed to affect global GDP for quite some time as we use annual data, but ultimately, they will not affect global GDP in the long run. This is also consistent with the robust evidence that oil supply shocks have only short-lived effects on U.S. real GDP (Kilian, 2009).

Finally, the inventory or other commodity-specific demand shock is a residual which captures all shocks that are not correlated with either the commodity demand shocks or the commodity supply shocks described above. We interpret this residual shock as a shock to the demand for storage of the respective commodity which potentially stems from three different sources: (1) government stocking programs, (2) commodity producers with market power who increase their inventories in an attempt to manipulate prices, and (3) shifts in the expectations of downstream commodity-processing industries or midstream commodity-trading firms about the future balance of supply and demand (on the last point, see Kilian, 2009, and Kilian and Murphy,

2014).<sup>4</sup> However, this residual shock may also encompass unexpected changes in a commodity's intensity of use with regard to world real GDP. As these processes are rather gradual and long-term on a global scale (see, e.g. Pindyck, 1980), we assume that they are primarily captured in the deterministic trend in the regression.

We make the assumption that price changes due to this inventory or other commodity-specific demand shock exhibits transitory but no long-run effects on global production of the respective commodities. They thereby only affect capacity utilization in the commodity-producing sector, but not long-run investment decisions. We consider this assumption to be plausible, in that permanently expanding production capacity (e.g. new mines, new land) generally exhibits significant fixed costs and takes many years—and in some instances, decades—to come on-line (Radetzki, 2008; Wellmer, 1992). We furthermore assume that this type of shock does not have any potential long-run effects on global GDP. Certainly, an increase in commodity prices driven by shocks to inventory demand decreases the income of consumers in importing countries. At the same time, it increases the income of consumers in exporting countries so that there may be no net effect on global GDP via aggregate demand. For instance, Rasmussen and Roitman (2011) show on a global scale that even oil price shocks only exhibit small and transitory negative effects for the majority of countries. Table 1 summarizes our assumptions on the persistent and transitory effects of the three orthogonal shocks discussed above.

### *B. Econometric model*

Formally, we use a structural vector autoregressive system with long-run restrictions for each commodity market. That is, the individual commodities are considered on a one-by-one

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<sup>4</sup> We are unable to directly include a proxy for inventories in this study due to data constraints.

basis. The econometric model for each commodity market includes three endogenous variables, notably the percentage change in global GDP ( $\Delta Y$ ), the percentage change in global production of the respective commodity ( $\Delta Q_i$ ), and the log of the real price of the respective commodity ( $\ln(P_i)$ ). The matrix of deterministic terms  $D$  consists of a constant and a linear trend. These deterministic terms are designed to account for long-run trends in the costs of production, the costs of trade, and the intensity of use of the respective commodity in the global economy.

We also add annual fixed effects for World War I and the three subsequent years after its conclusion (that is, from 1914 to 1921) as well as World War II and the three subsequent years after its conclusion (that is, from 1939 to 1948). These fixed effects are meant to control for the fact that world markets for commodities during these time periods were subject to market distortions related to government policy and restrictions to trade related to the nature of the conflicts.

The structural VAR representation is

$$(1) Ax_t = \alpha D_t + \beta_1^* x_{t-1} + \dots + \beta_p^* x_{t-p} + B\varepsilon_t,$$

where  $x$  is the vector of endogenous variables and  $\varepsilon$  is a vector of mutually and serially uncorrelated structural innovations. The reduced form coefficients are  $\beta_j = A^{-1}\beta_j^*$  for  $j = 1, \dots, p$ . The relation to the reduced form residuals is given by  $u_t = A^{-1}B\varepsilon_t$ . We impose zero restrictions on the long-run matrix of structural shocks by assuming that it is lower triangular (see Stuermer, 2016). This leaves the contemporaneous relationships completely unrestricted. We set the number of lags ( $p$ ) as four for all commodities for the benchmark regressions. We have also run the regressions allowing for a different number of lags across commodities with the number of lags being chosen according to the Akaike Information Criterion. The results

remain materially unaffected, and here, we focus on the former set of results for ease of presentation.

#### **4. Results**

We present results for a set of impulse response functions for and historical decompositions of real commodity prices in the following sub-sections.

##### *A. Impulse Response Functions*

Figures 5 to 7 present the impulse response functions for each commodity. The impulse response functions show how the percentage change in global GDP, the percentage change in global production of the respective commodity, and the log of the respective real commodity price react to a one-standard deviation change in one of the three respective shocks through time. We make use of the accumulated impulse response functions for the shocks to global commodity production and global GDP to illustrate the long-run effects on these variables. One of the purposes of this exercise is to ensure that our method produces economically meaningful results. In particular, we expect *a priori* that:

- (1) positive commodity demand shocks are associated with higher real global GDP, generally induce higher global commodity production, and serve to increase real commodity prices;
- (2) positive commodity supply shocks have limited effects on real global GDP, generally induce persistently higher global commodity production, and serve to decrease real commodity prices; and

(3) positive inventory or other commodity-specific demand shocks have limited effects on real global GDP, generally induce a muted response in global commodity production, and serve to increase real commodity prices.

Cumulatively, the impulse response functions demonstrate that the reaction of real prices to the different types of shocks are either in line with what one would reasonably expect or statistically insignificant. Positive commodity demand shocks and positive inventory or other commodity-specific demand shocks both serve to increase real commodity prices while positive commodity supply shocks serve to decrease real commodity prices. On average, the effects of commodity demand shocks are the most persistent, with effects lingering up to 10 years. This is followed by inventory or other commodity-specific demand shocks which are slightly less persistent, but with effects that also last up to 10 years in some cases. Finally, the effect of commodity supply shocks is, for the most part, insignificant. However, a few exceptions to this general result are to be found in the sugar and tin markets with effects which persist up to five years.

### *B. Historical Decompositions*

The historical decompositions show the contribution of each shock in driving fluctuations in each real commodity price series. They serve to quantify the independent contribution of the three shocks to the deviation of each commodity price from its base projection. Thus, Figures 8 to 10 depict the historical decomposition of booms and busts for each commodity under consideration here. The vertical scales are identical across the three sub-panels such that the figures illustrate the relative importance of a given shock. Another way of intuitively thinking about these historical decompositions is that each of the sub-panels represents a counterfactual

simulation of what the real price of a particular commodity would have been if it had only been driven by this particular shock.

For instance, take the case of commodity demand shocks. The collective story which emerges from our figures suggests that although the proportional contribution of the commodity demand shocks naturally varies across the different commodities, their accumulated effects broadly follow the same pattern with respect to timing across the 12 commodities (see Figure 11). Thus, commodity demand shocks affect real commodity prices to different degrees, but they affect the real commodity prices at the same time. These results then suggest that commodity demand shocks have a common source.

What is more, this interpretation of the accumulated commodity demand shocks is in line with what economic history has to say about fluctuations in global output. The historical decompositions start in 1875, when prices were depressed due to the negative accumulated effects of commodity demand shocks on prices during the first—but somewhat forgotten—great depression. Afterwards, the effects of commodity demand shocks are in line with our historical knowledge about the business cycles in major economies at the time. For example, the effects of the large negative commodity demand shock in 1907 can be associated to the so called Panic of 1907. Likewise, the early 1930s bear witness to the accumulated effects of a series of negative commodity demand shocks which sent real prices plummeting and which are clearly attributable to the—second—Great Depression.

After World War II, positive commodity demand shocks led to increases in real prices in the wake of the immediate post-war efforts at re-industrialization and re-urbanization in much of Europe and Japan as well as the later economic transformation of the East Asian Tigers and Japan. From 1970, negative commodity demand shocks are evident in the late 1970s, the early

1980s, and the late 1990s, respectively corresponding to the global recessions of 1974 and 1981 and the Asian financial crisis of 1997. These are followed in turn by a series of positive commodity demand shocks emerging from the late 1990s and early 2000s due to unexpectedly strong global growth, driven by the industrialization and urbanization of China. Finally, the lingering effects of the Global Financial Crisis are also clearly visible in the series for the accumulated effects of commodity demand shocks.

The historical decompositions show that inventory or other commodity-specific demand shocks also play an important role in driving fluctuations in real commodity prices, particularly in the short- to medium-run. For the most part, this type of shock follows idiosyncratic patterns across the examined commodities. Detailed historical accounts for base-metal markets provide evidence that this type of shock can also be attributed more often than not to changes in inventories by cartels, governments, and/or private firms (Stuermer, 2016). However, as this demand shock is, in fact, a residual term, it might also be explained by unexpected changes in the demand for specific commodities. For example, the United States introduced the copper-plated zinc penny in the 1980s which unexpectedly drove up the real price for zinc. Such events are naturally captured by this residual demand term.

In marked contrast, the accumulated effects of commodity supply shocks play a less important role in driving deviations in long-run real prices from their underlying trend for most of the commodities under consideration. Generally, this type of shock is idiosyncratic in the timing of its effects and only has a transient effect on real prices. That is, they only drive short-run fluctuations. However, there are two exceptions: commodity supply shocks dominate the formation of sugar prices and it is the second most important driver for tin prices as mentioned previously. Fairly ready explanations for these phenomena are the strong oligopolistic structure

of the two markets and their long history of government intervention (c.f., Stuermer, 2014 and United States Department of Agriculture, 1971). Thus, tin has been the only base-metal market in which cartel action and international commodity agreements have prevailed for extended periods of time while sugar also has a strong history of government intervention via cartel action, international commodity agreements, and especially tariffs.

Likewise, Table 2 numerically summarizes the contribution of each shock by commodity category and period. Thus, for the full period from 1871 to 2013 (Table 2, Panel A), commodity demand shocks explain 32-38% (across the three types of commodities examined here) of the variation in real commodity prices while inventory or other commodity-specific demand shocks explain 42-50%. These two types of shock, thus, cause an appreciable portion (74-82%) of the medium- and long-run fluctuations in real commodity prices. Conversely, commodity supply shocks play a rather secondary and transient role, explaining only 18-20% of the variation. This result is fairly consistent across agricultural, mineral, and soft commodities alike.

Averages for three sub-periods based on the full sample (see Table 2, Panels B to D) show that supply shocks have lost importance over time, as their average share declined from 24 percent in the period before World War I to 23 percent during the Interwar Period, and finally down to 16 percent in the period after World War II. At the same time, the average share of commodity demand shocks has increased from 29 percent in the pre-World War I period to 34 percent during the Interwar Period and up to 38 percent in the post-World War II period. While there are several potential explanations for this phenomenon, we leave their exploration to further research.

Results are robust to a number of different approaches to the data and econometric modelling. First, we have allowed for the possibility of non-linear trends in real commodity

prices. De-trended real commodity prices were derived via the Christiano-Fitzgerald asymmetric band-pass filter used in Jacks (2013). No material differences in our results were forthcoming. Second, we have used a shorter sample from 1900 to 2013 to reflect concerns about the quality of data, in particular, that for production in the nineteenth century. Again, the associated results are not qualitatively different than those presented here. Third, the results are by-an-large not sensitive to sub-period regressions for the time periods 1871-1938 and 1922-2013. Unfortunately, smaller sub-periods (e.g. for the interwar period alone) are not possible due to the low number of observations. Finally, we allowed for a different number of lags across commodities with the number of lags being chosen according to the Akaike Information Criterion. The results remain materially unaffected. Details on the sensitivity tests are available from the authors upon request.

## **5. Conclusions**

This paper is the first in providing evidence on the drivers of real commodity prices in the long-run across different types of commodities. To this end, we assemble a new data set on the level of price and production for 12 commodities, spanning the categories of agricultural, metal, and soft commodities from 1870 to 2013. We establish that commodity demand shocks and inventory or other commodity-specific demand shocks strongly dominate commodity supply shocks in driving the fluctuation in real commodity prices over a broad set of commodities and over a broad period of time.

Additionally, we find that the contribution of commodity demand shocks to real prices varies across the different commodities. However, commodity demand shocks exhibit common patterns with respect to timing across the markets for agricultural, metal, and soft commodities. Inventory or other commodity-specific demand shocks are the most important driver in

commodity price fluctuations for most of our agricultural and soft commodities. Commodity supply shocks play some role in explaining fluctuations for particular commodities, but in the main, their influence on real commodity prices is limited in impact and transitory in duration.

There are significant differences in the persistence across the different types of shocks. While commodity demand and inventory or other commodity-specific demand shocks affect prices up to 10 years, supply shocks only have an effect for up to 5 years. Finally, commodity demand shocks have gained importance over time; commodity supply shocks have become less relevant.

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## Appendix I

This appendix details the sources of the real commodity prices and production used throughout this paper.

### *Prices*

There are a few key sources of price data: the annual Sauerbeck/*Statist* (SS) series dating from 1850 to 1950; the annual Grilli and Yang (GY) series dating from 1900 to 1986; the annual unit values of mineral production provided by the United States Geographical Survey (USGS) dating from 1900; the annual Pfaffenzeller, Newbold, and Rayner (PNR) update to Grilli and Yang's series dating from 1987 to 2010; and the monthly International Monetary Fund (IMF), United Nations Conference on Trade and Development (UNCTAD), and World Bank (WB) series dating variously from 1960 and 1980. The relevant references are:

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- Copper*: 1870-2013, Stuermer.
- Corn*: 1870-1999, Global Financial Data; 2000-2013, United States Department of Agriculture National Agricultural Statistics Service.
- Cotton*: 1870-1899, SS; 1900-1959, GY; 1960-2013, WB.
- Cottonseed*: 1874-1972, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of*

*Statistics*. Baltimore and London: Johns Hopkins Press; 1973-2013, National Agricultural Statistics Service.

*Lead*: 1870-2013, Stuermer.

*Rice*: 1870-1899, SS; 1900-1956, GY; 1957-1979, Global Financial Data; 1980-2013, IMF.

*Rye*: 1870-1970, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of Statistics*. Baltimore and London: Johns Hopkins Press; 1971-2013, National Agricultural Statistics Service.

*Sugar*: 1870-1899, SS; 1900-1959, GY; 1960-2013, WB.

*Tin*: 1870-2013, Stuermer.

*Zinc*: 1870-2013, Stuermer.

### ***Production***

There are a few key sources of production data: the annual FAOSTAT (FAO) series for global production dating from 1961 to 2013; the annual Mitchell (MIT) series for country-level production dating from 1870 to 2010.

The relevant references are:

Food and Agricultural Administration of the United Nations Statistics,  
<http://faostat3.fao.org/home/E>

Mitchell, B.R. (2013), *International Historical Statistics, 1750-2010*,  
<http://www.palgraveconnect.com/pc/archives/ihs.html>.

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*Copper*: 1870-2013, Stuermer.

*Corn*: 1870-1961, MIT; 1962-2013, FAO.

*Cotton*: 1870-1961, MIT; 1962-2013, FAO.

*Cottonseed*: 1870-1961, MIT; 1962-2013, FAO.

*Lead*: 1870-2013, Stuermer.

*Rice*: 1870-1961, MIT; 1962-2013, FAO.

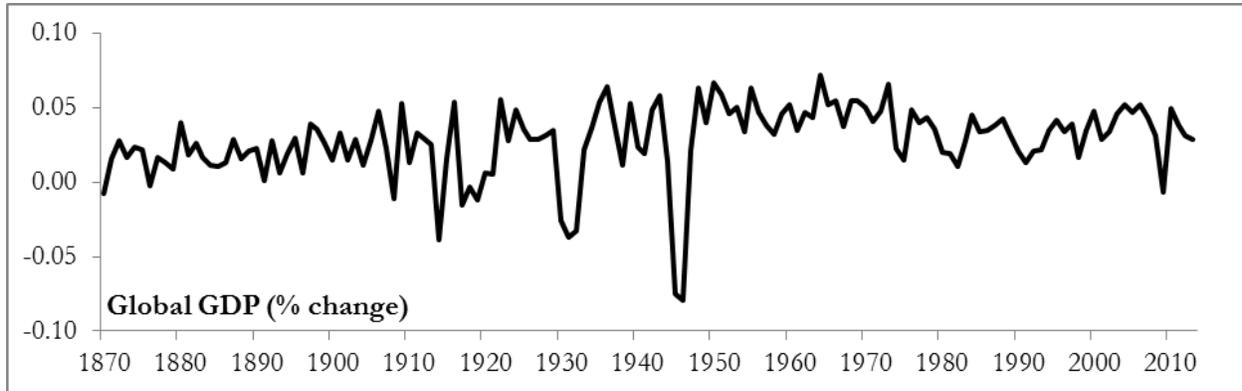
*Rye*: 1870-1961, MIT; 1962-2013, FAO.

*Sugar*: 1870-1961, MIT; 1962-2013, FAO.

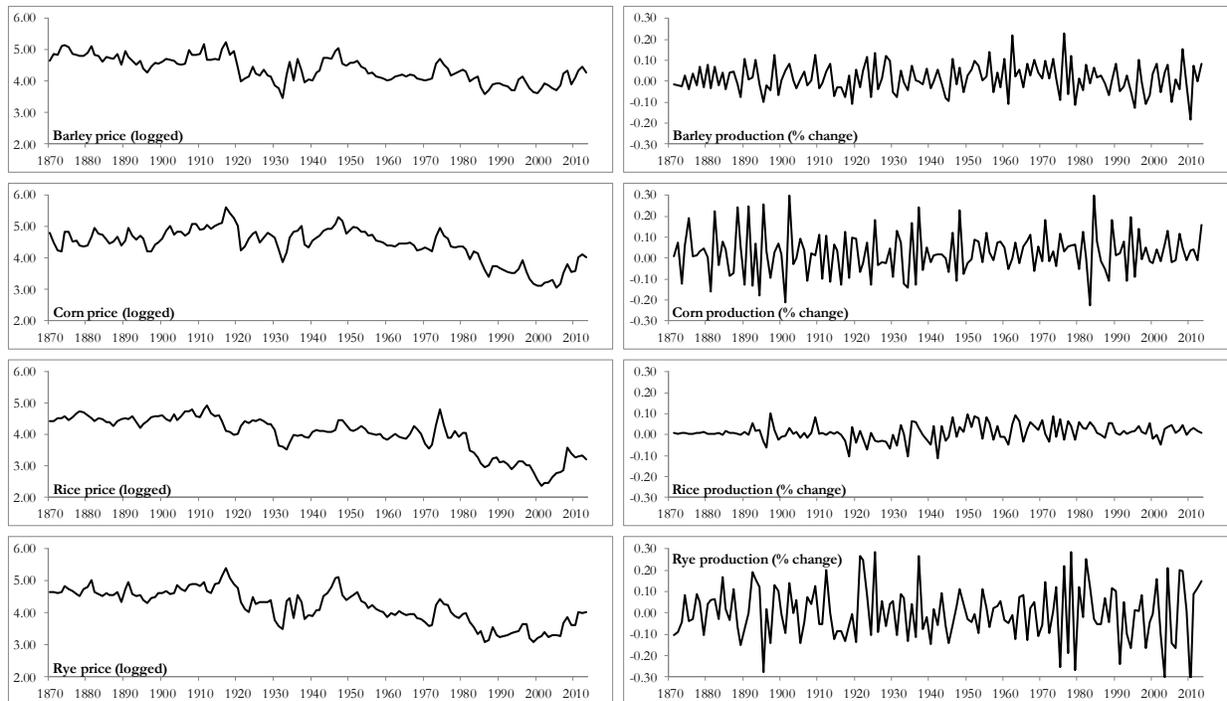
*Tin*: 1870-2013, Stuermer.

*Zinc*: 1870-2013, Stuermer.

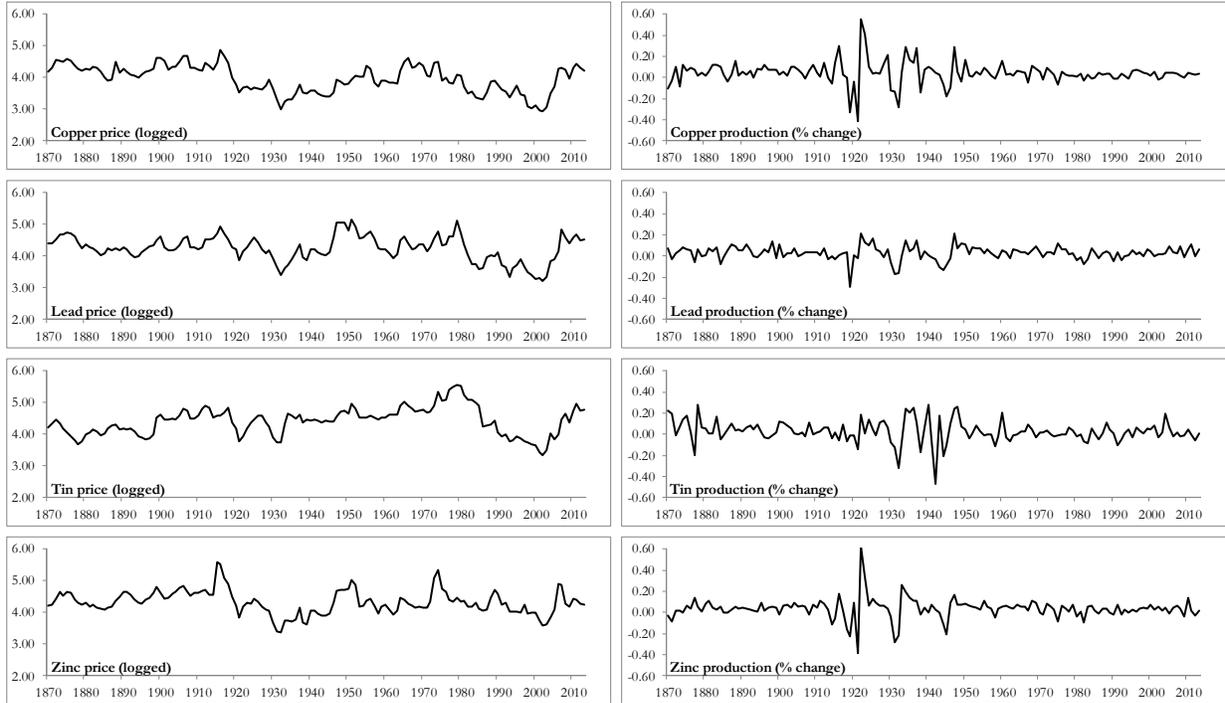
**Figure 1: Evolution of Global GDP, 1870-2013**



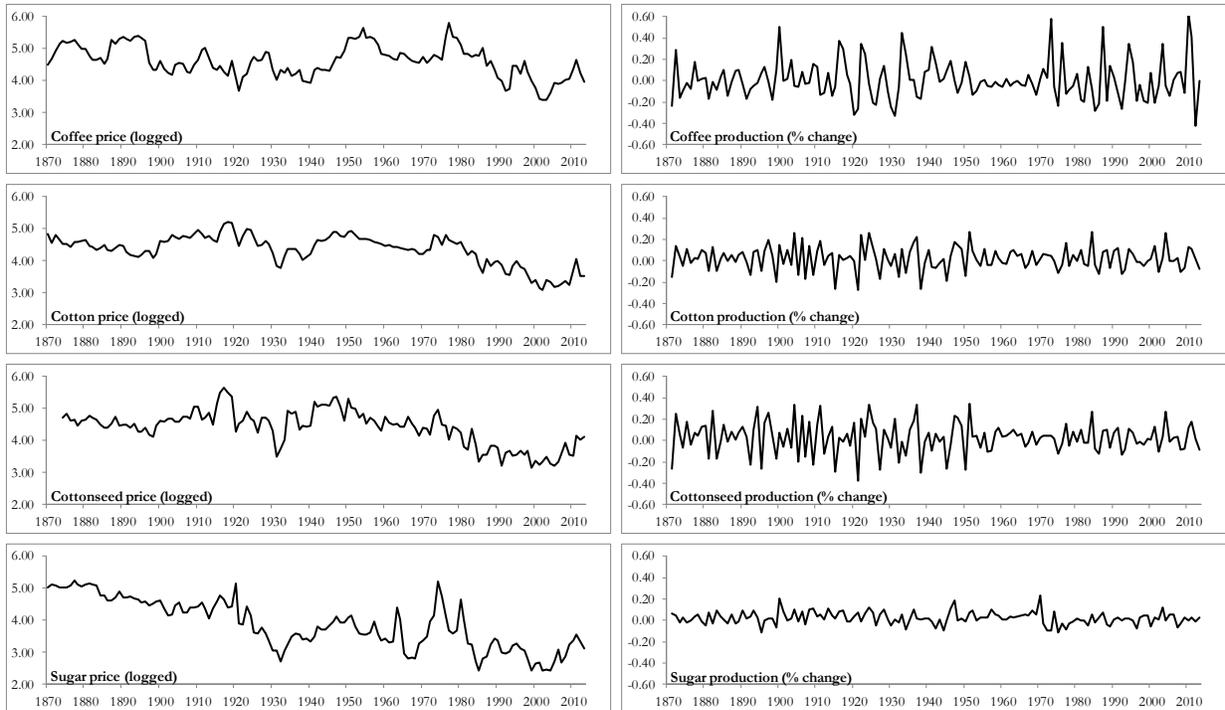
**Figure 2: Evolution of Agricultural Prices and Production**



**Figure 3: Evolution of Metal Prices and Production**



**Figure 4: Evolution of Soft Commodity Prices and Production**



**Table 1: Assumptions on Possible Effects of Three Orthogonal Shocks on Three Endogenous Variables**

**A. Persistent Effects**

	Global GDP	Production	Price
Commodity Demand Shock	YES	YES	YES
Commodity Supply Shock	NO	YES	YES
Commodity-Specific Demand Shock	NO	NO	YES

**B. Transitory Effects**

	Global GDP	Production	Price
Commodity Demand Shock	YES	YES	YES
Commodity Supply Shock	YES	YES	YES
Commodity-Specific Demand Shock	YES	YES	YES

Figure 5: Impulse Response Functions for Agricultural Commodities

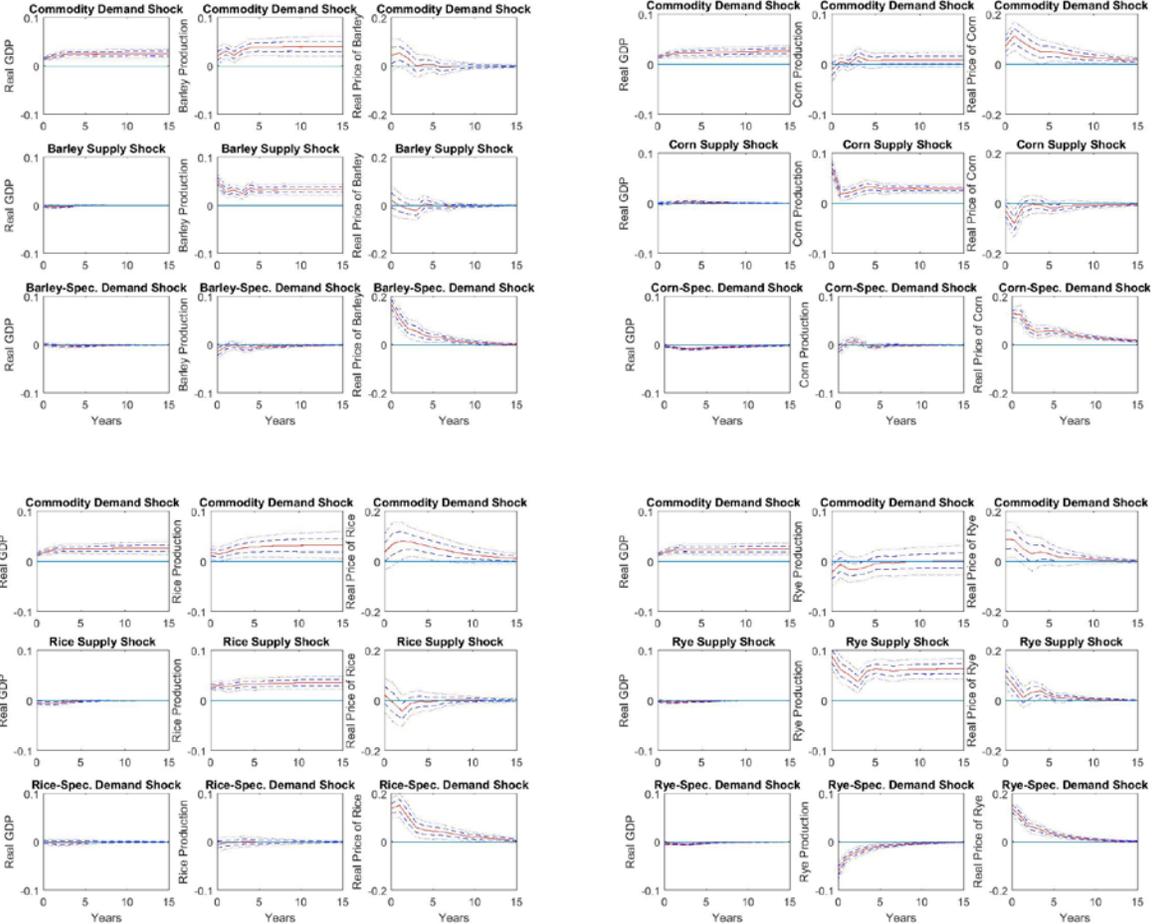
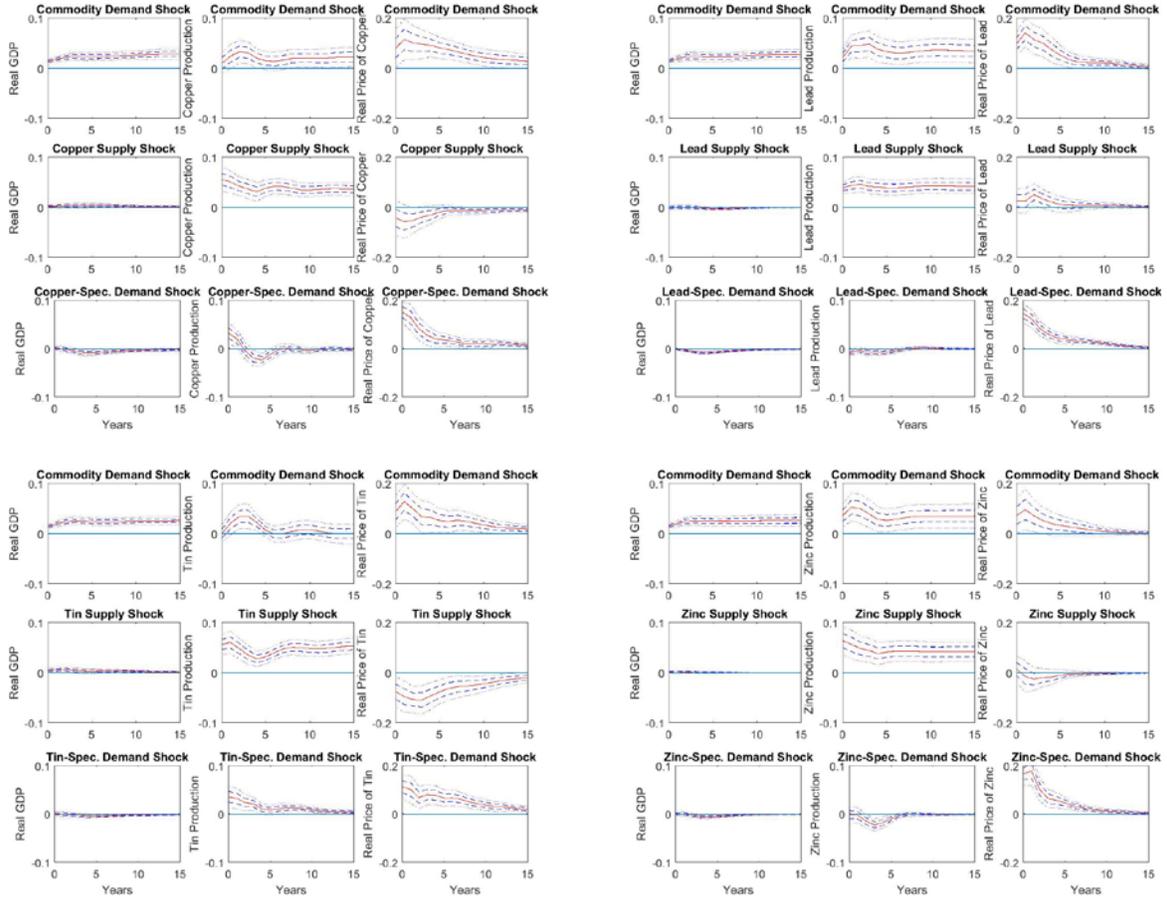
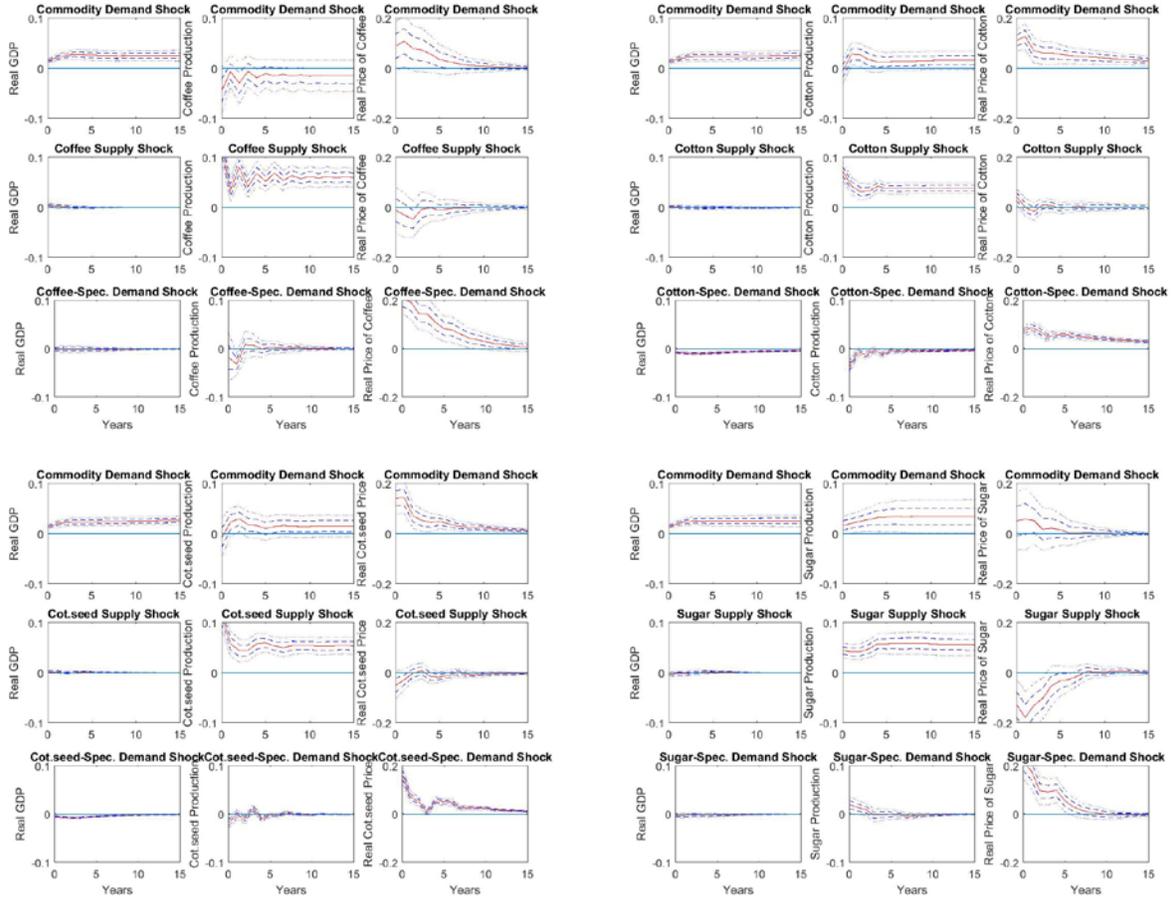


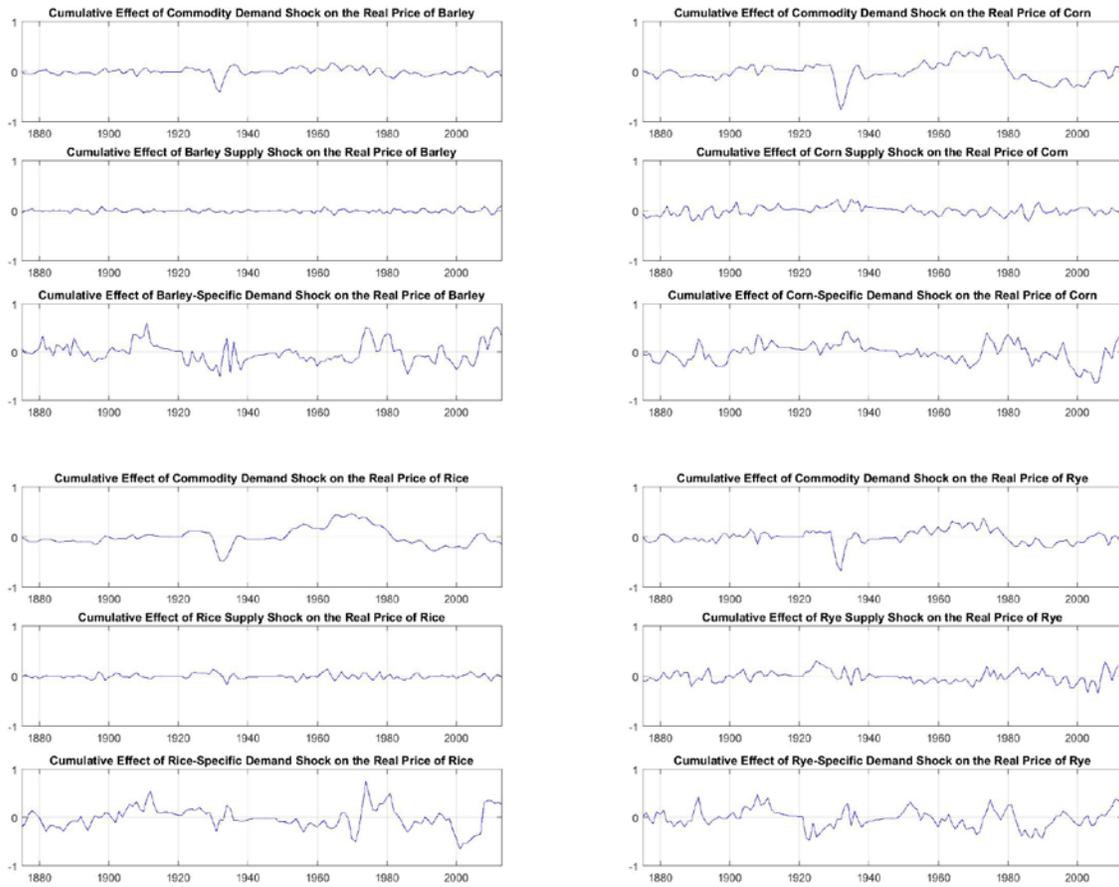
Figure 6: Impulse Response Functions for Metals



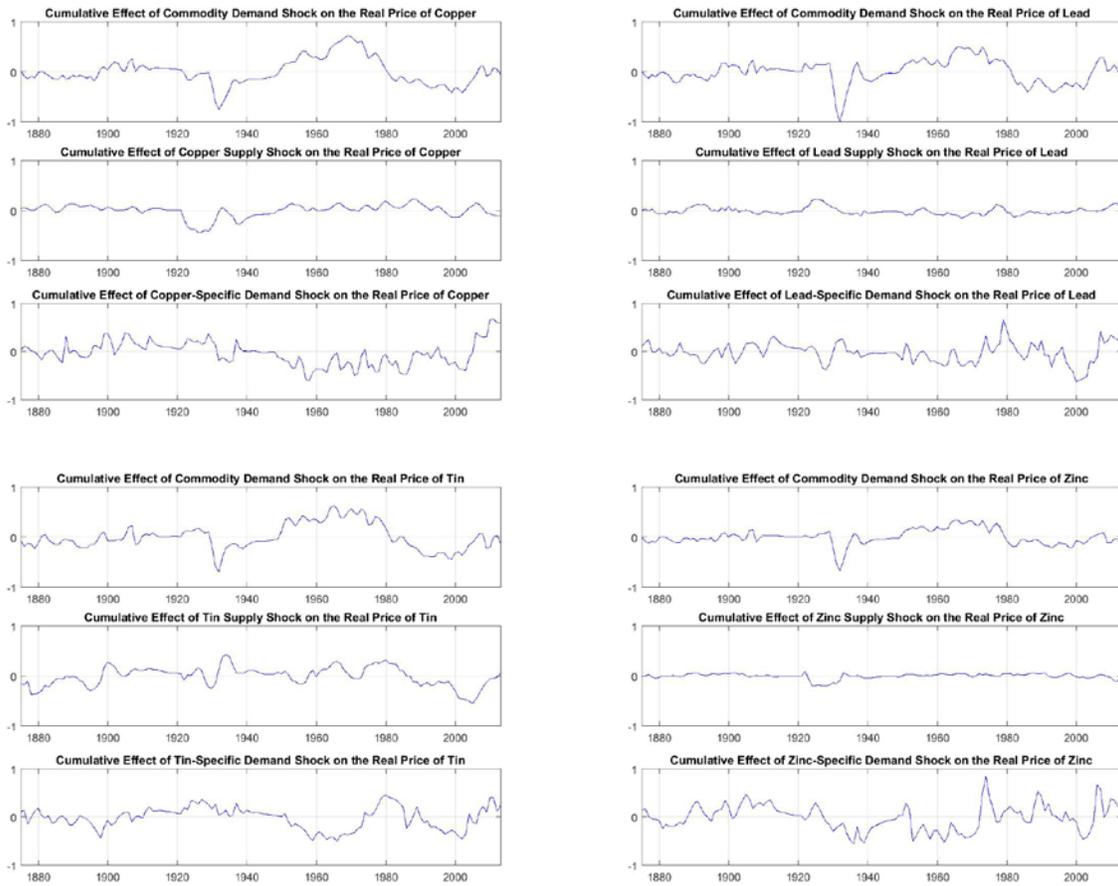
**Figure 7: Impulse Response Functions for Soft Commodities**



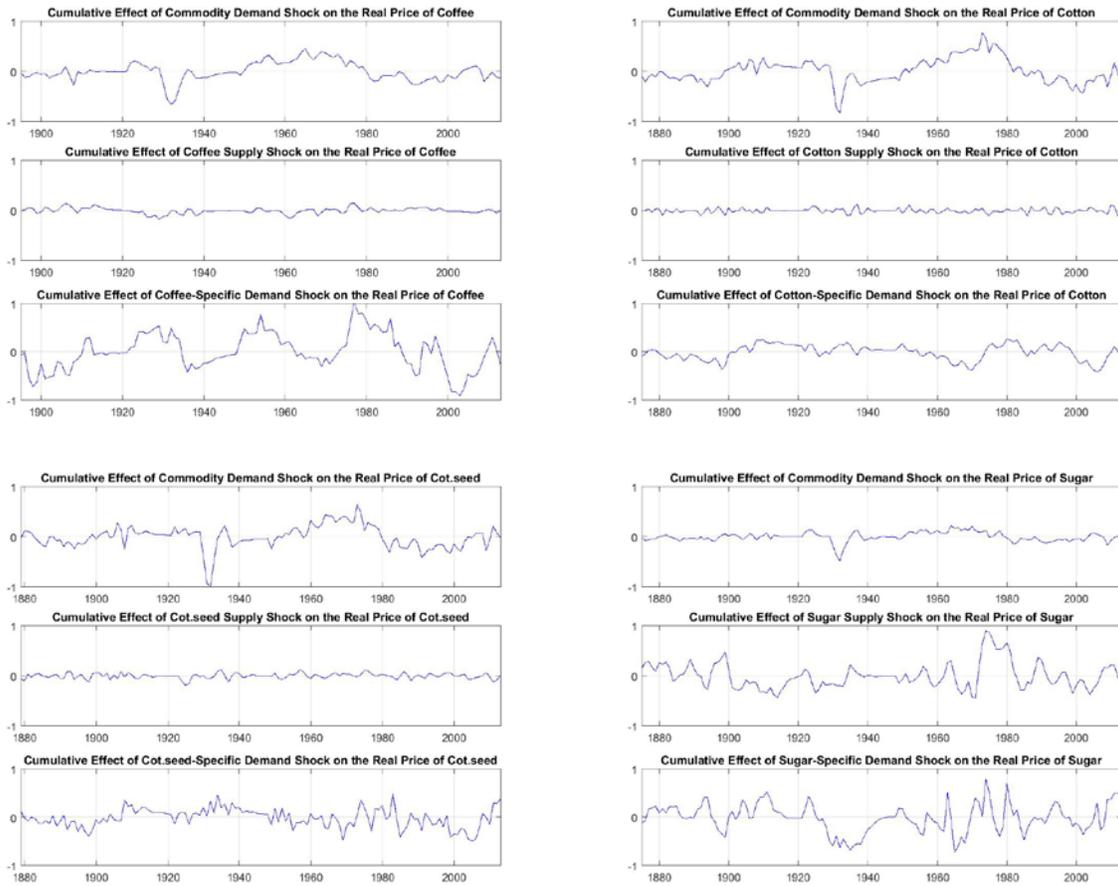
**Figure 8: Historical Decompositions of Real Agricultural Commodity Prices**



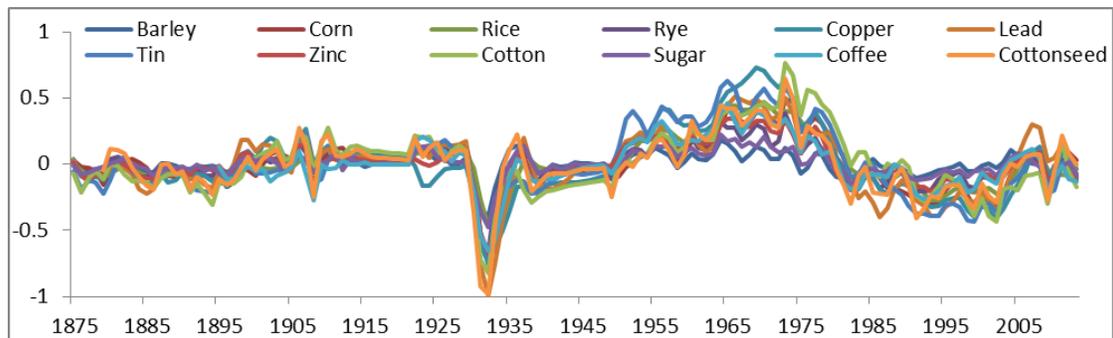
**Figure 9: Historical Decompositions of Real Metal Prices**



**Figure 10: Historical Decompositions of Real Soft Commodity Prices**



**Figure 11: Cumulative Effects of Commodity Demand Shocks on Different Real Commodity Prices**



**Table 2: Shares of Shocks in Explaining Commodity Price Booms and Busts by Period**

Panel A: 1871-2013			
	Commodity demand shock	Commodity supply shock	Commodity-specific demand shock
Grains	0.32	0.18	0.50
Metals	0.38	0.20	0.42
Softs	0.34	0.20	0.44
Total	0.35	0.20	0.46

Panel B: 1871-1913			
	Commodity demand shock	Commodity supply shock	Commodity-specific demand shock
Grains	0.26	0.23	0.52
Metals	0.33	0.24	0.44
Softs	0.27	0.24	0.48
Total	0.29	0.24	0.47

Panel C: 1919-1939			
	Commodity demand shock	Commodity supply shock	Commodity-specific demand shock
Grains	0.32	0.19	0.49
Metals	0.34	0.27	0.38
Softs	0.35	0.19	0.46
Total	0.34	0.23	0.45

Panel D: 1949-2013			
	Commodity demand shock	Commodity supply shock	Commodity-specific demand shock
Grains	0.37	0.16	0.47
Metals	0.42	0.16	0.42
Softs	0.38	0.18	0.45
Total	0.38	0.16	0.46