UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Inclusive and Sustainable Industrial Development Working Paper Series
WP 8 | 2018

ON THE DEVELOPMENT AND IMPACT OF COMMODITY PRICES AND CYCLES

DEPARTMENT OF POLICY, RESEARCH AND STATISTICS

WORKING PAPER 08/2018

On the development and impact of commodity prices and cycles

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Vienna, 2018

This is a background paper for UNIDO Industrial Development Report 2018: Demand for Manufacturing: Driving Inclusive and Sustainable Industrial Development.

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Abstract

In this paper, we observe the evolution of different commodity prices in a long-term perspective. We primarily use the "World Bank's Global Economic Monitor, Commodities", which covers data from 1960 to 2015 for 52 individual commodities. Following an initial descriptive analysis of commodity price developments, we follow the approach of Erten and Ocampo (2013) and apply the asymmetric Band-Pass (BP) filter of Christiano and Fitzgerald (2003) to consider the developments in medium-term cycles and super-cycles for different commodity groups. We further follow Collier and Goderis (2012), who use panel error correction models, to examine the short- and long-term effects of international commodity prices on output per capita. The results indicate that many commodities have reached the peak of the latest super-cycle and are often on the downward slope of a medium-term cycle, while on the other hand, the long-term trend in prices is positive. We also find evidence suggesting that cycles of different commodities are often not well synchronized, suggesting that it may not be relevant to talk of a global commodity price cycle and that drawing general recommendations and conclusions may be quite challenging. Finally, we show that while there is evidence of a long-term negative impact of commodity prices on per capita GDP, it tends to be limited to energy, with the effects of rising non-energy commodity prices tending to have a positive long-term impact on per capita GDP. The short-term effects of commodity price growth on per capita GDP growth tend to be positive.

1 Introduction

Understanding developments in the trajectory of commodity prices is highly relevant for policymaking in both the developed and the developing world. The debate on commodity prices dates back a long way, with the contributions of Prebisch (1950) and Singer (1950) being particularly relevant. In contrast to the conventional view at the time, these authors defended the argument that the international division of labour—via demand—generates a tendency for increases in manufacturing prices relative to commodity prices (thus increasing the gap between advanced and developing countries). The conventional view—a supply-side perspective—was based on three elements: 1) rapid technological progress in manufacturing; 2) the Ricardian perspective of diminishing returns in the production of primary goods; and 3) increases in population. These three elements are expected to generate a long-term decline in manufacturing prices relative to commodities (Otero, 2011). The Prebisch-Singer hypothesis, in radical opposition to these conventional conclusions, emerged as an important topic in the economic debate from the 1950s to 1970s. For this reason, a substantial amount of literature has been published, identifying the main properties and main determinants of commodity prices (see, for example, Frankel and Rose, 2009; Borensztein and Reinhart, 1994). One strand of the literature has sought to identify the long-term trends in commodity prices, and has in particular looked to find support or otherwise for the Prebisch-Singer hypothesis (see, for example, Grilli and Yang, 1988; Kim et al., 2003), though evidence in favour of the hypothesis remains mixed (Baffes and Etienne, 2016). A further and more recent strand of the literature has focused on identifying cycles in commodity prices. The reasons for such an approach relate to efforts to stabilise the macroeconomic impact of commodity price shocks, which requires a solid understanding of the duration and amplitude of commodity price cycles.

Some of the recent literature on developments in the terms of trade is framed in the context of the commodity price increase of the 2000s. Since 2002, there has been a major increase in commodity prices. Oil prices, followed by metal and food prices, increased throughout the early 2000s, benefiting commodity-exporting countries. In recent years, however, commodity prices have begun to fall relatively rapidly. Many papers, including Alquist and Coibion (2014), have tried to determine the reasons for the increase in the commodity cycle since 2002. For authors such as Erten and Ocampo (2013) and Reinhart (2016), the increase is related to a long-term commodity cycle, which is showing signs of having reached its peak in recent years. If this is true, such an outcome may suggest limited opportunities for commodities-based development in coming years.

Many recent papers that consider cycles in different economic series use various filtering methodologies, one of the most popular being the Band-Pass (BP) filter developed by Baxter and King (1999) and Christiano and Fitzgerald (2003). Comin and Gertler (2006), Boshoff (2010) and Zhu (2011), among others, estimate the cyclical components of business activity (i.e. they estimate the duration of business cycles), Drehmann et al (2012) use filtering techniques to consider short- and medium-term cycles in financial series, while Cuddington and Jerrett (2008), Jerrett and Cuddington (2008) and Erten and Ocampo (2013) consider cycles for various commodity price indices. One interesting aspect of these latter studies is that they consider the presence of very long-term or super-cycles with a periodicity between 30 and 70 years, with evidence suggesting that there have been a number of super-cycles over the period 1850 – 2010. Erten and Ocampo (2013) suggest the presence of a commodity cycle starting after 2003, with some evidence indicating that this cycle has been reverting since 2013 (Gruss, 2014). Using data for the period 1960 – 2015, we look for signs that may confirm this hypothesis.

In their study on business cycles, Comin and Gertler (2006) note the possibility of medium-term cycles, arguing that these tend to be longer than the typical business cycle. In conventional business cycle analysis, these medium-term cycles tend to get swept into the long-term ones. The presence of such medium-term business cycles has implications for the analysis of commodity price developments. To the extent that commodity prices are driven by demand, we may expect to find similar cycles in commodity prices. In this paper, we therefore consider the possibility that both super-cycles and medium-term cycles may be present in commodity price data. A recent study by Ojeda and Jaulin (2014) also considers this possibility, exploring both medium-term and super-cycles in the commodity price data of Grilli and Yang (1988).

Our analysis begins with a description of recent trends in world commodity prices, starting with broad commodity aggregates before looking at developments in sub-aggregate price indices. The discussion moves on to look at the possibility of cycles in commodity prices, considering both super-cycles and medium-term cycles (Comin and Gertler, 2006). While our evidence appears to confirm the view that many commodities have reached the peak of the most recent super-cycle and are often on the downward slope of a medium-term cycle, there is also evidence of the long-term trend in prices being positive. We further examine the synchronization of the different commodity price cycles, finding evidence suggesting that cycles of different commodities are often not well synchronized, which given the fact that countries specialize in different commodities, may suggest that drawing general recommendations and conclusions may be quite challenging. Finally, we link developments in commodity prices to economic growth at the country level, examining the extent to which the levels and changes in commodity

prices impact short- and long-term per capita GDP growth. The results suggest that while there is evidence of a long-term negative impact of commodity prices on per capita GDP, it tends to be limited to energy, with the effects of rising non-energy commodity prices tending to have a positive long-term impact on per capita GDP growth. The short-term effects of commodity price growth on per capita GDP growth tend to be positive.

The remainder of this paper is set out as follows. Section 2 discusses the data used in the analysis; Section 3 describes recent developments in commodity price indices, considering specific commodity prices in addition to more general commodity price indices; Section 4 examines the developments in commodity price cycles; Section 5 discusses whether different commodity price cycles are well synchronized; Section 6 uses the results of Section 5 to motivate the idea of looking at either country- or region-specific commodity prices, and reports results on the development in regional commodity price cycles; Section 7 describes the methodology and presents the results of a regression analysis of the relationship between commodity prices and economic growth; Section 8 concludes.

2 Data

In order to carry out an analysis of the developments in commodity prices, we require a time-series on commodity prices over a long period of time. Two major sources of data on commodity prices were considered, each with its advantages and disadvantages. The first data source is the commonly used data of Grilli and Yang (1988). The advantage of this data is that it is available all the way back to 1900, and with the recent update of Pfaffenzeller et al. (2007) now runs to 2011.[1] This data comprises 24 individual primary commodities, along with manufacturing unit values for a G5 aggregate, an aggregated non-oil commodity price index and sub-indices for metals, non-food agricultural commodities and agricultural food commodities. The major shortcoming of this data is that it is limited to the period up to 2011 and therefore does not allow for an analysis of the most recent period. The series also does not include information on oil prices.

The second source of data is the World Bank's Global Economic Monitor Commodities and the World Bank's Commodity Markets Pink Sheet.[2] This covers annual data from 1960 to 2015, as well as monthly data from January 1960 to June 2016 for 52 separate commodities (with 74 different price indices), including crude oil and other energy prices. No overall commodity price index is reported in the Pink Sheet, though methods are described for aggregating the different

[1] Data can be downloaded at http://www.stephan-pfaffenzeller.com/cpi.html (accessed 3 August 2016).
[2] Data can be downloaded at http://www.worldbank.org/en/research/commodity-markets (accessed 3 August 2016). The data is updated regularly such that the series runs from 1960 until roughly the current period.

indices into commodity groups, including an energy and a non-energy component (see Figure A1 in the Appendix for details of their construction). Data on annual manufacturing unit values are only available up to 2013. To update the manufacturing unit value index to 2015, we use data on export and import prices for the EU, USA, Canada, Switzerland, Japan, China, Republic of Korea, Singapore and Chinese Taipei from the World Trade Organization's monthly statistics of export and import prices of manufactured goods (SITC sections 5 to 8). This dataset includes data from January 2005 onwards.[3] We use the annual average of the monthly world manufacturing price index (measured as a weighted average of the countries' export and import prices) to construct an annual index and then splice it with the reported manufacturing unit value data from the World Bank to give us a time-series that spans the full period 1960 – 2015.

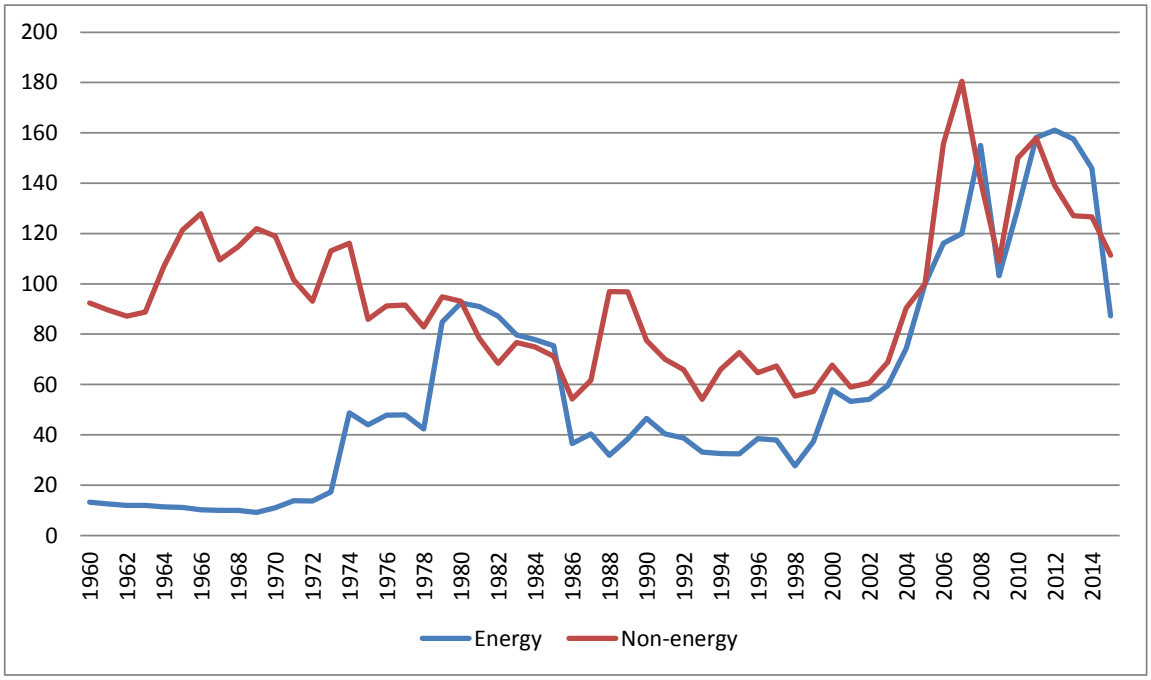
In the main text, we use data from the World Bank's Economic Monitor, Commodities, allowing us to consider the most recent period in our analysis. In a separate appendix we also report some results on cycles and super-cycles using the Grilli and Yang database, further comparing the results for the period in which the two series overlap.

3 Recent developments in world commodity prices

Figure 1 presents the developments in the prices of energy and non-energy commodities for the period 1960 – 2015. These data have been deflated using the manufacturing unit value index, with the indices being set equal to 100 in 2005. This figure shows the price spikes for energy commodities around 1973 and 1978, as well as the more recent increase in energy prices, which tended to be more protracted and more intense than earlier spikes. From 1998 to the pre-crisis peak in 2008, energy prices increased nearly five-fold, and following a drop in prices in 2009 and 2010 in response to the global financial crisis, increased further throughout 2011 and 2012. Since 2012, however, energy prices have declined rapidly, and in 2015 stood at barely half the price recorded in 2012. For the non-energy price series, a different pattern emerges. Most notably—with the exception of short-term fluctuations—there was a general downward trend in non-energy prices from the mid-1960s until the early 2000s. Following the initial increase in energy prices, the price for non-energy commodities also began to rise, with non-energy prices nearly tripling between 2002 and the pre-crisis peak of 2007. Similar to energy prices, the price of non-energy commodities fell in response to the global financial crisis before recovering in 2010 and 2011, but then quickly began to fall again, being 40 per cent lower than the 2007 peak in 2015.

[3] Data can be downloaded at https://www.wto.org/english/res_e/statis_e/short_term_stats_e.htm (accessed 3 August 2016).

Figure 1 **Developments in energy and non-energy price series**



Note: This figure illustrates the developments in energy and non-energy prices (deflated by a manufacturing price index) for the period 1960 – 2015. Both series are set equal to 100 in 2005.

Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

For the energy and non-energy aggregates as well as some of the individual price series, Table 1 reports the mean, standard deviation and coefficient of the variation of the different (deflated) commodity price indices for four roughly equal time periods (1960 – 74; 1975 – 1989; 1990 – 2004; 2005 – 2016). The table presents figures on developments in a selection of individual (deflated) commodity price indices for different commodities for the period 1960 – 2015.

The data reported in Table 1 point to a number of interesting conclusions. Most importantly, comparing the first and last periods, we observe an increase in the price level over time for both energy and non-energy aggregates. The increase in the case of energy is extremely high, with prices in the latter period (2005 – 2016) being around eight times higher than those in the initial period (1960 – 1974). This considerable price hike was driven by all three energy commodities (coal, crude oil and natural gas), with the increases in crude oil (835 per cent) and natural gas (485 per cent) being particularly pronounced. In the case of non-energy prices, the change was much smaller (27 per cent), with prices found to actually be substantially lower in the two intermediate periods (1975 – 1989 and 1990 – 2004) than in the initial period. This notwithstanding, prices increased for most non-energy commodities. Significant increases in the price of precious metals were observed over the period, most notably for gold, while—with the exception of aluminium—the price of different metals and minerals also increased over the

period. The major exception to these positive price trends was for agricultural prices, with the price of agricultural goods dropping by around 25 per cent between the first and last period. The price drops were most notable for cereals and to a lesser extent for oils and minerals and beverages.

The second relevant piece of information we glean from this table relates to the volatility of commodity prices across the different periods captured by the coefficient of variation. The first finding we can draw from the results on the coefficient of variation is that energy prices were less volatile in the most recent period (2005 – 2016) compared with the earliest period (1960 – 1974) and the two intermediate periods (1975 – 1989 and 1990 – 2004). This is true for both crude oil and particularly for natural gas, with the results suggesting increased volatility in coal prices. Conversely, non-energy prices are found to be more volatile in the latter period compared with earlier periods, though not dramatically so. This higher volatility tends to be driven by certain metals and minerals prices, in particular aluminium, iron ore, tin and nickel, as well as the relatively high volatility of silver prices.

Table 1 **Standard deviation and coefficient of variation of deflated price indices by period**

	Mean				Standard Deviation				Coefficient of Variation			
	1960-74	1975-1989	1990-2004	2005-2015	1960-74	1975-1989	1990-2004	2005-2015	1960-74	1975-1989	1990-2004	2005-2015
Energy	14.41	61.16	44.29	130.39	9.70	22.90	12.95	26.72	0.67	0.37	0.29	0.20
Crude oil	13.94	59.10	42.84	130.38	9.39	23.36	13.15	26.95	0.67	0.40	0.31	0.21
Coal	67.26	103.40	71.70	138.49	7.81	25.47	14.96	38.41	0.12	0.25	0.21	0.28
Natural Gas	18.38	57.43	48.76	107.35	4.05	19.54	14.27	15.34	0.22	0.34	0.29	0.14
Non-Energy	106.87	81.24	66.50	136.19	13.79	13.34	9.30	24.28	0.13	0.16	0.14	0.18
Agriculture	175.39	126.15	104.76	133.16	20.94	21.65	5.89	16.90	0.12	0.17	0.06	0.13
Cereals	226.71	157.47	99.73	149.21	54.11	46.78	11.45	29.21	0.24	0.30	0.11	0.20
Oils and Meals	203.72	150.05	99.78	150.67	37.90	41.38	14.76	30.05	0.19	0.28	0.15	0.20
Other Food	119.04	95.94	83.43	106.59	14.11	8.25	7.80	12.53	0.12	0.09	0.09	0.12
Beverages	184.59	218.83	99.96	134.88	11.03	85.63	20.90	22.29	0.06	0.39	0.21	0.17
Agricultural Raw Materials	151.48	107.77	108.37	120.90	31.87	10.97	6.86	12.07	0.21	0.10	0.06	0.10
Metals and Minerals	99.09	76.03	62.10	136.42	15.72	14.07	10.40	27.03	0.16	0.19	0.17	0.20
Aluminium	114.79	102.48	80.51	98.01	11.18	20.19	8.93	19.09	0.10	0.20	0.11	0.19
Iron Ore	62.40	56.49	49.54	147.48	10.97	8.78	5.30	46.12	0.18	0.16	0.11	0.31

Copper	119.49	65.75	59.96	157.97	32.46	11.44	11.14	27.92	0.27	0.17	0.19	0.18
Lead	105.99	89.83	61.92	171.71	21.53	33.56	13.53	36.08	0.20	0.37	0.22	0.21
Tin	181.39	214.69	79.81	201.53	32.33	72.58	12.20	57.67	0.18	0.34	0.15	0.29
Nickel	58.05	58.48	53.79	118.09	7.92	19.59	15.45	44.11	0.14	0.33	0.29	0.37
Zinc	95.66	86.39	80.53	137.45	40.15	18.32	13.62	43.00	0.42	0.21	0.17	0.31
Fertilizer	91.43	88.68	67.23	156.57	51.52	28.30	8.98	47.43	0.56	0.32	0.13	0.30
Precious Metals	40.61	101.62	78.40	202.65	12.83	30.77	8.52	62.77	0.32	0.30	0.11	0.31
Gold	39.87	105.08	80.38	208.68	13.90	32.01	8.73	67.23	0.35	0.30	0.11	0.32
Platinum	47.20	58.70	55.56	131.28	5.14	17.22	17.15	18.40	0.11	0.29	0.31	0.14
Silver	85.31	154.33	70.56	220.50	24.44	75.56	9.18	86.44	0.29	0.49	0.13	0.39

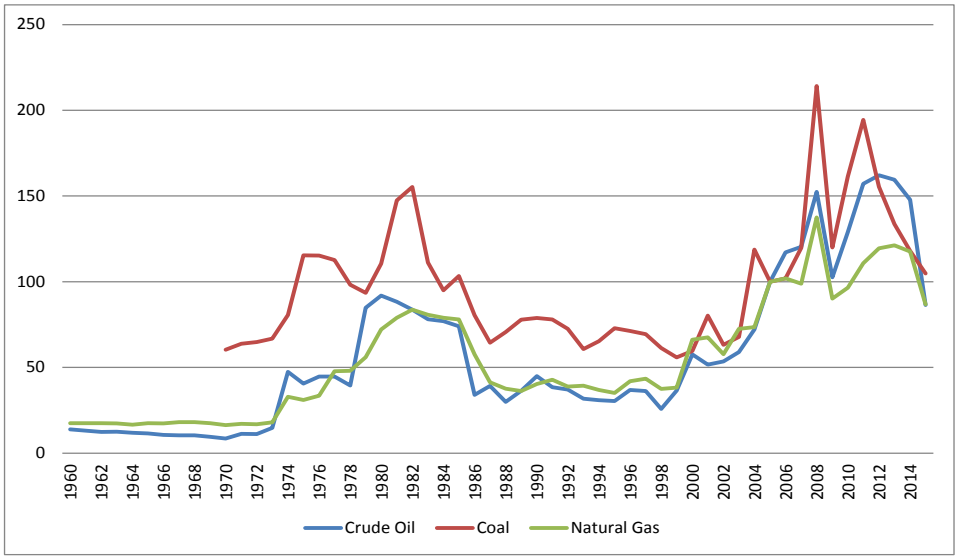
Notes: This table reports the average price of commodity aggregates and individual commodities across different time periods, along with the corresponding standard deviation and coefficient of variation. All commodity prices are deflated using a manufacturing unit value index (see Appendix I).

Figure 2 reports price developments in the commodities that make up the energy price index, namely crude oil, coal and natural gas. The figure shows that the three individual price series appear to be highly synchronized and tend to track each other quite closely. Price spikes for all of the series appear in 1973 and 1978, with the increase being more gradual for natural gas than for the other two commodities. The steep rise in prices from 1998 until the global financial crisis also appears for all three commodities, though again the rise and the extent of volatility appear smaller for natural gas than for the other two commodities.

Figure 3 presents the developments for different series constituting the agriculture price index. The developments differ quite substantially from those of energy prices, with declining prices observed over the period 1960 – 2015 for all price series, except other food. Price volatility tended to be higher during the 1970s, especially in the case of beverages, cereals and to a lesser extent oils and meals. Significant increases in prices were observed after the early 2000s, with these increases ceasing for cereals and oils and meals with the onset of the global financial crisis. While prices for these two commodities declined after 2012, there is no evidence of declining prices for other agricultural commodities.

Figure 4 and Figure 5 report price developments for metals and precious metals. The developments in metals prices are highly variable. During the 1960s and 1970s, the price for many metals was relatively high, most notably for tin and copper, and lower for others (e.g. nickel and iron ore). From the late 1980s to the early 2000s, the prices for all metals were relatively low. Prices for all metals rose from the early 2000s until the crisis of 2008; since then, declining prices have been observed, with particularly strong decreases for aluminium, nickel, iron ore and zinc. Relative to metals prices, the price of precious metals was quite stable up to 2000. The exception to this is a short-term price spike around 1980, which was particularly strong for silver. From 2000 onwards, prices rose rapidly, particularly for silver and gold, with considerable declines in prices after 2008.

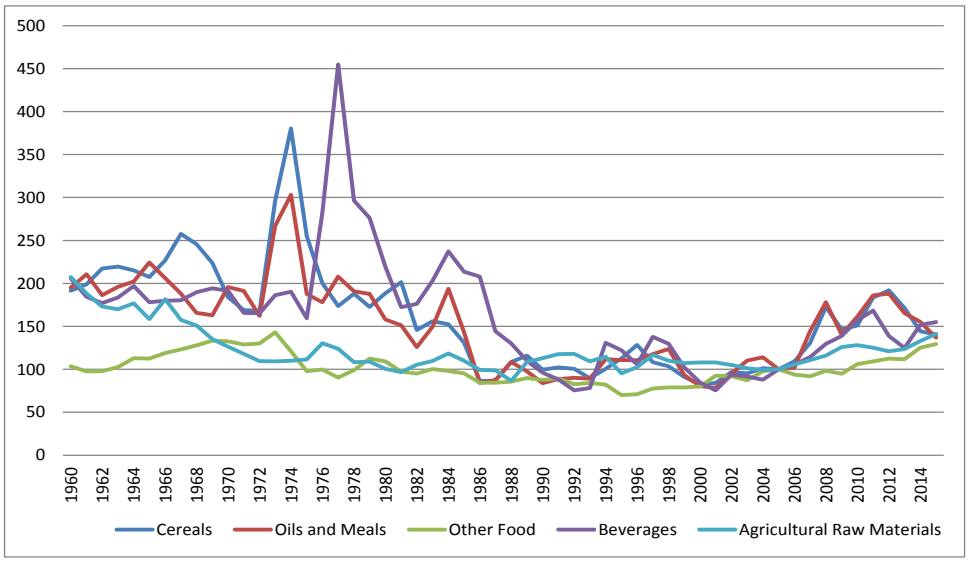
Figure 2 Developments in energy price components



Note: This figure reports the developments in different energy price indices (deflated by a manufacturing price index) for the period 1960 – 2015. All series are set equal to 100 in 2005.

Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

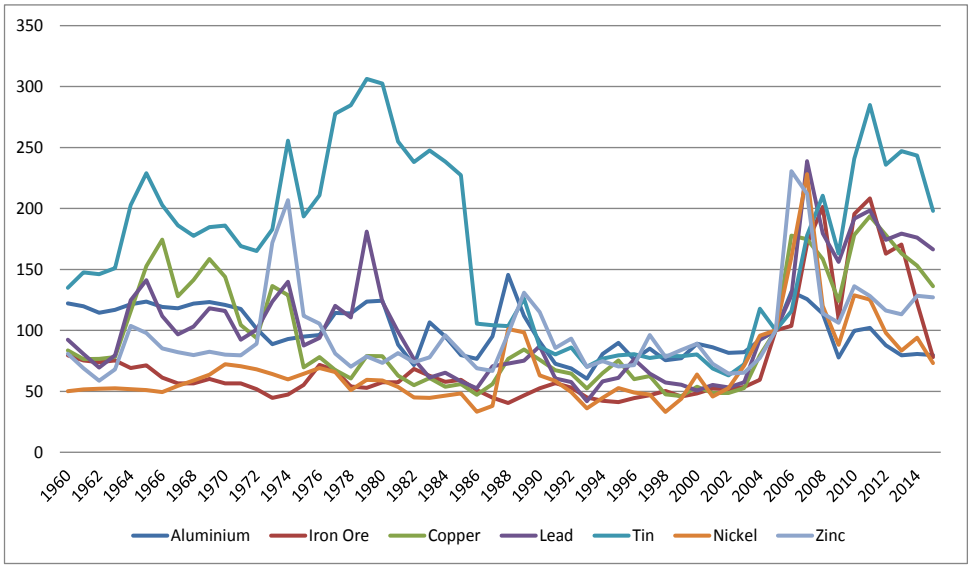
Figure 3 Developments in agriculture price components



Note: This figure reports the developments in different prices that make up the agriculture price index (deflated by a manufacturing price index) for the period 1960 – 2015. All series are set equal to 100 in 2005.

Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

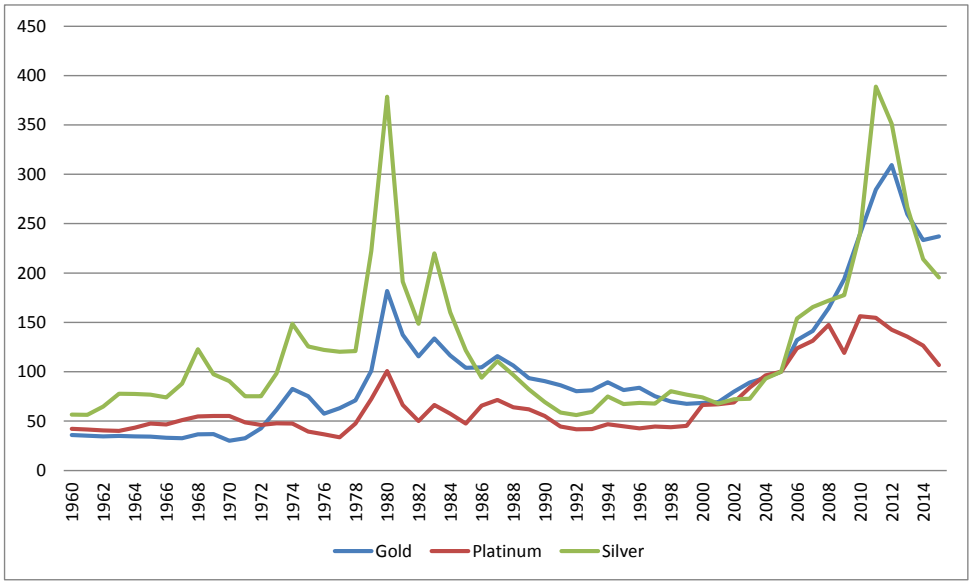
Figure 4 Developments in metal price components



Note: This figure reports the developments in different prices that make up the metals price index (deflated by a manufacturing price index) for the period 1960 – 2015. All series are set equal to 100 in 2005.

Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

Figure 5 Developments in precious metals price components



Note: This figure reports the developments in different prices that make up the precious metals price index (deflated by a manufacturing price index) for the period 1960 – 2015. All series are set equal to 100 in 2005.

Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

4. Commodity price cycles

In this section, we follow the approach of Erten and Ocampo (2013) and use the asymmetric Band-Pass (BP) filter of Christiano and Fitzgerald (2003) to identify cycles in our different commodity price indices. The BP filter allows for a time-series to be decomposed into different frequency components, which then identify the cycles in the different commodity prices. The approach we adopt in this analysis closely follows the approach of Erten and Ocampo (2013), the major addition being that we also search for the possibility of medium-term cycles following Comin and Gertler (2006) and Drehmann et al. (2012). The approach we adopt divides the natural logarithm of annual (deflated) commodity price indices (LP) into four components: (i) a long-term trend (LP^T) – with periodicities of more than 45 years; (ii) a super-cycle component (LP^{SC}) – with periodicities between 20 and 45 years; (iii) a medium-term cycle (LP^{MC}) – with periodicities between 8 and 20 years; and (iv) a short-term cyclical component (LP^O) – with periodicities of less than 8 years, i.e.

$$LP_t \equiv {LP^T}_t + {LP^{SC}}_t + {LP^{MC}}_t + {LP^O}_t$$

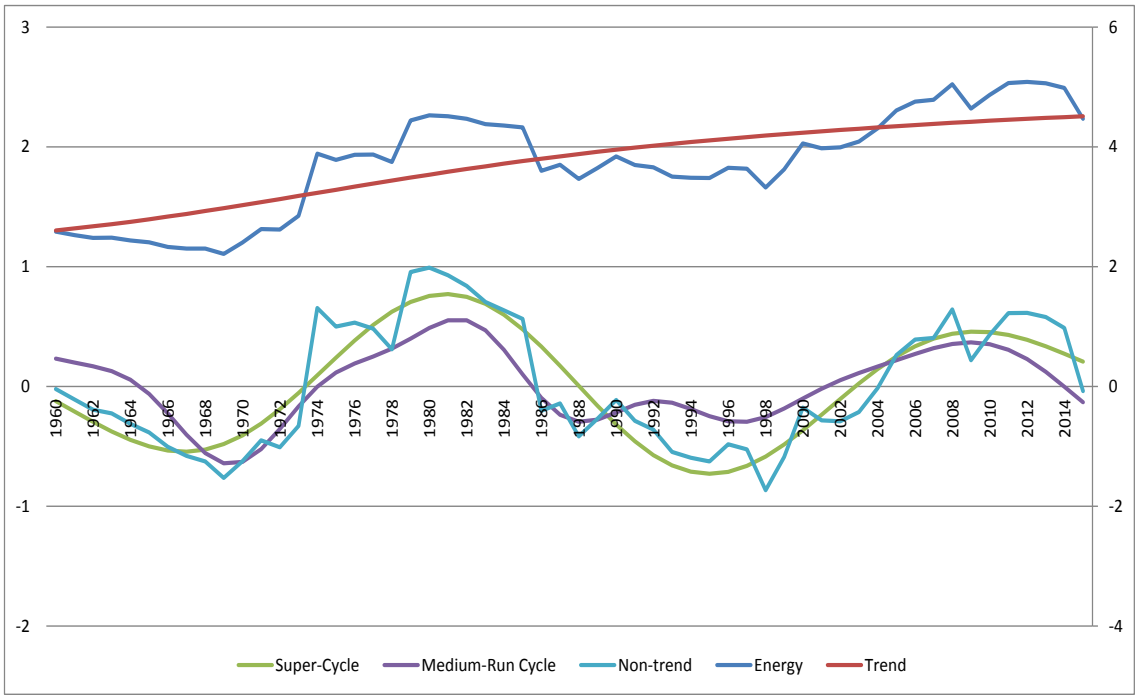
The average length of a super-cycle reported by Erten and Ocampo (2013) is 35.7 years, with a minimum of 24 years and just three (out of 18) super-cycles lasting over 40 years. We therefore consider super-cycles with a periodicity between 20 and 45 years. The long-term trend, therefore, has a periodicity that is greater than 45 years. A medium-term cycle is then defined as having a periodicity between 8 and 20 years, with the short-term cyclical trend having a periodicity of less than 8 years.

The analysis is carried out using annual data from the World Bank's Global Economic Monitor for the period 1960 – 2015, thus allowing us to consider the most recent data. As with the analysis above, all of the price series are deflated using a manufacturing price index. In the Appendix, we report further results using the Grilli and Yang dataset, which has the advantage of having a much longer time series.

Figure 6 and Figure 7 report the results based on the Band-Pass Filter to extract cycles in both energy and non-energy prices. Each figure provides information on the actual series, the long-term trend, the extracted super-cycle and medium-term cycle and the remaining non-cyclical component. Considering energy prices first, we observe a long-term rising trend in energy prices, albeit one that appears to become flatter. In terms of the super-cycle, we observe that the cycle's length is around 29 years (from a trough in 1967 to a trough in 1995). The peak of the cycle in 1981 is somewhat higher than the later peak in 2009, a result supporting Erten and Ocampo's (2013) view that there is a downward trend in the peaks of super-cycles, which is

consistent with a modified view of the Prebisch-Singer hypothesis. The observation that the world has been experiencing a downswing of the long-term energy super-cycle since 2010 is of additional interest for this paper. It can therefore be expected that, all else being equal, energy prices are likely to continue to fall in the medium- to long-term. The figure further reveals evidence of medium-term cycles, though in the case of energy prices, these cycles are somewhat irregular in terms of amplitude and duration, and tend to track the super-cycles quite closely. Again, however, the figure reveals that the world appears to be on the downswing of the latest medium-term cycle, compounding the long-term super-cycle's effect.

Figure 6 Cycles in energy prices

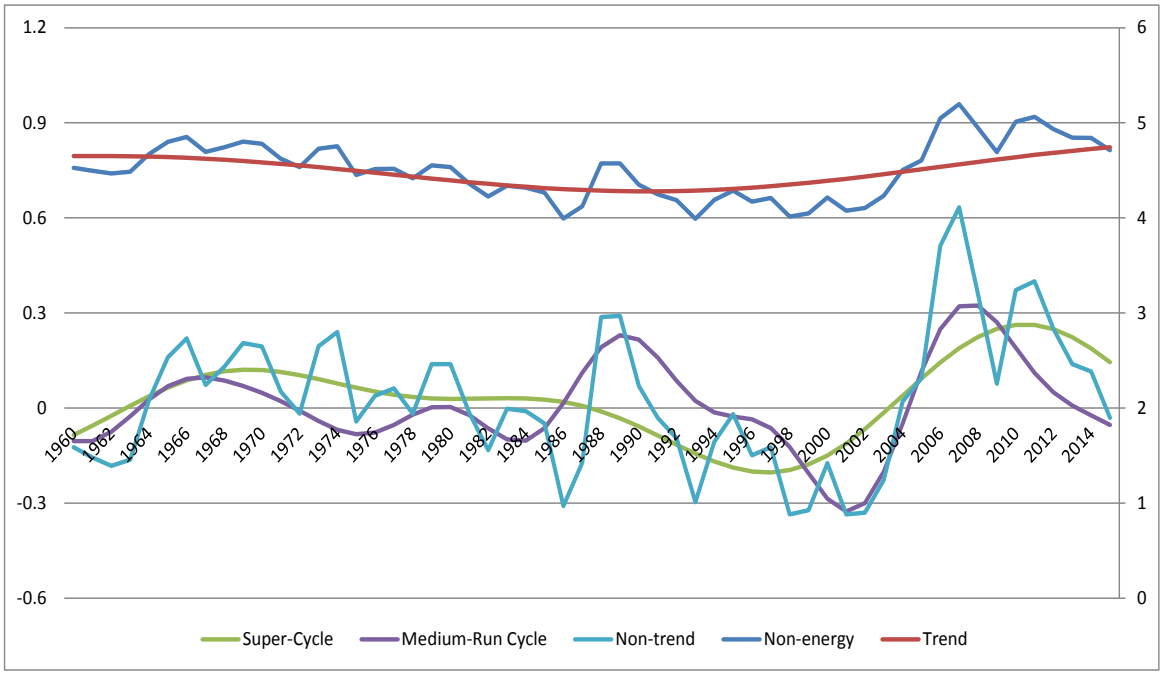


Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

In the case of non-energy prices, the results differ somewhat. For much of the considered period, the trend in non-energy prices was downwards, though some evidence suggests that since the mid-1990s, the trend has been rising. The estimated super-cycle in the case of non-energy prices also looks quite different from that for energy prices. While both dipped in the mid- to late 1990s, there is no corresponding dip for non-energy prices in the 1960s. In fact, the non-energy super-cycle reached a peak at the time. We observe a relatively long super-cycle of around 42 years from peak to peak. Comparing the two peaks, we also observe that the latter peak is considerably higher than that in the earlier period, a development that is in contrast to that for energy prices. Once again, the figure suggests that the world is on a downward slope of the latest super-cycle. Medium-term cycles appear more pronounced in the case of non-energy

prices (and tend not to closely track the super-cycle), and the results again suggest that the world is currently on a downward slope of a relatively strong medium-term cycle. Consistent with the results for energy prices, we may therefore expect declining prices for non-energy commodities in the medium- to long-term.

Figure 7 Cycles in non-energy prices

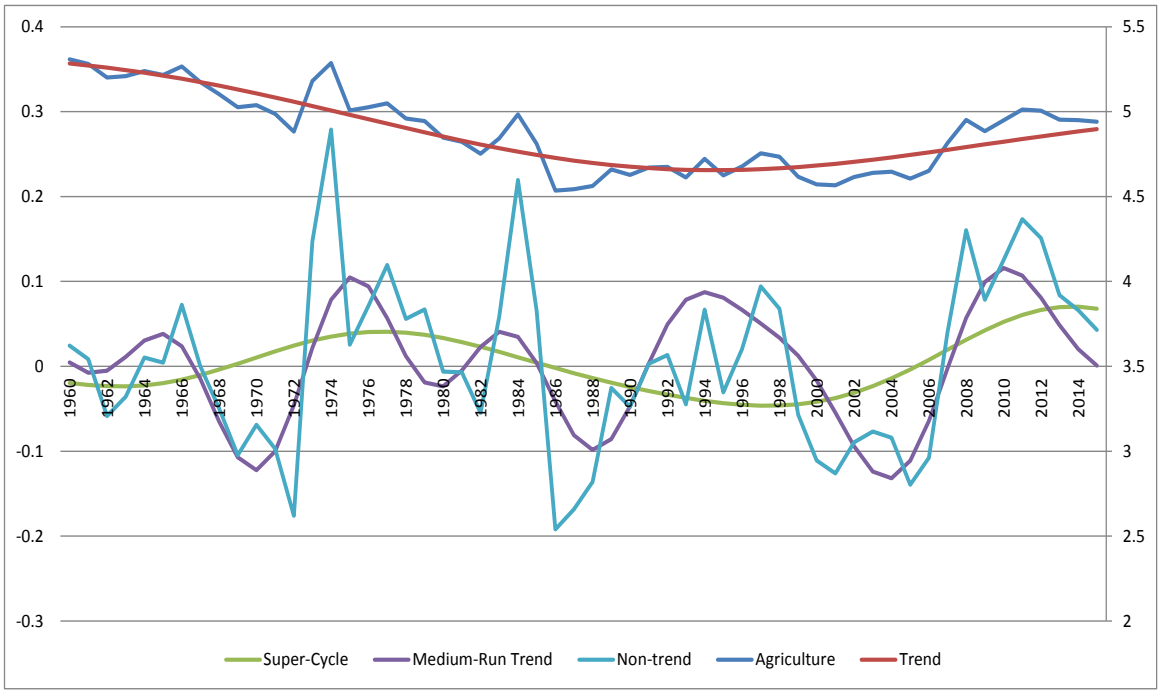


Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

Figures 8-11 report results of the cycle analysis for agriculture, metals and minerals, fertilizer and precious metals prices (i.e. the main sub-indices of the non-energy price index). Considering the cycles in agricultural prices (Figure 8), we observe developments that are quite similar to those for the aggregate non-energy price index. Specifically, we observe a recent shift towards a rising long-term trend in agricultural prices combined with a strong decline in the medium-term cycle beginning in 2011. The figure also reveals that the super-cycle reached its peak and began to decline in 2015, later than in the case of the non-energy index. Results for metals and minerals prices (Figure 9) strongly resemble those of the non-energy index. In particular, we observe a recent increase in the long-term trend combined with a relatively long super-cycle and recent strong declines in both the medium-term and super-cycle. In the case of fertilizers (Figure 10), we observe a relatively strong increase in the long-term trend since the mid-1990s, and a super-cycle (peak to peak) of around 30 years. As in the other cases, the medium-term and super-cycles have recently sloped downwards, with the medium-term cycle tending to decline prior to the super-cycle. For precious metals (Figure 11), the long-term trend

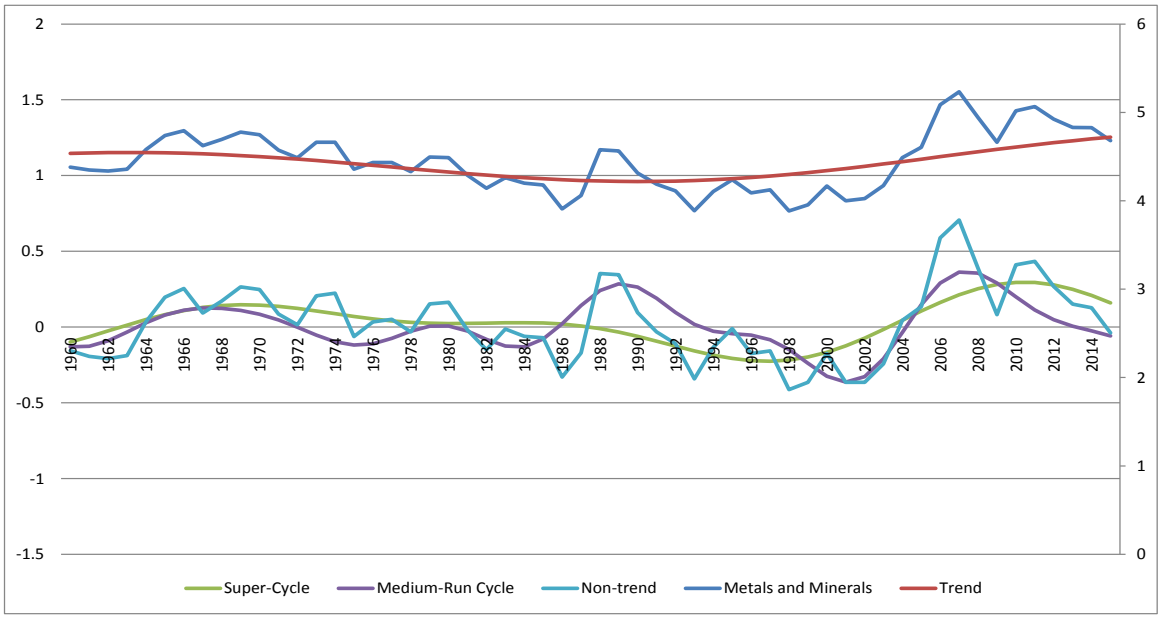
is consistently and positively upwards, with the super-cycles lasting around 30 years. Both the medium-term cycle and super-cycle have shown signs of decline in recent years, with the peak of the most recent super-cycle being somewhat below the earlier peak.

Figure 8 Cycles in agriculture prices



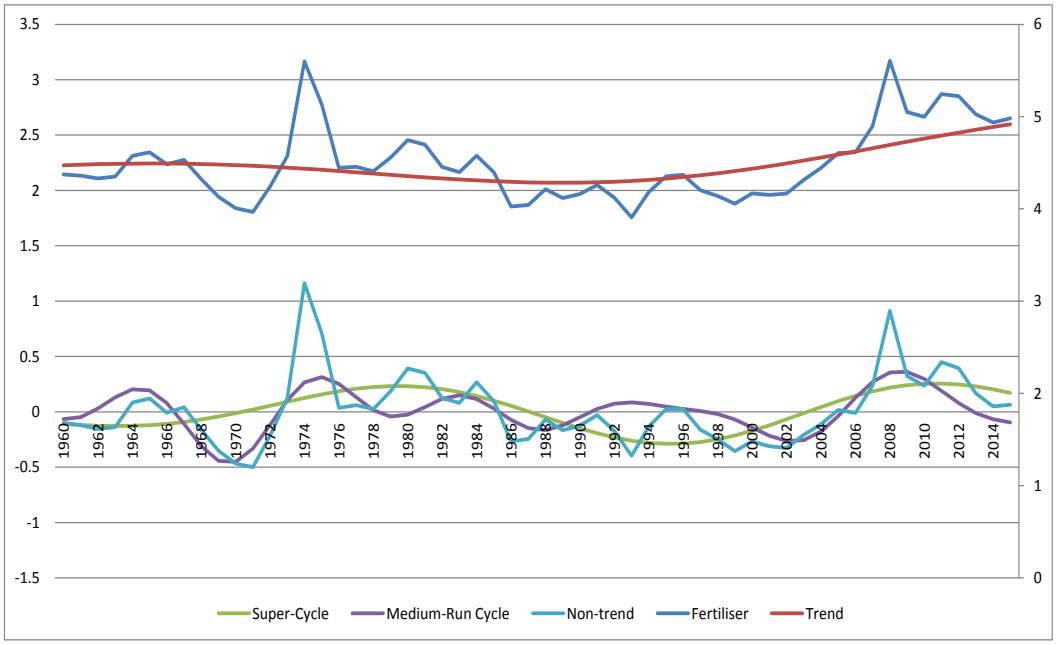
Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

Figure 9 Cycles in metals and minerals prices



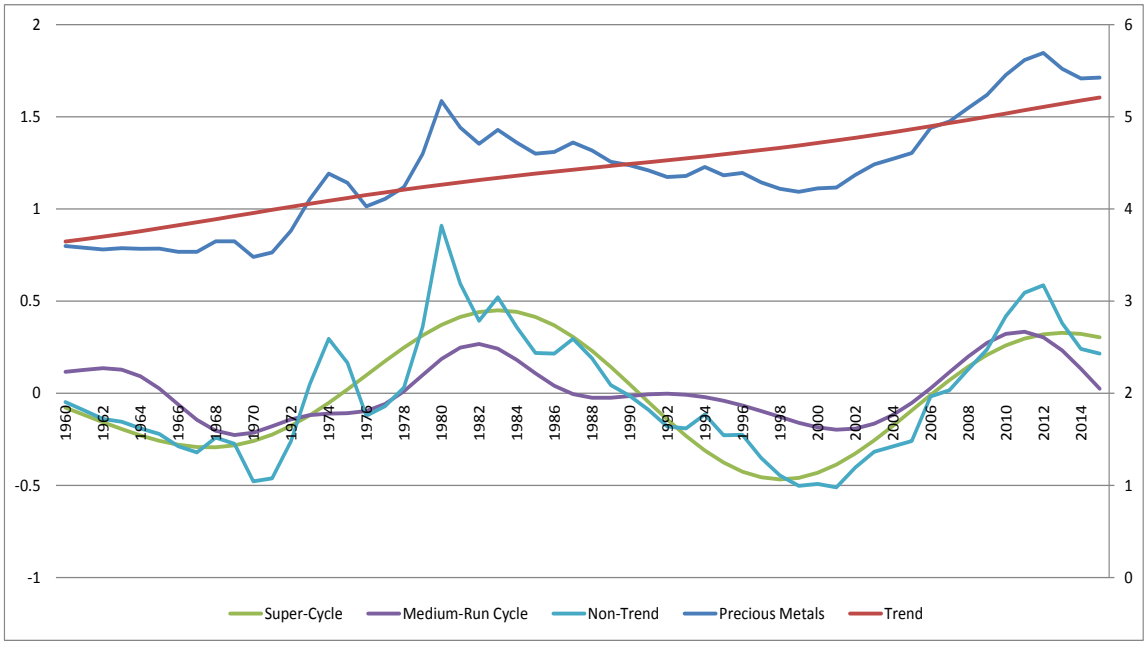
Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

Figure 10 Cycles in fertilizer prices



Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

Figure 11 Cycles in precious metals prices



Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016) and short-term trade statistics (WTO, 2016).

Table 2 Summary table of recent developments in commodity prices

	% change in long-term trend (1990-2015)	Year of latest peak of super-cycle	Annual % change in super-cycle since last peak	Year of latest peak of medium-term cycle	Annual % change in medium-term cycle since last peak
Energy	0.164	2009	-0.091	2009	-0.227
Non-energy	0.108	2010	-0.090	2008	-0.166
Agriculture	0.047	2014	-0.036	2010	-0.197
Metals and minerals	0.119	2010	-0.048	2007	-0.146
Fertilizers	0.148	2011	-0.040	2009	-0.212
Precious metals	0.161	2013	-0.028	2011	-0.220

Note: This table reports information on the percentage change in the estimated long-term trend of the different commodity prices over the period 1990 – 2015, the year in which the peaks of the latest super-cycle and medium-term cycle were reached, and the annual percentage change in the estimated super-cycle and medium-term cycle since these cycles' last peak year was reached.

Table 2 reports summary statistics on the recent developments in the estimated long-term trend and the different cycles. The table shows that there has been an increase in the long-term trend of all six commodity price aggregates since 1990, with a relatively high increase for energy (16.4 per cent over the period 1990-2015) and precious metals (16.1 per cent), but much lower for agriculture (4.7 per cent). The latest peak in the super-cycle was reached by energy first in 2009, by non-energy and metals and minerals in 2010 and by fertilizers in 2011. Super-cycle peaks were only reached towards the end of the sample for precious metals (2013) and agriculture (2014). The subsequent decline in super-cycles also shows some degree of heterogeneity (though it should be noted that this is based on only one and two years of data for agriculture and fertilizers, respectively), with the declines averaging 9 per cent annually for energy and non-energy, but a much lower 2.8 per cent for precious metals and 3.6 per cent for agriculture. In all cases, the peak of the estimated medium-term cycle precedes (or in the case of energy, coincides with) the peak of the super-cycle, the peak being as far back as 2007 (i.e. pre-crisis) for metals and minerals prices. The annual percentage declines in the medium-term cycles following the latest peak also tend to be much stronger than those for super-cycles, with the annual percentage falling beyond 20 per cent for energy, fertilizers and precious metals.

5. On the synchronization of commodity prices

In this section, we are interested in examining whether the cycles for the different commodity prices and commodity price aggregates are synchronized. When commodity prices are synchronized, we can speak of a global commodity price cycle, but if the cycles are not particularly well synchronized, we can expect cycles to develop differently for various countries and regions – something we will come back to later.

In our analysis, we are interested in examining the synchronization of both medium-term cycles and super-cycles. We use the concordance index developed by Harding and Pagan (2006), which defines the interdependence between cycles as the probability of their phases coinciding. For each commodity price index i, a dummy variable S_{it} is created, which takes a value of 1 when the cycle (either the super-cycle or the medium-term cycle) has an upward phase, and a value of zero otherwise. For a given pair of cycles, the concordance index is then defined as the probability that both cycles are simultaneously going through the same phase (either upward or downward), i.e. Pr $\left(S_{it} = S_{jt}\right)$. The concordance index is then calculated as:

$$I_C(p) = \frac{1}{T}\left\{\sum_{t=1}^{T} S_{it}S_{jt} + \sum_{t=1}^{T}(1 - S_{it})(1 - S_{jt})\right\}$$

The index takes values between zero (i.e. always in the opposite phase) and 1 (i.e. phases always coincide), with a value of 0.5 indicating no synchronization between these cycles during the sample period. In addition to reporting the values of the concordance index, we furthermore report the correlation coefficient between the two dummy variables (along with information on whether these correlations are significant).

Results for the medium-term and super-cycles are reported in Tables 3 and 4, respectively. These tables consider the cycles for the main price aggregates (energy and non-energy) and a number of sub-aggregate price indices.[4] Results from the concordance index are reported in the upper diagonal, while the correlation coefficient (along with its significance) is reported in the lower diagonal.

The values for the synchronization index in the case of medium-term cycles reported in Table 3 suggest that (on average) the degree of synchronization between many commodity cycles is not strong, with the average values of the synchronization index being close to 0.5, with a range of 0.39 for other food and a high of 0.68 for fertilizers. These averages tend to hide the fact that the degree of synchronization is high for some commodity pairs. In a number of cases, we find

[4] Results for all individual price indices are also available.

strong evidence that commodity pairs tend to be in different phases of the cycle, with other food and beverages (0.127) and other food and oils and meals (0.255) being the most extreme examples. In a majority of cases, however, the cycles of commodity pairs tend to be in the same phase, with the phase of the fertilizer cycle, for example, showing a high degree of synchronization with many of the agricultural commodities, and precious metals with energy prices. The limited degree of synchronization in the medium-term cycles is further confirmed by looking at the correlation coefficients. Of the 91 reported correlation coefficients, only 49 are significant, with 27 of the correlations being negative. A negative correlation is often found for other food and metals and minerals, suggesting that these commodities tend to be in different phases of the super-cycle compared to other commodities.

The results in Table 4—when considering the synchronization of super-cycles—are in many ways similar to those for medium-term cycles. The average value of the synchronization index is around 0.6, suggesting positive but not a particularly strong degree of synchronization. In the case of three prices—agricultural raw materials, timber and other raw materials—we observe an average of the synchronization index that is below 0.5. The strongest degree of synchronization, on average, is registered for agriculture and fertilizer. Different than in the case of medium-term cycles, we observe that the majority of correlations between the different cycles are significant (69 of 91). While 27 correlations are negative—the same number as for medium-term cycles—these tend to be more concentrated on specific commodities, most notably agricultural raw materials, timber and other raw materials.

Table 3 **Synchronization of medium-term cycles**

	Energy	Non-Energy	Agriculture	Beverages	Food	Cereals	Oils and Meals	Other Food	Agriculture Raw Materials	Timber	Other Raw Materials	Metals and Minerals	Fertilizers	Precious Metals
Energy		0.509	0.618	0.491	0.636	0.655	0.618	0.418	0.636	0.545	0.545	0.491	0.709	0.836
Non-Energy	0.03		0.455	0.582	0.436	0.491	0.382	0.473	0.4	0.745	0.382	0.982	0.545	0.564
Agriculture	0.25*	-0.10		0.618	0.873	0.891	0.818	0.364	0.764	0.6	0.673	0.436	0.873	0.673
Beverages	-0.01	0.15	0.23*		0.6	0.582	0.655	0.127	0.564	0.473	0.582	0.564	0.564	0.545
Food	0.27**	-0.13	0.75***	0.20		0.945	0.909	0.309	0.636	0.582	0.582	0.418	0.891	0.764
Cereals	0.31**	-0.02	0.79***	0.17	0.89***		0.855	0.364	0.655	0.636	0.564	0.473	0.873	0.745
Oils and Meals	0.24*	-0.24*	0.64***	0.31**	0.82***	0.71***		0.255	0.582	0.527	0.564	0.364	0.836	0.782
Other Food	-0.17	-0.04	-0.26*	-0.74***	-0.38***	-0.28**	-0.50***		0.491	0.582	0.473	0.491	0.309	0.364
Agriculture Raw Materials	0.27**	-0.20	0.53***	0.13	0.27**	0.31**	0.16	-0.02		0.509	0.909	0.382	0.673	0.545
Timber	0.09	0.50***	0.20	-0.05	0.16	0.27**	0.05	0.16	0.02		0.418	0.727	0.691	0.6
Other Raw Materials	0.09	-0.25*	0.34**	0.16	0.16	0.13	0.13	-0.05	0.82***	-0.16		0.364	0.582	0.491
Metals and Minerals	-0.01	0.96***	-0.15	0.11	-0.17	-0.05	-0.27**	0.00	-0.24*	0.46***	-0.29**		0.527	0.545
Fertilizers	0.43***	0.08	0.74***	0.12	0.78***	0.75***	0.68***	-0.38***	0.35***	0.39***	0.16	0.04		0.764
Precious Metals	0.67***	0.13	0.35***	0.09	0.53***	0.49***	0.56***	-0.28**	0.09	0.2	-0.02	0.10	0.53***	

Note: This table reports the values of the concordance index of the upper diagonal on whether medium-term cycles are in the same phase. A value of 0.5 indicates no synchronization between the medium-term cycles of two commodities, with a value of 0 (1) indicating that the phases are always in the opposite (same) phase. The lower diagonal reports the correlation coefficient between the phase of a medium-term cycle between two commodities; ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively.

Table 4 **Synchronization of super-cycles**

	Energy	Non-Energy	Agriculture	Beverages	Food	Cereals	Oils and Meals	Other Food	Agriculture Raw Materials	Timber	Other Raw Materials	Metals and Minerals	Fertilizers	Precious Metals
Energy		0.582	0.727	0.873	0.709	0.673	0.727	0.545	0.4	0.091	0.491	0.564	0.855	0.818
Non-Energy	0.17		0.673	0.527	0.727	0.764	0.709	0.782	0.382	0.509	0.364	0.982	0.655	0.582
Agriculture	0.46***	0.36***		0.855	0.8	0.8	0.818	0.818	0.382	0.364	0.473	0.655	0.873	0.764
Beverages	0.76***	0.08	0.70***		0.727	0.727	0.745	0.673	0.455	0.218	0.545	0.509	0.873	0.836
Food	0.43***	0.49***	0.59***	0.43***		0.927	0.982	0.764	0.182	0.345	0.273	0.709	0.855	0.6
Cereals	0.35***	0.55***	0.59***	0.44***	0.85***		0.909	0.836	0.218	0.382	0.273	0.745	0.818	0.6
Oils and Meals	0.46***	0.45***	0.63***	0.47***	0.96***	0.81***		0.745	0.2	0.327	0.291	0.691	0.873	0.618
Other Food	0.09	0.56***	0.64***	0.36***	0.55***	0.69***	0.51***		0.382	0.545	0.364	0.764	0.691	0.618
Agriculture Raw Materials	-0.20	-0.25*	-0.23*	-0.08	-0.64***	-0.56***	-0.60***	-0.24*		0.655	0.909	0.4	0.327	0.582
Timber	-0.82***	0.03	-0.29**	-0.60***	-0.34**	-0.26*	-0.37***	0.09	0.32**		0.564	0.527	0.236	0.236
Other Raw Materials	-0.02	-0.28**	-0.05	0.10	-0.46***	-0.45***	-0.42***	-0.27**	0.82***	0.13		0.382	0.418	0.673
Metals and Minerals	0.13	0.96***	0.32**	0.03	0.44***	0.51***	0.40***	0.53***	-0.21	0.06	-0.24*		0.636	0.564
Fertilizers	0.72***	0.33**	0.74***	0.74***	0.70***	0.63***	0.74***	0.39***	-0.34**	-0.55***	-0.16	0.29**		0.745
Precious Metals	0.64***	0.17	0.52***	0.67***	0.18	0.19	0.22	0.24*	0.17	-0.54***	0.35***	0.13	0.49***	

Note: This table reports the values of the concordance index of the upper diagonal on whether super-cycles are in the same phase. A value of 0.5 indicates no synchronization between the super-cycles of two commodities, with a value of 0 (1) indicating that the phases are always in the opposite (same) phase. The lower diagonal reports the correlation coefficient between the phase of a super-cycle between two commodities; ***, ** and * indicate significance at the 1, 5 and 10 per cent level respectively.

6. Developments in country/region-specific commodity price indices

As discussed by Deaton (1999), different commodities are important for different countries and the prices of different commodities do not move in parallel due to differing supply conditions across goods. The results in the previous section suggest that the observed cycles are not always highly synchronized. As the prices of different commodities evolve differently and since the significance of different commodities varies among countries, some authors such as Deaton and Miller (1995), amongst others, propose country-specific commodity export price indices which are constructed by combining international prices with country-level data on export volumes.

Using data from CEPII's BACI database, we obtain data on the exports of each of the commodities used in the construction of various price indices (see Table A2 in Appendix I for further details) for the year 1995.[5] For each country, we then calculate a country-specific set of commodity price indices by weighting the price of individual commodities with their export shares in total exports of that particular commodity group (e.g. metals and minerals, agriculture, etc.).[6] We further calculate region-specific commodity price indices by aggregating country-level exports. The regions considered are: (i) East Asia and the Pacific; (ii) Europe and Central Asia; (iii) Latin America; (iv) the Middle East and North Africa; (v) North America; (vi) South Asia; and (vii) Sub-Saharan Africa. These country and region-specific price indices are constructed for an overall commodity price index (including the prices of all 40 commodities listed in Table A2), as well as an energy and a non-energy price index, and indices for the sub-categories considered above (e.g. agriculture, metals and minerals, fertilizer, etc.).[7]

Figure 12 reports developments in regional energy and non-energy prices (both deflated by the world manufacturing unit value index), along with the estimated super-cycles and medium-term cycles. In the case of energy prices, we observe similar developments in the reported price index by region. This is also the case when we look at the super-cycles. Though there is some evidence to suggest that the amplitude of the super-cycle is slightly lower in South Asia and North America, they generally tend to follow a similar pattern.[8] The results for the medium-term

[5] Based on existing studies, we calculate the export shares for a specific base year (i.e. 1995) only. This has the advantage of ensuring that developments in the aggregate price indices are driven by actual price changes rather than changes in the composition of exports. On the flip side, it has the disadvantage of not being able to capture the importance of a country or a region's changing comparative advantage on the prices received for its exports.

[6] Note that for some commodities—most notably silver and platinum—data on trade values are sparse for most or all countries. In these cases, the weight of these commodities in the country aggregate is set to zero.

[7] When constructing these indices, we can use both export value and export volume shares. In the analysis reported in the main text, we use volume shares, though the results using value shares are similar and available upon request. Additionally, it is possible to weigh these price developments by the share of the specific commodity group in total exports. Results using this method of weighing are also available upon request.

[8] Results from the test of synchronization confirm a large degree of synchronization, with the index tending to be above 0.8 and usually above 0.9 for the different region pairs. This is also true when we look at medium-term cycles and at non-energy (and other commodity) prices. These results are available upon request.

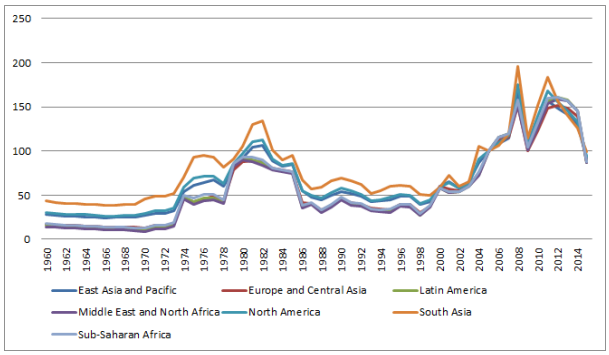
cycle also suggest a somewhat lower amplitude for South Asia and North America (at least in the early period), though the different medium-term cycles appear highly synchronized in general. The results for non-energy prices are similar to a large extent, with developments in non-energy prices tending to be quite similar (and becoming more similar over time). The exception is North Africa where recent developments have been highly volatile and differ considerably to the developments in other regions. While there are some differences in the amplitude of super- and medium-term cycles, they are generally synchronized quite well (particularly the latest cycles). Throughout the study period, the Middle East and North Africa registered a slightly different pattern in terms of the development of medium-term cycles.

Figure 13 presents the results from a replication of the above exercise but distinguishing by level of development rather than by region. For both energy and non-energy prices, we observe the development in prices and cycles that are quite similar. The one apparent outlier is the case of least developed countries which tend to have a lower amplitude of medium-term cycles (for both energy and non-energy prices), with these cycles being less synchronized than those for countries at other levels of development.

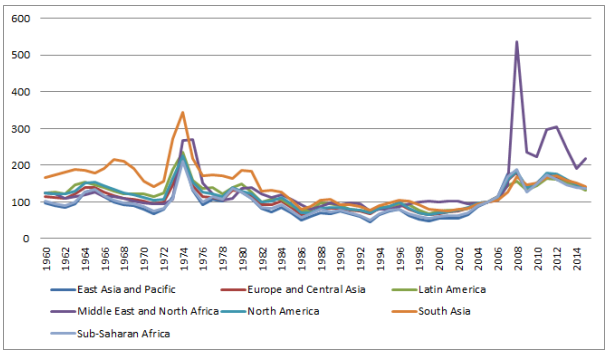
Figures 12 and 13 suggest that the degree of synchronization of commodity prices across countries tends to be high and that as a result there is a low degree of heterogeneity in commodity prices across countries. It should be remembered, however, that these figures report results for fairly aggregated groups of countries and for a fairly aggregated set of commodities. It should also be remembered that similar developments in commodity prices across countries does not imply a similar effect on different countries' performance – considering that some countries are more or less specialized in commodities. In the following section, we address the impact of commodity price developments on output per capita at the country level.

Figure 12 Developments in energy and non-energy price indices by region

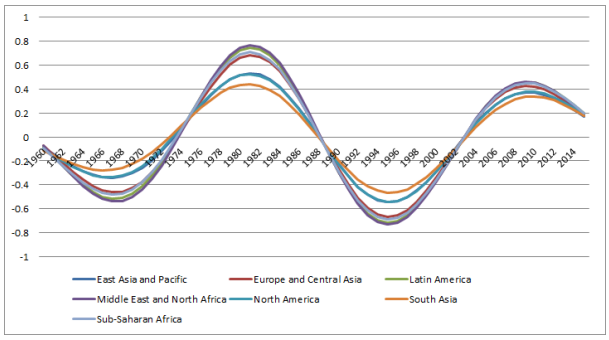
Energy Price Indices



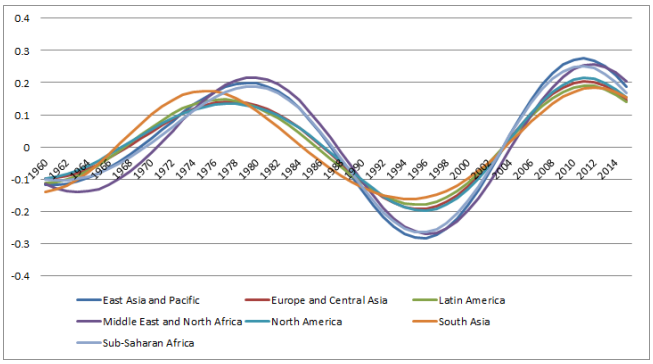
Non-Energy Price Indices



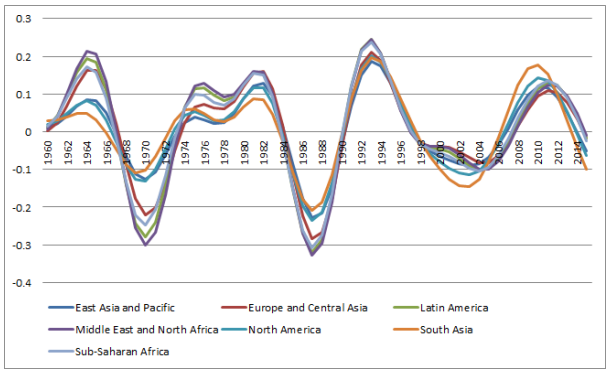
Super-Cycles in Energy Prices



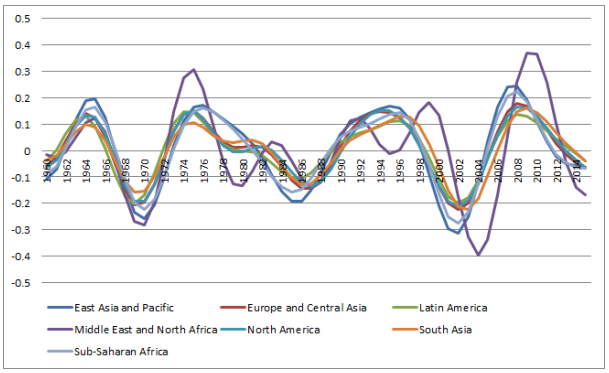
Super-Cycles in Non-Energy Prices



Medium-Term Cycles in Energy Prices



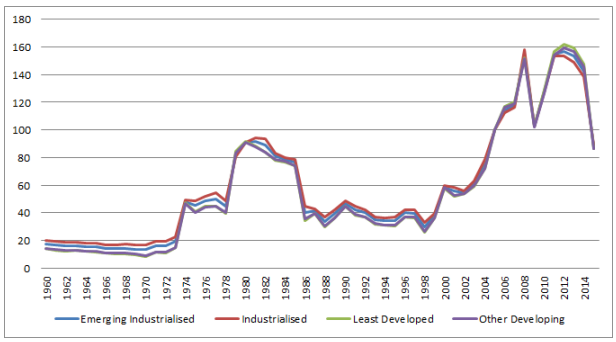
Medium-Term Cycles in Non-Energy Prices



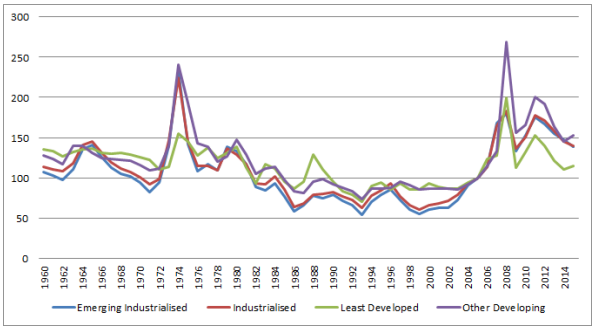
Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016).

Figure 13 Developments in energy and non-energy price indices by development level

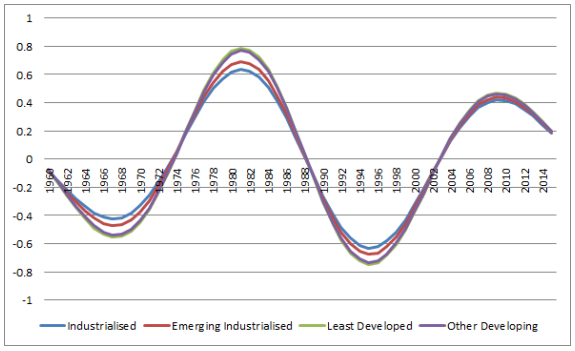
Energy Price Indices



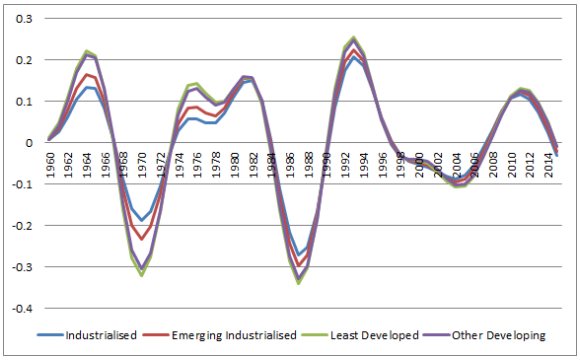
Non-Energy Price Indices



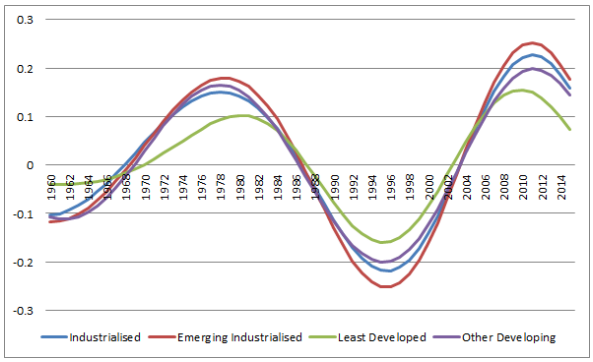
Super-Cycles in Energy Prices



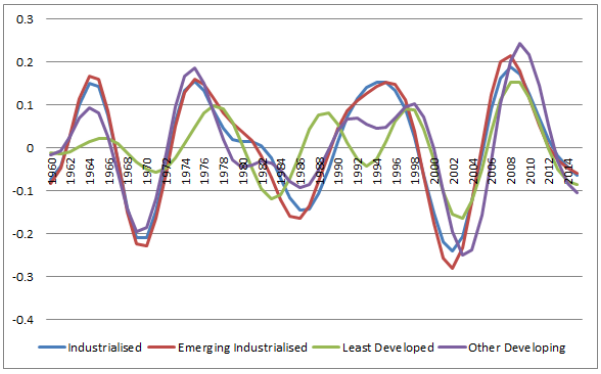
Super-Cycles in Non-Energy Prices



Medium-Term Cycles in Energy Prices



Medium-Term Cycles in Non-Energy Prices



Source: Authors' elaboration based on Global Economic Monitor Commodities (World Bank, 2016).

7. Commodity prices and economic growth

In this final substantive section, we consider whether developments in commodity prices experienced by individual countries have an impact on economic growth in both the short- and the long-run. We closely follow the work of Collier and Goderis (2012), who use panel error correction models to examine the short- and long-run effects of international commodity prices on output per capita. In their paper, Collier and Goderis (2012) argue that the evidence in favour of a long-run effect of natural resources on economic growth is ambiguous (e.g. Alexeev and Conrad, 2009; Lederman and Maloney, 2007; Sachs and Warner, 1999; Sala-i-Martin and Subramanian, 2003).

The initial estimating equation of Collier and Goderis (2012) is written as follows[9]:

$$\Delta y_{i,t} = \lambda y_{i,t-1} + \beta_1' x_{i,t-1} + \alpha_i + \delta t + \varepsilon_{i,t}$$

With $y_{i,t}$ being the log of real per capita GDP, $\Delta y_{i,t}$ the growth rate of real per capita GDP, $x_{i,t-1}$ a $m \times 1$ vector of m variables expected to affect the long-run steady state level of GDP per capita, α_i denotes a country-specific fixed effect (controlling for country-specific, time-invariant unobservables), t is a time trend (that allows for non-zero steady state growth in output per capita), and ε is a well-behaved error term.

Collier and Goderis (2012) note that the model above allows for the study of the potential determinants of the steady state level of output, but that it does not allow the transition to the steady state to be affected by short-term business cycle fluctuations because of shocks to the economic environment. As a result, they augment the model with contemporaneous and lagged changes in $x_{i,t}$ and a lagged dependent variable (to account for persistence in growth rates). The resulting model is then written as:

$$\Delta y_{i,t} = \lambda y_{i,t-1} + \beta_1' x_{i,t-1} + \beta_2 \Delta y_{i,t-1} + \sum_{j=0}^{k} \beta_{3j}' \Delta x_{i,t-j} + \alpha_i + \delta t + \varepsilon_{i,t}$$

Which can be written as an error correction model:

$$\Delta y_{i,t} = a_1\left(y_{i,t-1} + \theta'\, x_{i,t-1} - \mu_i - gt\right) + a_2 \Delta y_{i,t-1} + \sum_{j=0}^{k} a_{3j}' \Delta x_{i,t-j} + a_i + a_4 t + \varepsilon_{i,t}$$

[9] The discussion and description of the method that follows are largely based on the discussion in Collier and Goderis (2012).

With $\lambda = a_1,\ \beta_1 = -a_1\theta,\ \beta_2 = a_2,\ \beta_{3j} = a_{3j},\ \alpha_i = a_i - a_1\mu_i,$ and $\delta = a_4 - a_1 g$. In this latter model, output responds to deviations from a long-term equilibrium (captured by the term in brackets) that will eventually return the economy to its steady state. The coefficient a_1 is expected to be negative and represents the speed of convergence to a steady state.

In our analysis, the set of x-variables includes a commodity price index ($p_{i,t}$) that is country specific. This index is constructed using the method described in the previous section (with the variable being deflated by the manufacturing unit value index and included in logs). In addition to this variable, we further include the following variables in various specifications: (i) gross fixed capital investment ($gfcf$); (ii) population growth ($popgrow$); (iii) years of secondary schooling (sch); (iv) ratio of trade to GDP ($trade$); (v) fertility rate ($fert$); (vi) inflation rate (inf); (vii) log of population (pop); and (viii) an index of democracy ($polity$)[10]. With the exception of the polity score—which is taken from the Polity IV dataset—all of the variables are derived from the World Development Indicators Database.

To allow for a heterogeneous steady state growth path, we further include specific time trends of the level of development. The development levels are the same as those used in the previous section, namely industrialized economies, emerging and industrializing economies, other developing economies, and least developed countries. Table 5 reports summary descriptive statistics for the set of variables used in the econometric analysis.

[10] The polity index is normalized to lie between 0 and 1, with higher numbers indicating greater democracy.

Table 5 Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Δy	5,639	0.0179	0.056981	-1.04974	0.65062
$gfcf$	4,872	0.212753	0.071767	-0.02424	0.659804
$popgrow$	5,878	0.018645	0.011566	-0.06343	0.09932
sch	5,208	1.805412	1.37699	0.02	7.412169
$polity$	5,188	0.59201	0.363165	0	1
$trade$	5,449	0.681704	0.504771	0	4.554152
$fert$	5,702	0.042297	0.020157	0.00901	0.08449
inf	4,928	0.385242	5.741533	-0.35837	244.1103
pop	5,880	15.92689	1.86731	10.62702	21.03897
y	5,744	8.133982	1.544161	4.748713	11.46061
p^{ALL}	5,880	4.836621	0.449402	3.33972	6.710417
Δp^{ALL}	5,775	0.005622	0.194153	-1.03461	1.446855
p^{ENERGY}	4,704	4.855761	0.737025	3.327988	6.279549
Δp^{ENERGY}	4,620	0.028776	0.225646	-0.77876	1.165582
$p^{NON-ENERGY}$	5,880	4.799445	0.333648	3.847283	6.772892
$\Delta p^{NON-ENERGY}$	5,775	-0.00153	0.182764	-1.035	1.502968

Note: This table reports summary statistics for the main variables used in the econometric analysis of commodity prices and growth.

Table 6 reports the initial set of econometric results, with the first three columns presenting the results when using a price index for all commodities, the second three columns reporting the results when using a price index for energy commodities, and the final three columns reporting the results when including a price index for non-energy commodities. If we begin by considering the control variables in our analysis, we observe that the coefficient on the investment share is positive – as expected. While the coefficient is significant in the initial specification, it is found to be not robust to the inclusion of additional variables. Similar to the findings in the existing literature, we find mixed results for the coefficient on education, with both negative and positive coefficients being observed (though never significant). Coefficients on population growth and the polity index are also generally insignificant. For trade, however, we find coefficients that are consistently positive and significant, while negative and significant coefficients are found for inflation, fertility and population size. These results are largely in line with much of the existing literature.

Results on the long-term coefficient of the commodity price indices are interesting. In the case of all commodities, we find coefficients that are negative but not significant. The negative coefficient is consistent with a long-term resource curse effect, with higher commodity export prices significantly reducing the long-term level of real GDP in commodity exporting countries. The lack of significance, however, suggests that this long-term resource curse effect is limited. When splitting up the commodity prices between energy and non-energy commodities, we find quite different results. In the case of energy prices, a significant long-term resource curse effect is evident while in the case of non-energy prices, the reverse is the case (i.e. higher non-energy commodity prices raise the long-term GDP per capita of non-energy commodity exporters). The results thus suggest that commodities per se are not deleterious to long-term growth, but that such an effect is limited to energy commodities.

The coefficient on lagged GDP per capita is negative and highly significant, as expected. The coefficient represents the speed of adjustment to equilibrium, with the coefficients indicating that output per capita returns to its long-term level at a rate of around 3 per cent per year (the range is 2.2 per cent to 3.7 per cent). The transition to the long-term equilibrium is therefore prolonged. Finally, we turn to the coefficients capturing the short-term impacts of changes in commodity prices. When considering all commodities, we find coefficients on the lagged changes in commodity prices that are consistently positive and that tend to be significant. Significance is always observed in the case of contemporaneous change, with the first lag of the change being insignificant in two cases. Despite this, the results suggest that an increase in the growth rate of commodity prices has a positive short-term impact on the growth of GDP per capita. The results for the energy and non-energy price indices show certain similarities and differences. In all cases, we find that the short-term effect of contemporaneous commodity price growth on per capita GDP growth is positive and significant. In the case of energy prices, the lagged effect is found to be negative (and sometimes significant), while the second lag of the commodity price growth term tends to be positive and significant. In the case of non-energy prices, we observe no significant impact of the first or second lag of the commodity price growth term, suggesting that these short-term impacts show very little persistence.

In Table 7 we report similar results, but split up the sample into emerging and industrializing economies, industrialized economies, and least and other developing economies. The results on the control variables are often in line with those from Table 6 (with coefficients often being insignificant). One or two interesting results are visible, however. Notably, we observe a negative and significant coefficient on investment in the case of industrialized economies, with significantly negative effects of population size and inflation only being found in the least and

other developing country group. The long-term effects of commodity prices are found to be negative for all country groups (though not significantly in the case of least and other developing economies). This negative effect appears to be driven by energy prices, which also have a negative and significant impact on long-term per capita GDP in all three country groups. For non-energy prices, we again find a negative long-term impact in the case of industrialized economies, but observe positive effects in the other two groups – the effect being significant in the case of the least and other developing country group. In terms of short-term effects of commodity price growth on per capita GDP growth we tend to observe coefficients on the contemporaneous growth of commodity prices which are positive and significant. This is true for all commodities as well as the two sub-indices of energy and non-energy commodities. Coefficients on lagged growth rates tend to be either insignificant or positive and significant, with the exception of industrialized countries for which we find negative and significant coefficients for the first lag. This latter result reflects a delayed impact of rising prices on domestic demand.

Table 8 reports similar results, but split by geographical region rather than level of development. For reasons of presentation, Table 8 only reports the results for energy and non-energy price aggregates (Table A3 in Appendix III reports the results for all commodities). Focusing on the coefficients on commodity price variables, we find negative and significant effects of energy prices on long-term per capita GDP for all regions, except Africa (where no significant effect is found), while for non-energy prices, the long-term effect is positive for Africa, the Americas and Asia (though not significantly so for Asia), and negative and significant for Europe. The short-term effects tend to be positive in the case of Africa and the Americas for both energy and non-energy commodities, but for Asia and Europe, we find negative effects of rising energy prices on short-term per capita GDP growth, with little effect observed due to the growth in non-energy prices.

Table 6 Commodity prices and economic growth – Initial results

	All Commodities			Energy			Non-Energy		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Long-term coefficients									
$gfcf_{t-1}$	0.0441**	0.0284	0.0212	0.0331	0.00479	-0.00473	0.0410*	0.0229	0.0157
	(0.0206)	(0.0289)	(0.0296)	(0.0253)	(0.0298)	(0.0292)	(0.0218)	(0.0298)	(0.0307)
$popgrow_{t-1}$	-0.287	0.350	0.350	-0.294	0.426	0.419	-0.323	0.333	0.328
	(0.279)	(0.540)	(0.547)	(0.306)	(0.597)	(0.603)	(0.276)	(0.533)	(0.539)
sch_{t-1}	0.00127	-0.000172	0.000769	-0.000435	-0.000329	0.000843	0.000224	-0.00165	-0.000731
	(0.00222)	(0.00255)	(0.00262)	(0.00194)	(0.00235)	(0.00253)	(0.00211)	(0.00270)	(0.00271)
$trade_{t-1}$		0.0205***	0.0218***		0.0251***	0.0268***		0.0212***	0.0223***
		(0.00765)	(0.00781)		(0.00803)	(0.00823)		(0.00778)	(0.00789)
pop_{t-1}		-0.0279**	-0.0310***		-0.0238**	-0.0293**		-0.0304**	-0.0335***
		(0.0111)	(0.0115)		(0.0106)	(0.0120)		(0.0116)	(0.0120)
$polity_{t-1}$		0.00200	0.00111		0.00174	0.000424		0.00257	0.00179
		(0.00496)	(0.00494)		(0.00524)	(0.00518)		(0.00489)	(0.00492)
inf_{t-1}		-0.000466***	-0.000466***		-0.000446**	-0.000446**		-0.000462**	-0.000461**
		(0.000207)	(0.000206)		(0.000210)	(0.000210)		(0.000210)	(0.000209)
$fert_{t-1}$		-0.855***	-0.817**		-0.835**	-0.770**		-0.955***	-0.952***
		(0.307)	(0.318)		(0.318)	(0.329)		(0.318)	(0.337)
p_{t-1}	-0.00390	-0.00374	-0.00375	-0.00936***	-0.00798***	-0.00826***	0.00558**	0.00757**	0.00759**
	(0.00296)	(0.00321)	(0.00313)	(0.00228)	(0.00211)	(0.00210)	(0.00264)	(0.00325)	(0.00333)

Short-term coefficients									
y_{t-1}	-0.0254***	-0.0365***	-0.0349***	-0.0220***	-0.0339***	-0.0311***	-0.0250***	-0.0368***	-0.0353***
	(0.00564)	(0.00490)	(0.00545)	(0.00542)	(0.00481)	(0.00516)	(0.00548)	(0.00475)	(0.00546)
Δy_{t-1}	0.202***	0.249***	0.247***	0.227***	0.302***	0.298***	0.204***	0.250***	0.248***
	(0.0478)	(0.0392)	(0.0396)	(0.0575)	(0.0389)	(0.0404)	(0.0476)	(0.0386)	(0.0389)
Δp_t	0.0170***	0.0185***	0.0185***	0.00896**	0.00941***	0.00919***	0.0160***	0.0188***	0.0188***
	(0.00439)	(0.00409)	(0.00407)	(0.00348)	(0.00349)	(0.00347)	(0.00454)	(0.00450)	(0.00449)
Δp_{t-1}	0.00919*	0.00333	0.00317	-0.00428	-0.00789*	-0.00809*	0.00509	-0.00275	-0.00287
	(0.00483)	(0.00502)	(0.00498)	(0.00466)	(0.00456)	(0.00454)	(0.00396)	(0.00409)	(0.00416)
Δp_{t-2}	0.0105**	0.0120**	0.0119**	0.0102***	0.0109***	0.0107***	0.00378	0.00524	0.00510
	(0.00455)	(0.00459)	(0.00453)	(0.00380)	(0.00394)	(0.00394)	(0.00372)	(0.00381)	(0.00375)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trend	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Region trend	No	No	Yes	No	No	Yes	No	No	Yes
Observations	4,284	3,721	3,721	3,603	3,225	3,225	4,284	3,721	3,721
R-squared (within)	0.076	0.118	0.118	0.094	0.156	0.157	0.072	0.115	0.116
Number of countries	92	86	86	77	73	73	92	86	86
F-Stat	13.14***	18.24***	15.31***	23.11***	22.41***	18.34***	14.79***	17.32***	15.22***

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7 Commodity prices and economic growth – Results by development level

	Emerging Industrialized Economies			Industrialized Economies			Least Developed and Other Developing Economies		
	All Commodities	**Energy**	**Non-Energy**	**All Commodities**	**Energy**	**Non-Energy**	**All Commodities**	**Energy**	**Non-Energy**
Long-term coefficients									
$gfcf_{t-1}$	-0.0350	-0.0730	-0.0483	-0.100***	-0.0860***	-0.0989***	0.0724*	0.0460	0.0670*
	(0.0671)	(0.0737)	(0.0663)	(0.0328)	(0.0298)	(0.0316)	(0.0369)	(0.0370)	(0.0371)
$popgrow_{t-1}$	-0.924	-0.816	-0.765	-0.122	-0.198	-0.153	0.833	1.145*	0.767
	(0.542)	(0.622)	(0.661)	(0.268)	(0.260)	(0.265)	(0.582)	(0.565)	(0.575)
sch_{t-1}	0.0155*	0.0152*	0.00730	-0.00103	-7.88e-05	-0.00178	-0.00128	6.51e-05	-0.00248
	(0.00885)	(0.00733)	(0.00967)	(0.00230)	(0.00190)	(0.00233)	(0.00539)	(0.00533)	(0.00599)
$trade_{t-1}$	0.0330	0.0372	0.0351	0.0120	0.0149*	0.0122	0.0194	0.0247*	0.0195
	(0.0255)	(0.0289)	(0.0233)	(0.00928)	(0.00839)	(0.00929)	(0.0119)	(0.0123)	(0.0119)
pop_{t-1}	-0.0248	-0.0196	-0.0425	0.0107	0.0109	0.0126	-0.0628***	-0.0733***	-0.0607***
	(0.0452)	(0.0613)	(0.0492)	(0.0101)	(0.00877)	(0.00980)	(0.0178)	(0.0169)	(0.0188)
$polity_{t-1}$	-0.00732	-0.0135	-0.00534	-0.00387	-0.00316	-0.00261	0.00358	0.00417	0.00211
	(0.00764)	(0.00848)	(0.00887)	(0.00888)	(0.00717)	(0.00840)	(0.00811)	(0.00903)	(0.00795)
inf_{t-1}	0.000513	0.000469	0.000621	-0.00922	-0.00517	-0.00966	-0.000500**	-0.000476**	-0.000510**
	(0.000351)	(0.000431)	(0.000427)	(0.00537)	(0.00411)	(0.00581)	(0.000210)	(0.000217)	(0.000208)
$fert_{t-1}$	-0.107	-0.145	-0.457	-0.933***	-1.153***	-0.822***	-1.002**	-0.899**	-1.073**
	(0.567)	(0.733)	(0.681)	(0.282)	(0.251)	(0.257)	(0.394)	(0.415)	(0.411)

p_{t-1}	-0.0115**	-0.0110**	0.00386	-0.00604**	-0.0107***	-0.00836***	-0.00180	-0.00738*	0.0148**
	(0.00516)	(0.00389)	(0.00847)	(0.00285)	(0.00200)	(0.00241)	(0.00570)	(0.00367)	(0.00601)
Short-term coefficients									
y_{t-1}	-0.0270	-0.0173	-0.0279	-0.0355***	-0.0393***	-0.0356***	-0.0446***	-0.0465***	-0.0480***
	(0.0157)	(0.0163)	(0.0165)	(0.00749)	(0.00651)	(0.00776)	(0.00908)	(0.00976)	(0.00959)
Δy_{t-1}	0.302***	0.289***	0.320***	0.286***	0.260***	0.277***	0.207***	0.284***	0.208***
	(0.0463)	(0.0398)	(0.0469)	(0.0556)	(0.0521)	(0.0568)	(0.0551)	(0.0584)	(0.0531)
Δp_t	0.0264***	0.0143*	0.0320***	0.0238***	0.00836**	0.0237**	0.0138**	0.00803	0.0132**
	(0.00566)	(0.00689)	(0.00724)	(0.00771)	(0.00371)	(0.00943)	(0.00606)	(0.00554)	(0.00611)
Δp_{t-1}	0.0124*	-0.00665	0.00486	-0.0332***	-0.0269***	-0.0286***	0.0144*	0.00545	0.00409
	(0.00612)	(0.00834)	(0.00727)	(0.00759)	(0.00523)	(0.00704)	(0.00736)	(0.00710)	(0.00642)
Δp_{t-2}	0.00797	0.00315	0.00265	0.00100	0.00299	0.00335	0.0199***	0.0206***	0.00967
	(0.00715)	(0.00496)	(0.00839)	(0.00321)	(0.00291)	(0.00395)	(0.00714)	(0.00683)	(0.00610)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region trend	No	No	No	No	No	No	No	No	No
Observations	803	750	803	1,040	1,040	1,040	1,878	1,435	1,878
R-squared (within)	0.181	0.175	0.170	0.326	0.341	0.316	0.114	0.165	0.114
Number of countries	17	16	17	22	22	22	47	35	47
F-Stat	382.5***	177***	28.81***	170.5***	1738***	323.5***	15.83***	23.65***	14.53***

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8 Commodity prices and economic growth – Results by region

	Africa		**America**		**Asia**		**Europe**	
	Energy	**Non-Energy**	**Energy**	**Non-Energy**	**Energy**	**Non-Energy**	**Energy**	**Non-Energy**
Long-term coefficients								
$gfcf_{t-1}$	0.0470	0.0706	-0.0717	-0.0654	0.0163	0.0239	-0.193***	-0.204***
	(0.0406)	(0.0458)	(0.0549)	(0.0501)	(0.0503)	(0.0491)	(0.0452)	(0.0420)
$popgrow_{t-1}$	1.417**	1.156**	-0.702	-1.266	-0.387*	-0.459*	0.249	0.396*
	(0.543)	(0.471)	(0.738)	(0.792)	(0.211)	(0.253)	(0.272)	(0.213)
sch_{t-1}	0.00420	-0.00194	0.00423	-0.00435	0.000360	0.000732	0.00278	0.00157
	(0.00754)	(0.00861)	(0.00590)	(0.00465)	(0.00407)	(0.00398)	(0.00186)	(0.00199)
$trade_{t-1}$	0.0409***	0.0355**	0.0541**	0.0354**	0.00270	0.000610	0.0374**	0.0415**
	(0.0103)	(0.0135)	(0.0202)	(0.0159)	(0.00948)	(0.00966)	(0.0143)	(0.0163)
pop_{t-1}	0.000716	0.0289	-0.0436*	-0.0443*	-0.0318	-0.0373	0.0395*	0.0483*
	(0.0528)	(0.0448)	(0.0232)	(0.0218)	(0.0265)	(0.0295)	(0.0216)	(0.0229)
$polity_{t-1}$	0.0102	0.00597	0.00343	0.0111	-0.00283	5.10e-05	-0.0144*	-0.0190**
	(0.0167)	(0.0139)	(0.00960)	(0.00744)	(0.0120)	(0.00875)	(0.00740)	(0.00771)
inf_{t-1}	-0.000547*	-0.000581**	-0.000190**	-0.000160	-0.00427	-0.00888	-0.0134	-0.0220
	(0.000287)	(0.000261)	(7.08e-05)	(0.000104)	(0.00526)	(0.00596)	(0.00863)	(0.0144)
$fert_{t-1}$	-1.873**	-2.157***	0.0340	0.0913	-0.501	-0.524	-1.133***	-0.990**
	(0.708)	(0.606)	(0.492)	(0.491)	(0.347)	(0.307)	(0.374)	(0.360)
p_{t-1}	0.00436	0.0254***	-0.00608**	0.0156***	-0.0102*	0.000353	-0.0116***	-0.0108***
	(0.00631)	(0.00897)	(0.00268)	(0.00554)	(0.00506)	(0.00374)	(0.00281)	(0.00326)
Short-term coefficients								

y_{t-1}	-0.0549***	-0.0622***	-0.0470***	-0.0425***	-0.0250***	-0.0273***	-0.0366***	-0.0424***
	(0.0127)	(0.0171)	(0.00914)	(0.00905)	(0.00640)	(0.00642)	(0.00988)	(0.00889)
Δy_{t-1}	0.184**	0.0958	0.308***	0.300***	0.380***	0.370***	0.312***	0.352***
	(0.0712)	(0.0607)	(0.0466)	(0.0438)	(0.0754)	(0.0694)	(0.0671)	(0.0674)
Δp_t	0.0162	0.0143	0.0173***	0.0291***	0.00464	0.00915	0.00710	0.0452***
	(0.00982)	(0.00878)	(0.00407)	(0.00583)	(0.00666)	(0.00939)	(0.00651)	(0.00661)
Δp_{t-2}	0.00900	-0.00420	-0.00407	-0.00151	-0.0190**	-0.00339	-0.0216**	-0.0406***
	(0.0116)	(0.00938)	(0.00643)	(0.00529)	(0.00765)	(0.00723)	(0.00762)	(0.00807)
Δp_{t-3}	0.0187	0.0108	0.00922*	-0.00712	0.0111	0.00618	0.00983***	0.00860
	(0.0116)	(0.00770)	(0.00477)	(0.00664)	(0.00913)	(0.00720)	(0.00221)	(0.00884)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region trend	No	No	No	No	No	No	No	No
Observations	763	1,021	927	1,097	811	879	724	724
R-squared (within)	0.166	0.132	0.197	0.172	0.219	0.190	0.358	0.365
Number of countries	20	27	19	23	18	20	16	16
F-Stat	142.2***	19.01***	52.07***	71.30***	175.3***	95.01***	1154***	6156***

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 9 Commodity prices and economic growth – Results for surplus and deficit countries

	All Commodities		**Energy**		**Non-Energy**	
	Deficit	*Surplus*	*Deficit*	*Surplus*	*Deficit*	*Surplus*
Long-term coefficients						
$gfcf_{t-1}$	0.0294	0.0249	0.0180	0.0116	0.0276	0.0187
	(0.0280)	(0.0389)	(0.0364)	(0.0378)	(0.0253)	(0.0446)
$popgrow_{t-1}$	-0.673***	0.779	-0.397**	1.306*	-0.703**	0.778
	(0.232)	(0.603)	(0.189)	(0.733)	(0.268)	(0.612)
sch_{t-1}	-0.000705	0.00236	0.000522	0.00719	0.00159	-0.00131
	(0.00213)	(0.00440)	(0.00216)	(0.00523)	(0.00368)	(0.00539)
$trade_{t-1}$	0.0168	0.0322***	0.0174*	0.0412***	0.0177*	0.0313***
	(0.0102)	(0.0101)	(0.0103)	(0.0117)	(0.00926)	(0.0104)
pop_{t-1}	0.0159	-0.0668***	-0.000302	-0.0666***	0.0170	-0.0850***
	(0.0126)	(0.0159)	(0.0152)	(0.0189)	(0.0117)	(0.0191)
$polity_{t-1}$	0.00562	0.000905	0.00748	-0.00573	-0.00165	0.00737
	(0.00852)	(0.00666)	(0.00783)	(0.00863)	(0.00718)	(0.00744)
inf_{t-1}	8.24e-05	-0.000519**	-0.000651***	-0.000220***	-0.000595***	-0.000510**
	(9.05e-05)	(0.000236)	(0.000194)	(6.15e-05)	(0.000140)	(0.000244)
$fert_{t-1}$	-0.391	-1.242***	-0.575*	-1.252***	-0.205	-1.649***
	(0.256)	(0.338)	(0.299)	(0.370)	(0.248)	(0.370)
p_{t-1}	-0.00670**	-0.00372	-0.00420	-0.00930***	-0.00233	0.0167***
	(0.00316)	(0.00419)	(0.00279)	(0.00334)	(0.00362)	(0.00534)

Short-term coefficients						
y_{t-1}	-0.0323***	-0.0522***	-0.0268***	-0.0622***	-0.0376***	-0.0530***
	(0.00855)	(0.00819)	(0.00727)	(0.0105)	(0.00638)	(0.00901)
Δy_{t-1}	0.159**	0.254***	0.270***	0.293***	0.173***	0.250***
	(0.0644)	(0.0417)	(0.0538)	(0.0491)	(0.0543)	(0.0474)
Δp_t	0.00835*	0.0199***	0.00829**	0.0111**	0.0165***	0.0195**
	(0.00447)	(0.00535)	(0.00359)	(0.00471)	(0.00442)	(0.00805)
Δp_{t-1}	-0.00956**	0.00803	-0.0210***	0.000869	0.00180	-0.00592
	(0.00473)	(0.00612)	(0.00390)	(0.00645)	(0.00559)	(0.00613)
Δp_{t-2}	0.00779*	0.0116*	0.00675*	0.0130**	0.00707	0.00304
	(0.00458)	(0.00633)	(0.00370)	(0.00615)	(0.00453)	(0.00699)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Trend	Yes	Yes	Yes	Yes	Yes	Yes
Region Trend	No	No	No	No	No	No
Observations	1,365	2,356	1,501	1,724	1,806	1,915
R-squared (within)	0.111	0.129	0.191	0.157	0.123	0.141
Number of countries	69	84	61	70	77	78
F-Stat	15.54***	19.27***	20.04***	14.47***	9.689***	17.73***

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The final set of results (Table 9) distinguishes between observations for which countries have a trade surplus (*Surplus*) and those that have a trade deficit (*Deficit*). We may well expect that even though all countries included in the sample have positive exports in the particular commodity group (i.e. all commodities, energy commodities and non-energy commodities), the effects of commodity price changes impact on surplus (i.e. net exporters) and deficit (i.e. net importers) countries differently. This expectation is to some extent derived from the results. As regards the long-term effects, the results differ for deficit and surplus countries. Specifically, in the case of energy prices, the long-term negative impact of energy price increases on growth is limited to net exporters. In the case of non-energy prices, the positive long-term effects of non-energy prices are also limited to surplus countries. Conversely, when considering all commodities, we observe a negative long-term effect of commodity price increases that is limited to the set of deficit country observations. Turning to the short-term effects, we find fewer differences in the coefficients between deficit and surplus countries. In particular, we find coefficients on the contemporaneous changes in commodity prices that tend to be positive and significant. While coefficients tend to be somewhat larger for surplus countries, the differences are not pronounced. We do find some differences in the short-term coefficients when looking at the first lag of commodity price changes. Here we observe negative and significant coefficients in the case of all commodity and energy prices, suggesting that price increases—of energy in particular—have a lagged negative impact on the growth of net importers of energy products.

The results in the above three tables paint a fairly consistent picture of the role of commodity price developments on both short- and long-term per capita GDP growth. These results are summarized in Table 9 which indicates whether the effects on either short- or long-term growth of per capita GDP are negative (-) or positive (+), and whether the effects appear significant (*). To summarize, the long-term effects of commodity prices appear to be negative, a result that holds for all country groups except Africa, and to a lesser extent the Americas. This negative long-term impact is driven by developments in energy prices which have significant negative long-terms effects in all groups, except Africa (where it has no effect). For non-energy prices, however, we tend to find a positive long-term effect of rising commodity prices. This is true for all groups, except for industrialized and European economies. The short-term impact of commodity prices tends to be positive, with growth in commodity prices increasing short-term growth rates. This tends to be the case for all commodities and for energy and non-energy price indices. The major exception is industrialized economies, for which we find negative effects in the short-run, and to a lesser extent countries in the Asia group (particularly for energy).

Table 10 Summary table of results

	All	EIE	IE	ODE/LDC	Africa	America	Asia	Europe
All Commodities								
Long-Term Impact	-	-*	-*	-	+*	+	-*	-
Short-Term Impact	+*	+*	-*	+*	+*	+*	+	+
Energy								
Long-Term Impact	-*	-*	-*	-*	+	-*	-*	-*
Short-Term Impact	+*	+*	-*	+*	+	+*	-*	-
Non-Energy								
Long-Tern Impact	+*	+	-*	+*	+*	+*	+	-*
Short-Term Impact	+*	+*	-*	+*	+	+*	-	+

Note: This table summarizes the results assessing the impact of commodity price developments on both short-term and long-term per capita GDP growth. The table indicates whether the effect of increasing commodity prices is negative (-), positive (+) and statistically significant (*). Results are summarized for all countries (All), emerging and industrializing economies (EIEs), industrialized economies (IS), least and other developing economies (ODE/LDC), African countries, countries in the Americas, countries in Asia and countries in Europe.

Relating these results to the analysis above reveals two major implications. First, the evidence suggesting that the world is on a downward slope of both a medium-term cycle and a super-cycle suggests that we may expect a negative impact of commodity price development on per capita GDP growth in the short term. Secondly, the evidence suggesting that the long-term trend for most commodity prices is positive suggests that the long-term impact of commodity price developments is also negative for most country groups (with the exception of Africa and Asia). On this latter point, however, the implications are more nuanced, with the results suggesting that the long-term effects of a rising long-term trend in commodity prices has deleterious effects on the growth of countries that are intensive energy exporters, but that the effects may actually be positive for countries that are heavily engaged in non-energy commodity exports.

8. Summary and conclusion

This paper has a number of objectives. Specifically, it describes and discusses recent developments in the price of commodities (relative to manufacturing prices), considers the presence of cycles in commodity prices and the current phase of these cycles, and links developments in commodity prices to those in per capita GDP. A number of conclusions from this analysis can be drawn, which can be summarized as follows:

(i) The rise in commodity prices that continued throughout much of the 2000s came to an end towards the end of the 2000s, with prices showing signs of falling since around 2010;

(ii) For most commodity groups, the evidence suggests that the world is now on the downward phase of both a medium-term cycle and a super-cycle, suggesting that we may expect depressed commodity prices in the short- to medium-term;

(iii) Countering this latter point is the observation that the long-term price trend for most commodity groups—including agriculture—has been positive since at least the 1990s;

(iv) Considering different commodities, there is evidence suggesting that the cycles for the different commodity groups are not always strongly synchronized. As a result, it may not be relevant to talk of a world commodity price cycle, with country-specific specialization patterns being relevant for individual countries' positioning in the commodity cycle;

(v) The long-term effect of commodity price increases on per capita GDP tends to be negative;

(vi) This negative long-term impact on per capita GDP is driven by energy prices, with the effect of non-energy prices on per capita GDP tending to be positive;

(vii) The impact of commodity price growth on short-term per capita GDP growth tends to be positive;

(viii) the evidence suggesting that the world is on the downward slope of both a medium-term cycle and a super-cycle suggests that we may expect a negative impact of commodity price developments on per capita GDP growth in the short term;

(ix) the evidence suggesting that the long-term trend for most commodity prices is positive suggests that the long-term impact of commodity price developments is also negative for most country groups;

(x) On this latter point, however, the implications are more nuanced, with the results suggesting that the long-term effects of a rising long-run trend in commodity prices

would have deleterious effects on the growth of countries that are intensive energy exporters, but that the effects may actually be positive for countries that are heavily engaged in non-energy commodity exports.

References

Alexeev, M. and R. Conrad, 2009. The elusive curse of oil. *Review of Economics and Statistics*, 91, 586-598.

Alquist, R. and O. Coibion, 2014. Commodity-price comovement and global economic activity. NBER Working Paper no. 20003, National Bureau of Economic Research.

Baffes, J. and X.L. Etienne, 2016. Analysing food price trends in the context of Engel's Law and the Prebisch-Singer hypothesis. *Oxford Economic Papers*, 68(3), 688-713.

Baxter, M. and King, R.G., 1999. Measuring business cycles: approximate band-pass filters for economic time series. *Review of Economics and Statistics*, *81*(4), 575-593.

Borensztein, E. and Reinhart, C.M., 1994. The macroeconomic determinants of commodity prices. *Staff Papers*, *41*(2), 236-261.

Boshoff, W.H., 2010. Band-pass filters and business cycle analysis: High frequency and medium-term deviation cycles in South Africa and what they measure. *Universeteit Stellenbosch University, Working Paper*, *200*.

Christiano, L.J. and Fitzgerald, T.J., 2003. The band pass filter. *International Economic Review*, *44*(2), 435-465.

Collier, P. and B. Goderis, 2012. Commodity prices and growth: An empirical investigation. *European Economic Review*, 56, 1241-1260.

Comin, D. and Gertler, M., 2006. Medium-term business cycles. *American Economic Review*, *96*(3), 523-551.

Cuddington, J.T. and Jerrett, D., 2008. Super cycles in real metals prices?*IMF Economic Review*, *55*(4), pp.541-565.

Deaton, A., 1999. Commodity prices and growth in Africa. *Journal of Economic Perspectives*, *13*(3), 23-40

Deaton, A. and S. Miller, 1995. *International Commodity Prices, Macroeconomic Performance, and Politics in Sub-Saharan Africa*. Princeton Studies in International Finance 79, Princeton University Press.

Drehmann, M., Borio, C.E. and Tsatsaronis, K., 2012. Characterising the financial cycle: don't lose sight of the medium term! BIS Working Paper no. 380, Bank for International Settlements.

Erten, B. And J.A. Ocampo, 2013. *Super cycles of commodity prices since the mid-nineteenth century*. *World Development*, 44, 14-30.

Frankel, J. and Rose, A., 2010. *Determinants of Agricultural and Mineral Commodity Prices*. Harvard Kennedy School of Government.

Grilli, E. and M. Yang, 1988. Primary commodity prices, manufactured goods prices, and the terms of trade of developing countries: What the long run shows. *World Bank Economic Review*, 2(1), 1-47.

Gruss, B., 2014. *After the boom–commodity prices and economic growth in Latin America and the Caribbean.* IMF Working Paper no. 14-154, International Monetary Fund.

Harding, P. and A. Pagan, 2006. Synchronisation of cycles. *Journal of Econometrics*, 132, 59-79.

Jerrett, D. and Cuddington, J.T., 2008. Broadening the statistical search for metal price super cycles to steel and related metals. *Resources Policy*, *33*(4), 188-195.

Lederman, D. and W.F. Maloney, 2007. Trade structure and growth. In D. Ledermand W.F. Maloney (eds.), *Natural Resources, Neither Curse nor Destiny*. Stanford University Press and World Bank, Stanford and Washington DC.

Ojeda-Joya, J.N., Jaulin-Mendez, O. and Bustos-Peláez, J.C., 2015. *The Interdependence between Commodity-Price and GDP Cycles: A Frequency Domain Approach*. Working Paper no. 913. Bank of Colombia.

Otero, J. and A.M. Iregui, 2011. *The Long-Run Behaviour of the Terms of Trade between Primary Commodities and Manufactures.* UNU-WIDER Research Paper WP2011/71, UNU-WIDER.

Pfaffenzeller, S., Newbold, P. and A. Rayner, 2007. A short note on updating the Grilli and Yang commodity price index. *World Bank Economic Review*, 21(1), 151-163.

Prebisch, R., 1950. *The Economic Development of Latin America and its Principal Problems*. Economic Commission for Latin America, United Nations, Department of Economic Affairs, New York: Lake Success.

Reinhart, C. M., Reinhart, V., and C. Trebesch, 2016. Global Cycles: Capital Flows, Commodities, and Sovereign Defaults, 1815–2015. *American Economic Review*, 106(5), 574-580.

Sachs, J. and D. Warner, 1999. Natural resource abundance and economic growth. NBER Working Paper no. 5398 (update of 1995 version of the paper), National Bureau of Economic Research.

Sala-i-Martin, X. and A. Subramanian, 2003. Addressing the natural resource curse: An illustration from Nigeria. NBER Working Paper no. 9804, National Bureau of Economic Research.

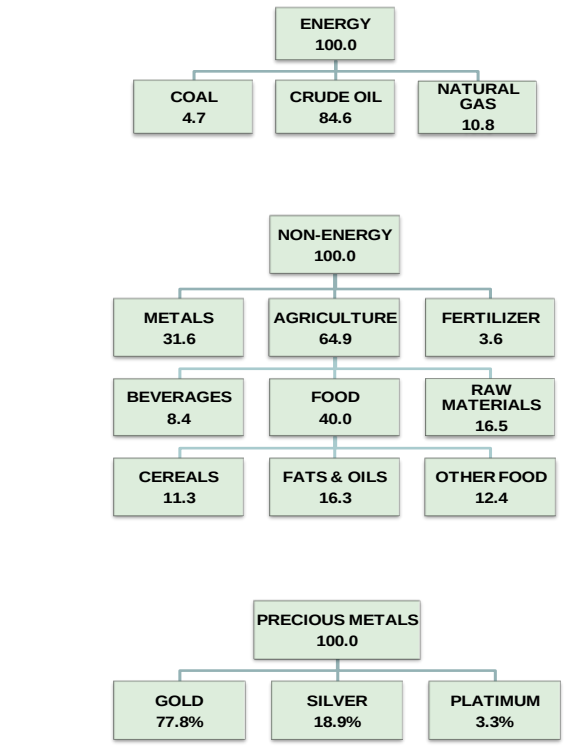
Singer, H.W., 1950. The distribution of gains between investing and borrowing countries. *American Economic Review*, 40, 473-485.

Zhu, 2011 Borio, C. and Zhu, H., 2012. Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism? *Journal of Financial Stability*, *8*(4), 236-251.

Appendices

Appendix I: Data description

Figure A1 Weighting used in the construction of commodity price indices



Source: World Bank Development Prospects Group

Table A1 **HS codes used in the construction of country/region-specific commodity price indices**

Commodity Name	HS Code	HS Description
Energy		
Coal	2701	Coal, briquettes, ovoids etc., mfr from coal
Crude Oil	2709	Crude oil from petroleum and bituminous minerals
Natural Gas	2711	Petroleum gases & other gaseous hydrocarbons
Non-energy Commodities		
Agriculture		
Food		
Cereals		
Rice	1006	Rice
Wheat	1001	Wheat and meslin
Maize	1005	Corn (maize)
Barley	1003	Barley
Vegetable Oils and Meals		
Soybeans	1201	Soybeans, whether or not broken
Soybean Oil	1507	Soybean oil & its fractions, not chemically modified
Soybean Meal	2304	Soybean oilcake & other solid residue, wh/not ground
Palm Oil	1511	Palm oil & its fractions, not chemically modified
Coconut Oil	1513	Coconut, palm kernel or babassu oil etc, not ch mod
Groundnut Oil	1508	Peanut oil & its fractions, not chemically modified
Other Food		
Sugar	1701	Cane or beet sugar & chem pure sucrose, solid form
Bananas	0803	Bananas and plantains, fresh or dried
Meat, beef	0201/0202	Meat of bovine animals, fresh or chilled / meat of bovine animals, frozen
Meat, chicken	0207	Meat & ed offal of poultry, fresh, chill or frozen
Oranges	080510	Oranges
Beverages		
Coffee	0901	Coffee, coffee husks etc, substitutes with coffee
Cocoa	1801	Cocoa beans, whole or broken, raw or roasted
Tea	0902	Tea

Agricultural Raw Materials		
Timber		
Hardwood		
Logs	4401	Fuel wood in logs etc, wood in chips, etc.
Sawnwood	4407	Wood sawn or chipped length, sliced etc, ov6mm thick
Other Raw Materials		
Cotton	5201	Cotton, not carded or combed
Natural Rubber	4001	Natural rubber, balata, gutta-percha, guayule, chicle and similar natural gums, in primary forms or in plates, sheets or strip
Tobacco	2401	Tobacco, unmanufactured, tobacco refuse
Metals and Minerals		
Aluminium	2606	Aluminium ores and concentrates
Copper	2603	Copper ores and concentrates
Iron Ore	2601	Iron ores & concentrates, including roast pyrites
Lead	2607	Lead ores and concentrates
Nickel	2604	Nickel ores and concentrates
Tin	2609	Tin ores and concentrates
Zinc	2608	Zinc ores and concentrates
Fertilizers		
Natural Phosphate Rock	2510	Natural calcium (inc alum cal) phosp & phosp chalk
Phosphate	3103	Mineral or chemical fertilizers, phosphatic
Potassium	3104	Mineral or chemical fertilizers, potassic
Nitogenous	3102	Mineral or chemical fertilizers, nitrogenous
Precious Metals		
Gold	7108	Gold (incl put plated), unwr, semimfr or powder
Silver	7106	Silver (incl prec plated), unwr, semimfr or powder
Platinum	7110	Platinum, unwrought, semimfr forms or in powder fm

Table A2 **HS codes used in the construction of country/region-specific commodity price indices**

Commodity Name	HS Code	HS Description
Energy		
Coal	2701	Coal, briquettes, ovoids etc, mfr from coal
Crude Oil	2709	Crude oil from petroleum and bituminous minerals
Natural Gas	2711	Petroleum gases & other gaseous hydrocarbons
Non-energy Commodities		
Agriculture		
Food		
Cereals		
Rice	1006	Rice
Wheat	1001	Wheat and meslin
Maize	1005	Corn (maize)
Barley	1003	Barley
Vegetable Oils and Meals		
Soybeans	1201	Soybeans, whether or not broken
Soybean Oil	1507	Soybean oil & its fractions, not chemically modified
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Groundnut Oil	1508	Peanut oil & its fractions, not chemically modified
Other Food		
Sugar	1701	Cane or beet sugar & chem pure sucrose, solid form
Bananas	0803	Bananas and plantains, fresh or dried
Meat, beef	0201/0202	Meat of bovine animals, fresh or chilled / meat of bovine animals, frozen
Meat, chicken	0207	Meat & ed offal of poultry, fresh, chill or frozen
Oranges	080510	Oranges
Beverages		
Coffee	0901	Coffee, coffee husks etc, substitutes with coffee
Cocoa	1801	Cocoa beans, whole or broken, raw or roasted
Tea	0902	Tea

Agricultural Raw Materials		
Timber		
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Lead	2607	Lead ores and concentrates
Nickel	2604	Nickel ores and concentrates
Tin	2609	Tin ores and concentrates
Zinc	2608	Zinc ores and concentrates
Fertilizers		
Natural Phosphate Rock	2510	Natural calcium (inc alum cal) phosp & phosp chalk
Phosphate	3103	Mineral or chemical fertilizers, phosphatic
Potassium	3104	Mineral or chemical fertilizers, potassic
Nitogenous	3102	Mineral or chemical fertilizers, nitrogenous
Precious Metals		
Gold	7108	Gold (incl put plated), unwr, semimfr or powder
Silver	7106	Silver (incl prec plated), unwr, semimfr or powder
Platinum	7110	Platinum, unwrought, semimfr forms or in powder fm

UNIDO country groups

Industrialized Economies			Emerging Industrialized Economies		Least Developed Countries	
Austria	Spain	China, Hong Kong	Belarus	Suriname	Haiti	Burkina Faso
Belgium	Sweden	China, Macao	Bulgaria	Uruguay	Kiribati	Gambia
Czech Republic	United Kingdom	China, Taiwan	Croatia	Venezuela	Samoa	Guinea
Denmark	Iceland	Japan	Cyprus	Kazakhstan	Solomon Islands	Guinea-Bissau
Estonia	Liechtenstein	Malaysia	Greece	China	Timor-Leste	Liberia
Finland	Norway	Republic of Korea	Latvia	India	Vanuatu	Mali
France	Russian Federation	Singapore	Poland	Brunei	Afghanistan	Mauritania
Germany	Switzerland	Australia	Romania	Indonesia	Bangladesh	Niger
Hungary	British Virgin Islands	French Polynesia	Serbia	Thailand	Bhutan	Senegal
Ireland	Curaçao	Guam	Rep of Macedonia	Oman	Nepal	Sierra Leone
Italy	Puerto Rico	New Caledonia	Turkey	Saudi Arabia	Cambodia	Togo
Lithuania	US Virgin Islands	New Zealand	Ukraine	Tunisia	Lao PDR	
Luxembourg	Aruba	Bahrain	Costa Rica	Mauritius	Myanmar	
Malta	Bermuda	Israel	Mexico	South Africa	Yemen	
Netherlands	Canada	Kuwait	Argentina		Central African Republic	
Portugal	Greenland	Qatar	Brazil		Chad	
Slovakia	United States of America	United Arab Emirates	Chile		Sao Tome and Principe	
Slovenia	French Guiana		Colombia		Burundi	
Other Developing Economies					Comoros	
Albania	Montserrat	Kyrgyzstan	Philippines	Algeria	Djibouti	
Bosnia Herzegovina	Saint Kitts and Nevis	Mongolia	Viet Nam	Egypt	Eritrea	
Georgia	Saint Lucia	Tajikistan	Armenia	Libya	Ethiopia	
Montenegro	St Vincent & Grenadines	Turkmenistan	Azerbaijan	Morocco	Rwanda	
Moldova	Trinidad & Tobago	Uzbekistan	Iran	Angola	Somalia	
Anguilla	Belize	Cook Islands	Iraq	Botswana	Uganda	
Antigua & Barbuda	El Salvador	DPR Korea	Jordan	Namibia	South Sudan	
Bahamas	Guatemala	Fiji	Lebanon	Seychelles	Sudan	
Barbados	Honduras	Marshall Islands	State of Palestine	Swaziland	DR Congo	
Cuba	Nicaragua	Micronesia	Syria	Zimbabwe	Lesotho	
Dominica	Panama	Palau	Cameroon	Cabo Verde	Madagascar	
Dominican Republic	Bolivia	Papua New Guinea	Congo	Côte d'Ivoire	Malawi	
Grenada	Ecuador	Tonga	Equatorial Guinea	Ghana	Mozambique	
Guadeloupe	Guyana	Maldives	Gabon	Nigeria	Tanzania	
Jamaica	Paraguay	Pakistan	Kenya		Zambia	
Martinique	Peru	Sri Lanka	Réunion		Benin	

ISIC REV. 3 two-digit sectors

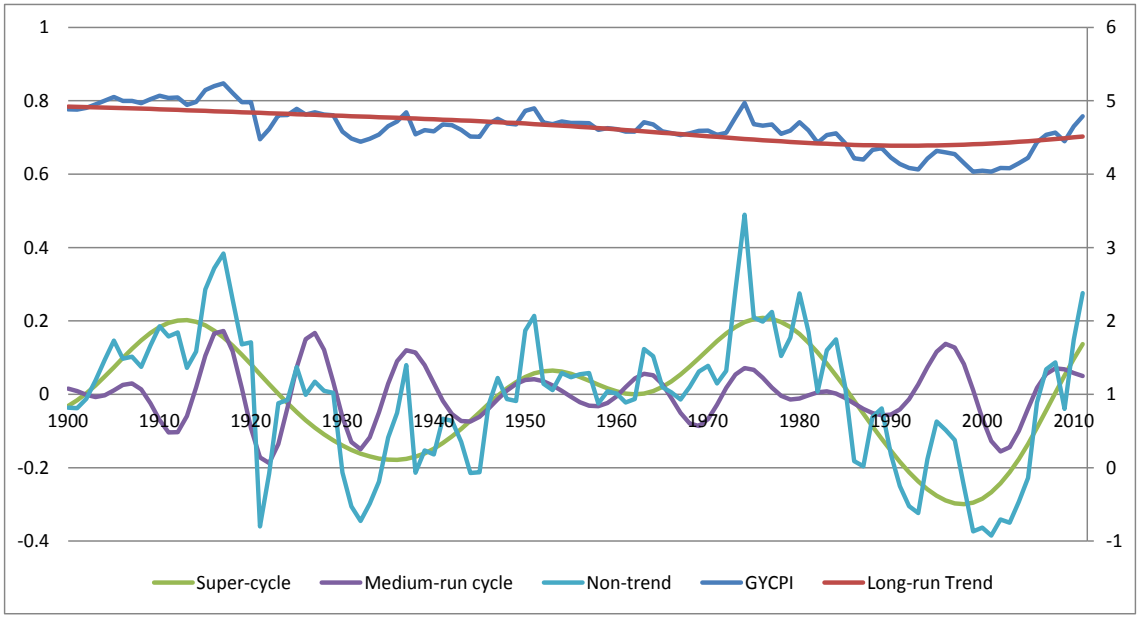
	Primary Sectors
1	Agriculture, Hunting and related service activities
2	Forestry, Logging and related service activities
5	Fishing, Operation of Fish Hatcheries and Fish Farms; Service activities incidental to Fishing
10	Mining of Coal and Lignite; Extraction of Peat
11	Extraction of Crude Petroleum and Natural Gas; Service activities incidental to Oil and Gas extraction, excluding surveying
12	Mining of Uranium and Thorium Ores
13	Mining of Metal Ores
14	Other Mining and Quarrying
	Manufacturing Sector
15	Manufacture of Food Products and Beverages
16	Manufacture of Tobacco Products
17	Manufacture of Textiles
18	Manufacture of Wearing Apparel; Dressing and Dyeing of Fur
19	Tanning and Dressing of Leather; Manufacture of Luggage, Handbags, Saddlery, Harness and Footwear
20	Manufacture of Wood and of Products of Wood and Cork, except Furniture; Manufacture of articles of Straw and Plaiting Materials
21	Manufacture of Paper and Paper Products
22	Publishing, Printing and Reproduction of Recorded Media
23	Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel
24	Manufacture of Chemicals and Chemical Products
25	Manufacture of Rubber and Plastics Products
26	Manufacture of Other Non-Metallic Mineral Products
27	Manufacture of Basic Metals
28	Manufacture of Fabricated Metal Products, except Machinery and Equipment
29	Manufacture of Machinery and Equipment NEC **
30	Manufacture of Office, Accounting and Computing Machinery
31	Manufacture of Electrical Machinery and Apparatus NEC **
32	Manufacture of Radio, Television and Communication Equipment and Apparatus
33	Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks
34	Manufacture of Motor Vehicles, Trailers and Semi-Trailers
35	Manufacture of other Transport Equipment
36	Manufacture of Furniture; Manufacturing NEC **
37	Recycling

	Other Sectors
40	Electricity, Gas, Steam and Hot Water Supply
41	Collection Purification and Distribution of Water
45	Construction
50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Automotive Fuel
51	Wholesale Trade and Commission Trade, except of Motor Vehicles and Motorcycles
52	Retail Trade, except of Motor Vehicles and Motorcycles; Repair of Personal and Household Goods
55	Hotels and Restaurants
60	Land Transport; Transport via Pipelines
61	Water Transport
62	Air Transport
63	Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
64	Post and Telecommunications
65	Financial Intermediation, except Insurance and Pension Funding
66	Insurance and Pension Funding, except Compulsory Social Security
67	Activities auxiliary to Financial Intermediation
70	Real Estate activities
71	Renting of Machinery and Equipment without Operator and of Personal and Household Goods
72	Computer and related activities
73	Research and Development
74	Other Business activities
75	Public Administration and Defence; Compulsory Social Security
80	Education
85	Health and Social Work
90	Sewage and Refuse Disposal, Sanitation and similar activities
91	Activities of Membership Organizations NEC
92	Recreational, Cultural and Sporting activities
93	Other Service activities
95	Private Households with Employed Persons
99	Extra-Territorial Organizations and Bodies

Appendix II: Additional results on cycles using the Grilli and Yang database

In this Appendix, we report additional results on cycles in commodity prices using the updated dataset of Grilli and Yang (1988), which comprises data over a longer period (1900-2011) than the World Bank data used in the main text. The approach adopted is the same as in the main text, with the Band-Pass filter used to extract the long-term trend (longer than 45 years), a super-cycle (20-45 years) and a medium-term cycle (8-20 years). Figure A2 reports the results for the non-oil commodity price index (GYCPI) of Grilli and Yang. As with the previous cases, the commodity price series is deflated by a manufacturing unit value index.

Figure A2 Cycles in non-oil commodity prices



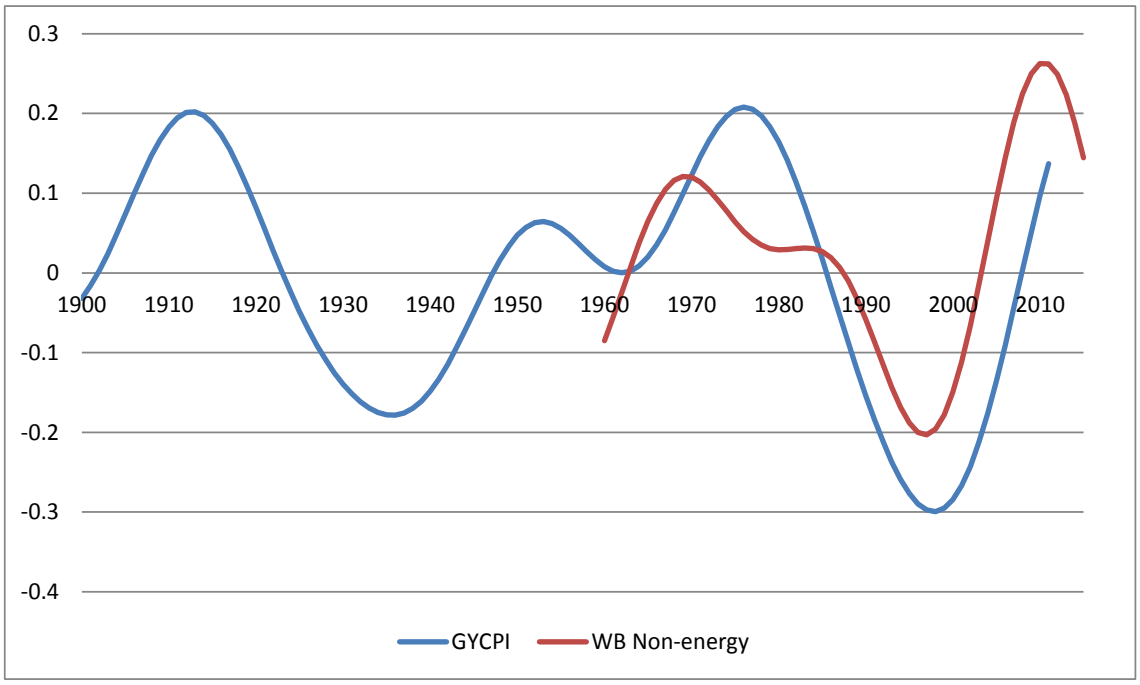
Source: Authors' elaboration based on Grilli and Yang (1988).

In many respects, the results in Figure A2 are consistent with those reported using the World Bank series on non-energy commodity prices (Figure 7), with evidence of an upturn in the long-term trend in commodity prices from the early 2000s onwards and an upward trend in the super-cycle up to 2010 and in the medium-term cycle to the mid-2000s. Considering the super-cycle, there is little evidence suggesting that the peaks of the super-cycles decline over time, though the trough of the most recent cycle was lower than previous cycles. The medium-term cycles were relatively volatile before the early 1940s, and appear to have become more volatile since the mid-1990s, following a period of relative calm between 1950 and 1990.

Figures A3 and A4 below compare the super-cycle and the medium-term cycle obtained using the Grilli and Yang dataset (for non-oil commodities) with that found when using the World Bank data (for non-energy commodities). In the case of the super-cycle (Figure A3), we see that

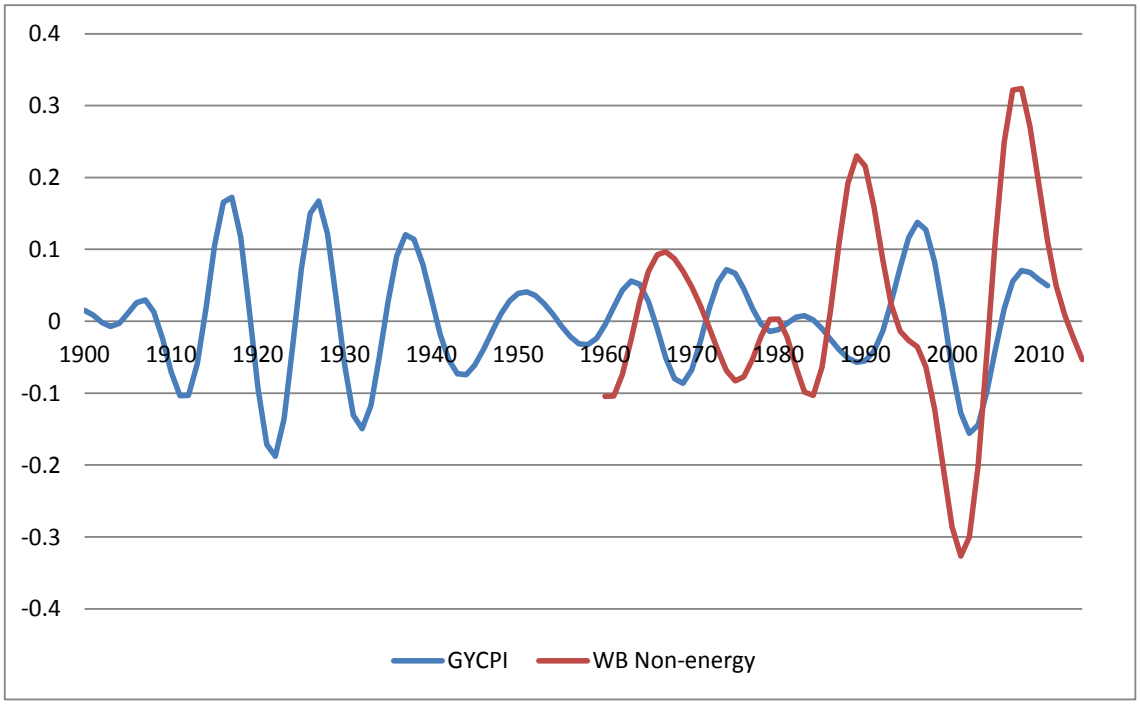
the cycles slightly differ during the early period for which World Bank data is available—though the expansion and contraction phases are largely similar—but that for the later period, there is a strong correlation between the phases of the two series. In the case of medium-term cycles (Figure A4), the picture looks quite different, with the cycles obtained from the two series often being in different phases at particular points in time. From the 2000s onwards, the phases of the medium-term cycles tend to correspond, though the amplitude in the case of the World Bank series is larger than that for the Grilli and Yang dataset.

Figure A3 Comparison of super-cycles



Source: Authors' elaboration based on Grilli and Yang (1988) and Global Economic Monitor Commodities (World Bank, 2016).

Figure A4 Comparison of medium-term cycles



Source: Authors' elaboration based on Grilli and Yang (1988) and Global Economic Monitor Commodities (World Bank, 2016).

Appendix III: Additional results on commodity prices and economic growth

Table A3 Commodity prices and economic growth by region

	Africa	America	Asia	Europe
Long-run Coefficients				
$gfcf_{t-1}$	0.0815*	-0.0547	0.0298	-0.215***
	(0.0430)	(0.0466)	(0.0493)	(0.0416)
$popgrow_{t-1}$	1.164**	-1.452*	-0.389*	0.397
	(0.494)	(0.790)	(0.204)	(0.230)
sch_{t-1}	-0.00208	-0.00264	0.00447	0.00232
	(0.00720)	(0.00518)	(0.00405)	(0.00207)
$trade_{t-1}$	0.0349**	0.0342*	-0.00176	0.0372**
	(0.0129)	(0.0168)	(0.00901)	(0.0166)
pop_{t-1}	0.0161	-0.0357*	-0.0291	0.0432
	(0.0411)	(0.0203)	(0.0255)	(0.0278)
inf_{t-1}	-0.000553*	-0.000181**	-0.00753	-0.0190
	(0.000277)	(8.60e-05)	(0.00446)	(0.0142)
$polity_{t-1}$	0.00908	0.00801	0.00157	-0.0194**
	(0.0142)	(0.00782)	(0.00929)	(0.00780)
$fert_{t-1}$	-2.194***	0.285	-0.396	-1.124**
	(0.653)	(0.490)	(0.300)	(0.469)
p_{t-1}	0.0116*	0.000423	-0.0131**	-0.00495
	(0.00648)	(0.00354)	(0.00613)	(0.00462)
Short-run Coefficients				
y_{t-1}	-0.0573***	-0.0373***	-0.0302***	-0.0387***
	(0.0153)	(0.00819)	(0.00832)	(0.00827)
Δy_{t-1}	0.0904	0.293***	0.362***	0.352***
	(0.0588)	(0.0420)	(0.0716)	(0.0672)
Δp_t	0.0156*	0.0298***	0.0107	0.0356***
	(0.00875)	(0.00432)	(0.00740)	(0.00777)
Δp_{t-2}	0.0123	0.00995	-0.00753	-0.0337***
	(0.0117)	(0.00633)	(0.00910)	(0.00968)
Δp_{t-3}	0.0218**	0.00336	0.0174	0.000251
	(0.00901)	(0.00701)	(0.0114)	(0.00675)

Country FE	Yes	Yes	Yes	Yes
Trend	Yes	Yes	Yes	Yes
Region Trend	No	No	No	No
Observations	1,021	1,097	879	724
R-squared (within)	0.132	0.173	0.212	0.354
Number of countries	27	23	20	16
F-Stat	18.17	53.50	94.42	392.8

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

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