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FROM BOOM TO BUST:
A TYPOLOGY OF REAL COMMODITY PRICES IN THE LONG RUN

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ABSTRACT

This paper considers the evidence on real commodity prices over 160 years for 30 commodities representing 7.89 trillion USD worth of production in 2011. In so doing, it suggests and documents a complete typology of real commodity prices, comprising long-run trends, medium-run cycles, and short-run boom/bust episodes. The findings of the paper can be summarized as follows: real commodity prices of both energy and non-energy commodities have been on the rise from 1950 across all weighting schemes; there is a consistent pattern, in both past and present, of commodity price super-cycles which entail decades-long positive deviations from these long-run trends with the latest set of super-cycles likely at their peak; these commodity price super-cycles are punctuated by booms and busts which are historically pervasive and becoming more exacerbated over time. These last elements of boom and bust are also found to be particularly bearing in determining real commodity price volatility as well as potentially bearing in influencing growth in commodity exporting economies.

This version of the paper includes an updated chartbook which introduces a new—and now publicly available—dataset on an expanded range of 40 commodities, comprising 8.72 trillion USD worth of production in 2011 and spanning the years from 1850 to 2013. It also presents evidence on three new general commodity price indices using various weighting schemes for the period from 1900 to 2013.

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I. Introduction

Once—maybe twice—in every generation, the global economy witnesses a protracted and widespread commodity boom. And in each boom, the common perception is that the world is quickly running out of key materials. The necessary consequence of this demand-induced scarcity is that economic growth must inexorably grind to a halt. While many in the investment community acknowledge this as a possibility, they also suggest that in the meantime serious fortunes are to be made in riding the wave of ever increasing prices. On the other hand, economists are often quick to counter that such thinking is somehow belied by the long-run history of real commodity prices. Building on an extensive academic and policy literature chartering developments in the price of commodities relative to manufactured goods in particular, this side of the debate argues that the price signals generated in the wake of a global commodity boom are always sufficiently strong to induce a countervailing supply response as formerly dormant exploration and extraction activities take off.

What is missing from this discussion is a consistent body of evidence on real commodity prices and a consistent methodology for characterizing their long-run evolution. To that end, this paper considers the evidence on real commodity prices over 160 years for 30 commodities. Individually, these series span the entire range of economically meaningful commodities, being drawn from the animal product, energy product, grain, metals, minerals, precious metals, and soft commodity sectors. What is more, they collectively represent 7.89 trillion USD worth of production in 2011. Even accounting for potential double-counting and excluding potentially idiosyncratic sectors like energy, the sample constitutes a meaningful share of global economic activity.

Furthermore, this paper suggests and documents a complete typology of real commodity prices from 1850. This typology argues for real commodity price series as being comprised of long-run trends, medium-run cycles, and short-run boom/bust episodes. As such, there a few key findings of the paper. First, perceptions of the trajectory of real commodity prices over time are vitally influenced by how long a period is being considered and by how particular commodities are weighted when constructing generic commodity price indices. Applying weights drawn from the value of production in 2011, real commodity prices have increased by 252.41% from 1900, 191.77% from 1950, and 46.23% from 1975. Drilling down even further, extensions of this approach which exclude energy products and precious metals as well as apply equal weights reveal that real commodity prices have collectively been on the rise—albeit sometimes quite modestly—from at least 1950 across all weighting schemes. This suggests that much of the conventional wisdom on long-run trends in real commodity prices may be unduly "pessimistic" about their prospects for future appreciation or unduly swayed by events either in the very distant or very recent past. It also suggests a potentially large, but somewhat underappreciated distinction in between "commodities to be grown" which have evidenced secular declines in real prices versus "commodities in the ground" which have evidenced secular increases in real prices.

Second, there is a consistent pattern of commodity price super-cycles which entail decades-long positive deviations from these long-run trends in both the past and present. In this paper as in others it follows, commodity price super-cycles are thought of as broad-based, medium-run cycles corresponding to upswings in commodity prices of roughly 10 to 35 years. These are demand-driven episodes closely linked to historical episodes of mass industrialization and urbanization which interact with acute capacity constraints in many product categories—in particular, energy, metals, and minerals—in order to generate above-trend real commodity prices

for years, if not decades on end. Significantly, this paper finds that fully 15 of our 30 commodities are in the midst of super-cycles, evidencing above-trend real prices starting from 1994 to 1999. The common origin of these commodity price super-cycles in the late 1990s underlines an important theme of this paper: namely that much of the recent appreciation of real commodity prices simply represents a recovery from their multi-year—and in some instances, multi-decade—nadir around the year 2000. At the same time, the accumulated historical evidence on super-cycles suggests that the current super-cycles are likely at their peak and, thus, nearing the beginning of the end of above-trend real commodity prices in the affected categories.

Third, this paper offers a consistently applied methodology for determining real commodity price booms and busts which punctuate—and help identify—the aforementioned commodity price super-cycles. These boom/bust episodes are found to be historically pervasive with a few clear patterns: periods of freely floating nominal exchange rates have historically been associated with longer and larger real commodity price boom/bust episodes with the last 40 years in particular having witnessed increasingly longer and larger real commodity price booms and busts than the past.

Finally, these last elements of boom and bust are also found to be particularly bearing in determining real commodity price volatility. Simply by neglecting periods associated with commodity price booms and busts as determined above generates counterfactual levels of volatility which, on average, stand at 60-80% of their observed levels. Here, we also draw motivation from a long-standing literature which has documented a distinct correlation between higher commodity price volatility and lower economic growth. One of the key outputs of this paper, then, is providing long-run series on commodity-specific price booms and busts which

may be of interest to other researchers looking for plausibly exogenous shocks to either domestic economies or global markets.

To illustrate this idea, the paper considers the case of Australia and constructs a country-specific indicator of boom/bust episodes based on export-share weighted sums of commodity-specific booms and busts for the period from 1900 to 2012. The paper then relates this index to deviations in Australian GDP from its long-run trend, finding that the transition from relatively placid conditions in global commodity markets for Australian exports to a full-blown commodity price boom is associated with a positive and significant 6.47% deviation in GDP from its long-run trend while the opposite transition to a full-blown commodity price bust is associated with a negative and significant 8.22% deviation in GDP from its long-run trend. Undoubtedly, much more work could and should be done on the front connecting commodity price booms and busts and their potentially asymmetric linkages to economic growth. However, this exercise at the very least points one way forward in using the dating of commodity price booms and busts presented in this paper as the raw material for a more rigorous treatment of the nexus among commodity price booms and busts, commodity price volatility, and economic growth.

The rest of the paper proceeds as follows. Section II sets out the underlying data and addresses the themes of long-run trends and short-run variability in real commodity prices. Section III provides the evidence on (medium-run) super-cycles in real commodity prices. Section IV introduces one of this paper's unique contributions in the form of characterizing real commodity price booms and busts. Section V considers the implications of these boom and bust episodes for commodity price volatility in general and economic growth over the business cycle for commodity-exporting nations in particular. Section VI concludes.

II. Long-run Trends in Real Commodity Prices

A long-standing view in the literature holds that in real terms commodity prices do little better than tread water, exhibiting either non-discernible or decidedly downward trends. This seems to be true regardless of whether the window of observation runs in the mere handful of decades or across entire centuries (Harvey *et al*., 2010). Another well-known fact is the pronounced short-run movement of commodity prices around these long-run trends. It is this extreme inter- and intra-year volatility against a backdrop of exceedingly slow evolving dynamics which lead Cashin and McDermott (2002) to typify the long-run behavior of commodity prices as "small trends and big variability". Or as Deaton (1999, p. 27) put it: "What commodity prices lack in trend, they make up for in variance." A less appreciated fact is the potential existence of cycles in real commodity prices spanning decades associated with key events in economic development over time. What the subsequent sections set out to do is reassess the conventional wisdom on long-run trends as well as introduce new perspectives on commodity price cycles in the medium run.

The data used in this study comprise long-run annual prices for commodities with at least 5 billion USD worth of production in 2011. Consistent and reliable data collection begins for the majority of price series in 1850 while no price series enters the data set later than 1900. All told, this paper considers the evidence on 30 individual commodity price series which are drawn from seven product categories (animal products, energy products, grains, metals, minerals, precious metals, and soft commodities) and which are enumerated in Table 1.

As Table 1 also demonstrates, the data series are not only large in number, but also economically significant representing 7.89 trillion USD worth of production in 2011.[1] Finally, the individual price series (being expressed in US dollars) were deflated by the US CPI

[1] Neglecting energy products, these production values are still in excess of 4.25 trillion USD.

underlying Officer (2012), supplemented by updates taken from the BLS. The choice of the CPI as deflator—although not entirely uncontroversial—is a fairly standard practice in the literature.[2] In what follows, none of the results are materially altered by the consideration of alternative measures of economy-wide prices such as the US GDP deflator or the US PPI. Appendix I details the sources for the individual series.

Figures 1 through 7 document the evolution of real commodity prices from 1850 to 2012. All series have been converted into index form with real prices in 1900 set equal to 100. A simple visual inspection of these series reveals the previously noted "big variability" of real commodity prices. Using one common measure of volatility, namely the standard deviation of annual changes in logged real prices yields an average value of 0.1938 for all commodities and a range of (0.1249, 0.2957) across commodities. Somewhat curiously, this measure of volatility is itself fairly narrowly distributed with the vast majority of all observations falling in a much tighter range defined by 0.1959 +/- 0.04. For better or worse, no clear patterns emerge with respect to volatility across product categories, except for slightly lower average volatility for metals and slightly higher average volatility for soft commodities.

However, with respect to long-run trends in the real commodity price data, there are clear patterns across product categories. Notwithstanding some common global shocks like the peaks in real prices surrounding World War I, the 1970s, and, to a lesser extent, the late 2000s as well as the troughs in the 1930s and 1990s, there is a clear divergence in between those commodities mired in a perpetual downward trend and those exhibiting a perpetual upward trend. Table 2

[2] Naturally, to the extent that the quality of commodities has remain unchanged over time (which is highly likely), any upward bias in the US CPI induced by insufficient correction for changes in quality over time will lead to a downward bias in the calculation of increases in real commodity price documented below.

draws out this divergence across categories more clearly. Here, real prices in 2012 are compared to those in 1850, 1900, 1950, and 1975.[3]

It will come as no surprise that energy products have uniformly registered increases in real prices since 1900. Slightly more surprising is the presence of precious metals as well as steel and its related minerals—chromium, iron ore, and manganese—in the same category. On the opposite end of the spectrum, soft commodities have been in collective and perpetual decline since 1850.[4] Indeed, a broader interpretation of soft commodities often includes grains and hides which suffer from the same fate. The list of perpetual decliners is rounded out by aluminum—and the related mineral of bauxite—as well as zinc. This leaves six commodities with a more mixed performance over the past 162 years: beef and tin which demonstrate a long-run upward trend, but which have eased off somewhat from their all-time highs in the 1970s; copper and potash which have a consistent upward trend from 1950; and lead and nickel which have essentially been trendless from 1975. Thus, energy products, minerals, and precious metals are clearly in the "gainer" camp, grains and soft commodities are clearly in the "loser" camp, and metals are left as contested territory.

Interestingly, the combination of Tables 1 and 2 suggest that if anything real commodity prices are on the rise if evaluated on the basis of the value of production. Applying weights drawn from the value of production in 2011 suggests that real commodity prices have increased by 252.41% from 1900, 191.77% from 1950, and 46.23% from 1975. Of course, this result is largely driven by energy products. Applying weights drawn from the value of production in 2011 but which exclude energy suggests that real commodity prices have still been on the rise, having

[3] Appendix II presents the results of a related exercise which considers the cumulative changes in long-run trends in real commodity prices as estimated below. A cursory review suggests that the results presently discussed remain broadly unaffected.

[4] The only exception to this statement is the rise in the real price of rubber from 1975 to 2012. However, this result is more a function of the absolute collapse in rubber prices from the early 1950s and their partial recovery: the index value stood at 31.96 in 1951, at 7.16 in 1975, and at 10.59 in 2012.

increased by 7.76% from 1900, 58.44% from 1950, and 1.97% from 1975. Applying weights drawn from the value of production in 2011 but which exclude both energy and precious metals suggests that real commodity prices have a more mixed record, declining by 3.94% from 1900, increasing by 39.91% from 1950, and declining again by 10.97% from 1975. Finally, applying equal weights (but including both energy and precious metals), real commodity prices have increased 2.01% from 1900, have increased 44.18% from 1950, and have decreased by 3.93% from 1975. Cumulatively, the picture emerging from this exercise is a clear pattern of rising real commodity prices from at least 1950.

How then are these results reconciled with the conclusions of Cashin and McDermott (2002), for instance? First, Cashin and McDermott among others rely on generic commodity price indices which apply equal weights to individual commodities, so many of the long-run trends for "gainers" are washed out by those of "losers". Second, there is a slightly different composition of commodities with only 11 of their 16 commodities matching the 30 under consideration in this paper. Finally and most importantly, there is a massively different composition of product categories: their index only spans the metals and soft commodities categories. Although metals are somewhat of a mixed bag, soft commodities—both broadly and narrowly defined—have been the biggest of "losers" over the past 150 years. This suggests that much of the conventional wisdom on long-run trends in real commodity prices may be unduly pessimistic about their prospects for future appreciation or unduly swayed by events in both the very distant and the very recent past. It also suggests a potentially very large, but somewhat underappreciated distinction in between "commodities to be grown" versus "commodities in the ground".

III. Medium-Run Cycles in Real Commodity Prices

In recent years, the investing community has run with the idea of commodity price super-cycles (Heap, 2005; Rogers, 2004). In this view, commodity price super-cycles are broad-based, medium-run cycles corresponding to upswings in commodity prices of roughly 10 to 35 years, implying that a full trough-to-trough cycle is roughly twice that length. These are demand-driven episodes closely linked to historical episodes of mass industrialization and urbanization which interact with acute capacity constraints in many product categories—in particular, energy, metals, and minerals—in order to generate above-trend real commodity prices for years, if not decades on end.

At the same time, a burgeoning literature in identifying commodity price super-cycles has emerged in the research community (cf. Cuddington and Jerrett, 2008; Erten and Ocampo, 2012; Jerrett and Cuddington, 2008). The common theme of this literature is that commodity price super-cycles can be detected in the data by use of asymmetric band pass filters which decompose the natural log of the real price of commodity i in time t, $\ln(P_{it})$, into three components: a long-run trend in excess of 70 years in duration, $\ln(P_{it})\_LR_t$; a super-cycle of 20 to 70 years duration, $\ln(P_{it})\_SC_t$; and all other shorter cyclical components, $\ln(P_{it})\_CC_t$. This entails estimating three orthogonal components for the log of real commodity price series:

1.) $\ln(P_{it}) \equiv \ln(P_{it})\_LR_t + \ln(P_{it})\_SC_t + \ln(P_{it})\_CC_t$

Procedurally, this simply entails taking the logarithmic transformation of the real price indices reported earlier, estimating a long-run trend (that is, all cyclical components with periods in excess of 70 years), calculating the deviations of log real prices from this trend, and using these deviations to identify commodity price super-cycles (that is, all cyclical components with periods in excess of 20 to 70 years). The reader is referred to the work of Christiano and Fitzgerald

(2003) for details of the asymmetric band pass filter used in this paper (and the previously cited papers) to identify both the long-run trends and the medium-run commodity price super-cycles.

Figure 8a displays the log of real beef prices from 1850 to 2012 and its estimated long-run trend. Figure 8b displays the detrended real beef price and the super-cycle component evident in the former. The scaling on the left-hand-side of the figure is in logs, so a value of 1.00 in Figure 8b represents a 174% deviation from the long-run trend. Thus, the cyclical fluctuations in beef prices are sizeable. The complete super-cycles for beef prices which deliver deviations from trend above 20% can be dated from 1890 to 1929, from 1929 to 1953, and from 1953 to 1999. Figures 9a through 37b replicate the same exercise for the 29 remaining real commodity price series at our disposal. Evidence of large deviations from trend is apparent in almost all series as is the existence of numerous super-cycles over the past 163 years.[5]

Tables 3 through 9 enumerate six features of commodity price super-cycles across the seven products categories, namely their start dates, peak dates, trough dates, years to peak, complete cycle length, and peak value (the largest positive deviation from trend in real prices). All told, 68 complete commodity price super-cycles with positive price deviations from trend of at least 20% are identified.[6] In an attempt to characterize systematic differences in these super-cycles across time, a battery of regressions were run using three of these features (years to peak, cycle length, and peak value) as dependent variables and a set of indicator variables capturing three different time periods, namely from 1914 to 1949 (interwar), from 1950 to 1971 (Bretton Woods), and from 1972 to 2012 (post-Bretton Woods). Thus, the period from 1850 to 1913 (pre-World War I) acts as the omitted category. Only two statistically significant results emerge from

[5] Curiously, although subject to wide fluctuations in its real price (both in absolute terms and relative to trend), tobacco is the only commodity for which no super-cycle can be detected. This result does not, however, preclude the existence of multiple booms and busts in real tobacco prices as will be demonstrated below.

[6] An additional 31 incomplete commodity price super-cycles are also identified with an indeterminate start date (that is, pre-1850) or an indeterminate end date (that is, post-2012).

this exercise: the post-Bretton Woods era has given rise to a lower value for the years to peak at 15.88 years $(\hat{\beta}_0 + \hat{\beta}_{PBW} = 19.67 - 3.79)$ and for the length of cycles at 34.72 years $(\hat{\beta}_0 + \hat{\beta}_{PBW} = 40.00 - 5.28)$.[7]

Figures 38 through 43 display the histograms for all six features of the 68 commodity price super-cycles pooled across the seven product categories. Briefly summarizing, we find that the 1890s, 1930s, and 1960s gave rise to the majority (40) of the start dates for commodity price super-cycles while the 1910s, 1950s, and 1970s gave rise to the majority (38) of the peak dates and the 1930s, 1960s, and 1990s gave rise to the majority (44) of the end dates. Collectively, this suggests a big role for not only American industrialization/urbanization in the late 19th century and European/Japanese re-industrialization/re-urbanization in the mid-20th century but also the World Wars in determining the timing of past super-cycles. Rounding things out, Figures 41 through 43 respectively suggest that the majority (49) of super-cycles peak within 10-20 years of their start date, the majority (44) of super-cycles also evidence complete cycle lengths of less than 40 years, and the majority (45) of super-cycles are associated with positive deviations of 20-50% from trend.

Curiously, as Figures 38 through 43 exclude incomplete cycles, they are silent about currently evolving super-cycles: fully 15 of our 30 commodities demonstrate above-trend real prices starting from 1994 to 1999; of these, 9 are in the energy products, metals, and precious metals categories (with chromium and iron ore critically also making appearances). The common origin of these commodity price super-cycles in the late 1990s underlines an important theme of this paper: namely that much of the recent appreciation of real commodity prices simply represents a recovery from their multi-year—and in some instances, multi-decade—nadir around

[7] Similar regressions across commodities suggest there is no evidence that commodity price super-cycles differ systematically across product categories.

the year 2000. A further insight comes from combining these results with Figure 41 which suggests that we are also likely nearing the beginning of the end of above-trend real commodity prices in the affected categories.[8]

Thus, we have been able to establish a consistent pattern of evidence supportive of: 1.) the contention that real commodity prices might best be characterized by upward trends, especially when evaluated on the basis of the value of production and over the years from 1950; 2.) the notion of commodity price super-cycles in the historical record and present day as well as for a broader range of commodities than has been previously considered in the literature. What is missing, however, is any sense of short-run movements in real commodity prices which may be particularly bearing in determining real commodity price volatility and potentially bearing in determining economic growth. It is to these themes which the following sections turn.

IV. Short-run Boom/Bust Episodes in Real Commodity Prices

Up to this point, we have confronted the standing literature on long-run trends and medium-run cycles through a consideration of 163 years of real commodity price data, finding some results which can be aligned with the received wisdom on commodity price super-cycles, but which offers a slightly contrarian view of the long-run course of real commodity prices. Next, we turn to exploring the short-run dynamics of real commodity prices, in particular, the widely appreciated phenomena of commodity booms and busts.

Naturally, one important question looms large in this context: how exactly should real commodity price booms and busts be characterized? Admittedly, there are a number of ways

[8] Indeed, for at least one commodity, natural gas, real prices have already registered their largest deviation from trend (in 2006). It remains to be seen whether this is symptomatic of other commodity price super-cycles or whether it simply reflects idiosyncratic features of the natural gas industry, in particular, recent breakthroughs in extraction technology.

forward, but one of the most natural is to build on what we have already seen before. Here, we follow the lead of Mendoza and Terrones (2012) and will take as our basic input the deviations from the long-run trend in logged real prices for commodity *i* in time *t*, calling this component d_{it}. Let z_{it} represent the standardized version of d_{it}—that is, for any given observation, we simply subtract the sample mean of all z_i's and divide by their standard deviation. Commodity *i* is defined to have experienced a commodity price boom when we identify one or more contiguous dates for which the boom condition $z_{it} > 1.282$ holds (as the value of 1.282 defines the threshold for the 10% upper tail of a standardized normal distribution). A commodity price boom peaks at t^*_{boom} when the maximum value of z_{it} is reached for the set of contiguous dates that satisfy the commodity boom condition. A commodity price boom starts at t^s_{boom} where $t^s_{boom} < t^*_{boom}$ and $z_{it} > 1.00$ and is the smallest, positive observation satisfying this condition in a 5-year centered window. A commodity price boom ends at t^e_{boom} where $t^e_{boom} > t^*_{boom}$ and $z_{it} > 1.00$ and is the smallest, positive observation satisfying this condition in a 5-year centered window.

Highly symmetric conditions define the opposite set of circumstances as well. Commodity *i* is defined to have experienced a commodity price bust when we identify one or more contiguous dates for which the bust condition $z_{it} < -1.282$ holds (as the value of -1.282 defines the threshold for the 10% lower tail of a standardized normal distribution). A commodity price bust troughs at t^*_{bust} when the minimum value of z_{it} is reached for the set of contiguous dates that satisfy the commodity bust condition. A commodity price bust starts at t^s_{bust} where $t^s_{bust} < t^*_{bust}$ and $z_{it} < -1.00$ and is the largest, negative observation satisfying this condition in a 5-year centered window. A commodity price bust ends at t^e_{bust} where $t^e_{bust} > t^*_{bust}$ and

$z_{it} < -1.00$ and is the largest, negative observation satisfying this condition in a 5-year centered window.

For illustration purposes, the reader is referred to Figure 44 which presents the evidence on price booms and busts for beef. Again, the log of real beef prices from 1850 to 2012 is chartered along with the episodes of boom and bust determined by the algorithm given above. This indicates the presence of four booms (in green) and three busts (in red) for real beef prices over the past 163 years. Notably, the booms occurred from 1915 to 1919, from 1942 to 1944, from 1966 to 1974, and from 1978 to 1980 while the busts occurred from 1922 to 1924, from 1949 to 1958, and from 1995 to 2003, suggesting that in this context real commodity price booms do not mechanically generate real commodity price busts, nor vice versa. This pattern—or lack thereof—is repeated in Figures 45 through 73 which replicate the same exercise for the 29 remaining real commodity price series at our disposal. Evidence of both common and idiosyncratic real commodity price booms and busts is readily apparent.

Just as in the case of commodity price super-cycles, we provide a full enumeration of the various commodity price booms and busts underlying these figures in Tables 10 through 16. There, six features of commodity price super-cycles across the seven product categories are documented, namely their start dates, peak/trough dates, end dates, years to peak/trough, boom/bust lengths, and deviations from trend (the cumulative deviations from the long-run trends in real prices from the beginning of the boom/bust to the peak/trough). All told, 140 commodity price booms and 135 commodity price busts are identified.

As before, we attempt to characterize systematic difference in these commodity price booms/busts across time. First, considering commodity price booms alone, a battery of regressions were run using three of their features (years to peak, cycle length, and cumulative

deviation from trend) as dependent variables and a set of indicator variables capturing three different time periods, namely from 1914 to 1949 (interwar), from 1950 to 1971 (Bretton Woods), and from 1972 to 2012 (post-Bretton Woods). Thus, the period from 1850 to 1913 (pre-World War I) acts as the omitted category. In terms of statistically significant results, the interwar and post-Bretton Woods eras gave rise to higher values for the years to peak at 1.45 and 1.57 years, respectively $(\hat{\beta}_0 + \hat{\beta}_{IW} = 0.84 + 0.61;\ \hat{\beta}_0 + \hat{\beta}_{PBW} = 0.84 + 0.73)$. Likewise, the interwar and post-Bretton Woods eras witnessed longer boom lengths at 2.66 and 3.05 years, respectively $(\hat{\beta}_0 + \hat{\beta}_{IW} = 1.82 + 0.84;\ \hat{\beta}_0 + \hat{\beta}_{PBW} = 1.82 + 1.23)$. As to the cumulative increase in real prices from the beginning of the boom to the peak, this variable has witnessed a fairly dramatic increase over time $(\hat{\beta}_0 = \hat{\beta}_{PWWI} = 66.39,\ \hat{\beta}_{IW} = 33.98,\ \hat{\beta}_{BW} = 11.72, \hat{\beta}_{PBW} = 52.75)$. These results immediately suggest two things: periods of freely floating nominal exchange rates have historically been associated with longer and larger real commodity price booms and the last 40 years have witnessed increasingly longer and larger real commodity price booms than the past.[9]

Figures 74 through 79 display the histograms for these six features of the 140 complete commodity price booms pooled across the seven product categories. Briefly summarizing, we find that the 1900/10s, 1950s, and 1970/80s gave rise to the majority (87) of the start, peak, and end dates for commodity price booms. Collectively, this suggests much shorter years to peak and cycle lengths than in the case of commodity price super-cycles as demonstrated in Figures 77 and 78 with the majority (114) of commodity price booms peaking 0-2 years from their start and the majority (91) of commodity price booms being 0-2 years in length. What is also very clear is

[9] There is also clear evidence that commodity price booms in the energy and animal product categories display longer years to peak $(\hat{\beta}_0 = \hat{\beta}_A,\ \hat{\beta}_A + \hat{\beta}_E = 2.67 + 2.08)$ and longer boom lengths $(\hat{\beta}_0 = \hat{\beta}_A,\ \hat{\beta}_A + \hat{\beta}_E = 3.89 + 2.86)$. What is more, the energy product category alone—but perhaps not surprisingly—evidences significantly larger deviations from trend $(\hat{\beta}_0 = \hat{\beta}_A,\ \hat{\beta}_A + \hat{\beta}_E = 85.33 + 51.41)$.

that commodity price booms are associated with much more pronounced deviations from long-run trends in real prices than would be suggested by the evidence on commodity price super-cycles alone: the majority (78) of booms are associated with spikes in real prices of 50-100% with values in excess of 500% not being unheard of.[10]

Turning to the evidence on commodity price busts, another battery of regressions were run using three of their features (years to trough, cycle length, and cumulative deviation from trend) as dependent variables and the same set of indicator variables capturing the three different time periods with the period from 1850 to 1913 (pre-World War I) acting as the omitted category. Once again, the post-Bretton Woods era distinguishes itself with significantly longer years to trough at 2.63 years $(\hat{\beta}_0 + \hat{\beta}_{PBW} = 1.04 + 1.59)$ and cycle length at 4.65 years $(\hat{\beta}_0 + \hat{\beta}_{PBW} = 2.46 + 2.19)$. The post-Bretton Woods era along with the interwar period also distinguished themselves with lower associated values for the cumulative deviation from trend at -45.86% and -45.66%, respectively $(\hat{\beta}_0 = -37.32;\ \hat{\beta}_{IW} = -8.54;\ \hat{\beta}_{PBW} = -8.34)$. Thus, the last 40 years have witnessed longer and larger real commodity price busts—in addition to booms—than the past.[11]

Figures 80 through 85 display the histograms for these six features of the 135 commodity price busts pooled across the seven product categories. Briefly summarizing, we find that the 1920/30s and 1990s gave rise to the majority (72) of the start dates for commodity price busts while the 1920/30s and 1990s/2000s gave rise to the majority (81) of the trough dates and end

[10] We also note that currently nine commodities are currently experiencing a boom: copper, corn, gold, iron ore, lead, palm oil, rubber, silver, and wool.

[11] There is a little evidence that commodity price busts differ systematically across product categories. Precious metals demonstrate longer years to trough $(\hat{\beta}_0 = \hat{\beta}_A,\ \hat{\beta}_A + \hat{\beta}_P = 1.30 + 3.10)$; grains, precious metals, and soft commodities also demonstrate different cycle lengths than other commodities $(\hat{\beta}_0 = \hat{\beta}_A,\ \hat{\beta}_A + \hat{\beta}_G = 4.10 - 1.82, \hat{\beta}_A + \hat{\beta}_S = 4.10 + 4.50, \hat{\beta}_A + \hat{\beta}_S = 4.10 - 1.47)$.

dates. Figures 83 and 84 suggest similar dynamics as with commodity price booms with the majority (73) of commodity price busts troughing 1-2 years from their start and the majority (81) of commodity price busts being 1-4 years in length. What is also very clear is that commodity price busts are likewise associated with very pronounced deviations from long-run trends in real prices: the majority (85) of busts are associated with a cratering in real prices of 30-50%.[12]

In sum, this consideration of commodity price booms and busts gives rise to a much more turbulent view of commodities than provided from the lofty perspective of the medium- and long-run, subject as these real commodity price booms and busts are to manic price increases and depressive price declines. And this is seemingly a situation which has only exacerbated over time and, thus, promises to do so in the future.

V. Implications for Commodity Price Volatility and Economic Growth

In light of these results, it may be worth our while to consider the broader implications of commodity price booms and busts, in particular their relation to commodity price volatility and economic growth. Admittedly, the nexus between volatility and growth is a well-tread path (see Jacks, O'Rourke, and Williamson, 2011 on this point), and this paper does not make any claims to originality in this respect. However, one of the problems with this literature is that there has been very little work on distinguishing between episodes of commodity price volatility where real prices are in a boom as opposed to episodes when real prices in a bust. Rather than take the correlation between higher commodity price volatility and lower economic growth as given, in this section, the aim is to associate commodity price booms and busts with periods of acute commodity price volatility and present some suggestive evidence relating commodity price booms and busts to economic growth.

[12] There is only one commodity currently experiencing a bust: natural gas.

To begin, we can consider once again the deviations from the long-run trend in logged real prices estimated in section II. Taking the standard deviation of these values over the entire span of prices available for each series, we arrive at the figures reported in column (A) of Table 17. There, we can see that the average volatility of these deviations stands at 0.3048 (with a low of 0.1717 for tea and a high of 0.4586 for rubber). Next, we calculate the standard deviation of these values over the entire span of prices still available for each series, once we exclude periods of time associated with commodity booms and busts as defined in section III. Thus, we arrive at the figures reported in column (B) of Table 15 with the average volatility of these deviations at 0.1766 (and a low of 0.1030 for tobacco and a high of 0.2647 for rubber). Finally, taking the ratio of (B) to (A), we find that simply by neglecting periods associated with commodity price booms and busts generates levels of volatility which, on average, stand at 58% of their actual levels (with an associated range of 40% for silver and 72% for gold—that is, every commodity demonstrates lower levels of volatility in the absence of commodity price booms and busts).

Of course, this may be an unsatisfying exercise for some in that commodity price booms and busts were defined as those deviations in log prices from their long-run trend which exceeded a certain threshold. Therefore, the association between boom and bust and volatility as defined above may seem mechanical. Table 18 repeats the same exercise but with a different metric for commodity price volatility. Here, we return to a standard measure in the literature, namely the standard deviation of annual changes in logged real prices. Column (A) again reports the value of this metric over the entire span of data by commodity, reporting an average value of 0.1938 (and a low of 0.1249 for gold and a high of 0.2957 for sugar). Column (B) again reports the value of this metric over the entire span of data by commodity, once we exclude periods of time associated with commodity booms and busts as defined in section III. Thus, we arrive at an

average value of 0.1610 (and a low of 0.0965 for gold and a high of 0.2260 for rubber). Finally, taking the ratio of (B) to (A), we find that simply by neglecting periods associated with commodity price booms and busts generates levels of volatility which, on average, stand at 83% of their actual levels (with an associated range of 68% for nickel and 96% for tin—again, every commodity demonstrates lower levels of volatility in the absence of commodity price booms and busts).

In combination then, it is hard to escape the conclusion that commodity price booms and busts as defined in this paper are associated with heightened levels of commodity price volatility, variously defined. But can we push these results even further and more closely examine the presumed link between commodity price volatility and economic growth? Here, things become a little murkier in that the share of any one commodity in the value of exports—much less to say aggregate production—is typically small apart from some very rare instances. Thus, with booms and busts necessarily being defined at the commodity level, more work is needed in: 1.) determining the patterns of commodity production across countries and time; and 2.) determining what constitutes an economy-wide commodity price shock, whether boom or bust.

In this regard, the following pieces of antipodean evidence are submitted for consideration. Currently, aluminum, beef, copper, cotton, iron ore, lead, natural gas, nickel, petroleum, sugar, tin, wheat, wool, and zinc represent 112.55 billion AUD, or roughly 43%, of Australian goods and services exports.[13] What is more, these are also the mainstays of Australian exports historically speaking. Thus, it is possible to combine information on Australian exports shares over time with the previously described indicators of real commodity price booms and

[13] We exclude gold and silver in this instance. Gold, in particular, is and has been a very large Australian export, reaching a peak export share in our sample of 48% in 1903 and a contemporary export share of 14% in 2012. However, the official and widespread revaluation of gold in the 1930s generates a simultaneous spike in its export share and a consequent indication of a commodity price boom for Australia in the same period. This "false positive" is, of course, vastly at odds with what we know of conditions in global commodity markets at this time.

busts.[14] Specifically, we define an economy-wide commodity price shock as the export-share weighted sum of commodity booms and busts which ranges from 0 to 1 by construction. Figure 86 plots these series from 1900 to 2012. There, we find that over the past 113 years Australia has experienced four large commodity price booms (roughly, from 1916 to 1919, from 1950 to 1951, from 1973 to 1980, and from 2009 onwards) and four large commodity price busts (roughly, 1921, from 1930 to 1933, 1938, and from 1998 to 2003).

Supplementing the data from Barro and Ursua (2008) on the evolution of GDP per capita from 1900 to 2009, we can also document deviations of GDP from its long-run trend over this same period. Thus, Figure 87 depicts the evolution of this series, capturing both the long sub-par growth experience initiated by the Great Depression from 1930 to 1960 and the pre-World War I and post-1960 above-trend growth episodes. Informally then, the timing of commodity price booms and busts seems to correspond to upswings and downswings in these deviations from trend growth. Taking a more formal approach, we can simply regress the deviations in GDP from its long-run trend on the series for commodity price booms and busts. Doing so yields a coefficient on commodity price booms of 0.0647 with a standard error of 0.0327 and associated p-value of 0.051 and a coefficient on commodity price busts of -0.0822 with a standard error of 0.0446 and associated p-value of 0.068.

Taken literally, these results suggest that the transition from relatively placid conditions in global commodity markets for Australian exports to a full-blown commodity price boom is associated with a positive 6.47% deviation in GDP from its long-run trend of 3.44%, or a 9.91% growth rate in real GDP. Likewise, the transition from relatively placid conditions in global commodity markets for Australian exports to a full-blown commodity price bust is associated

[14] These exports shares were calculated from Lougheed (2007) and the Australian Bureau of Agricultural and Resource Economics and Sciences.

with a negative 8.22% deviation in GDP from its long-run trend of 3.44%, or a -4.78% growth rate in real GDP. Undoubtedly, much more work could and should be done on connecting commodity price booms and busts and their potentially asymmetric linkages to economic growth. At the very least, however, the previous exercise at least points one way forward in using the dating of commodity price booms and busts presented in this paper as the raw material for a more rigorous treatment of the nexus among commodity price booms and busts, commodity price volatility, and economic growth.

VI. Conclusions and Future Prospects

Drawing motivation from the current debate surrounding the likely trajectory of commodity prices, this paper has sought to forward our understanding of real commodity prices in the long-run along two dimensions. First, the paper has provided a consistent body of evidence on real commodity prices for 30 economically significant goods since 1850. Second, the paper has provided a consistent methodology for thinking about their long-run evolution.

In so doing, it suggests and documents a complete typology of real commodity prices, comprising long-run trends, medium-run cycles, and short-run boom/bust episodes. The findings of the paper can be summarized as follows. First, real commodity prices of both energy and non-energy commodities have been on the rise from 1950 across all weighting schemes. Second, there is a consistent pattern, in both past and present, of commodity price super-cycles which entail decades-long positive deviations from these long-run trends with the latest set of super-cycles likely at their peak. Third, these commodity price super-cycles are punctuated by booms and busts which are historically pervasive and becoming more exacerbated over time. These last elements of boom and bust are also found to be particularly bearing in determining real

commodity price volatility as well as potentially bearing in influencing growth in commodity exporting economies.

At the same time, this paper remained relatively silent about real commodity prices as they relate to future prospects for the global economy. However, there are two consistent messages on this issue which emerge from this paper. First, much of the academic and policy literature has tended to over-emphasize the behavior of real commodity prices in both the very distant and very recent past. For all the differences in periodization, this literature has cumulatively arrived at the conclusion that real commodity prices exhibit little trend and what trend they do exhibit is distinctly in the downward direction. In this regard, the experience of the 1990s and early 2000s should be put in perspective: the levels of real commodity prices seen in this period are anomalous as they represent multi-year—and in some instances, multi-decade—lows. It should always be borne in mind that the past was a much more expensive place and the future promises to likely be the same.

Finally, greater volatility is a slightly more certain prospect for real commodity prices in the future. As this paper has clearly documented, periods of freely floating nominal exchange rates in general, but the last 40 years after the fall of the Bretton Woods system in particular, have been associated with longer and larger real commodity price booms and busts. And these booms and busts were, in turn, strongly associated with higher commodity price volatility. It remains to be seen whether anything can be done to mitigate this volatility in a coordinated fashion either through market or policy mechanisms, but this volatility will certainly continue to affect the growth prospects of nations, particularly those which are commodity exporters and which have relatively low levels of financial development.

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Appendix I

This appendix details the sources of the real commodity prices used throughout this paper. As such, there are a few key sources of data: the annual Sauerbeck/*Statist* (SS) series dating from 1850 to 1950; the annual Grilli and Yang (GY) series dating from 1900 to 1986; the annual unit values of mineral production provided by the United States Geographical Survey (USGS) dating from 1900 to 2012; the annual Pfaffenzeller, Newbold, and Rayner (PNR) update to Grilli and Yang's series dating from 1987 to 2010; and the monthly International Monetary Fund (IMF), United Nations Conference on Trade and Development (UNCTAD), and World Bank (WB) series dating variously from 1960 and 1980 to 2012. The relevant references are:

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"Wholesale Prices in 1950." *Journal of the Royal Statistical Society* 114(3): 408-422.

A more detailed enumeration of the sources for each individual series is as follows.

Aluminum: 1900-2010, GY and PNR; 2011-2012, UNCTAD.
Bauxite: 1900-2012, USGS.
Beef: 1850-1899, SS; 1900-1959, GY; 1960-2012, WB.
Chromium: 1900-2012, USGS.
Cocoa: 1850-1899, Global Financial Data; 1900-1959, GY; 1960-2012, WB.
Coffee: 1850-1899, SS; 1900-1959, GY; 1960-2012, WB.
Copper (wire bars): 1850-1899, SS; 1900-2010, GY and PNR; 2011-2012, UNCTAD.
Corn: 1850-1851, Cole, A.H. (1938), *Wholesale Commodity Prices in the United States, 1700-1861: Statistical Supplement*. Cambridge: Harvard University Press; 1852-1859; Bezanson, A. (1954), *Wholesale Prices in Philadelphia 1852-1896*. Philadelphia: University of Pennsylvania Press; 1860-1999, Global Financial Data; 2000-2012, United States Department of Agriculture National Agricultural Statistics Service.
Cotton: 1850-1899, SS; 1900-1959, GY; 1960-2012, WB.
Gold: 1850-1999, Global Financial Data; 2000-2012, Kitco.
Hides: 1850-1899, SS; 1900-1959, GY; 1960-2012, UNCTAD.
Iron ore: 1900-2012, USGS.

Lead: 1850-1899, SS; 1900-2010, GY and PNR; 2011-2012, UNCTAD.
Manganese: 1900-2012, USGS.
Natural gas (wellhead): 1900-1921, Carter, S. *et al*. (2006), *Historical Statistics of the United States, Millennial Edition*. Cambridge: Cambridge University Press; 1922-2012, United States Energy Information Administration.
Nickel: 1850-1899, Carter, S. *et al*. (2006), *Historical Statistics of the United States, Millennial Edition*. Cambridge: Cambridge University Press; 1900-2012, USGS.
Palm oil: 1850-1899, SS; 1900-1959, GY; 1960-2012, WB.
Petroleum (WTI): 1860-2000, Global Financial Data; 2001-2012, IMF.
Potash: 1900-2012, USGS.
Rice: 1850-1899, SS; 1900-1956, GY; 1957-1979, Global Financial Data; 1980-2012, IMF.
Rubber: 1890-1899, Global Financial Data; 1900-1959, GY; 1960-2012, WB.
Silver: 1850-2012, Kitco.
Steel (hot-rolled bar): 1897-1998, Carter, S. *et al*. (2006), *Historical Statistics of the United States, Millennial Edition*. Cambridge: Cambridge University Press; 1999-2012, WB.
Sugar: 1850-1899, SS; 1900-1959, GY; 1960-2012, WB.
Tea: 1850-1899, SS; 1900-1959, GY; 1960-2012, WB.
Tin: 1850-1899, SS; 1900-2010, GY and PNR; 2011-2012, UNCTAD.
Tobacco: 1850-1865, Clark, G. (2005), "The Condition of the Working Class in England, 1209-2004." *Journal of Political Economy* 113(6): 1307-1340; 1866-1899, Carter, S. *et al*. (2006), *Historical Statistics of the United States, Millennial Edition*. Cambridge: Cambridge University Press; 1900-1959, GY; 1960-2012, WB.
Wheat: 1850-1999, Global Financial Data; 2000-2012, United States Department of Agriculture National Agricultural Statistics Service.
Wool: 1850-1899, SS; 1900-1979, GY; 1980-2012, IMF.
Zinc: 1850-2000, Global Financial Data; 2001-2012, IMF.

Appendix II

Table A1 below replicates the exercise first reported in Table 2. Instead of comparing observed price levels in 1850, 1900, 1950, and 1975 versus 2012, it compares the estimated value of the long-run trend in the same years as described in the text. The results remain broadly unaffected.

Table A1: Cumulative Changes in Prices Relative to Long-Run Trend

Commodity	Cumulative change in in price from 1850 (%)	Cumulative change in price from 1900 (%)	Cumulative change in price from 1950 (%)	Cumulative change in price from 1975 (%)
Animal products				
Beef	116.41	66.22	11.89	-32.65
Hides	-41.18	-57.18	-26.87	-20.90
Energy products				
Natural gas	N/A	88.64	394.02	89.52
Petroleum	N/A	434.01	267.67	195.57
Grains				
Corn	-57.42	-58.58	-65.18	-36.45
Rice	-81.12	-78.32	-65.54	-46.29
Wheat	-75.64	-75.28	-73.09	-50.76
Metals				
Aluminum	N/A	-89.05	-50.23	-37.44
Copper	-51.01	-43.26	24.04	22.58
Lead	-60.20	-44.80	-36.12	-8.64
Nickel	-87.78	-49.13	39.00	17.18
Steel	N/A	-5.65	20.36	9.02
Tin	44.00	-11.08	-19.13	-20.83
Zinc	-12.72	-24.69	-3.55	-2.68
Minerals				
Bauxite	N/A	-72.60	-64.27	-58.69
Chromium	N/A	37.26	206.01	73.74
Iron ore	N/A	3.96	34.80	4.16
Manganese	N/A	52.17	77.11	29.76
Potash	N/A	-71.41	26.72	137.23
Precious metals				
Gold	92.36	127.19	206.05	143.91
Silver	-49.21	4.89	123.68	63.80
Soft commodities				
Cocoa	-71.86	-78.81	-44.51	-57.24
Coffee	-60.04	-55.87	-65.11	-67.29
Cotton	-75.39	-67.72	-68.70	-55.84
Palm oil	-73.38	-69.25	-61.26	-39.44
Rubber	N/A	-93.33	-49.87	-16.37
Sugar	-88.88	-78.12	-43.85	-32.03
Tea	-84.63	-72.65	-63.70	-50.43
Tobacco	-56.29	-28.70	-66.75	-45.42
Wool	-82.24	-77.50	-74.58	-36.92

Table 1: Value of Production across Commodities			
Commodity	**Production in 2011**	**Units of measurement**	**Value of production (b 2011 USD)**
Animal products			**257.81**
Beef	62.54	Million tonnes	252.79
Hides	6.12	Million tonnes	5.02
Energy products			**3641.60**
Natural gas	3.39	Trillion cubic m.	472.63
Petroleum	4.01	Billion tonnes	3168.98
Grains			**768.85**
Corn	883.46	Million tonnes	206.59
Rice	722.76	Million tonnes	398.75
Wheat	704.08	Million tonnes	163.50
Metals			**2104.15**
Aluminum	43.99	Million tonnes	109.88
Copper	16.10	Million tonnes	146.51
Lead	10.59	Million tonnes	25.27
Nickel	1.59	Million tonnes	36.41
Steel	1.49	Billion tonnes	1746.65
Tin	383.50	Thousand tonnes	10.53
Zinc	13.12	Million tonnes	28.90
Minerals			**457.26**
Bauxite	259.00	Million tonnes	8.00
Chromium	23.30	Million tonnes	64.80
Iron ore	2.94	Billion tonnes	339.25
Manganese	16.00	Million tonnes	18.76
Potash	36.40	Million tonnes	26.45
Precious metals			**277.88**
Gold	4.52	Thousand tonnes	251.14
Silver	21.59	Thousand tonnes	26.75
Soft commodities			**386.52**
Cocoa	4.05	Million tonnes	12.08
Coffee	8.28	Million tonnes	19.94
Cotton	26.57	Million tonnes	88.42
Palm oil	48.98	Million tonnes	55.12
Rubber	10.98	Million tonnes	52.98
Sugar	172.15	Million tonnes	98.68
Tea	4.27	Million tonnes	12.48
Tobacco	7.57	Million tonnes	33.94
Wool	1.07	Million tonnes	12.88

Figure 1: Real Animal Product Prices, 1850-2012 (1900=100)

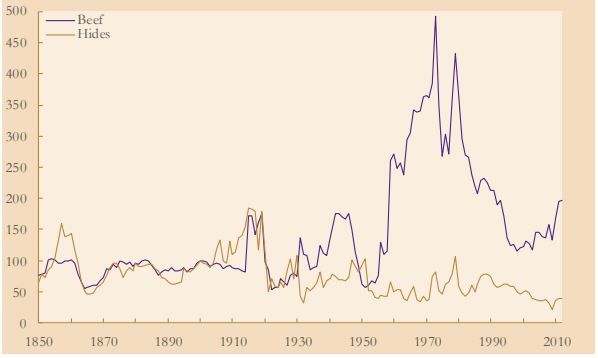


Figure 2: Real Energy Prices, 1860-2012 (1900=100)

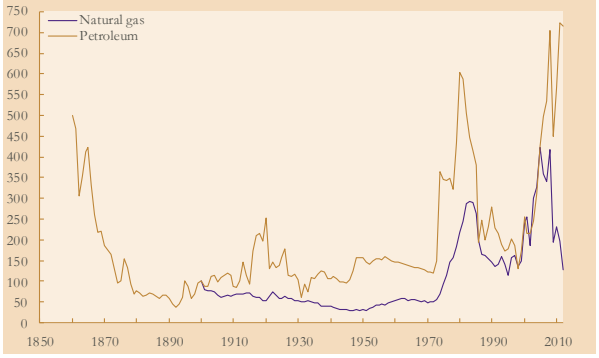


Figure 3: Real Grain Prices, 1850-2012 (1900=100)

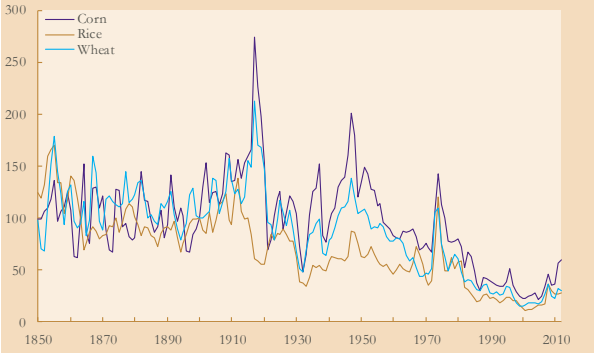


Figure 4a: Real Metal Prices, 1850-2012 (1900=100)

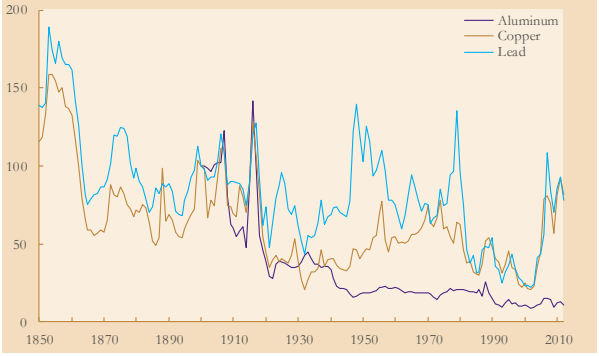


Figure 4b: Real Metal Prices, 1850-2012 (1900=100)

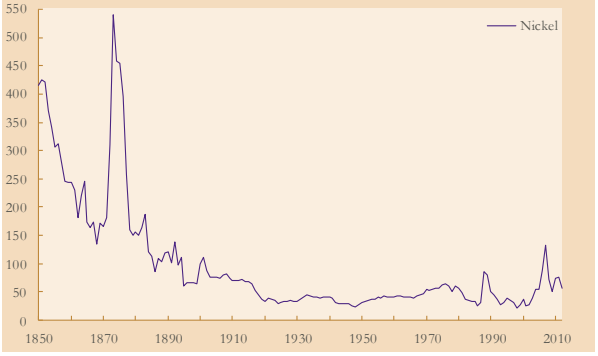


Figure 4c: Real Metal Prices, 1850-2012 (1900=100)

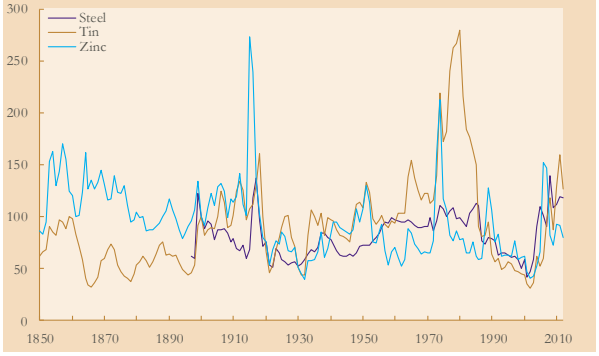


Figure 5a: Real Mineral Prices, 1900-2012 (1900=100)

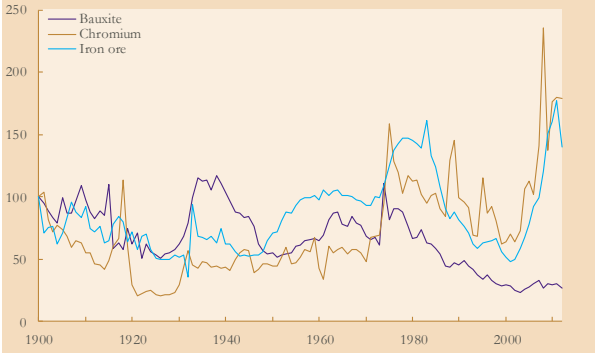


Figure 5b: Real Mineral Prices, 1900-2012 (1900=100)

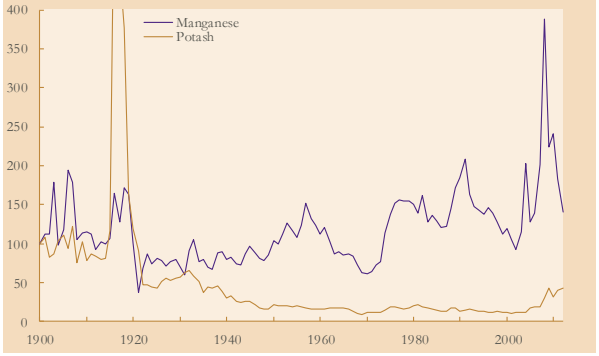


Figure 6: Real Precious Metals Prices, 1850-2012 (1900=100)

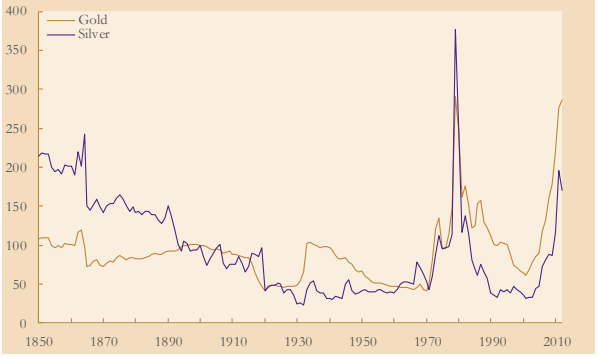


Figure 7a: Real Soft Commodity Prices, 1850-2012 (1900=100)

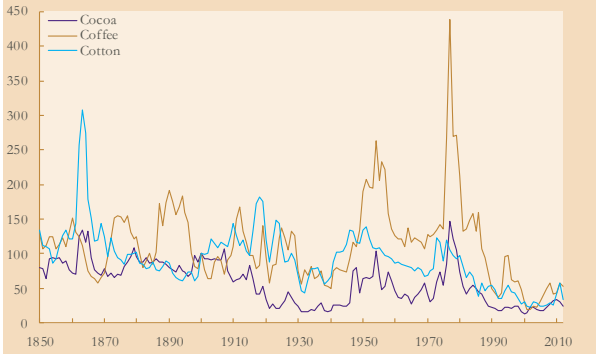


Figure 7b: Real Soft Commodity Prices, 1850-2012 (1900=100)

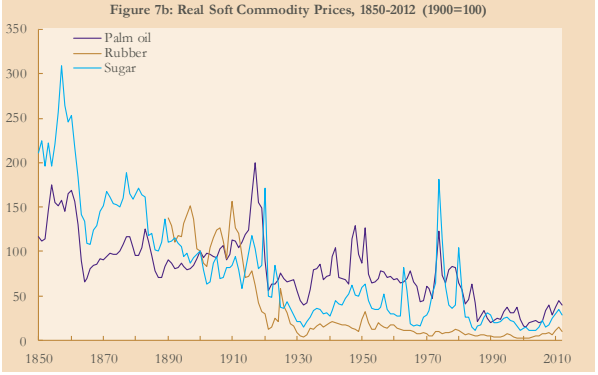


Figure 7c: Real Soft Commodity Prices, 1850-2012 (1900=100)

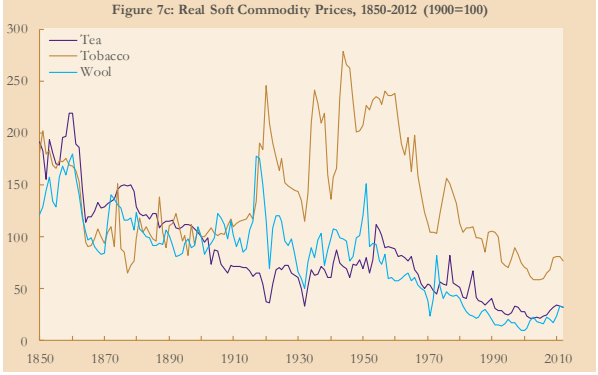


Table 2: Cumulative Changes in Prices over the Long-Run

Commodity	Cumulative change in in price from 1850 (%)	Cumulative change in price from 1900 (%)	Cumulative change in price from 1950 (%)	Cumulative change in price from 1975 (%)
Animal products				
Beef	155.75	96.44	214.71	-26.82
Hides	-40.21	-61.42	-58.47	-16.23
Energy products				
Natural gas	N/A	28.82	292.52	39.62
Petroleum	N/A	614.05	355.65	106.60
Grains				
Corn	-39.93	-40.65	-55.90	-47.34
Rice	-77.77	-72.21	-55.68	-62.54
Wheat	-69.33	-69.93	-71.74	-59.80
Metals				
Aluminum	N/A	-89.56	-42.97	-43.28
Copper	-29.51	-18.37	84.07	37.57
Lead	-43.51	-21.67	-23.86	5.16
Nickel	-86.42	-43.50	85.32	-9.84
Steel	N/A	18.30	62.37	10.23
Tin	104.46	26.25	16.88	-26.53
Zinc	-7.87	-20.50	-26.09	-32.19
Minerals				
Bauxite	N/A	-73.60	-52.38	-67.74
Chromium	N/A	79.15	301.05	13.04
Iron ore	N/A	40.00	97.83	12.17
Manganese	N/A	40.12	36.00	1.63
Potash	N/A	-57.75	96.90	135.01
Precious Metals				
Gold	166.18	186.23	325.06	198.66
Silver	-20.52	70.40	308.32	78.79
Soft commodities				
Cocoa	-69.55	-75.67	-62.32	-54.99
Coffee	-58.70	-46.70	-71.99	-60.51
Cotton	-75.06	-66.38	-75.03	-62.29
Palm oil	-66.48	-60.67	-54.58	-46.03
Rubber	N/A	-89.89	-57.87	41.17
Sugar	-86.62	-71.79	-52.57	-75.32
Tea	-83.17	-67.84	-53.34	-40.51
Tobacco	-58.00	-23.87	-63.27	-45.34
Wool	-73.29	-67.64	-73.09	-20.19

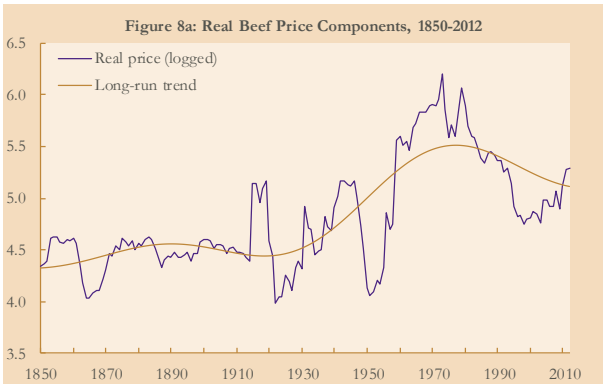


Figure 8a: Real Beef Price Components, 1850-2012
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

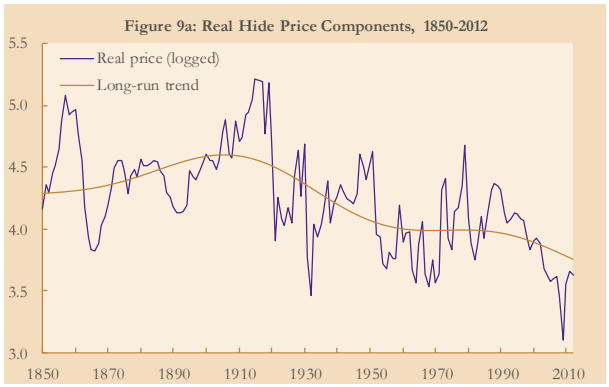


Figure 9a: Real Hide Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

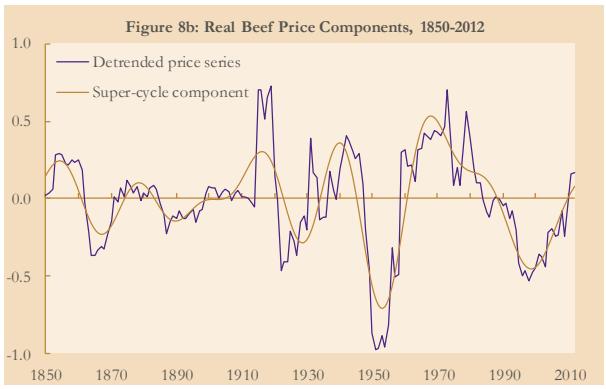


Figure 8b: Real Beef Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

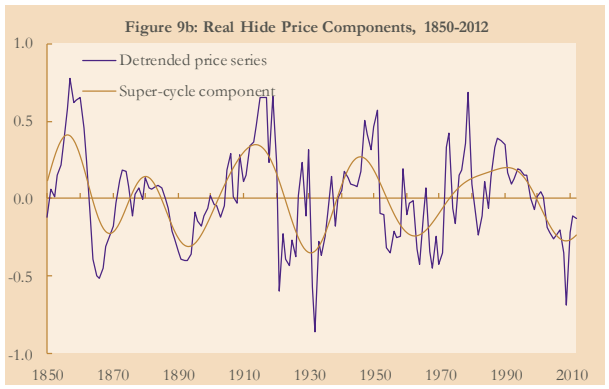


Figure 9b: Real Hide Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

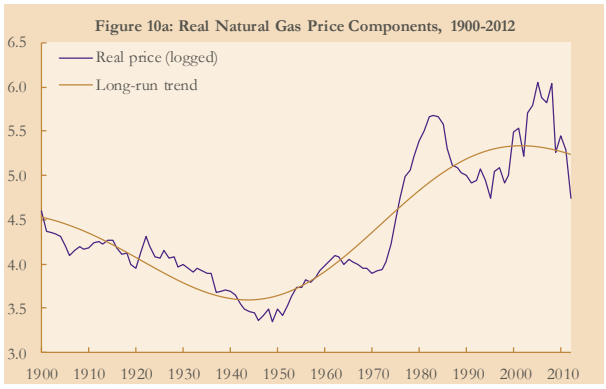


Figure 10a: Real Natural Gas Price Components, 1900-2012
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

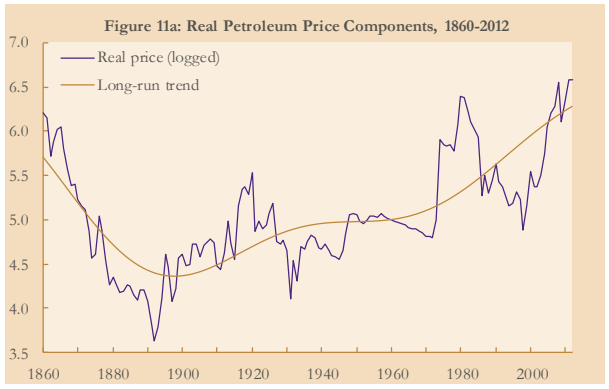


Figure 11a: Real Petroleum Price Components, 1860-2012
Real price (logged)
Long-run trend
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
1860
1880
1900
1920
1940
1960
1980
2000

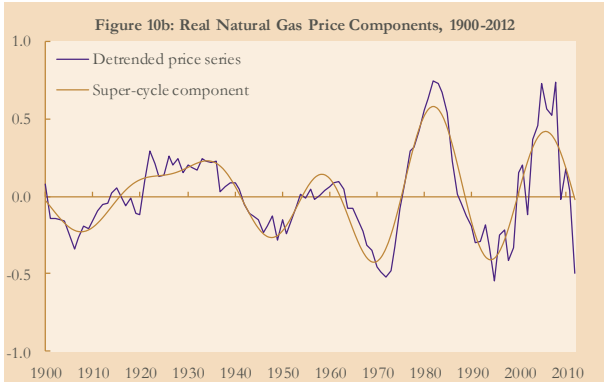


Figure 10b: Real Natural Gas Price Components, 1900-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

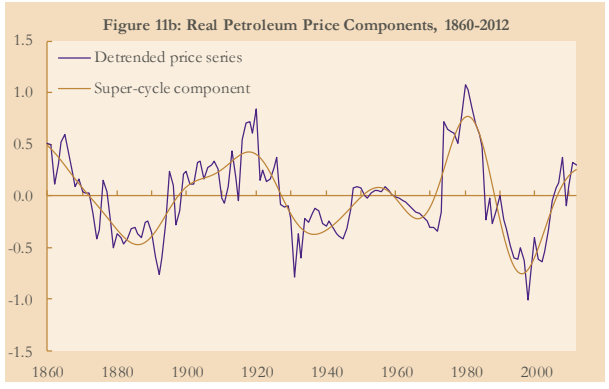


Figure 11b: Real Petroleum Price Components, 1860-2012
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1860
1880
1900
1920
1940
1960
1980
2000

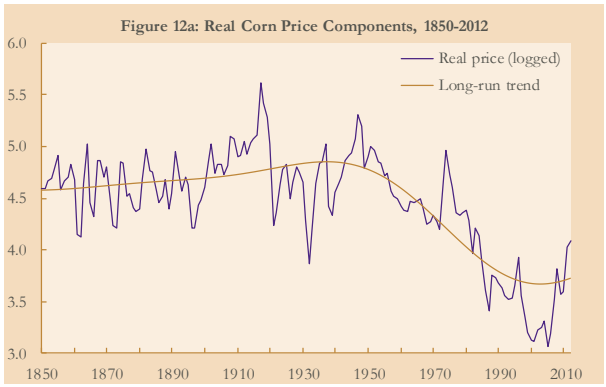


Figure 12a: Real Corn Price Components, 1850-2012
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

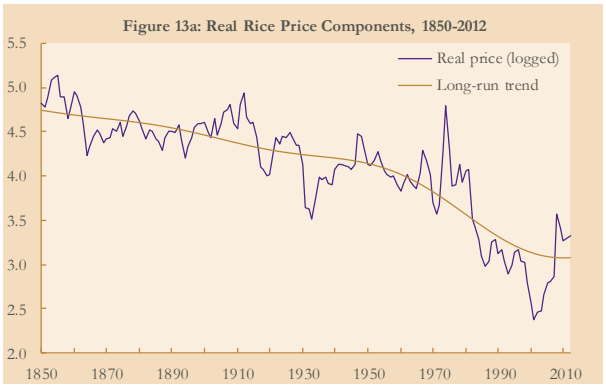


Figure 13a: Real Rice Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

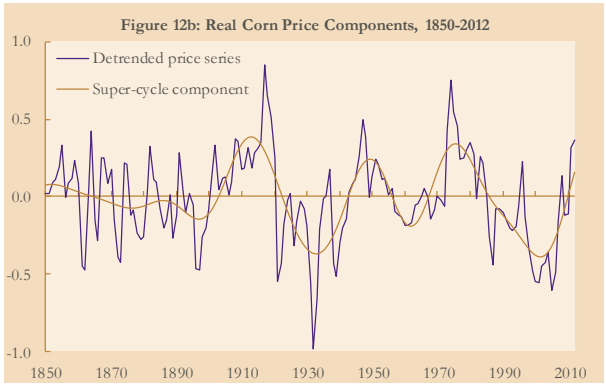


Figure 12b: Real Corn Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

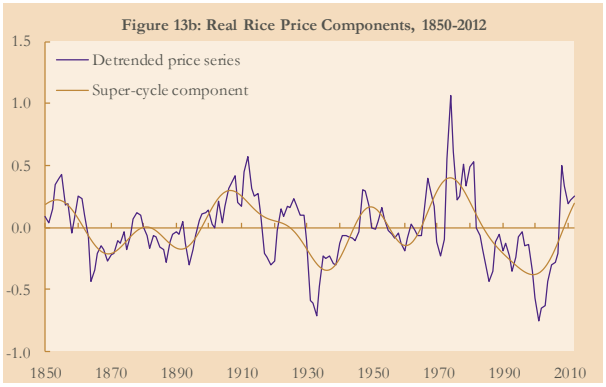


Figure 13b: Real Rice Price Components, 1850-2012
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

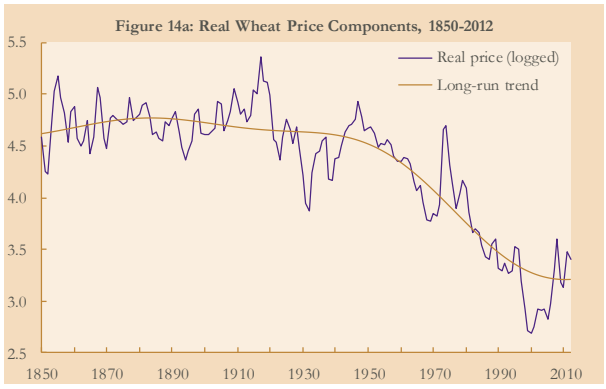


Figure 14a: Real Wheat Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

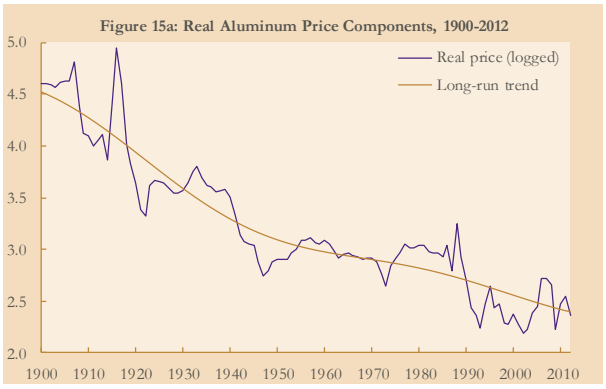


Figure 15a: Real Aluminum Price Components, 1900-2012
Real price (logged)
Long-run trend
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

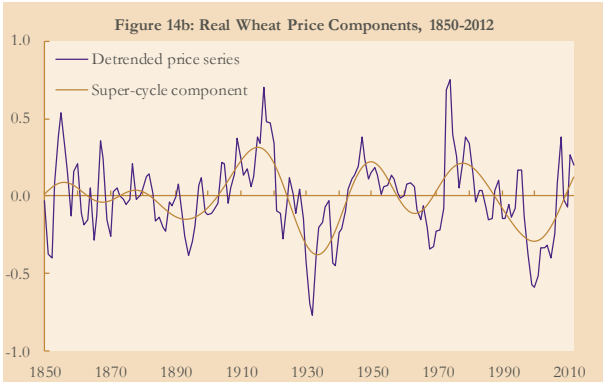


Figure 14b: Real Wheat Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

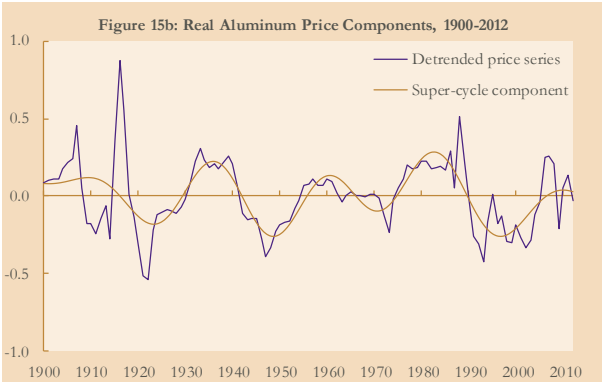


Figure 15b: Real Aluminum Price Components, 1900-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

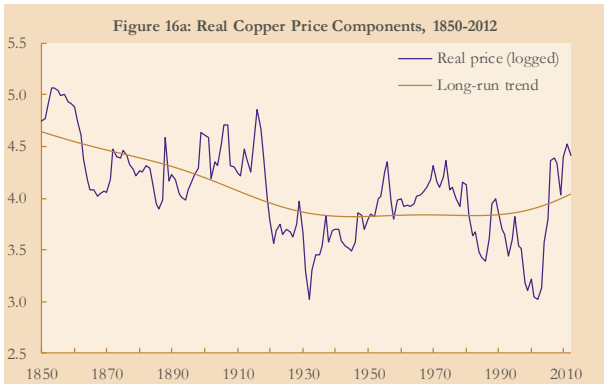


Figure 16a: Real Copper Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

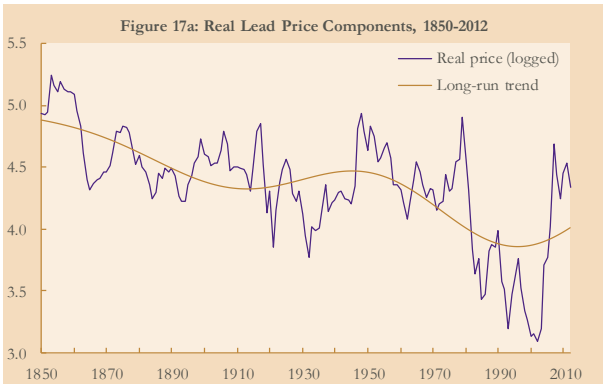


Figure 17a: Real Lead Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

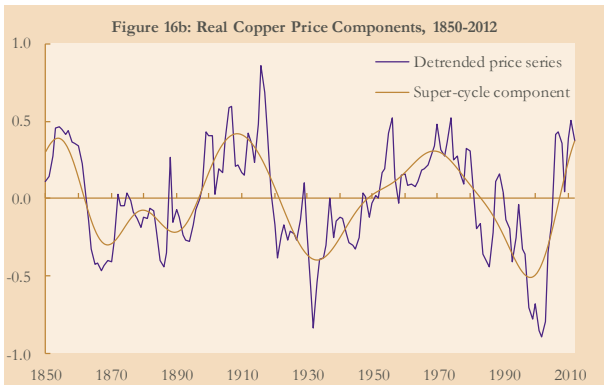


Figure 16b: Real Copper Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

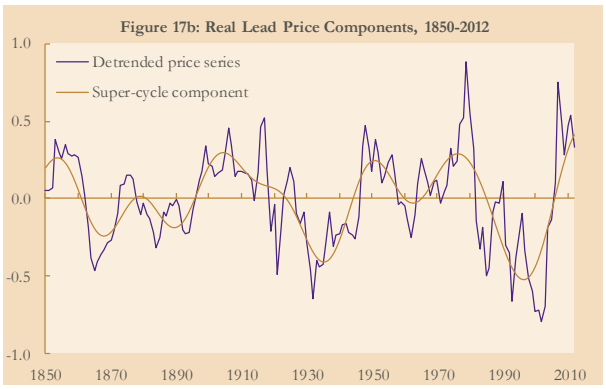


Figure 17b: Real Lead Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

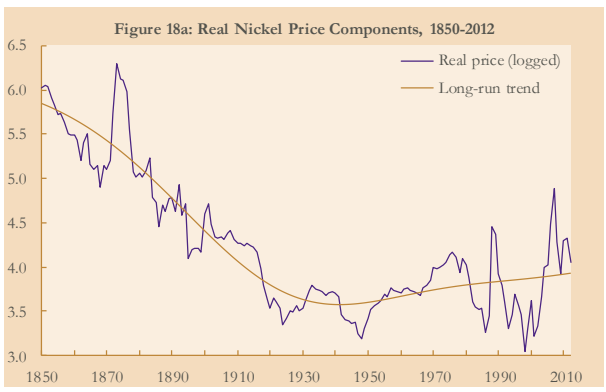


Figure 18a: Real Nickel Price Components, 1850-2012
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

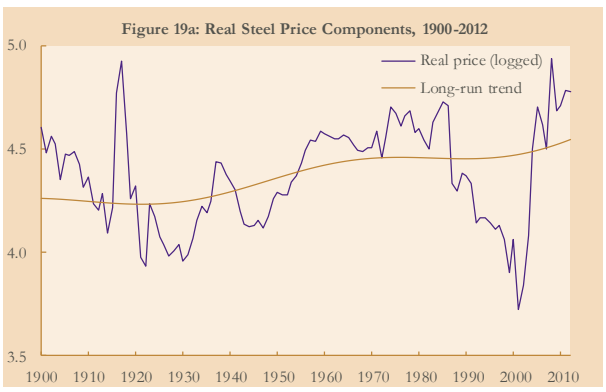


Figure 19a: Real Steel Price Components, 1900-2012
Real price (logged)
Long-run trend
5.0
4.5
4.0
3.5
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

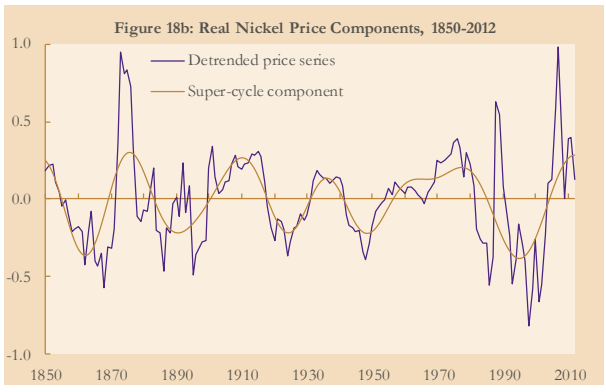


Figure 18b: Real Nickel Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

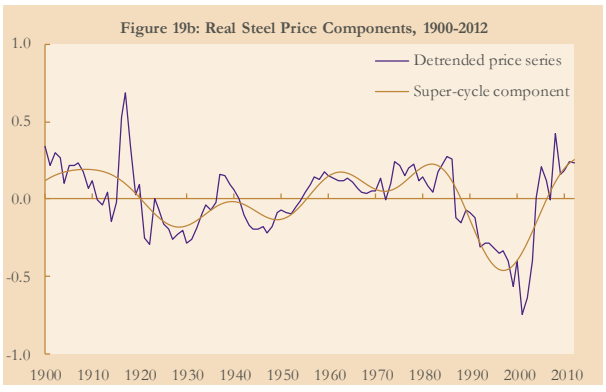


Figure 19b: Real Steel Price Components, 1900-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

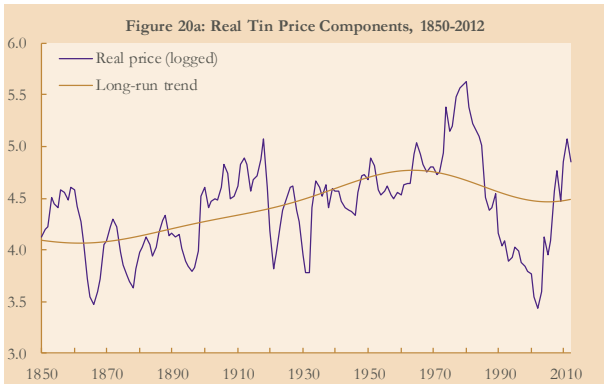


Figure 20a: Real Tin Price Components, 1850-2012
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

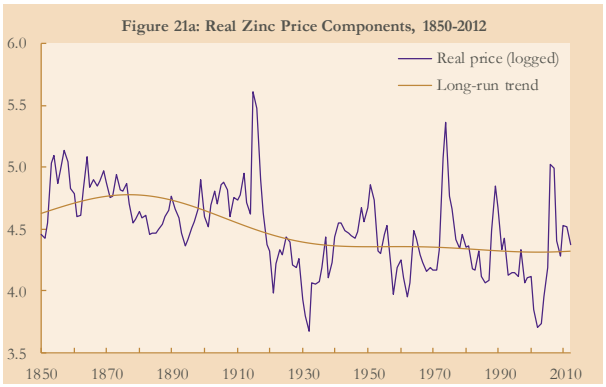


Figure 21a: Real Zinc Price Components, 1850-2012
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
1850 1870 1890 1910 1930 1950 1970 1990 2010

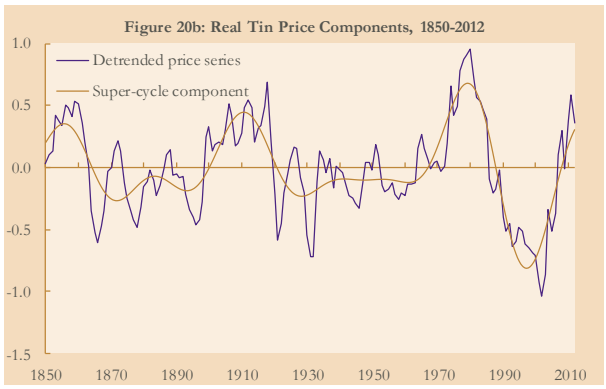


Figure 20b: Real Tin Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
-1.5
1850 1870 1890 1910 1930 1950 1970 1990 2010

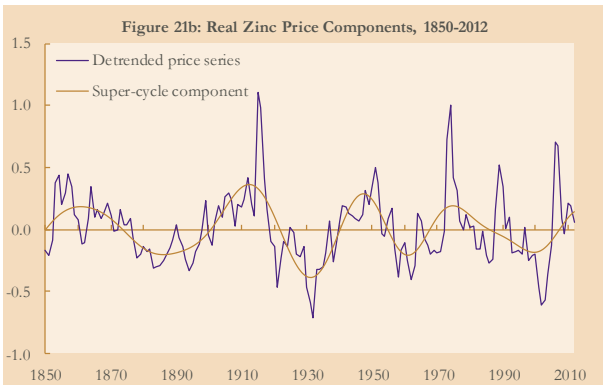


Figure 21b: Real Zinc Price Components, 1850-2012
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

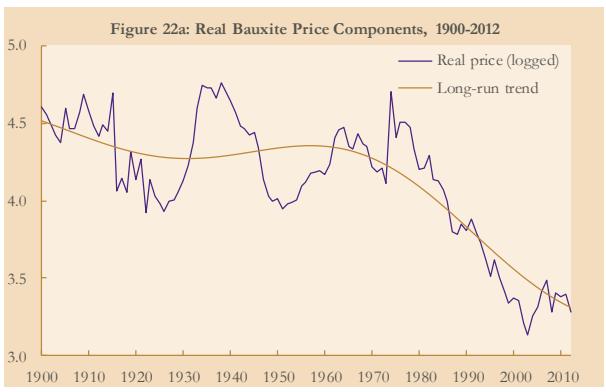


Figure 22a: Real Bauxite Price Components, 1900-2012
Real price (logged)
Long-run trend
5.0
4.5
4.0
3.5
3.0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

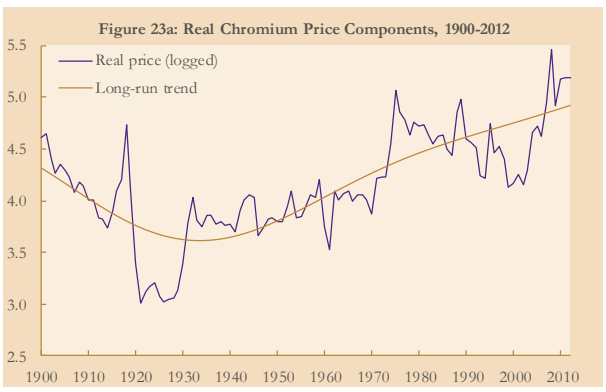


Figure 23a: Real Chromium Price Components, 1900-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

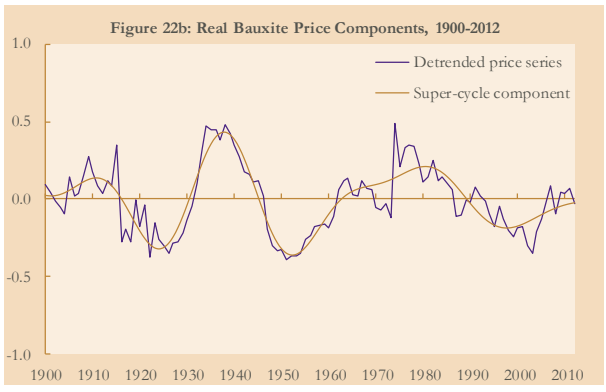


Figure 22b: Real Bauxite Price Components, 1900-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

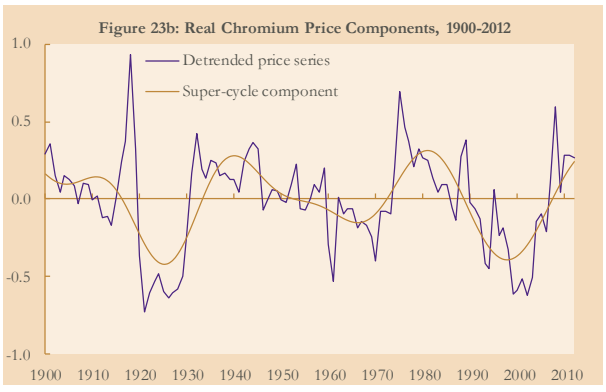


Figure 23b: Real Chromium Price Components, 1900-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

Figure 24a: Real Iron Ore Price Components, 1900-2012

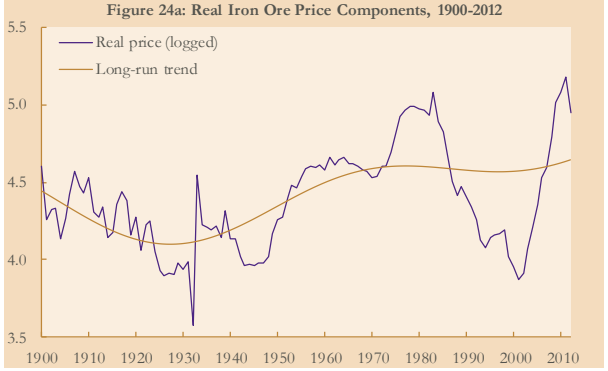


Figure 25a: Real Manganese Price Components, 1900-2012

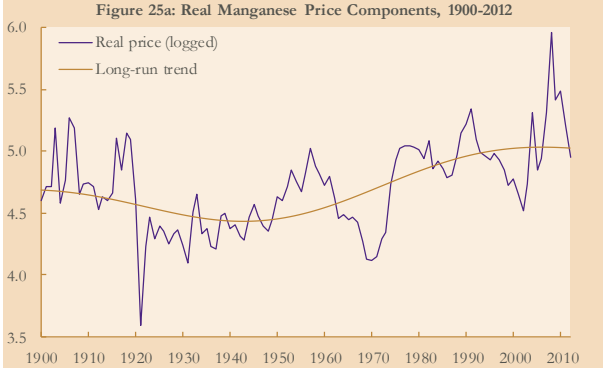


Figure 24b: Real Iron Ore Price Components, 1900-2012

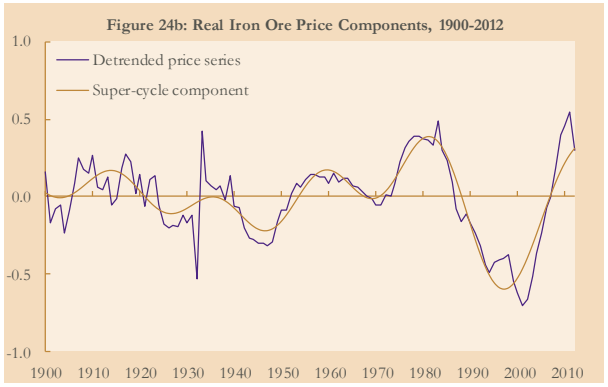


Figure 25b: Real Manganese Price Components, 1900-2012

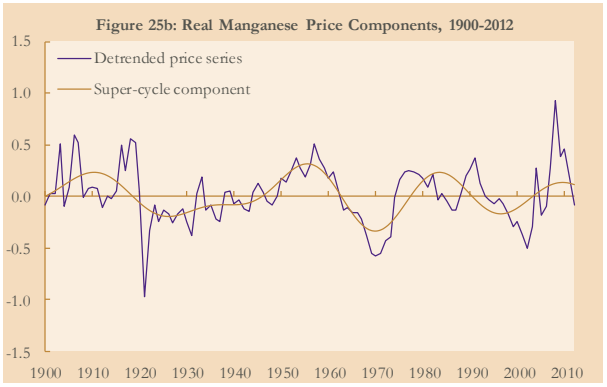


Figure 26a: Real Potash Price Components, 1900-2012

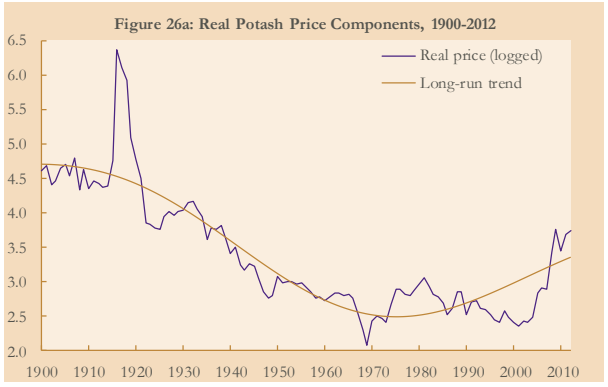


Figure 27a: Real Gold Price Components, 1850-2012

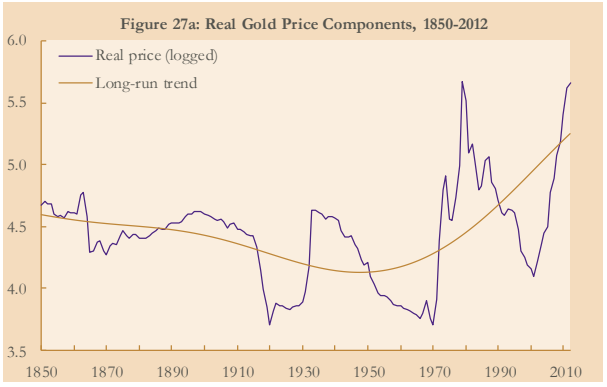


Figure 26b: Real Potash Price Components, 1900-2012

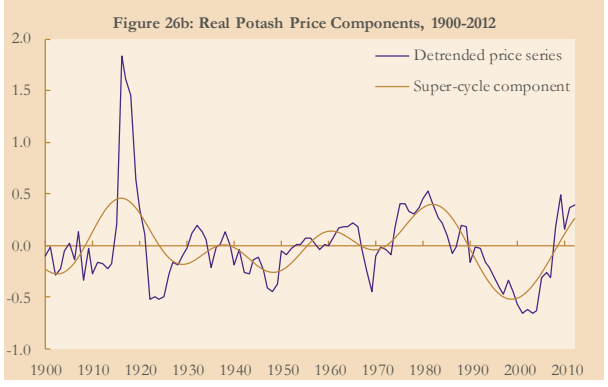
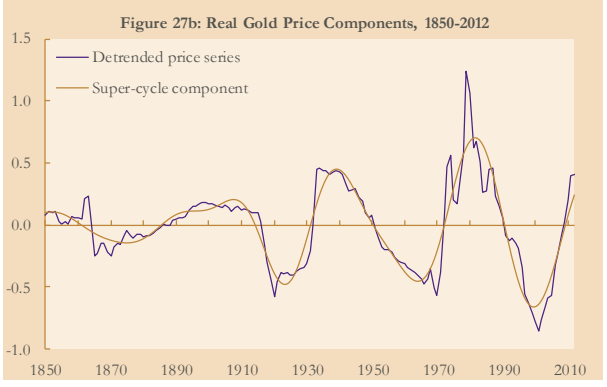


Figure 27b: Real Gold Price Components, 1850-2012



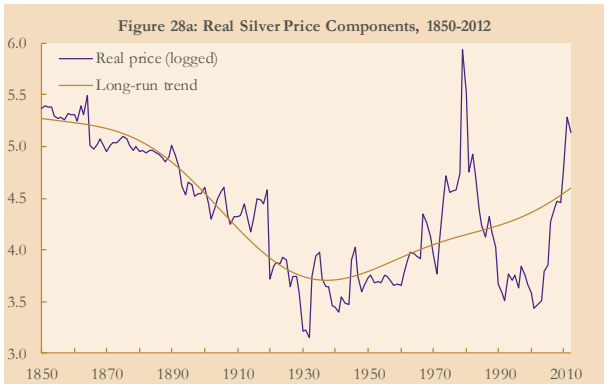


Figure 28a: Real Silver Price Components, 1850-2012
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

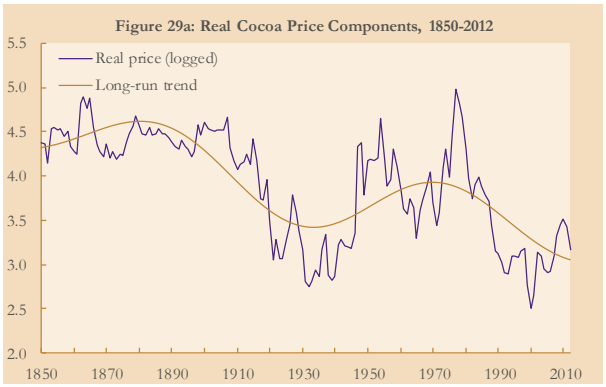


Figure 29a: Real Cocoa Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

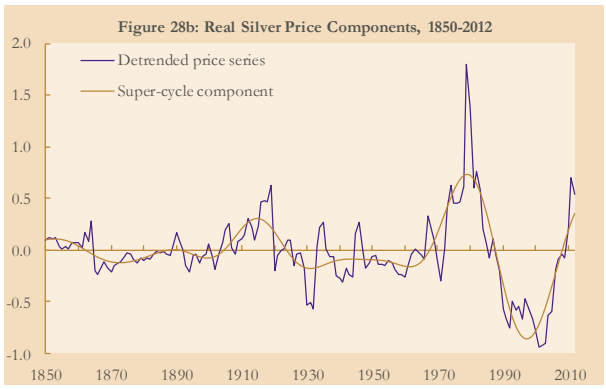


Figure 28b: Real Silver Price Components, 1850-2012
Detrended price series
Super-cycle component
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

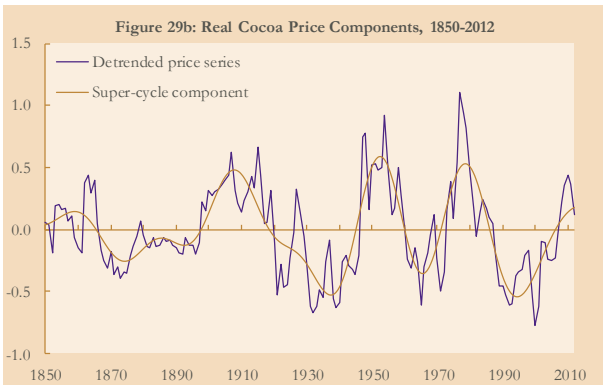


Figure 29b: Real Cocoa Price Components, 1850-2012
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

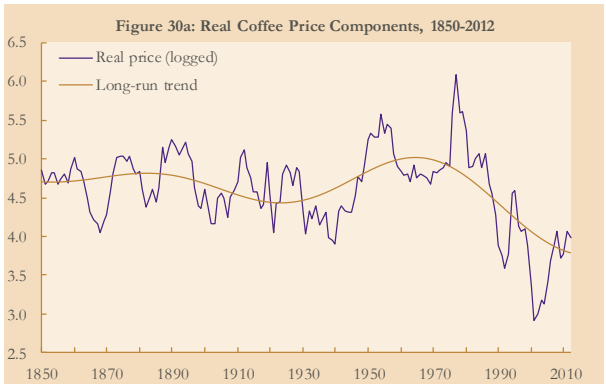


Figure 30a: Real Coffee Price Components, 1850-2012
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

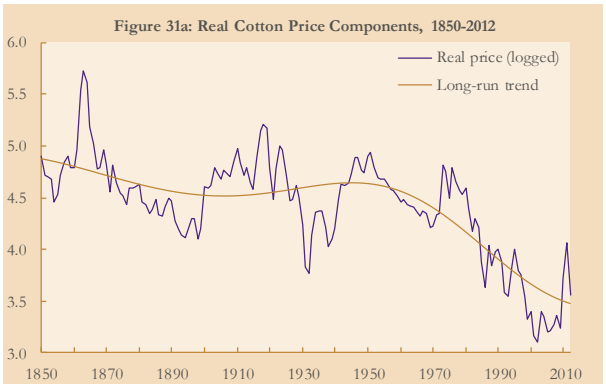


Figure 31a: Real Cotton Price Components, 1850-2012
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

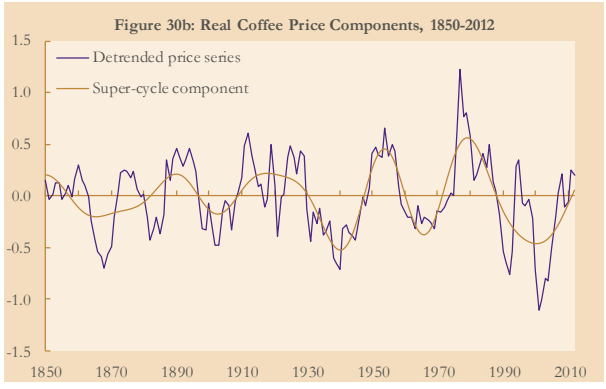


Figure 30b: Real Coffee Price Components, 1850-2012
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

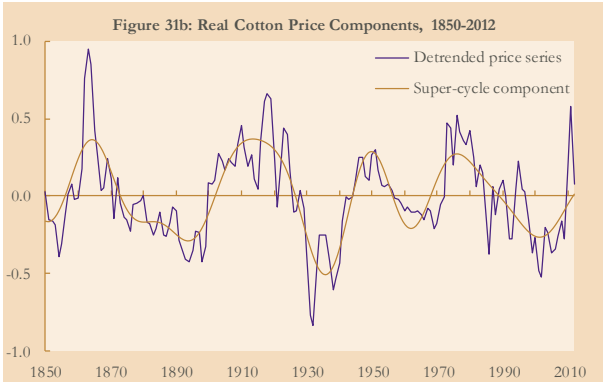


Figure 31b: Real Cotton Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

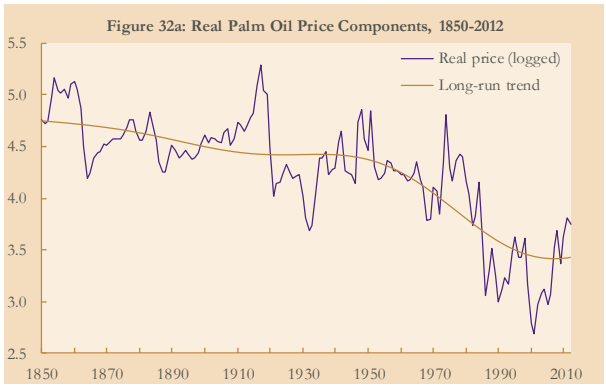


Figure 32a: Real Palm Oil Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

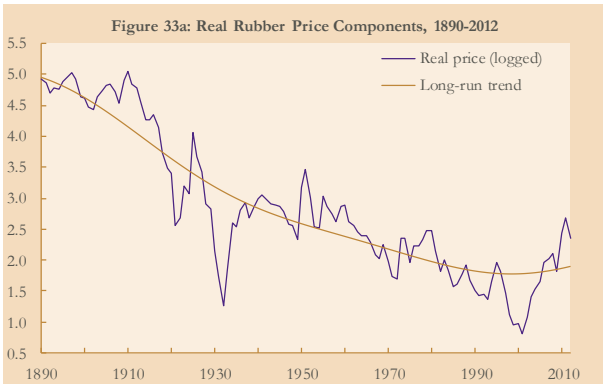


Figure 33a: Real Rubber Price Components, 1890-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1890
1910
1930
1950
1970
1990
2010

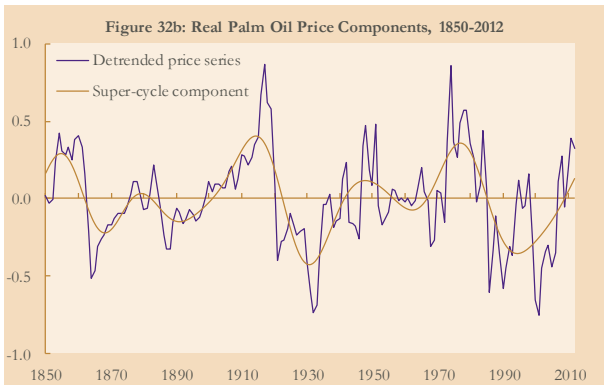


Figure 32b: Real Palm Oil Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

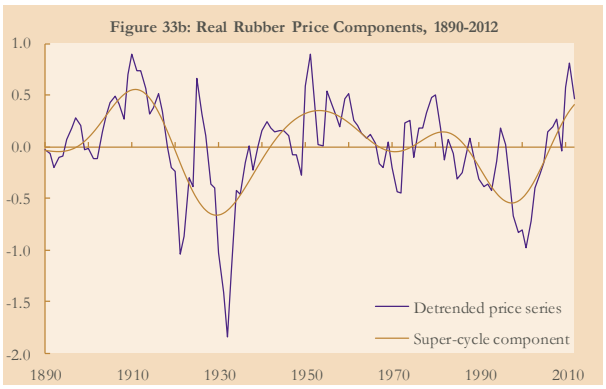


Figure 33b: Real Rubber Price Components, 1890-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
1890
1910
1930
1950
1970
1990
2010

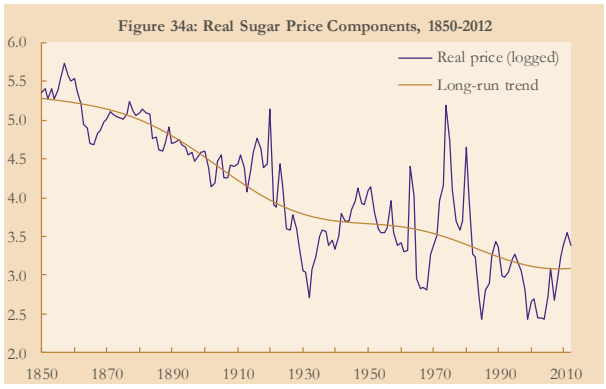


Figure 34a: Real Sugar Price Components, 1850-2012
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

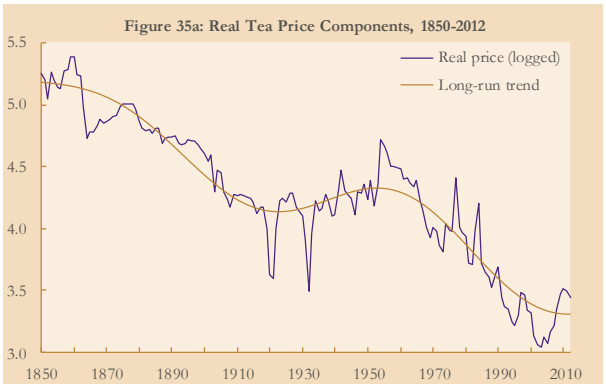


Figure 35a: Real Tea Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

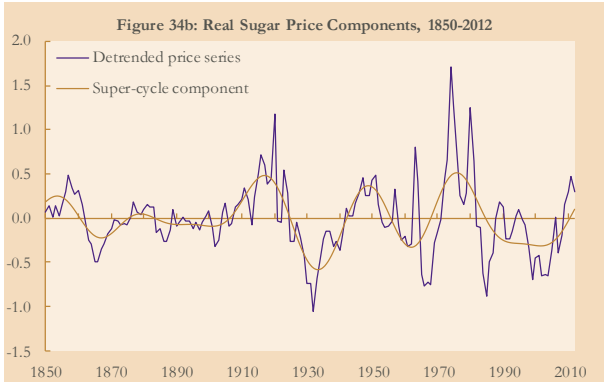


Figure 34b: Real Sugar Price Components, 1850-2012
Detrended price series
Super-cycle component
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

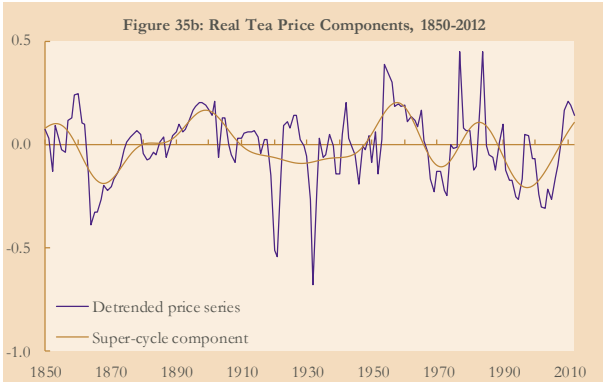


Figure 35b: Real Tea Price Components, 1850-2012
Detrended price series
Super-cycle component
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

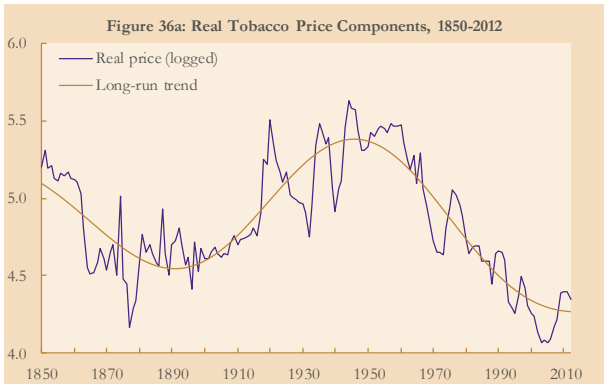


Figure 36a: Real Tobacco Price Components, 1850-2012
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

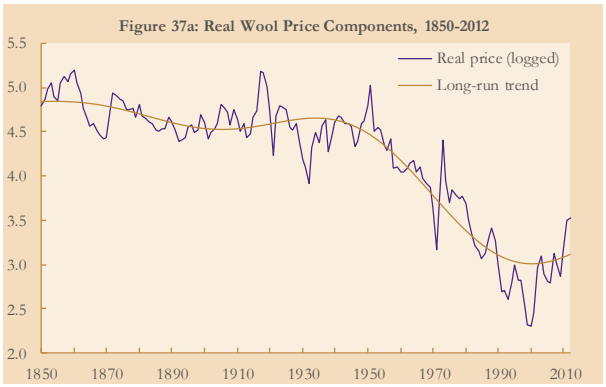


Figure 37a: Real Wool Price Components, 1850-2012
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

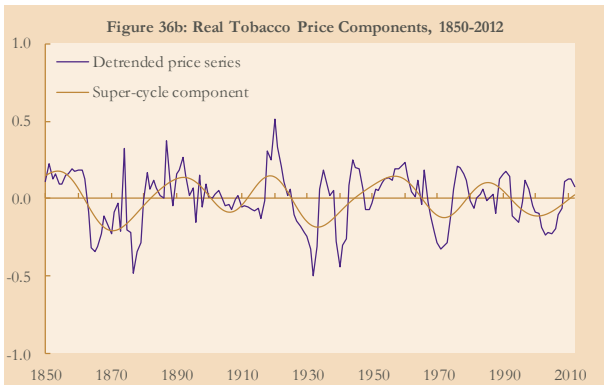


Figure 36b: Real Tobacco Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

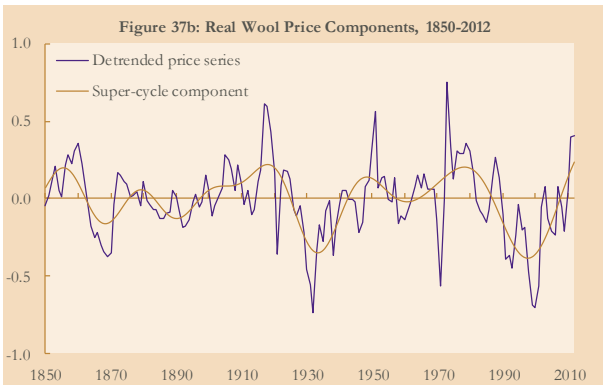


Figure 37b: Real Wool Price Components, 1850-2012
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

Table 3: Dates of Commodity Price Supercycles for Animal Products

Commodity	Start	Peak	Trough	Years to peak	Cycle length	Peak value (%)
Beef	1850?	1854	1867	4?	17?	27.49
Hides	1850?	1856	1869	6?	19?	50.77
Beef	1890	1916	1929	26	39	35.30
Hides	1893	1914	1931	21	39	41.56
Beef	1929	1940	1953	11	24	43.21
Hides	1931	1946	1963	15	32	30.87
Beef	1953	1968	1999	15	46	70.34
Hides	1963	1991	2009	28	46	22.11

Table 4: Dates of Commodity Price Supercycles for Energy Products

Commodity	Start	Peak	Trough	Years to peak	Cycle length	Peak value (%)
Petroleum	1860?	1860	1886	0?	26?	62.65
Petroleum	1886	1918	1936	32	50	53.14
Natural gas	1907	1934	1948	27	41	25.70
Petroleum	1966	1981	1996	15	30	116.04
Natural gas	1969	1982	1994	13	25	78.47
Natural gas	1994	2006	-	12	-	51.84
Petroleum	1996	-	-	-	-	29.10

Table 5: Dates of Commodity Price Supercycles for Grains

Commodity	Start	Peak	Trough	Years to peak	Cycle length	Peak value (%)
Rice	1850?	1853	1869	3?	19?	24.85
Rice	1891	1907	1936	16	45	34.67
Wheat	1893	1915	1934	22	41	36.89
Corn	1897	1913	1933	16	36	46.93
Corn	1933	1949	1962	16	29	27.16
Wheat	1933	1950	1963	17	30	24.68
Rice	1960	1974	1999	14	39	49.29
Corn	1962	1976	2002	14	40	40.31
Wheat	1963	1978	2000	15	37	23.59
Rice	1999	-	-	-	-	21.49

Table 6: Dates of Commodity Price Supercycles for Metals						
Commodity	Start	Peak	Trough	Years to peak	Cycle length	Peak value (%)
Copper	1850?	1854	1869	4?	19?	47.56
Lead	1850?	1854	1868	4?	18?	29.93
Nickel	1850?	1850	1862	0?	12?	27.92
Tin	1850?	1856	1872	6?	22?	42.30
Zinc	1850?	1861	1886	11?	36?	20.19
Nickel	1862	1876	1891	14	29	34.94
Zinc	1886	1912	1931	26	45	43.63
Copper	1889	1909	1933	20	44	51.86
Lead	1889	1904	1935	15	46	34.36
Nickel	1891	1910	1924	19	33	30.41
Tin	1893	1911	1928	18	35	56.18
Steel	1897?	1908	1920	11?	23?	21.05
Aluminum	1923	1936	1949	13	26	25.00
Zinc	1931	1947	1961	16	30	33.20
Copper	1933	1969	1998	36	65	35.85
Lead	1935	1951	1963	16	28	27.76
Nickel	1948	1977	1995	29	47	22.52
Tin	1961	1979	1997	18	36	97.34
Zinc	1961	1975	2000	14	39	21.02
Lead	1963	1976	1997	13	34	33.43
Aluminum	1971	1983	1997	12	26	32.65
Steel	1972	1982	1997	10	25	25.23
Nickel	1995	-	-	-	-	32.78
Lead	1997	-	-	-	-	50.70
Steel	1997	-	-	-	-	28.90
Tin	1997	-	-	-	-	35.65
Copper	1998	-	-	-	-	44.88

Table 7: Dates of Commodity Price Supercycles for Minerals						
Commodity	Start	Peak	Trough	Years to peak	Cycle length	Peak value (%)
Manganese	1900?	1910	1926	10?	26?	26.34
Potash	1902	1916	1929	14	27	58.21
Bauxite	1924	1938	1952	14	28	53.90
Chromium	1925	1940	1966	15	41	32.19
Manganese	1926	1955	1970	29	44	37.02
Bauxite	1952	1980	1998	28	46	23.25
Chromium	1966	1981	1998	15	32	36.74
Iron ore	1969	1981	1997	12	28	47.25
Manganese	1970	1983	1996	13	26	26.20
Potash	1970	1982	1999	12	29	49.02
Iron ore	1997	-	-	-	-	36.40
Chromium	1998	-	-	-	-	27.25
Potash	1999	-	-	-	-	29.87

Table 8: Dates of Commodity Price Supercycles for Precious Metals						
Commodity	Start	Peak	Trough	Years to peak	Cycle length	Peak value (%)
Gold	1875	1908	1923	33	48	22.65
Silver	1900	1915	1931	15	31	35.74
Gold	1923	1939	1964	16	41	56.88
Silver	1961	1979	1997	18	36	108.21
Gold	1964	1982	2000	18	36	101.80
Silver	1997	-	-	-	-	42.51
Gold	2000	-	-	-	-	27.22

Table 9: Dates of Commodity Price Supercycles for Soft Commodities

Commodity	Start	Peak	Trough	Years to peak	Cycle length	Peak value (%)
Coffee	1850?	1850	1865	0?	15?	22.73
Cotton	1850?	1864	1894	14?	44?	43.80
Palm oil	1850?	1855	1868	5?	18?	33.57
Sugar	1850?	1853	1867	3?	17?	23.76
Wool	1850?	1855	1868	5?	18?	21.75
Coffee	1865	1890	1903	25	38	23.57
Wool	1890	1918	1933	28	43	24.53
Palm oil	1891	1914	1931	23	40	49.59
Cocoa	1892	1908	1937	16	45	61.66
Rubber	1893	1911	1929	18	36	74.38
Cotton	1894	1914	1936	20	42	44.41
Sugar	1901	1917	1933	16	32	61.84
Coffee	1903	1918	1940	15	37	24.45
Tea	1928	1958	1971	30	43	22.38
Rubber	1929	1953	1971	24	42	42.20
Sugar	1933	1949	1962	16	29	44.06
Cotton	1936	1950	1962	14	26	33.11
Cocoa	1937	1952	1966	15	29	79.55
Coffee	1940	1954	1966	14	26	57.36
Wool	1961	1978	1998	17	37	22.45
Cotton	1962	1976	2001	14	39	31.19
Palm oil	1962	1977	1994	15	32	43.01
Sugar	1962	1976	2002	14	40	66.85
Cocoa	1966	1979	1995	13	29	69.66
Coffee	1966	1979	2000	13	34	75.67
Rubber	1998	-	-	-	-	50.61
Tea	1998	-	-	-	-	26.50

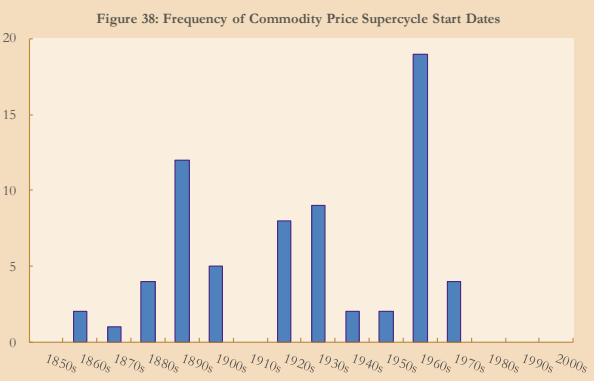


Figure 38: Frequency of Commodity Price Supercycle Start Dates
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

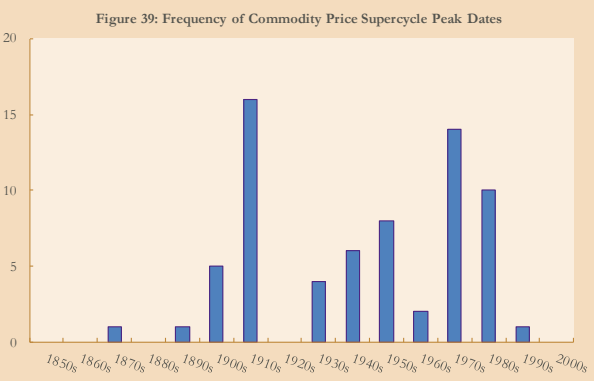


Figure 39: Frequency of Commodity Price Supercycle Peak Dates
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

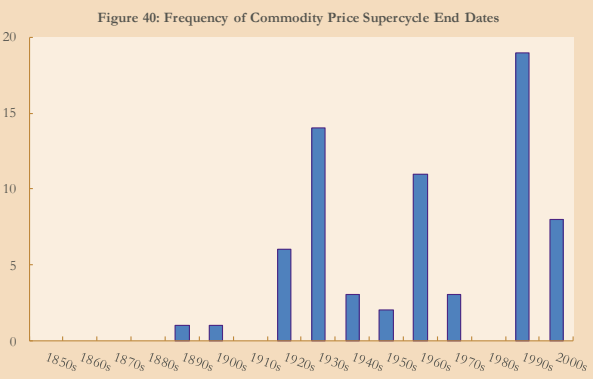


Figure 40: Frequency of Commodity Price Supercycle End Dates
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

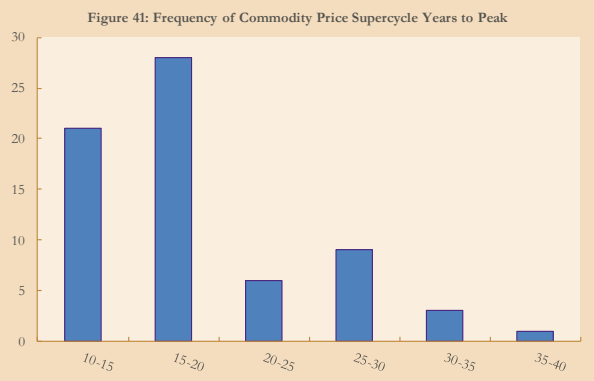


Figure 41: Frequency of Commodity Price Supercycle Years to Peak
30
25
20
15
10
5
0
10-15 15-20 20-25 25-30 30-35 35-40

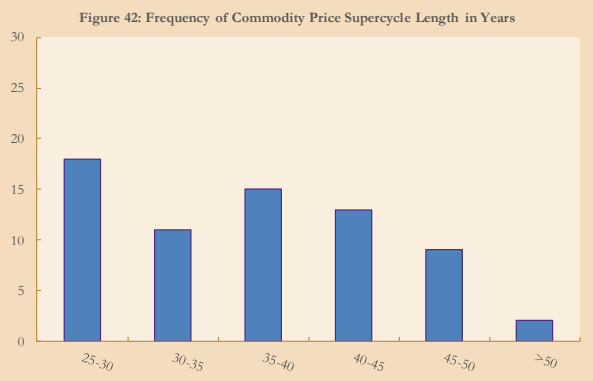


Figure 42: Frequency of Commodity Price Supercycle Length in Years
30
25
20
15
10
5
0
25-30 30-35 35-40 40-45 45-50 >50

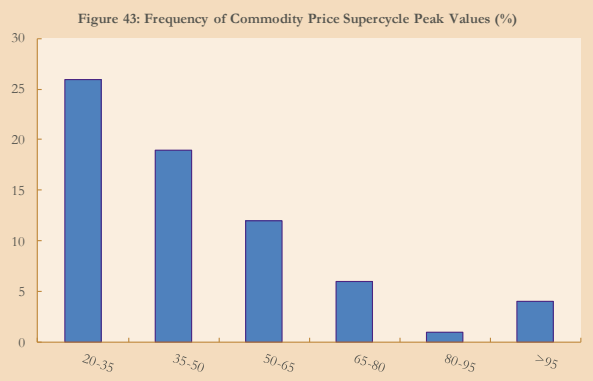


Figure 43: Frequency of Commodity Price Supercycle Peak Values (%)
30
25
20
15
10
5
0
20-35 35-50 50-65 65-80 80-95 >95

Figure 44: Real Beef Price Booms & Busts, 1850-2012

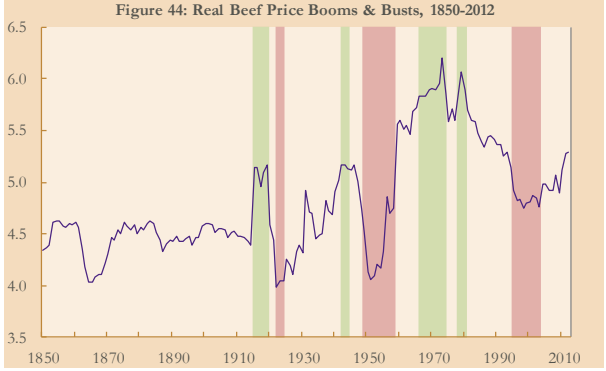


Figure 45: Real Hide Price Booms & Busts, 1850-2012

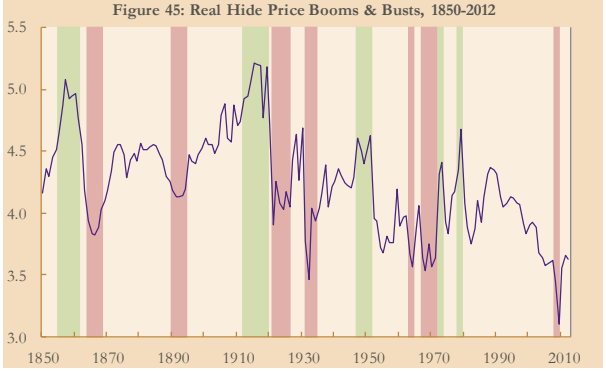


Figure 46: Real Natural Gas Price Booms & Busts, 1900-2012

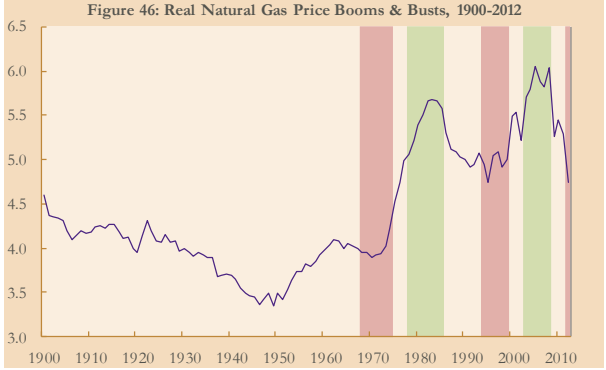


Figure 47: Real Petroleum Price Booms & Busts, 1860-2012

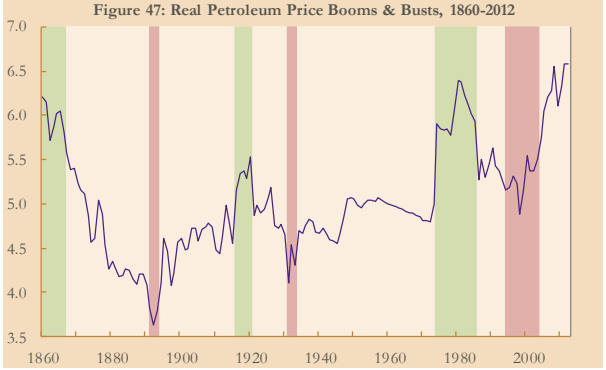


Figure 48: Real Corn Price Booms & Busts, 1850-2012

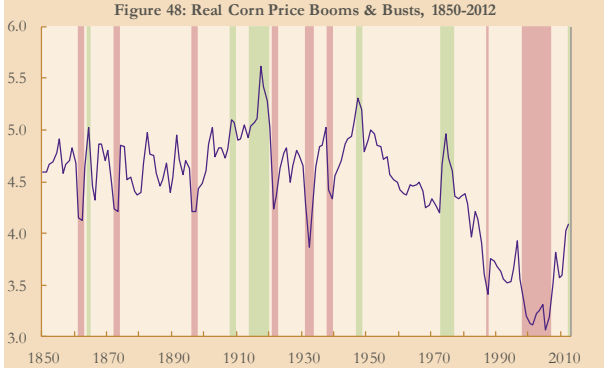


Figure 49: Real Rice Price Booms & Busts, 1850-2012

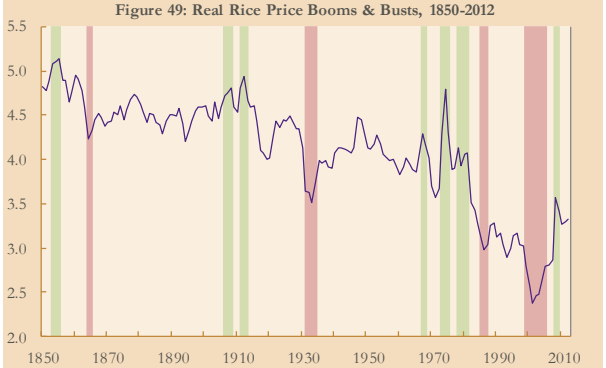


Figure 50: Real Wheat Price Booms & Busts, 1850-2012

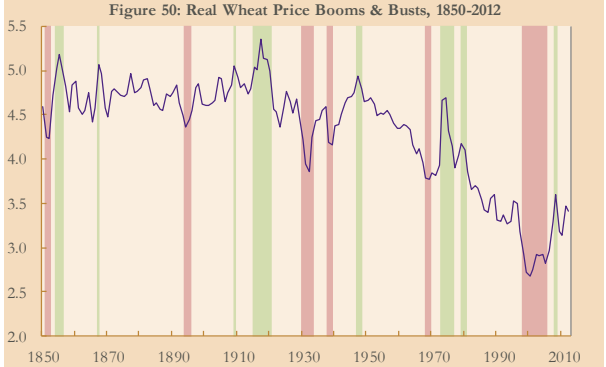
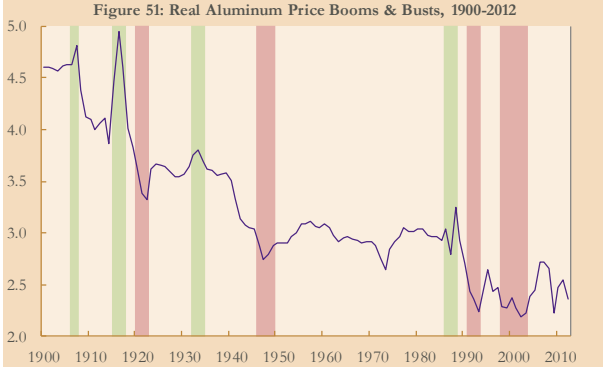


Figure 51: Real Aluminum Price Booms & Busts, 1900-2012



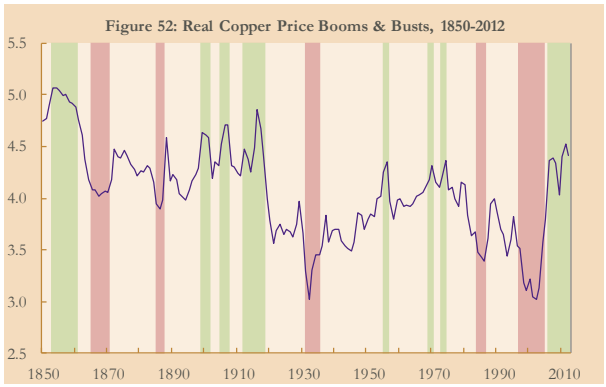


Figure 52: Real Copper Price Booms & Busts, 1850-2012
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850 1870 1890 1910 1930 1950 1970 1990 2010

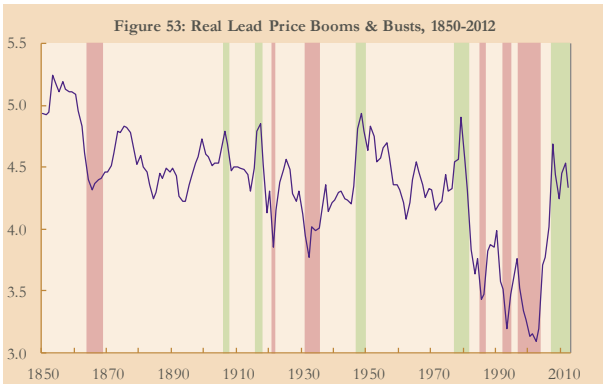


Figure 53: Real Lead Price Booms & Busts, 1850-2012
5.5
5.0
4.5
4.0
3.5
3.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

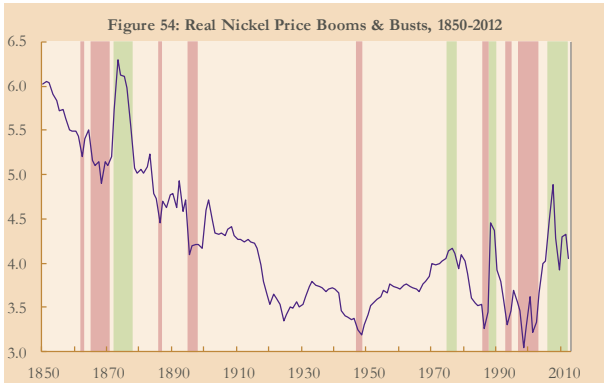


Figure 54: Real Nickel Price Booms & Busts, 1850-2012
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

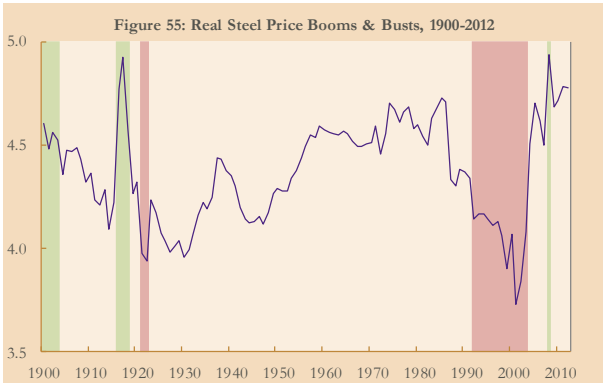


Figure 55: Real Steel Price Booms & Busts, 1900-2012
5.0
4.5
4.0
3.5
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

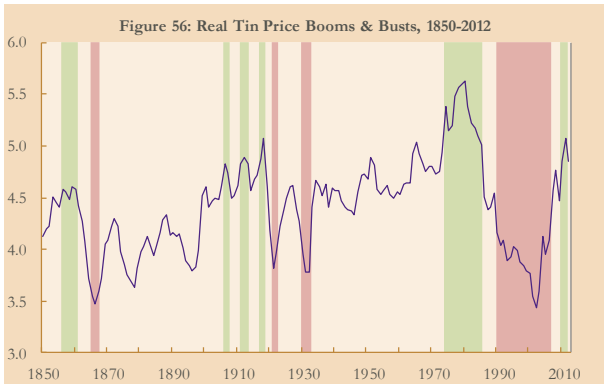


Figure 56: Real Tin Price Booms & Busts, 1850-2012
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

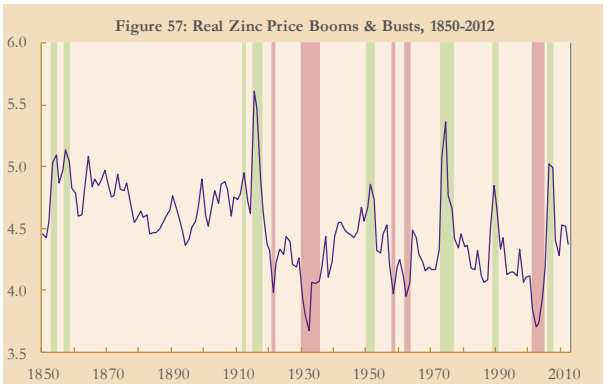


Figure 57: Real Zinc Price Booms & Busts, 1850-2012
6.0
5.5
5.0
4.5
4.0
3.5
1850 1870 1890 1910 1930 1950 1970 1990 2010

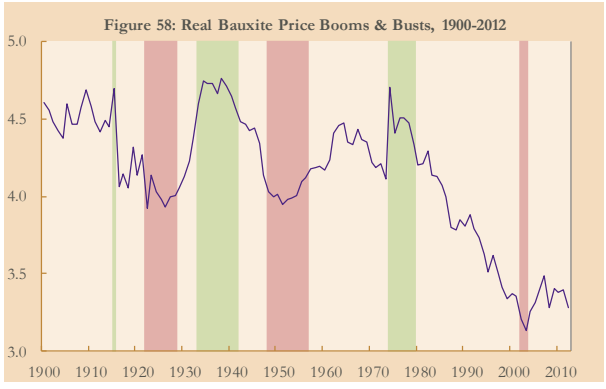


Figure 58: Real Bauxite Price Booms & Busts, 1900-2012
5.0
4.5
4.0
3.5
3.0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

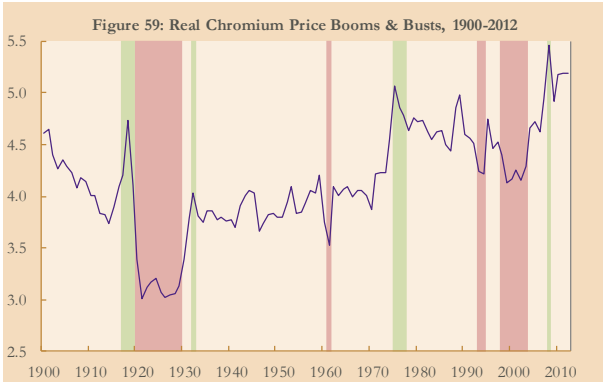


Figure 59: Real Chromium Price Booms & Busts, 1900-2012
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

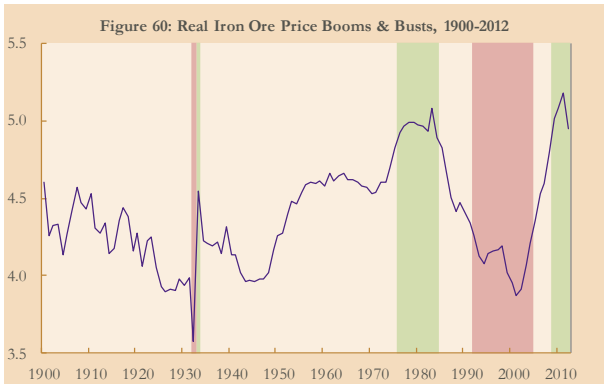


Figure 60: Real Iron Ore Price Booms & Busts, 1900-2012
5.5
5.0
4.5
4.0
3.5
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

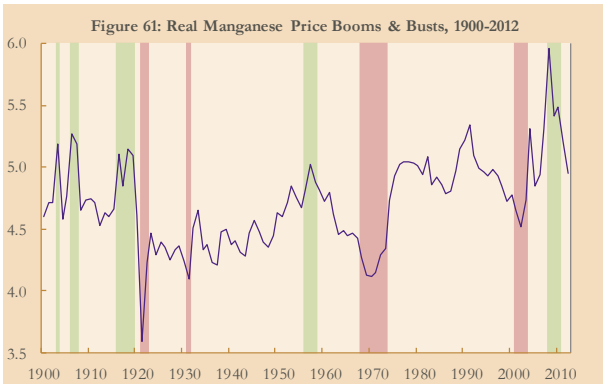


Figure 61: Real Manganese Price Booms & Busts, 1900-2012
6.0
5.5
5.0
4.5
4.0
3.5
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

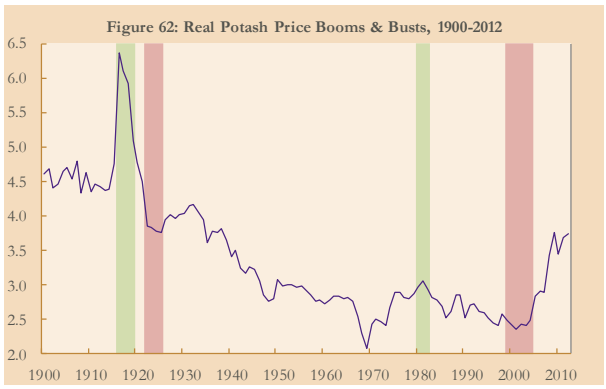


Figure 62: Real Potash Price Booms & Busts, 1900-2012
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

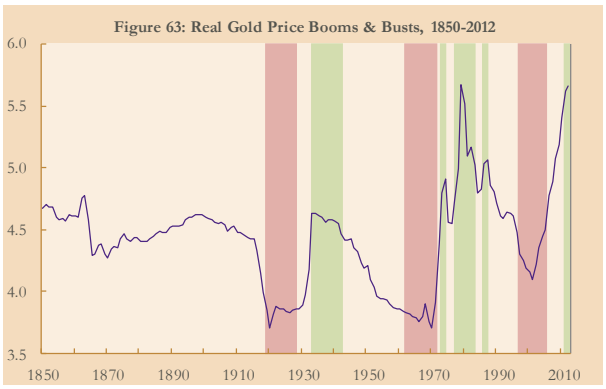


Figure 63: Real Gold Price Booms & Busts, 1850-2012
6.0
5.5
5.0
4.5
4.0
3.5
1850 1870 1890 1910 1930 1950 1970 1990 2010

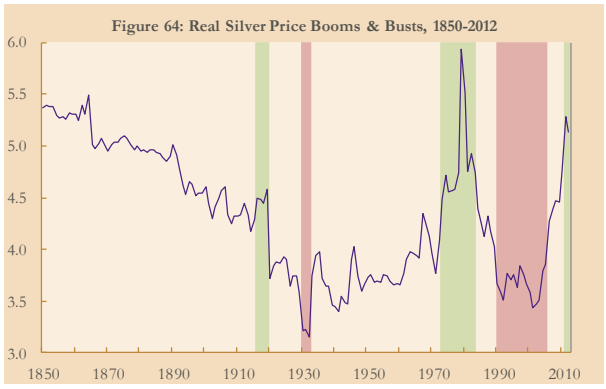


Figure 64: Real Silver Price Booms & Busts, 1850-2012
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

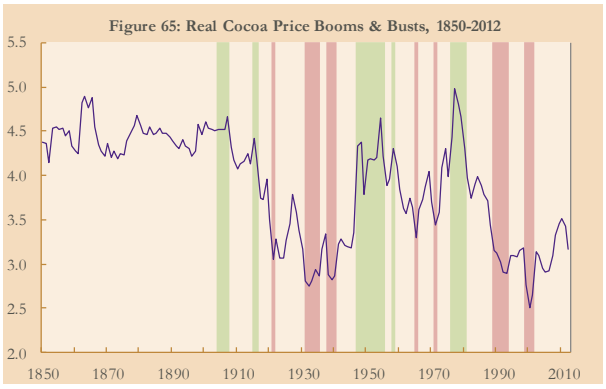


Figure 65: Real Cocoa Price Booms & Busts, 1850-2012
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

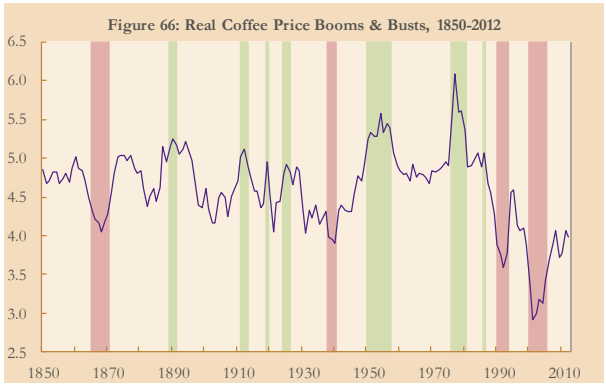


Figure 66: Real Coffee Price Booms & Busts, 1850-2012
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850 1870 1890 1910 1930 1950 1970 1990 2010

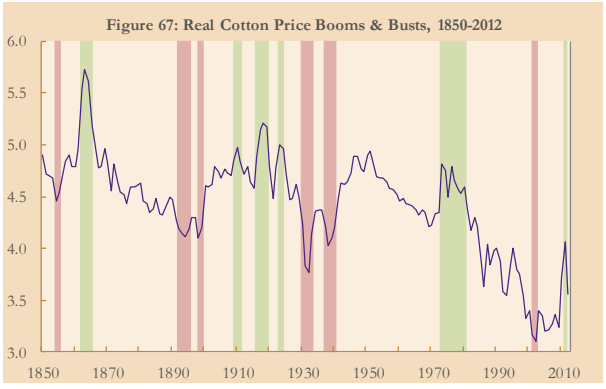


Figure 67: Real Cotton Price Booms & Busts, 1850-2012
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850 1870 1890 1910 1930 1950 1970 1990 2010

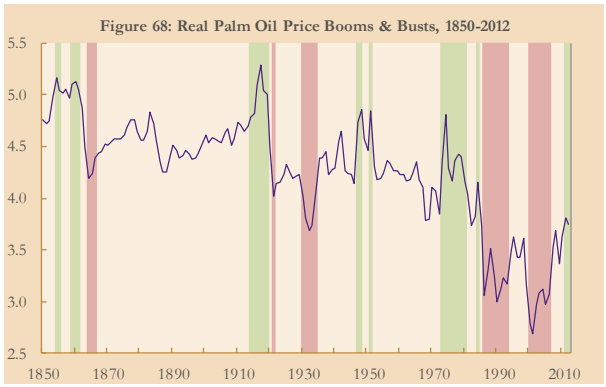


Figure 68: Real Palm Oil Price Booms & Busts, 1850-2012
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

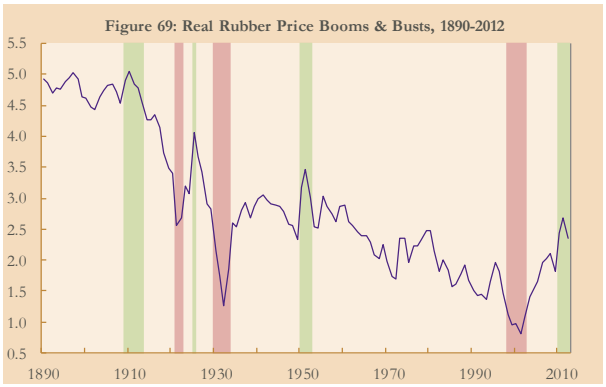


Figure 69: Real Rubber Price Booms & Busts, 1890-2012
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1890
1910
1930
1950
1970
1990
2010

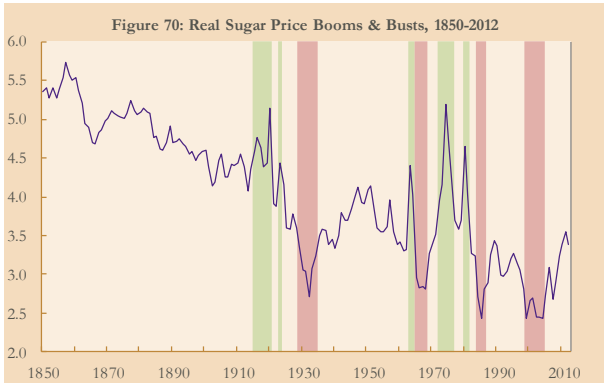


Figure 70: Real Sugar Price Booms & Busts, 1850-2012
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

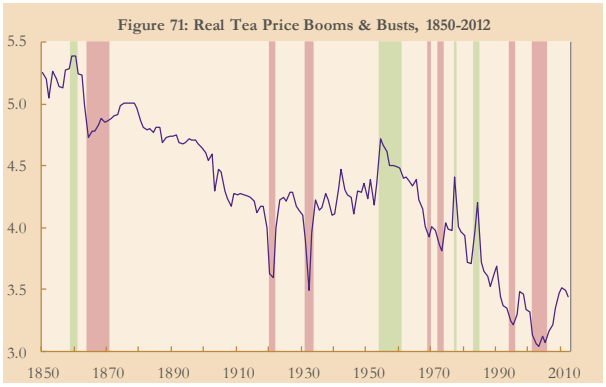


Figure 71: Real Tea Price Booms & Busts, 1850-2012
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

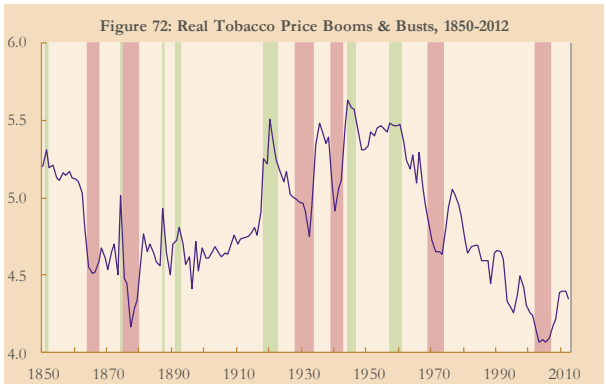


Figure 72: Real Tobacco Price Booms & Busts, 1850-2012
6.0
5.5
5.0
4.5
4.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

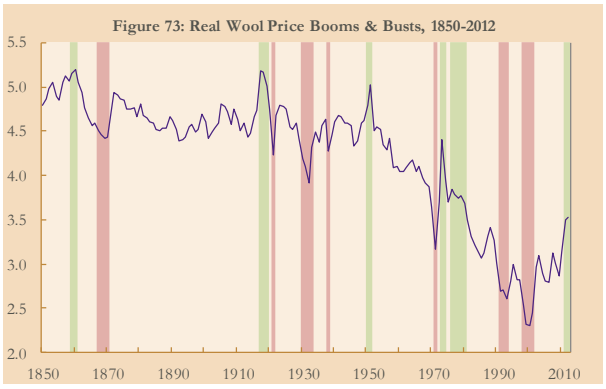


Figure 73: Real Wool Price Booms & Busts, 1850-2012
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

Table 10: Dates of Commodity Price Booms & Busts for Animal Products

Panel A: Booms

Commodity	Start	Peak	End	Years to peak	Boom length	Deviation from trend (%)
Hides	1855	1857	1861	2	6	116.54
Hides	1912	1916	1919	4	7	92.19
Beef	1915	1919	1919	4	4	106.59
Beef	1942	1942	1944	0	2	49.43
Hides	1947	1951	1951	4	4	76.48
Beef	1966	1973	1974	7	8	101.62
Hides	1972	1973	1973	1	1	52.03
Beef	1978	1979	1980	1	2	75.05
Hides	1978	1979	1979	1	1	98.08

Panel B: Busts

Commodity	Start	Trough	End	Years to trough	Bust length	Deviation from trend (%)
Hides	1864	1866	1868	2	4	-40.16
Hides	1890	1892	1894	2	4	-33.12
Hides	1921	1921	1926	0	5	-44.94
Beef	1922	1922	1924	0	2	-37.24
Hides	1931	1932	1934	1	3	-57.86
Beef	1949	1951	1958	2	9	-62.35
Hides	1963	1964	1964	1	1	-34.63
Hides	1967	1968	1971	1	4	-36.25
Beef	1995	1998	2003	3	8	-41.48
Hides	2008	2009	2009	1	1	-49.86

Table 11: Dates of Commodity Price Booms & Busts for Energy Products

Panel A: Booms

Commodity	Start	Peak	End	Years to peak	Boom length	Deviation from trend (%)
Petroleum	1860?	1865	1866	5?	6?	82.30
Petroleum	1916	1920	1920	4	4	131.54
Petroleum	1974	1980	1985	6	11	195.39
Natural gas	1978	1982	1985	4	7	110.85
Natural gas	2003	2008	2008	5	5	109.21

Panel B: Busts

Commodity	Start	Trough	End	Years to trough	Bust length	Deviation from trend (%)
Petroleum	1891	1892	1893	1	2	-53.31
Petroleum	1931	1931	1933	0	2	-54.21
Natural gas	1968	1972	1974	4	6	-40.42
Natural gas	1994	1995	1999	1	5	-42.08
Petroleum	1994	1998	2003	4	9	-63.45
Natural gas	2012	-	-	-	-	-39.06

Table 12: Dates of Commodity Price Booms & Busts for Grains

Panel A: Booms

Commodity	Start	Peak	End	Years to peak	Boom length	Deviation from trend (%)
Rice	1853	1855	1855	2	2	52.81
Wheat	1854	1855	1856	1	2	71.09
Corn	1864	1864	1864	0	0	52.02
Wheat	1867	1867	1867	0	0	42.30
Rice	1906	1908	1908	2	2	52.62
Corn	1908	1908	1909	0	1	45.26
Wheat	1909	1909	1909	0	0	45.09
Rice	1911	1912	1913	1	2	77.85
Corn	1914	1917	1919	3	5	133.62
Wheat	1915	1917	1920	2	5	101.35
Corn	1947	1947	1948	0	1	63.86
Wheat	1947	1947	1948	0	1	45.79
Rice	1967	1967	1968	0	1	48.93
Corn	1973	1974	1976	1	3	112.02
Rice	1973	1974	1975	1	2	191.48
Wheat	1973	1974	1976	1	3	111.21
Rice	1978	1981	1981	3	3	69.35
Wheat	1979	1979	1980	0	1	46.20
Rice	2008	2008	2009	0	1	64.88
Wheat	2008	2008	2008	0	0	46.86
Corn	2012	-	-	-	-	43.77

Panel B: Busts

Commodity	Start	Trough	End	Years to trough	Bust length	Deviation from trend (%)
Wheat	1851	1852	1852	1	1	-33.15
Corn	1861	1862	1862	1	1	-37.57
Rice	1864	1864	1865	0	1	-35.18
Corn	1872	1873	1873	1	1	-34.47
Wheat	1894	1894	1895	0	1	-32.05
Corn	1896	1897	1897	1	1	-37.61
Corn	1921	1921	1922	0	1	-42.25
Wheat	1930	1932	1933	2	3	-53.62
Corn	1931	1932	1933	1	2	-62.58
Rice	1931	1933	1934	2	3	-50.92
Corn	1938	1939	1939	1	1	-40.18
Wheat	1938	1939	1939	1	1	-36.23
Wheat	1968	1968	1969	0	1	-29.06
Rice	1985	1986	1987	1	2	-35.21
Corn	1987	1987	1987	0	0	-35.88
Corn	1998	2005	2006	7	8	-45.29
Wheat	1998	2000	2005	2	7	-44.78
Rice	1999	2001	2005	2	6	-52.88

Table 13a: Dates of Commodity Price Booms & Busts for Metals

Panel A: Booms

Commodity	Start	Peak	End	Years to peak	Boom length	Deviation from trend (%)
Copper	1853	1854	1860	1	7	58.97
Zinc	1853	1854	1854	1	1	54.29
Tin	1856	1859	1860	3	4	70.89
Zinc	1857	1857	1858	0	1	56.82
Nickel	1872	1873	1877	1	5	157.97
Copper	1899	1899	1901	0	2	53.62
Steel	1899	1899	1903	0	4	72.70
Copper	1905	1907	1907	2	2	80.96
Aluminum	1906	1907	1907	1	1	57.14
Lead	1906	1907	1907	1	1	57.34
Tin	1906	1907	1907	1	1	66.94
Tin	1911	1912	1913	1	2	72.90
Copper	1912	1916	1918	4	6	135.91
Zinc	1912	1912	1912	0	0	52.03
Aluminum	1915	1916	1917	1	2	140.40
Zinc	1915	1915	1917	0	2	202.56
Lead	1916	1917	1917	1	1	68.23
Steel	1916	1917	1918	1	2	99.04
Tin	1917	1918	1918	1	1	99.78
Aluminum	1932	1933	1934	1	2	36.25
Lead	1947	1948	1949	1	2	60.39
Zinc	1950	1951	1952	1	2	65.60
Copper	1955	1956	1956	1	1	67.97
Copper	1969	1970	1970	1	1	60.92
Copper	1973	1974	1974	1	1	68.66
Zinc	1973	1974	1976	1	3	174.04
Tin	1974	1980	1985	6	11	161.21
Nickel	1975	1976	1977	1	2	47.68
Lead	1977	1979	1981	2	4	140.83
Aluminum	1986	1988	1988	2	2	67.51
Nickel	1988	1988	1989	0	1	87.64
Zinc	1989	1989	1990	0	1	68.60
Copper	2006	-	-	-	-	-
Nickel	2006	2007	2011	1	5	167.85
Zinc	2006	2006	2007	0	1	102.71
Lead	2007	-	-	-	-	-
Steel	2008	2008	2008	0	0	52.54
Tin	2010	2011	2011	1	1	80.41

Table 13b: Dates of Commodity Price Booms & Busts for Metals

Panel B: Busts

Commodity	Start	Trough	End	Years to trough	Bust length	Deviation from trend (%)
Nickel	1862	1862	1862	0	0	-34.91
Tin	1863	1864	1865	1	2	-45.38
Lead	1864	1865	1868	1	4	-37.13
Copper	1865	1867	1870	2	5	-37.50
Nickel	1865	1868	1870	3	5	-43.84
Copper	1885	1886	1887	1	2	-35.86
Nickel	1886	1886	1886	0	0	-37.33
Nickel	1895	1895	1897	0	2	-39.03
Aluminum	1920	1922	1922	2	2	-41.96
Lead	1921	1921	1921	0	0	-38.69
Steel	1921	1922	1922	1	1	-25.71
Tin	1921	1921	1922	0	1	-44.56
Zinc	1921	1921	1921	0	0	-37.58
Tin	1930	1932	1932	2	2	-51.56
Zinc	1930	1932	1935	2	5	-51.03
Copper	1931	1932	1935	1	4	-56.61
Lead	1931	1932	1935	1	4	-47.51
Aluminum	1946	1947	1949	1	3	-32.57
Nickel	1947	1948	1948	1	1	-32.67
Zinc	1958	1958	1958	0	0	-31.95
Zinc	1962	1962	1963	0	1	-33.24
Lead	1985	1985	1986	0	1	-39.50
Nickel	1986	1986	1987	0	1	-42.62
Tin	1990	2002	2006	12	16	-64.49
Aluminum	1991	1993	1993	2	2	-34.46
Lead	1992	1993	1994	1	2	-48.55
Steel	1992	2001	2003	9	11	-52.69
Nickel	1993	1993	1994	0	1	-42.15
Copper	1997	2002	2004	5	7	-59.05
Lead	1997	2002	2003	5	6	-54.77
Nickel	1997	1998	2002	1	5	-55.92
Aluminum	1998	2002	2003	4	5	-28.73
Zinc	2001	2002	2004	1	3	-45.77

Table 14: Dates of Commodity Price Booms & Busts for Minerals

Panel A: Booms

Commodity	Start	Peak	End	Years to peak	Boom length	Deviation from trend (%)
Manganese	1903	1903	1903	0	0	66.18
Manganese	1906	1906	1907	0	1	82.46
Bauxite	1915	1915	1915	0	0	41.32
Manganese	1916	1919	1919	3	3	68.09
Potash	1916	1916	1919	0	3	530.32
Chromium	1917	1918	1919	1	2	153.96
Chromium	1932	1932	1932	0	0	51.90
Bauxite	1933	1938	1941	5	8	61.39
Iron ore	1933	1933	1933	0	0	53.03
Manganese	1956	1957	1958	1	2	66.63
Bauxite	1974	1974	1979	0	5	63.55
Chromium	1975	1975	1977	0	2	100.61
Iron ore	1976	1983	1984	7	8	62.41
Potash	1980	1981	1982	1	2	70.58
Chromium	2008	2008	2008	0	0	81.90
Manganese	2008	2008	2010	0	2	153.56
Iron ore	2009	-	-	-	-	-

Panel B: Busts

Commodity	Start	Trough	End	Years to trough	Bust length	Deviation from trend (%)
Chromium	1920	1921	1929	1	9	-51.73
Manganese	1921	1921	1922	0	1	-61.95
Bauxite	1922	1922	1928	0	6	-31.15
Potash	1922	1924	1925	2	3	-40.40
Manganese	1931	1931	1931	0	0	-31.64
Iron ore	1932	1932	1932	0	0	-41.49
Bauxite	1948	1951	1956	3	8	-32.57
Chromium	1961	1961	1961	0	0	-41.19
Manganese	1968	1970	1973	2	5	-43.64
Iron ore	1992	2001	2004	9	12	-50.48
Chromium	1993	1993	1994	0	1	-36.24
Chromium	1998	2002	2003	4	5	-46.35
Potash	1999	2003	2004	4	5	-48.40
Manganese	2001	2002	2003	1	2	-39.75
Bauxite	2002	2003	2003	1	1	-29.44

Table 15: Dates of Commodity Price Booms & Busts for Precious Metals

Panel A: Booms

Commodity	Start	Peak	End	Years to peak	Boom length	Deviation from trend (%)
Silver	1916	1919	1919	3	3	87.91
Gold	1933	1934	1942	1	9	58.41
Gold	1973	1974	1974	1	1	76.19
Silver	1973	1979	1983	6	10	502.23
Gold	1977	1979	1983	2	6	245.34
Gold	1986	1987	1987	1	1	58.12
Gold	2011	-	-	-	-	50.15
Silver	2011	-	-	-	-	102.83

Panel B: Busts

Commodity	Start	Trough	End	Years to trough	Bust length	Deviation from trend (%)
Gold	1919	1920	1928	1	9	-43.78
Silver	1930	1932	1932	2	2	-43.64
Gold	1962	1966	1971	4	9	-37.63
Silver	1990	2001	2005	11	15	-61.01
Gold	1997	2001	2005	4	8	-57.66

Table 16a: Dates of Commodity Price Booms & Busts for Soft Commodities

Panel A: Booms

Commodity	Start	Peak	End	Years to peak	Boom length	Deviation from trend (%)
Tobacco	1851	1851	1851	0	0	25.58
Palm oil	1854	1854	1855	0	1	52.76
Palm oil	1859	1860	1861	1	2	50.50
Tea	1859	1860	1860	1	1	27.85
Wool	1859	1860	1860	1	1	42.64
Cotton	1862	1863	1865	1	3	158.89
Tobacco	1874	1874	1874	0	0	38.13
Tobacco	1887	1887	1887	0	0	45.78
Coffee	1889	1890	1891	1	2	59.42
Tobacco	1891	1892	1892	1	1	30.21
Cocoa	1904	1907	1907	3	3	86.24
Cotton	1909	1910	1911	1	2	57.43
Rubber	1909	1910	1913	1	4	147.00
Coffee	1911	1912	1913	1	2	83.55
Palm oil	1914	1917	1919	3	5	138.65
Cocoa	1915	1916	1916	1	1	93.61
Sugar	1915	1920	1920	5	5	224.49
Cotton	1916	1918	1919	2	3	94.35
Wool	1917	1917	1919	0	2	84.81
Tobacco	1918	1920	1922	2	4	67.48
Coffee	1919	1919	1919	0	0	65.09
Cotton	1923	1923	1924	0	1	54.82
Sugar	1923	1923	1923	0	0	70.84
Coffee	1924	1925	1926	1	2	63.30
Rubber	1925	1925	1925	0	0	94.16
Tobacco	1944	1944	1946	0	2	28.55
Cocoa	1947	1954	1955	7	8	150.19
Palm oil	1947	1948	1948	1	1	60.53
Coffee	1950	1954	1957	4	7	92.08
Rubber	1950	1951	1952	1	2	145.59
Wool	1950	1951	1951	1	1	75.07
Palm oil	1951	1951	1951	0	0	61.36
Tea	1954	1954	1960	0	6	47.69
Tobacco	1957	1960	1960	3	3	26.62
Cocoa	1958	1958	1958	0	0	64.51
Sugar	1963	1963	1964	0	1	122.00
Sugar	1972	1974	1976	2	4	454.53
Cotton	1973	1976	1980	3	7	68.75
Palm oil	1973	1974	1980	1	7	135.51
Wool	1973	1974	1974	1	1	111.33
Cocoa	1976	1977	1980	1	4	201.85
Coffee	1976	1977	1979	1	3	241.33
Wool	1976	1979	1980	3	4	42.68
Tea	1977	1977	1977	0	0	57.19
Sugar	1980	1980	1981	0	1	250.78
Tea	1983	1984	1984	1	1	56.74
Palm oil	1984	1984	1984	0	0	55.48
Coffee	1986	1986	1986	0	0	65.02
Rubber	2010	-	-	-	-	-
Cotton	2011	2011	2011	0	0	78.06
Palm oil	2011	-	-	-	-	-
Wool	2011	-	-	-	-	-

Table 16b: Dates of Commodity Price Booms & Busts for Soft Commodities						
Panel B: Busts						
Commodity	**Start**	**Trough**	**End**	**Years to trough**	**Bust length**	**Deviation from trend (%)**
Cotton	1854	1854	1855	0	1	-32.21
Palm oil	1864	1864	1866	0	2	-40.34
Tea	1864	1864	1870	0	6	-32.19
Tobacco	1864	1865	1867	1	3	-28.79
Coffee	1865	1868	1870	3	5	-50.53
Wool	1867	1869	1870	2	3	-31.18
Tobacco	1875	1877	1879	2	4	-38.09
Cotton	1892	1894	1895	2	3	-34.81
Cotton	1898	1898	1899	0	1	-34.67
Tea	1920	1921	1921	1	1	-41.80
Cocoa	1921	1921	1921	0	0	-41.25
Palm oil	1921	1921	1921	0	0	-32.83
Rubber	1921	1921	1922	0	1	-64.52
Wool	1921	1921	1921	0	0	-30.23
Tobacco	1928	1932	1933	4	5	-39.54
Sugar	1929	1932	1934	3	5	-65.34
Cotton	1930	1932	1933	2	3	-56.62
Palm oil	1930	1932	1934	2	4	-52.34
Rubber	1930	1932	1933	2	3	-84.17
Wool	1930	1932	1933	2	3	-52.30
Cocoa	1931	1932	1935	1	4	-49.05
Tea	1931	1932	1933	1	2	-49.38
Cotton	1937	1938	1940	1	3	-45.53
Cocoa	1938	1939	1940	1	2	-46.89
Coffee	1938	1940	1940	2	2	-51.18
Wool	1938	1938	1938	0	0	-30.70
Tobacco	1939	1940	1942	1	3	-35.87
Cocoa	1965	1965	1965	0	0	-45.69
Sugar	1965	1966	1968	1	3	-53.34
Tea	1969	1969	1969	0	0	-20.74
Tobacco	1969	1971	1973	2	4	-28.01
Cocoa	1971	1971	1971	0	0	-38.93
Wool	1971	1971	1971	0	0	-43.29
Tea	1972	1973	1973	1	1	-22.18
Sugar	1984	1985	1986	1	2	-58.73
Palm oil	1986	1986	1993	0	7	-45.63
Cocoa	1989	1992	1993	3	4	-45.86
Coffee	1990	1992	1993	2	3	-53.17
Wool	1991	1993	1993	2	2	-36.22
Tea	1994	1995	1995	1	1	-23.37
Rubber	1998	2001	2002	3	4	-62.40
Wool	1998	2000	2001	2	3	-50.62
Cocoa	1999	2000	2001	1	2	-54.17
Sugar	1999	1999	2004	0	5	-50.19
Coffee	2000	2001	2005	1	5	-67.11
Palm oil	2000	2001	2006	1	6	-53.00
Cotton	2001	2002	2002	1	1	-40.55
Tea	2001	2003	2005	2	4	-26.59
Tobacco	2002	2003	2006	1	3	-21.32

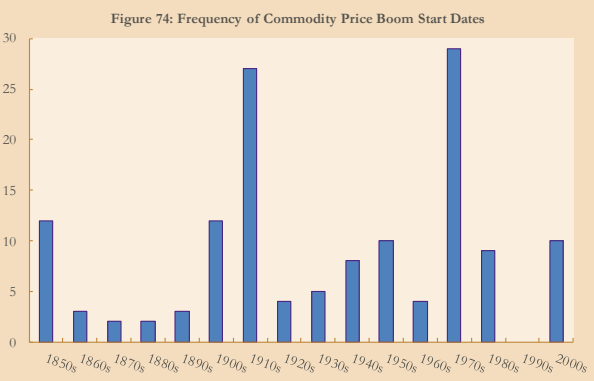


Figure 74: Frequency of Commodity Price Boom Start Dates
30
25
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

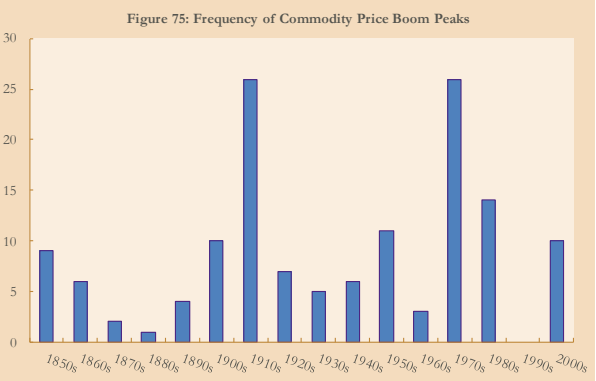


Figure 75: Frequency of Commodity Price Boom Peaks
30
25
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

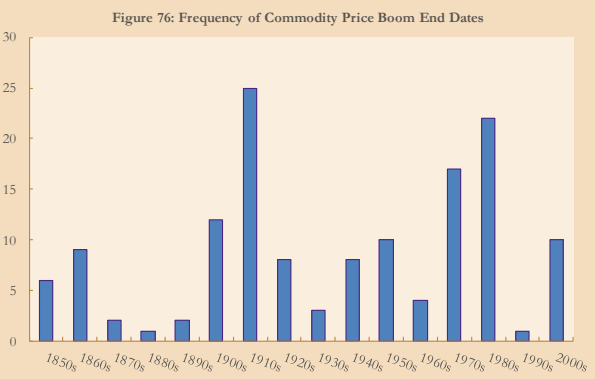


Figure 76: Frequency of Commodity Price Boom End Dates
30
25
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

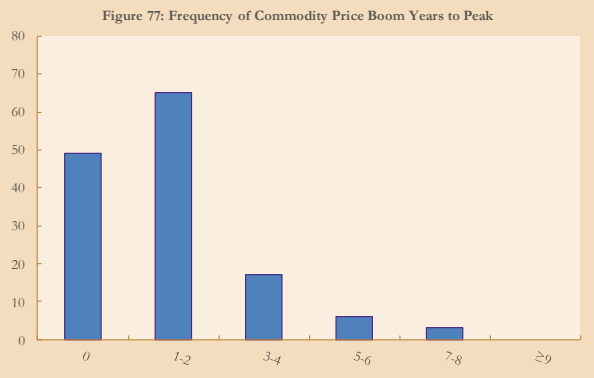


Figure 77: Frequency of Commodity Price Boom Years to Peak
80
70
60
50
40
30
20
10
0
0 1-2 3-4 5-6 7-8 ≥9

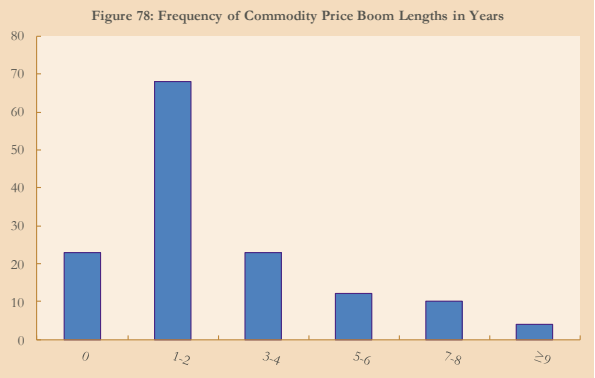


Figure 78: Frequency of Commodity Price Boom Lengths in Years
80
70
60
50
40
30
20
10
0
0 1-2 3-4 5-6 7-8 ≥9

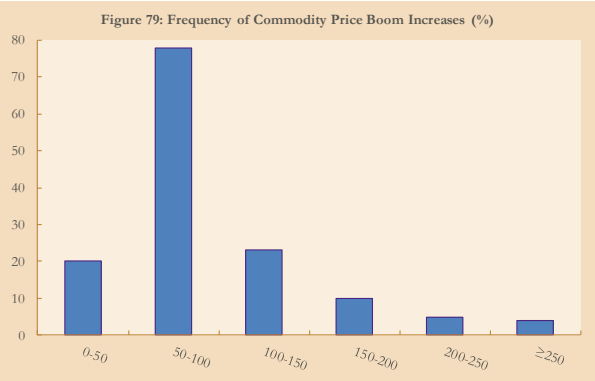


Figure 79: Frequency of Commodity Price Boom Increases (%)
80
70
60
50
40
30
20
10
0
0-50 50-100 100-150 150-200 200-250 ≥250

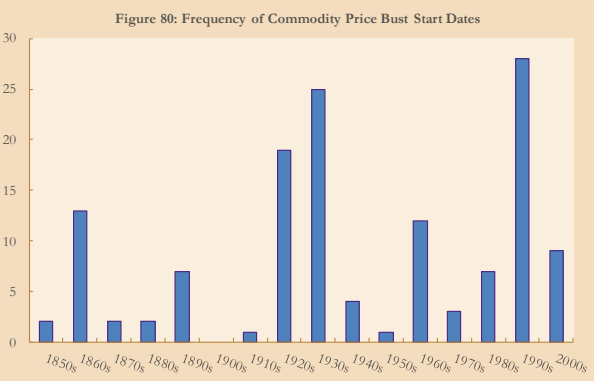


Figure 80: Frequency of Commodity Price Bust Start Dates
30
25
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

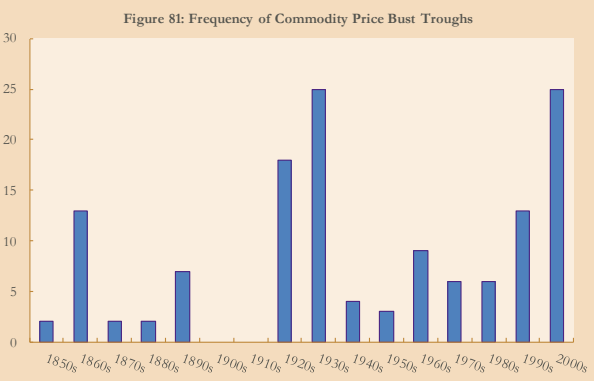


Figure 81: Frequency of Commodity Price Bust Troughs
30
25
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

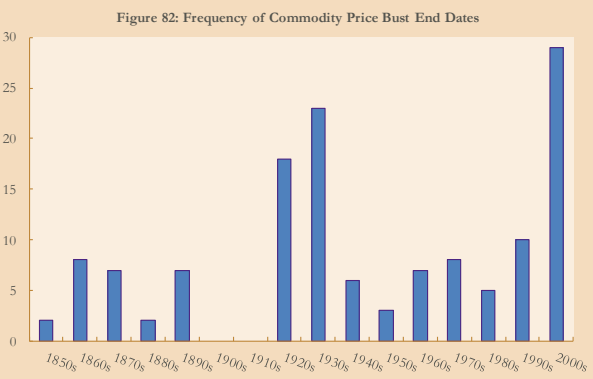


Figure 82: Frequency of Commodity Price Bust End Dates
30
25
20
15
10
5
0
1850s 1860s 1870s 1880s 1890s 1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s

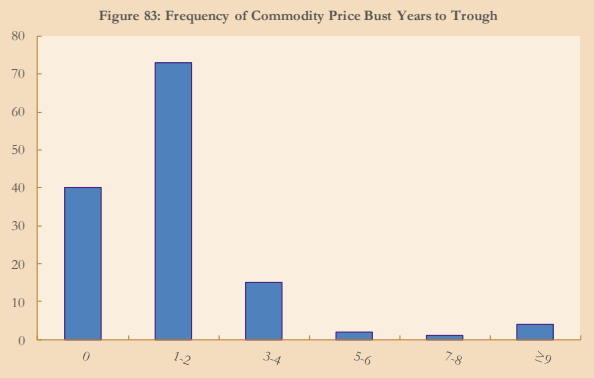


Figure 83: Frequency of Commodity Price Bust Years to Trough
80
70
60
50
40
30
20
10
0
0
1-2
3-4
5-6
7-8
≥9

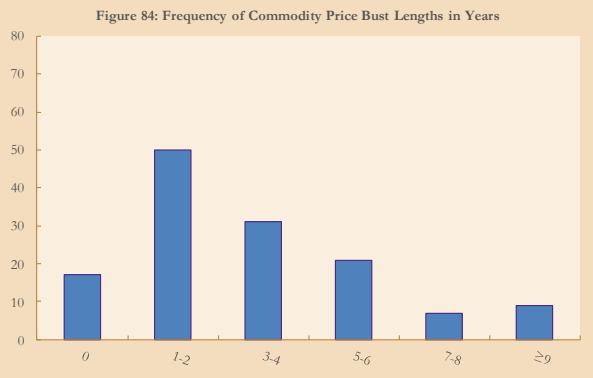


Figure 84: Frequency of Commodity Price Bust Lengths in Years
80
70
60
50
40
30
20
10
0
0
1-2
3-4
5-6
7-8
≥9

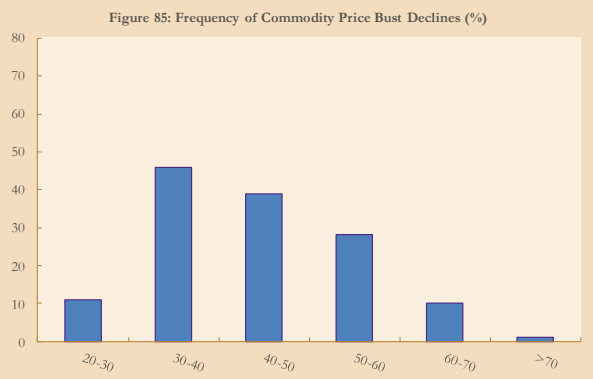


Figure 85: Frequency of Commodity Price Bust Declines (%)
80
70
60
50
40
30
20
10
0
20-30
30-40
40-50
50-60
60-70
>70

Table 17: Contribution of Booms & Busts to Volatility of Deviations from Long-run Trends

Commodity	SD of deviation from long-run trend (A)	SD of deviation without booms/busts (B)	Proportion of two SDs (B)/(A)
Animal products			
Beef	0.3214	0.1711	0.53
Hides	0.3060	0.1658	0.54
Energy products			
Natural gas	0.2882	0.1618	0.56
Petroleum	0.3921	0.2301	0.59
Grains			
Corn	0.2902	0.1712	0.59
Rice	0.2774	0.1621	0.58
Wheat	0.2531	0.1370	0.54
Metals			
Aluminum	0.2253	0.1450	0.64
Copper	0.3361	0.1955	0.58
Lead	0.3041	0.1876	0.62
Nickel	0.3017	0.1774	0.59
Steel	0.2328	0.1466	0.63
Tin	0.3821	0.2201	0.58
Zinc	0.2887	0.1655	0.57
Minerals			
Bauxite	0.2197	0.1306	0.59
Chromium	0.3116	0.1708	0.55
Iron ore	0.2601	0.1517	0.58
Manganese	0.2810	0.1624	0.58
Potash	0.3898	0.2214	0.57
Precious Metals			
Gold	0.3371	0.2440	0.72
Silver	0.3593	0.1429	0.40
Soft commodities			
Cocoa	0.3637	0.2322	0.64
Coffee	0.3759	0.2351	0.63
Cotton	0.2953	0.1750	0.59
Palm oil	0.2986	0.1587	0.53
Rubber	0.4586	0.2647	0.58
Sugar	0.4031	0.2183	0.54
Tea	0.1717	0.1192	0.69
Tobacco	0.1788	0.1030	0.58
Wool	0.2417	0.1317	0.54

Table 18: Contribution of Booms & Busts to Volatility of Deviations from Long-run Trends

Commodity	SD of price changes (A)	SD of price changes without booms/busts (B)	Proportion of two SDs (B)/(A)
Animal products			
Beef	0.1677	0.1501	0.90
Hides	0.2243	0.1915	0.85
Energy products			
Natural gas	0.1560	0.1461	0.94
Petroleum	0.2166	0.1925	0.89
Grains			
Corn	0.2242	0.2013	0.90
Rice	0.1715	0.1325	0.77
Wheat	0.1852	0.1614	0.87
Metals			
Aluminum	0.1650	0.1397	0.85
Copper	0.1790	0.1697	0.95
Lead	0.1725	0.1487	0.86
Nickel	0.2052	0.1395	0.68
Steel	0.1525	0.1065	0.70
Tin	0.1838	0.1758	0.96
Zinc	0.2161	0.1609	0.74
Minerals			
Bauxite	0.1349	0.1216	0.90
Chromium	0.2210	0.1929	0.87
Iron ore	0.1489	0.1122	0.75
Manganese	0.2384	0.1888	0.79
Potash	0.2473	0.1752	0.71
Precious Metals			
Gold	0.1249	0.0965	0.77
Silver	0.2051	0.1638	0.80
Soft commodities			
Cocoa	0.2250	0.1866	0.83
Coffee	0.2269	0.2109	0.93
Cotton	0.1800	0.1625	0.90
Palm oil	0.1996	0.1645	0.82
Rubber	0.2885	0.2260	0.78
Sugar	0.2957	0.2211	0.75
Tea	0.1368	0.1187	0.87
Tobacco	0.1370	0.1182	0.86
Wool	0.1831	0.1557	0.85

Figure 86: Australian Booms and Busts, 1900-2012

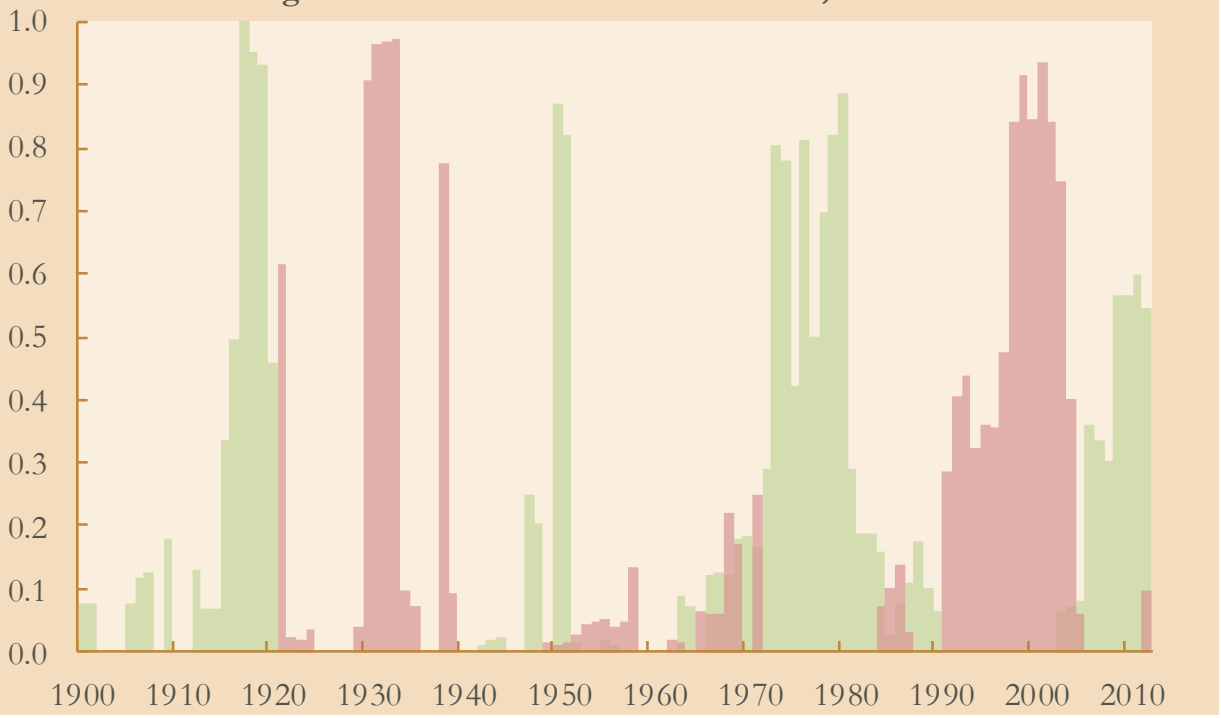
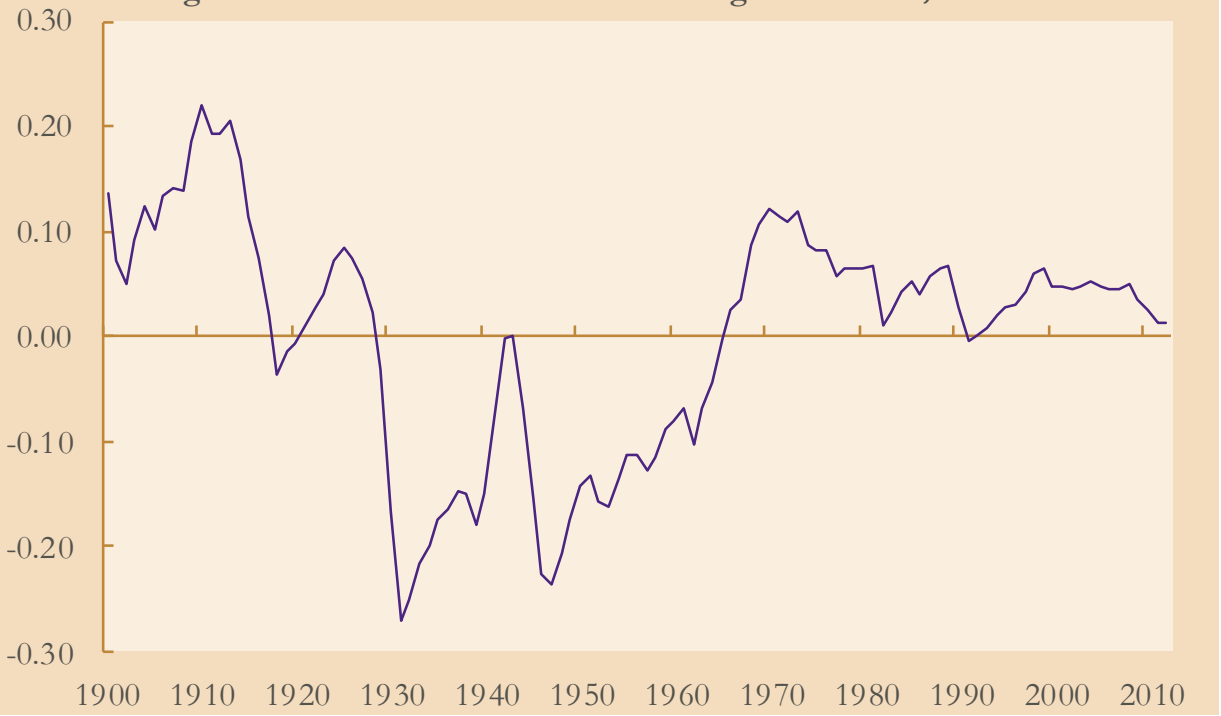


Figure 87: Deviations in GDP from Long-Run Trend, 1900-2012



From Boom to Bust Chartbook: Real Commodity Prices, 1850-2013[*]

David S. Jacks (Simon Fraser University and NBER)

March 2014

Abstract

This chartbook is an update of Jacks (2013). It introduces a new—and now publicly available—dataset on an expanded range of 40 commodities, comprising 8.72 trillion USD worth of production in 2011 and spanning the years from 1850 to 2013. It also presents evidence on three new general commodity price indices using various weighting schemes for the period from 1900 to 2013. Applying weights drawn from the value of production in 1975, real commodity prices are estimated to have increased by 59.24% from 1900, 67.58% from 1950, and 40.58% from 1975. The data also indicates the presence of two complete commodity price cycles, entailing multi-year positive deviations from the long-run trend. A currently evolving cycle was initiated in 1997 and likely reached its peak in 2013. Finally, a consistently applied methodology for determining real commodity price booms yields another key output from this project, namely long-run series on commodity-specific price booms and busts which will be of interest to researchers looking for plausibly exogenous shocks to real commodity prices.

[*]This chartbook is an update of Jacks (2013), "From Boom to Bust: A Typology of Real Commodity Prices in the Long Run," *NBER Working Paper 18874*. The author gratefully acknowledges the Social Science and Humanities Research Council of Canada for continuing research support.

Charts

This chartbook considers the evidence on 40 real commodity price series which are drawn from seven product categories—animal products, energy products, grains, metals, minerals, precious metals, and soft commodities—and which are enumerated in Table 1.

Figure 1a applies three weighting schemes to the real commodity price series from 1900 to 2013: equal shares, shares based on 1975 production values, and shares based on 2011 production values. Here, we treat the index based on 1975 production values as our preferred measure of general commodity price movements.[1] Figures 1b and 1c represent an exercise in trend-cycle decomposition for this series as described in Jacks (2013).

Table 2 reports the proportionate changes in the estimated long-run trends for the 40 commodities while Figures 2a through 8d depict the evolution of the underlying series. Figures 9a through 48b replicate the previously mentioned exercise in trend-cycle decomposition at the individual commodity level.

Figures 49 through 88 combine the logged real price series for the 40 commodities under consideration and the characterization of boom/bust episodes detailed in Jacks (2013). Finally, all data related to real commodity prices, long-run trends, medium-run cycles, and boom-bust episodes are now freely available at http://www.sfu.ca/~djacks/data/boombust/index.html

[1] Using weights from the value of production prior to 1975 is highly problematic for the fact that the prices of certain key commodities were dictated by government and industry as opposed to being determined by market forces. The case of gold and the role of the US Treasury in maintaining its nominal value from 1934 to 1972 is one well-known example. A less well-known, but much more important example comes from the actions of the Texas Railroad Commission in effectively setting global petroleum prices up to the first oil shock in 1973.

Sources

For 30 commodities, the sources remain the same as those referenced in Jacks (2013). The sources for the ten new commodities are as follows. There are a few key sources of data: the annual Sauerbeck/*Statist* (SS) series dating from 1850 to 1950; the annual Grilli and Yang (GY) series dating from 1900 to 1986; the annual unit values of mineral production provided by the United States Geographical Survey (USGS) dating from 1900 to 2012; and the monthly International Monetary Fund (IMF) and World Bank (WB) series dating variously from 1960 and 1980 to 2013.

Barley: 1850-1869, SS; 1870-1959, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of Statistics*. Baltimore and London: Johns Hopkins Press; 1960-2013, WB.

Coal: 1850-1851, Cole, A.H. (1938), *Wholesale Commodity Prices in the United States, 1700-1861: Statistical Supplement*. Cambridge: Harvard University Press; 1852-1859, Bezanson, A. (1954), *Wholesale Prices in Philadelphia 1852-1896*. Philadelphia: University of Pennsylvania Press; 1880-1948, Carter, S. *et al*. (2006), *Historical Statistics of the United States, Millennial Edition*. Cambridge: Cambridge University Press; 1949-2010, United States Energy Information Administration; 2011-2013, *BP Statistical Review of World Energy 2013*.

Cottonseed: 1874-1972, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of Statistics*. Baltimore and London: Johns Hopkins Press; 1973-2013, National Agricultural Statistics Service.

Lamb: 1850-1914, SS; 1915-1970, GY; 1971-2013, WB.

Peanuts: 1870-1972, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of Statistics*. Baltimore and London: Johns Hopkins Press; 1973-1979, National Agricultural Statistics Service; 1980-2013, WB.

Phosphate: 1880-1959, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of Statistics*. Baltimore and London: Johns Hopkins Press; 1960-2013, WB.

Platinum: 1900-1909, USGS; 1910-1997, Global Financial Data; 1998-2013, Kitco.

Pork: 1850-1851, Cole, A.H. (1938), *Wholesale Commodity Prices in the United States, 1700-1861: Statistical Supplement*. Cambridge: Harvard University Press; 1852-1857, Bezanson, A. (1954), *Wholesale Prices in Philadelphia 1852-1896*. Philadelphia: University of Pennsylvania Press; 1858-1979, Global Financial Data; 1980-2013, IMF.

Rye: 1850-1851, Cole, A.H. (1938), *Wholesale Commodity Prices in the United States, 1700-1861: Statistical Supplement*. Cambridge: Harvard University Press; 1852-1869, Bezanson, A. (1954), *Wholesale Prices in Philadelphia 1852-1896*. Philadelphia: University of Pennsylvania Press; 1870-1970, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of Statistics*. Baltimore and London: Johns Hopkins Press; 1971-2013, National Agricultural Statistics Service.

Sulfur: 1870-1899, Manthy, R.S. (1974), *Natural Resource Commodities - A Century of Statistics*. Baltimore and London: Johns Hopkins Press; 1900-2010, USGS.

Table 1: Value of Production across Commodities in 2011			
Commodity	**Production in 2011**	**Units of measurement**	**Value of production (b 2011 USD)**
Animal products			**528.46**
Beef	62.54	Million tonnes	252.79
Hides	6.12	Million tonnes	5.02
Lamb	8.16	Million tonnes	54.14
Pork	110.27	Million tonnes	216.52
Energy products			**4180.65**
Coal	7.70	Billion tonnes	566.82
Natural gas	3.28	Trillion cubic m.	457.03
Petroleum	4.00	Billion tonnes	3156.81
Grains			**801.99**
Barley	133.05	Million tonnes	27.57
Corn	883.46	Million tonnes	206.59
Rice	722.76	Million tonnes	398.75
Rye	12.82	Million tonnes	5.57
Wheat	704.08	Million tonnes	163.50
Metals			**2133.32**
Aluminum	44.40	Million tonnes	110.91
Chromium	7.18	Million tonnes	19.97
Copper	16.10	Million tonnes	146.51
Lead	4.70	Million tonnes	11.21
Manganese	16.00	Million tonnes	18.76
Nickel	1.94	Million tonnes	44.42
Steel	1.49	Billion tonnes	1746.65
Tin	244.00	Thousand tonnes	6.70
Zinc	12.80	Million tonnes	28.20
Minerals			**419.04**
Bauxite	259.00	Million tonnes	8.00
Iron ore	2.94	Billion tonnes	339.25
Phosphate	198.00	Million tonnes	36.61
Potash	36.40	Million tonnes	26.45
Sulfur	70.50	Million tonnes	8.74
Precious metals			**154.67**
Gold	2.66	Thousand tonnes	110.94
Platinum	484.00	Tonnes	22.09
Silver	23.30	Thousand tonnes	21.65
Soft commodities			**503.34**
Cocoa	4.05	Million tonnes	12.08
Coffee	8.28	Million tonnes	38.53
Cotton	27.67	Million tonnes	92.10
Cottonseed	48.84	Million tonnes	15.56
Palm oil	48.98	Million tonnes	55.12
Peanuts	37.87	Million tonnes	79.00
Rubber	10.98	Million tonnes	52.98
Sugar	172.15	Million tonnes	98.68
Tea	4.27	Million tonnes	12.48
Tobacco	7.57	Million tonnes	33.94
Wool	1.07	Million tonnes	12.88

Figure 1a: Real Commodity Price Indices, 1900-2013 (1900=100)

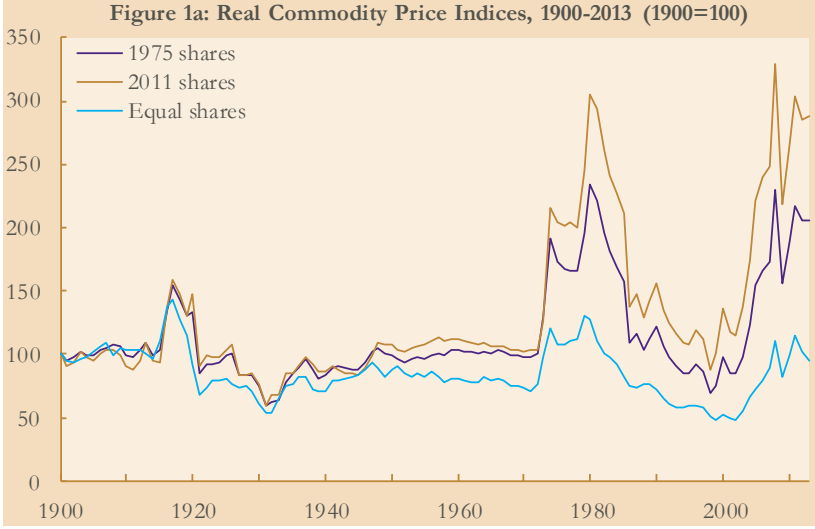


Figure 1b: Real Commodity Price Index Components, 1900-2013

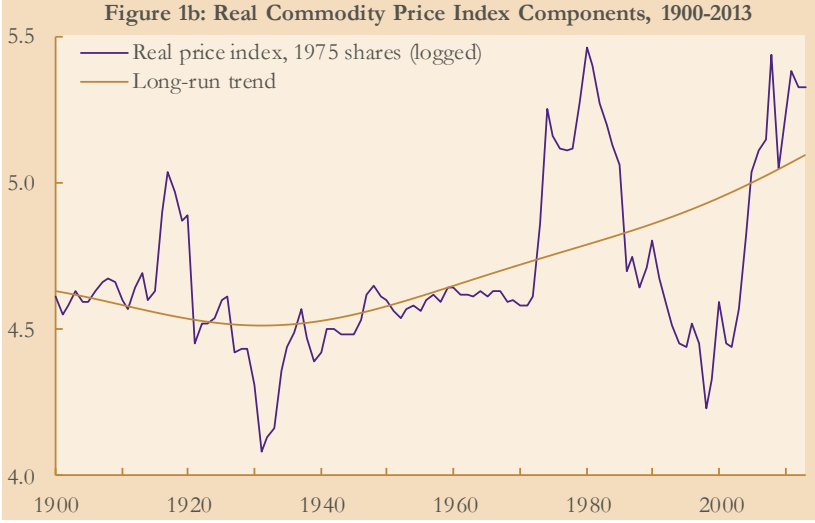


Figure 1c: Real Commodity Price Index Components, 1900-2013

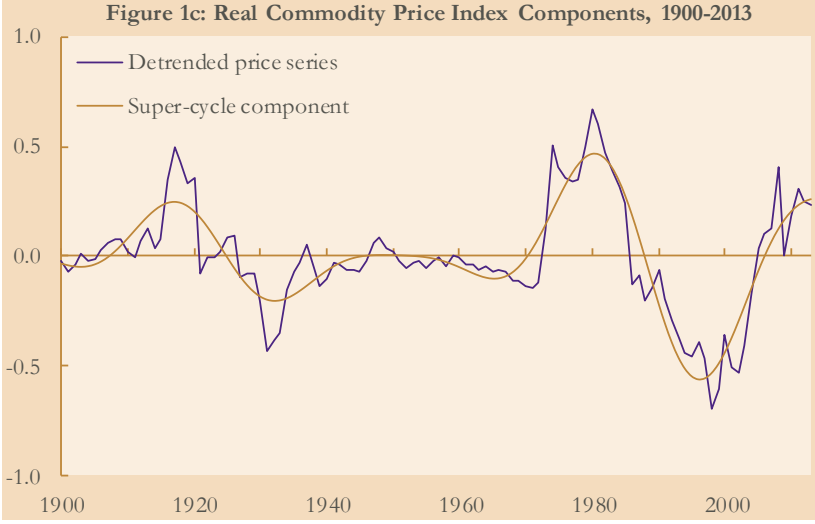


Table 2: Cumulative Changes in Prices Relative to Estimated Long-Run Trend				
Commodity	Cumulative change in in price from 1850 (%)	Cumulative change in price from 1900 (%)	Cumulative change in price from 1950 (%)	Cumulative change in price from 1975 (%)
Animal products				
Beef	115.88	75.89	9.73	-34.21
Hides	-38.33	-54.12	-23.65	-16.18
Lamb	99.92	70.55	52.56	9.39
Pork	-72.46	-84.01	-73.33	-61.71
Energy products				
Coal	72.39	92.27	36.40	9.33
Natural gas		129.75	450.04	117.90
Petroleum		526.78	242.69	171.07
Grains				
Barley	-52.17	-42.78	-23.04	-2.07
Corn	-58.43	-63.08	-65.94	-38.44
Rice	-82.27	-76.58	-67.44	-50.05
Rye	-74.09	-58.11	-42.50	-3.21
Wheat	-75.38	-77.82	-72.74	-50.03
Metals				
Aluminum		-88.93	-53.15	-41.92
Chromium		65.97	181.42	55.78
Copper	-47.06	-17.63	20.56	17.72
Lead	-56.86	-29.11	-34.42	-6.02
Manganese		61.70	101.89	51.72
Nickel	-86.45	-42.99	29.09	6.66
Steel		23.98	13.23	0.75
Tin	53.30	27.67	-16.87	-18.28
Zinc	-27.67	-29.36	-5.01	-4.62
Minerals				
Bauxite		-70.49	-64.70	-59.23
Iron ore		22.25	35.30	4.39
Phosphate		-44.79	4.14	23.23
Potash		-76.55	17.07	113.06
Sulfur		-84.02	-78.34	-67.47
Precious metals				
Gold	78.47	110.65	187.09	123.58
Platinum		73.53	79.20	83.32
Silver	-55.36	-8.05	99.66	41.02
Soft commodities				
Cocoa	-72.02	-71.12	-44.91	-57.47
Coffee	-61.59	-54.61	-58.22	-62.01
Cotton	-75.62	-65.33	-69.03	-56.34
Cottonseed		-54.27	-64.72	-31.89
Palm oil	-75.46	-68.70	-64.09	-45.09
Peanuts		-73.74	-70.19	-60.46
Rubber		-94.16	-54.61	-26.48
Sugar	-90.00	-78.70	-49.05	-39.91
Tea	-84.84	-67.99	-64.21	-51.25
Tobacco	-55.25	-26.23	-66.05	-43.93
Wool	-82.77	-76.64	-75.19	-39.13

Figure 2a: Real Animal Product Prices, 1850-2013 (1900=100)

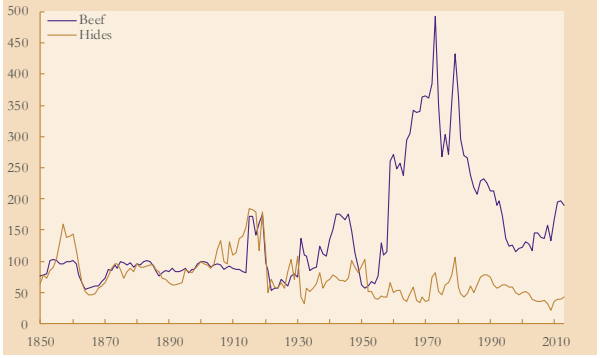


Figure 2b: Real Animal Product Prices, 1850-2013 (1900=100)

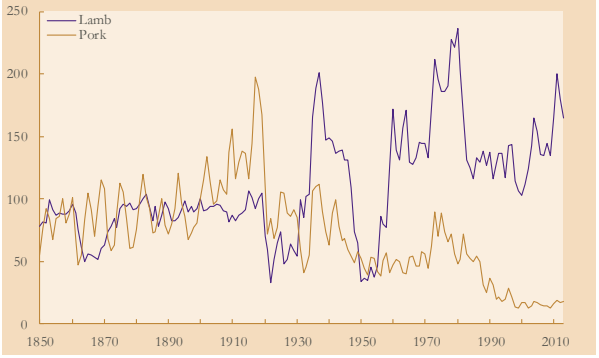


Figure 3: Real Energy Prices, 1850-2013 (1900=100)

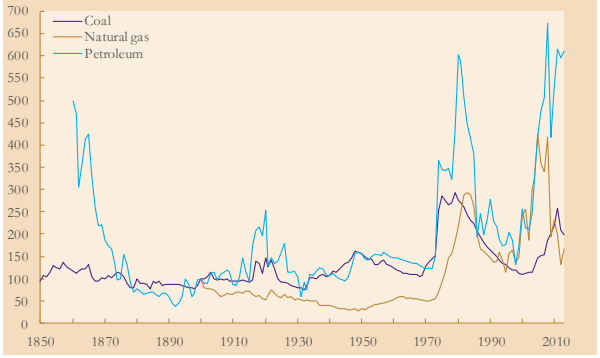


Figure 4a: Real Grain Prices, 1850-2013 (1900=100)

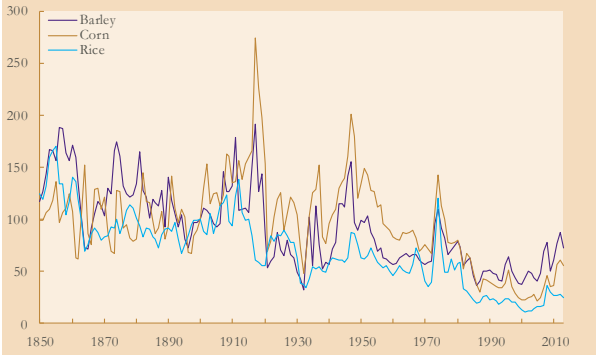


Figure 4b: Real Grain Prices, 1850-2013 (1900=100)

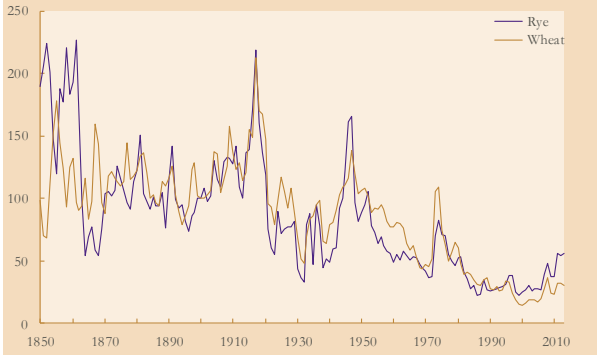


Figure 5a: Real Metal Prices, 1850-2013 (1900=100)

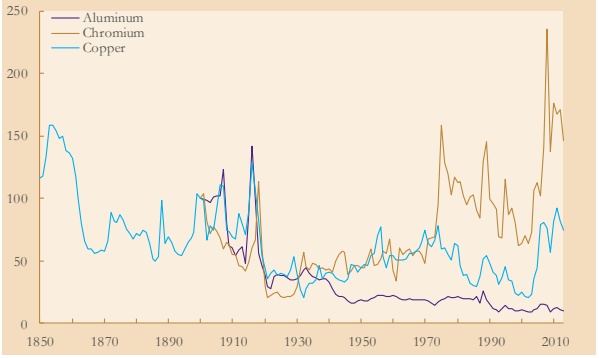


Figure 5b: Real Metal Prices, 1850-2013 (1900=100)

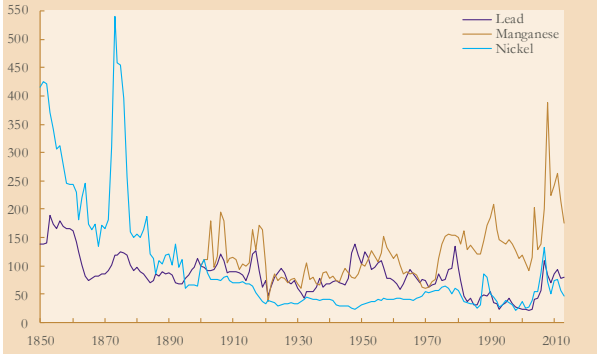


Figure 5c: Real Metal Prices, 1850-2013 (1900=100)

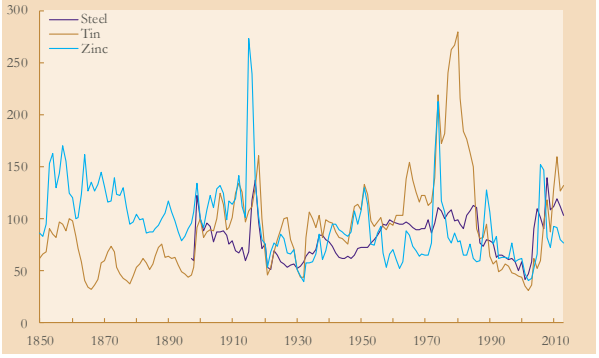


Figure 6a: Real Mineral Prices, 1880-2013 (1900=100)

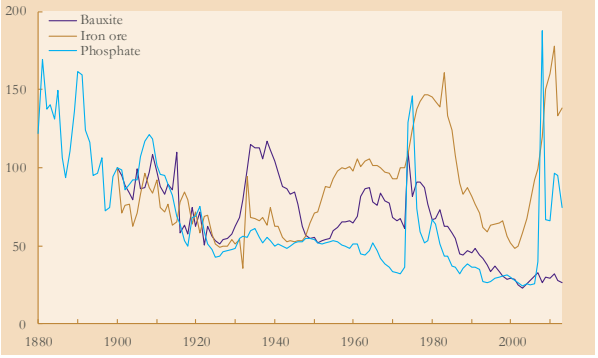


Figure 6b: Real Mineral Prices, 1870-2013 (1900=100)

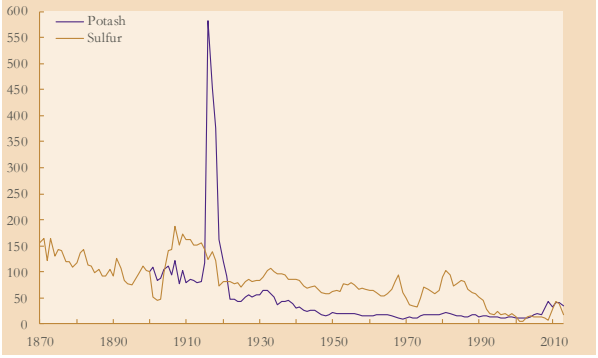


Figure 7: Real Precious Metals Prices, 1850-2013 (1900=100)

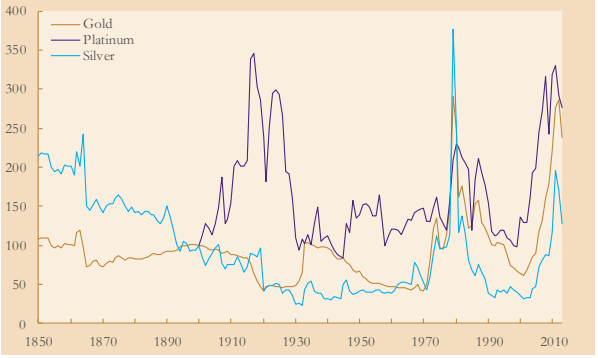


Figure 8a: Real Soft Commodity Prices, 1850-2013 (1900=100)

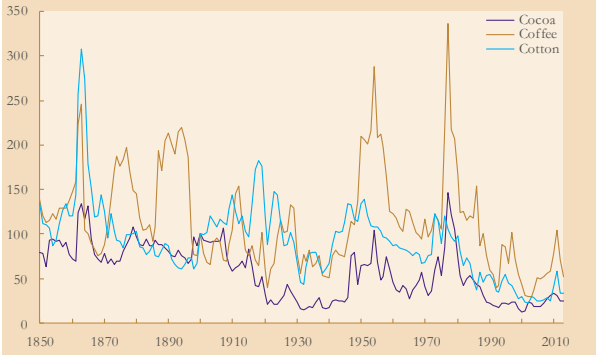


Figure 8b: Real Soft Commodity Prices, 1850-2013 (1900=100)

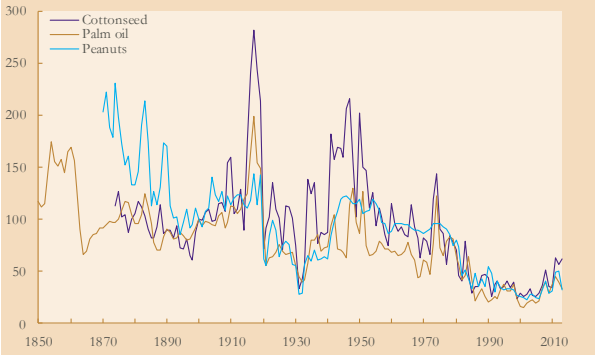


Figure 8c: Real Soft Commodity Prices, 1850-2013 (1900=100)

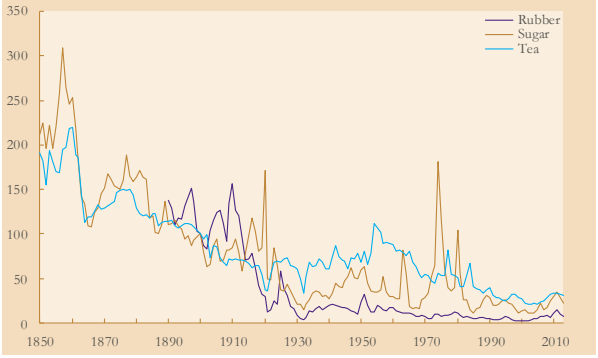
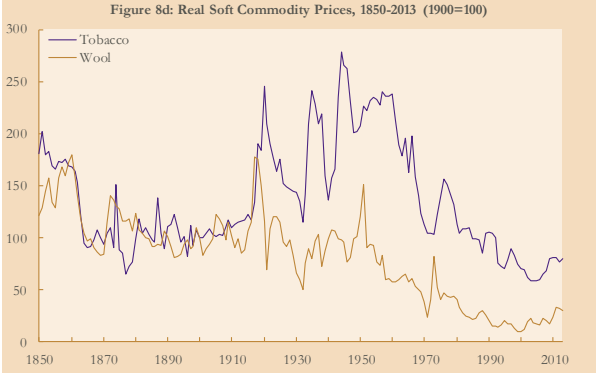


Figure 8d: Real Soft Commodity Prices, 1850-2013 (1900=100)



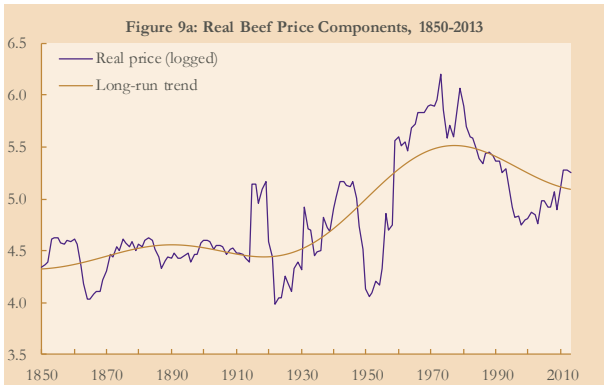


Figure 9a: Real Beef Price Components, 1850-2013
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

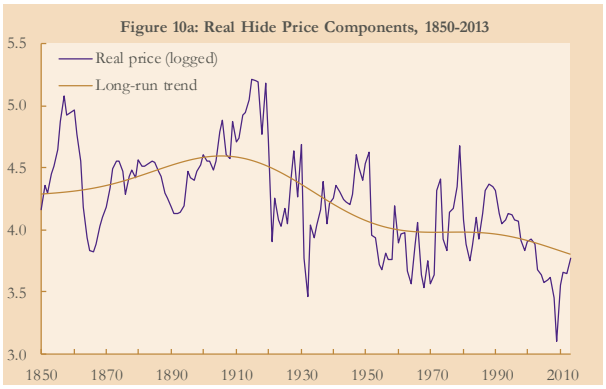


Figure 10a: Real Hide Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

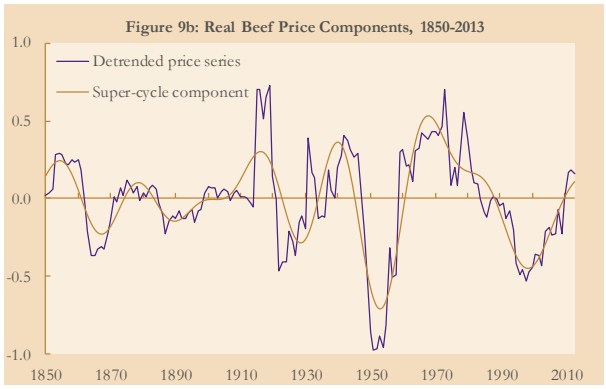


Figure 9b: Real Beef Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

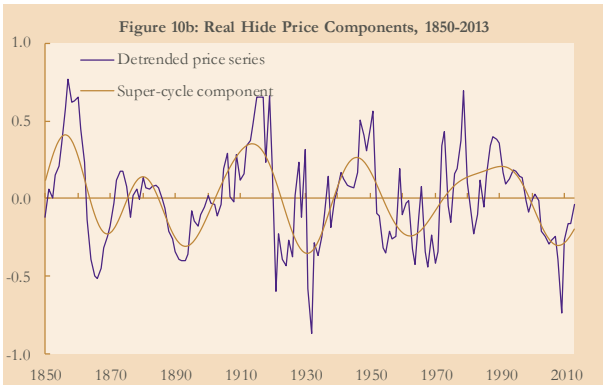


Figure 10b: Real Hide Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

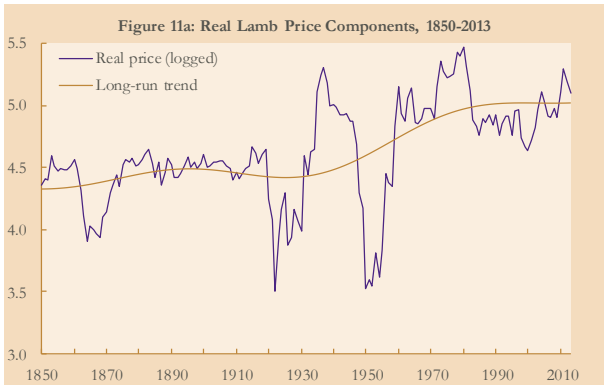


Figure 11a: Real Lamb Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

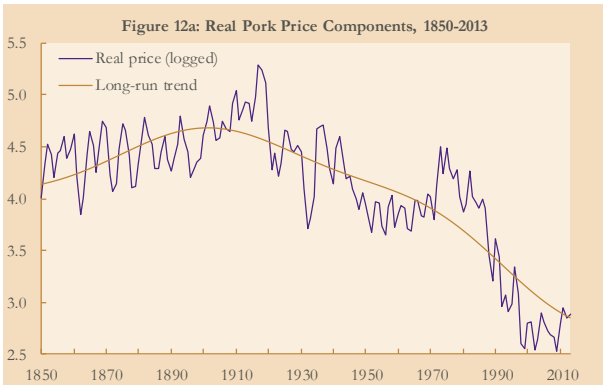


Figure 12a: Real Pork Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

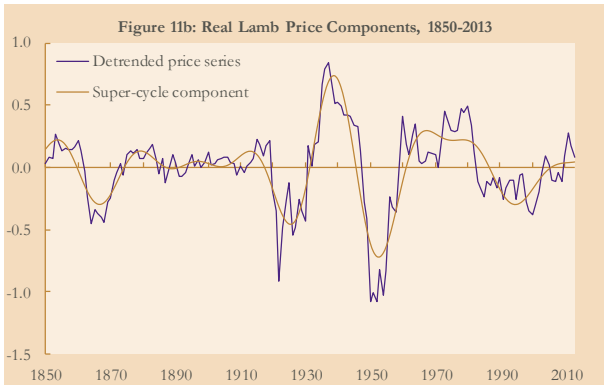


Figure 11b: Real Lamb Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
-1.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

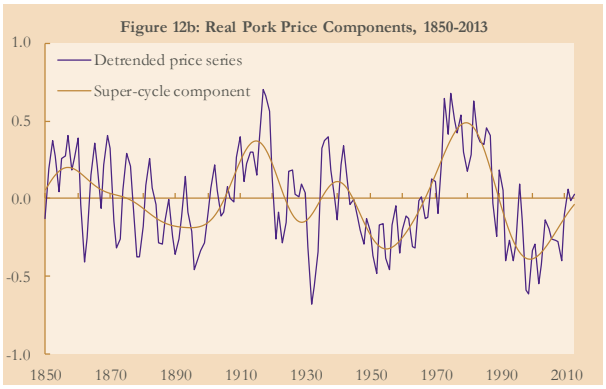


Figure 12b: Real Pork Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

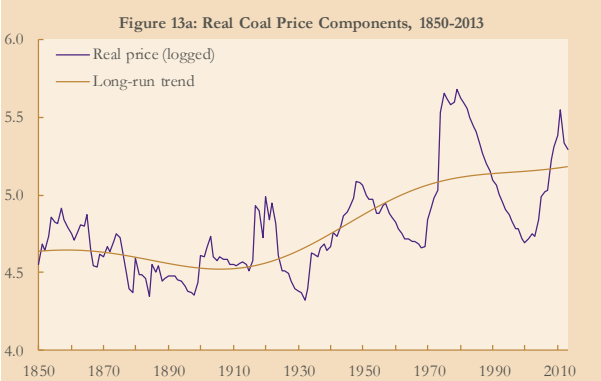


Figure 13a: Real Coal Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

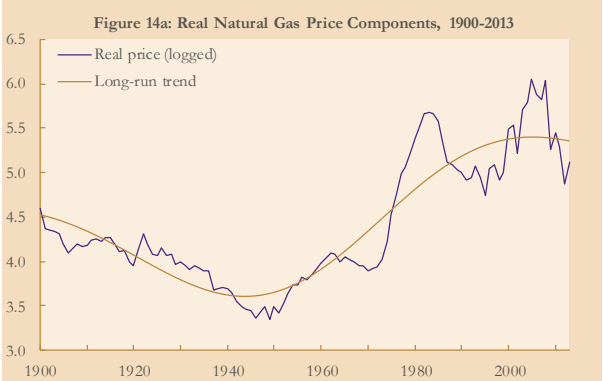


Figure 14a: Real Natural Gas Price Components, 1900-2013
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1900
1920
1940
1960
1980
2000

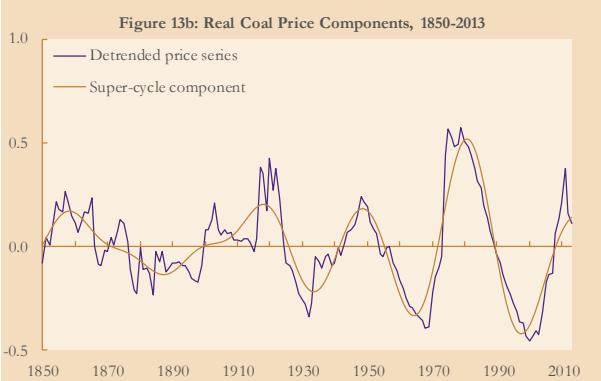


Figure 13b: Real Coal Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

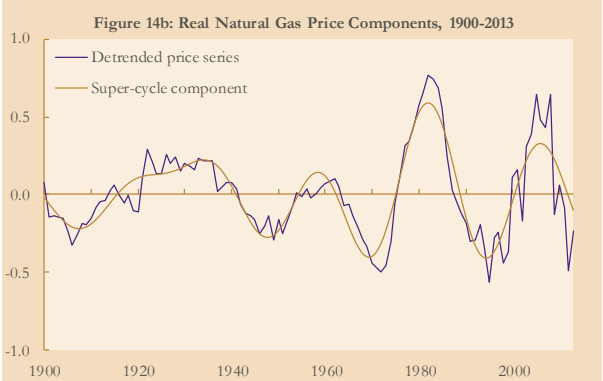


Figure 14b: Real Natural Gas Price Components, 1900-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

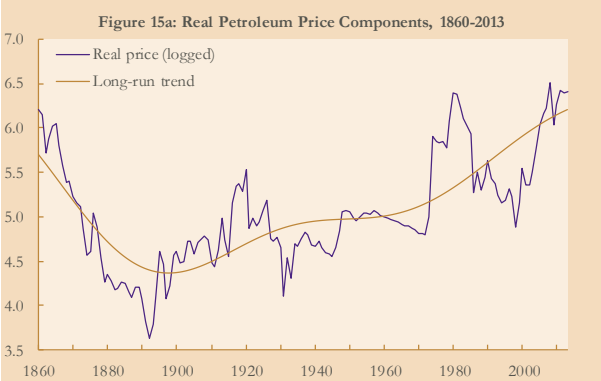


Figure 15a: Real Petroleum Price Components, 1860-2013
Real price (logged)
Long-run trend
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
1860
1880
1900
1920
1940
1960
1980
2000

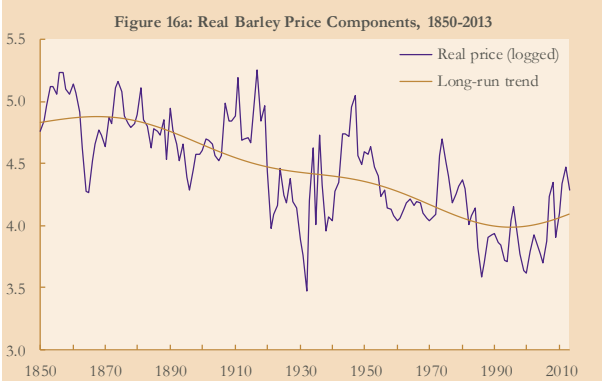


Figure 16a: Real Barley Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

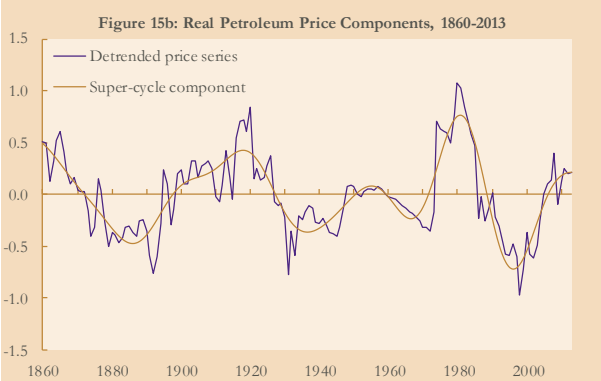


Figure 15b: Real Petroleum Price Components, 1860-2013
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1860
1880
1900
1920
1940
1960
1980
2000

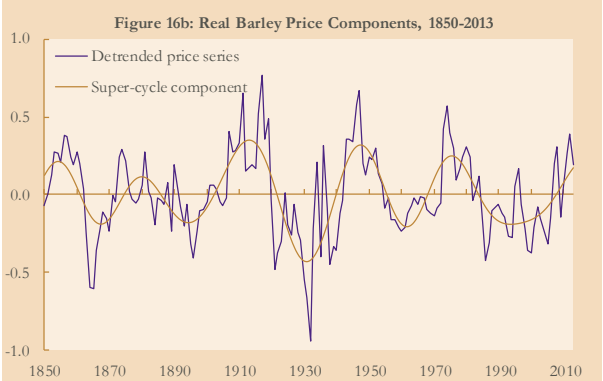


Figure 16b: Real Barley Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

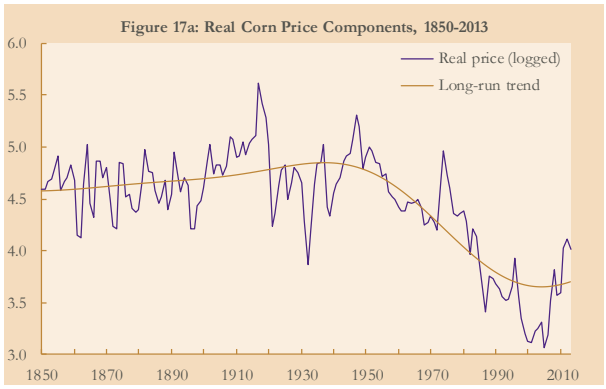


Figure 17a: Real Corn Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

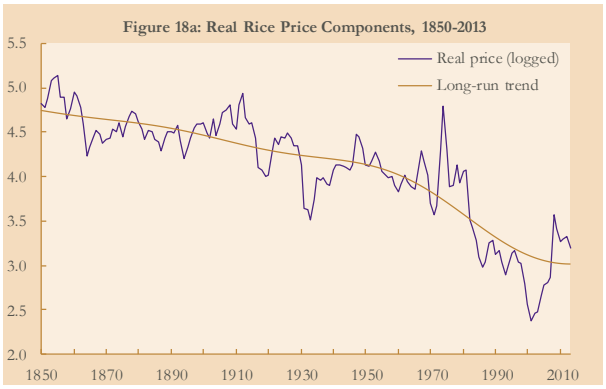


Figure 18a: Real Rice Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

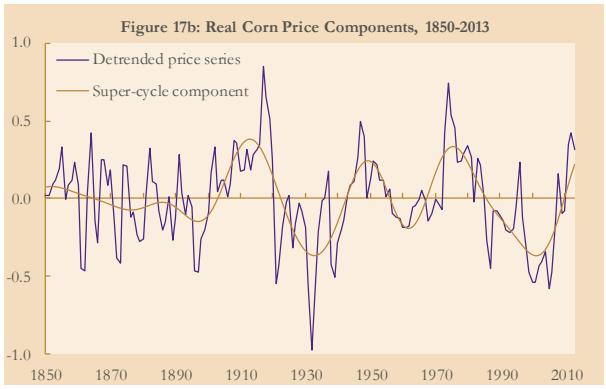


Figure 17b: Real Corn Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

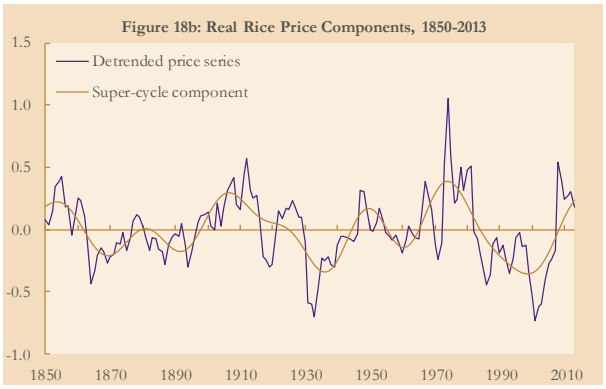


Figure 18b: Real Rice Price Components, 1850-2013
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

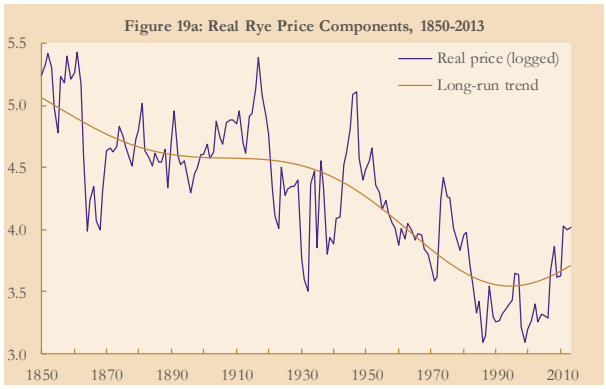


Figure 19a: Real Rye Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

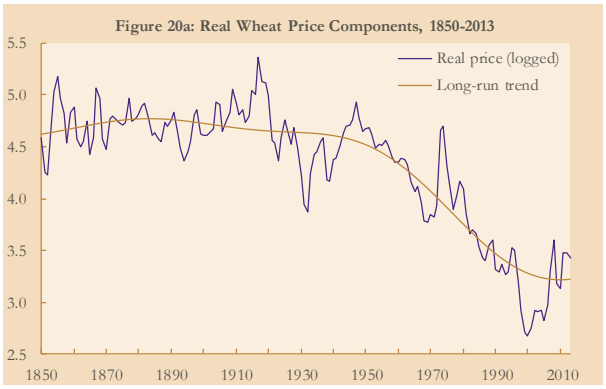


Figure 20a: Real Wheat Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

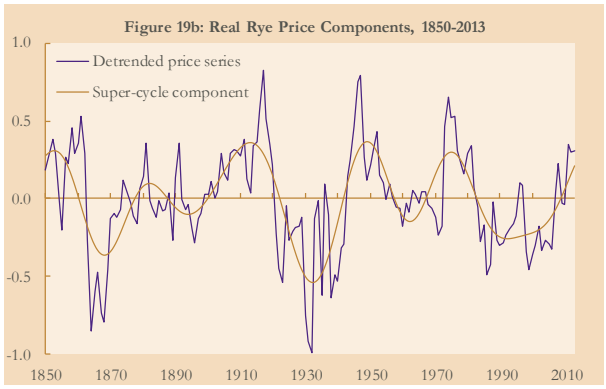


Figure 19b: Real Rye Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

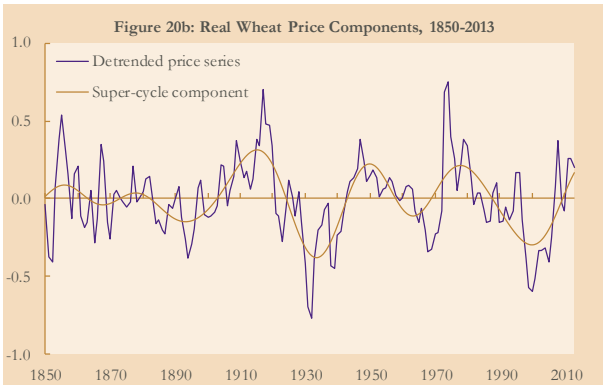


Figure 20b: Real Wheat Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

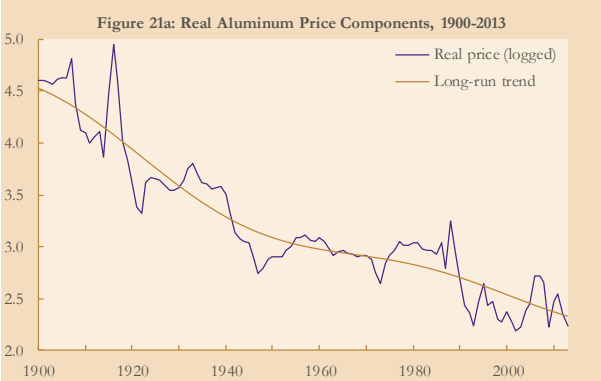


Figure 21a: Real Aluminum Price Components, 1900-2013
Real price (logged)
Long-run trend
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1900
1920
1940
1960
1980
2000

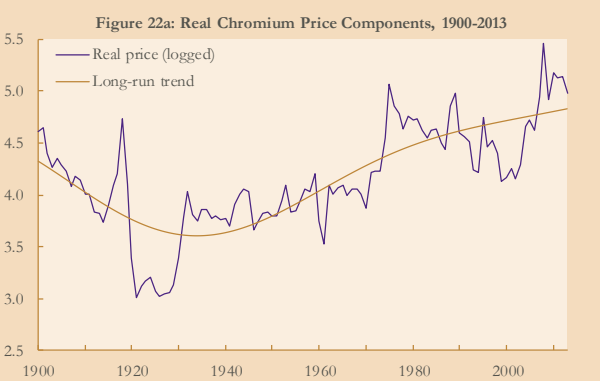


Figure 22a: Real Chromium Price Components, 1900-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1900
1920
1940
1960
1980
2000

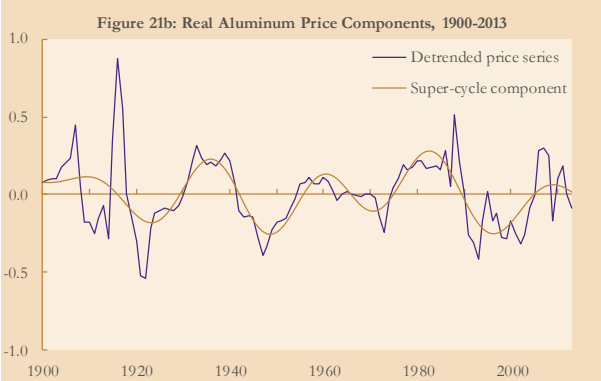


Figure 21b: Real Aluminum Price Components, 1900-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

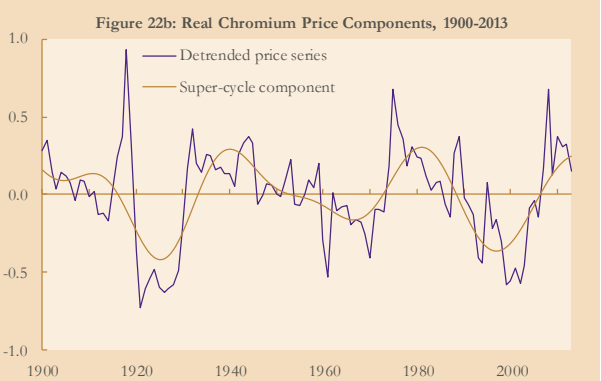


Figure 22b: Real Chromium Price Components, 1900-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

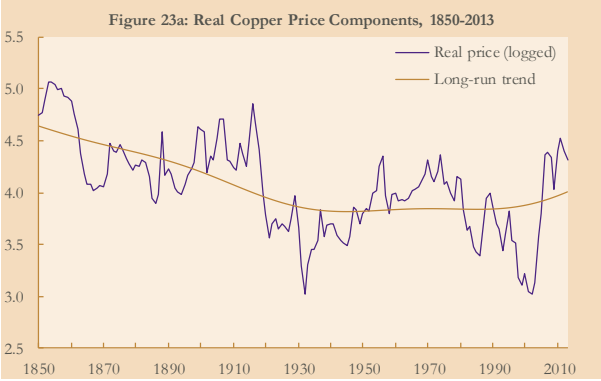


Figure 23a: Real Copper Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

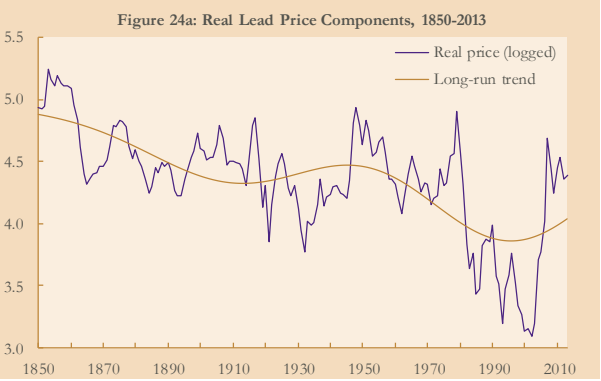


Figure 24a: Real Lead Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

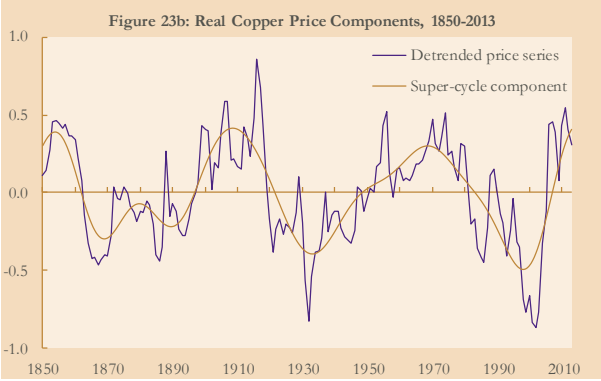


Figure 23b: Real Copper Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

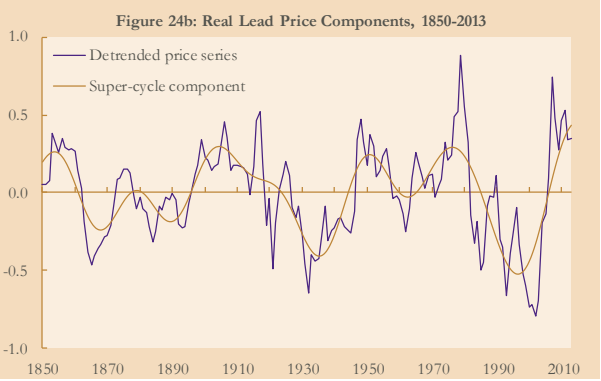


Figure 24b: Real Lead Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

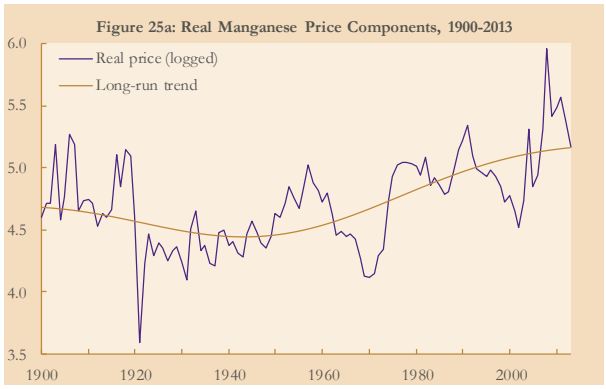


Figure 25a: Real Manganese Price Components, 1900-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
1900
1920
1940
1960
1980
2000

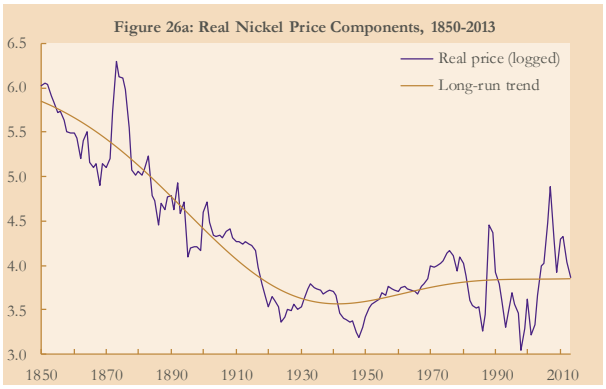


Figure 26a: Real Nickel Price Components, 1850-2013
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

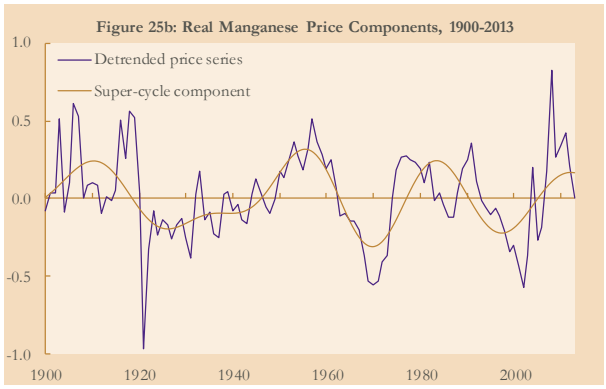


Figure 25b: Real Manganese Price Components, 1900-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

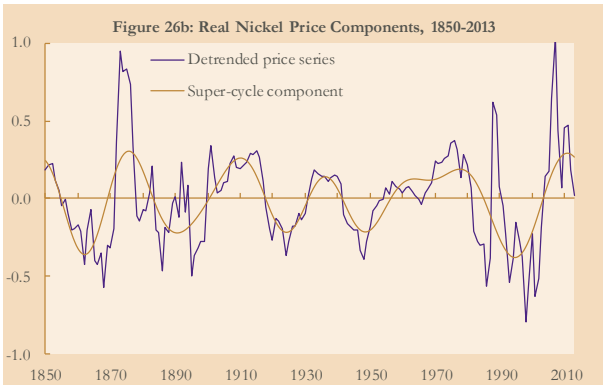


Figure 26b: Real Nickel Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

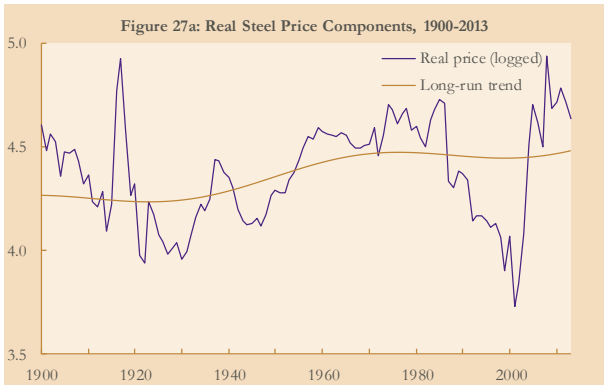


Figure 27a: Real Steel Price Components, 1900-2013
Real price (logged)
Long-run trend
5.0
4.5
4.0
3.5
1900
1920
1940
1960
1980
2000

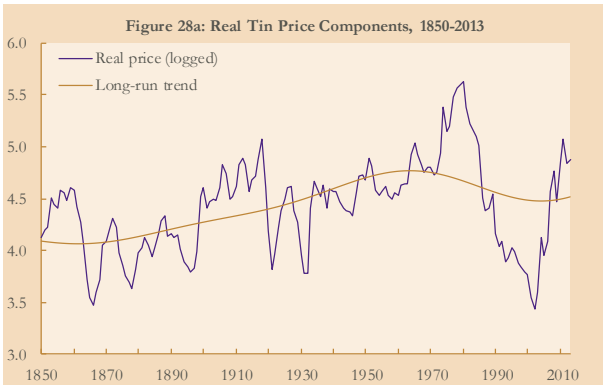


Figure 28a: Real Tin Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

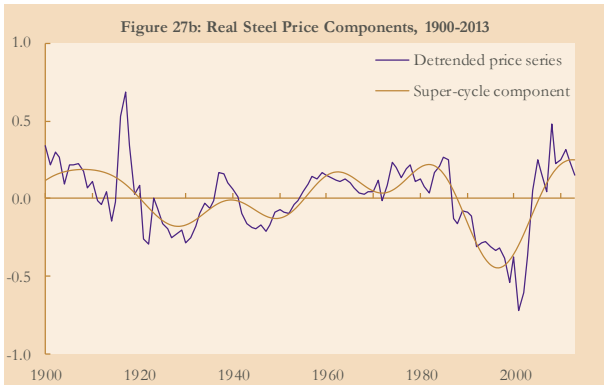


Figure 27b: Real Steel Price Components, 1900-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

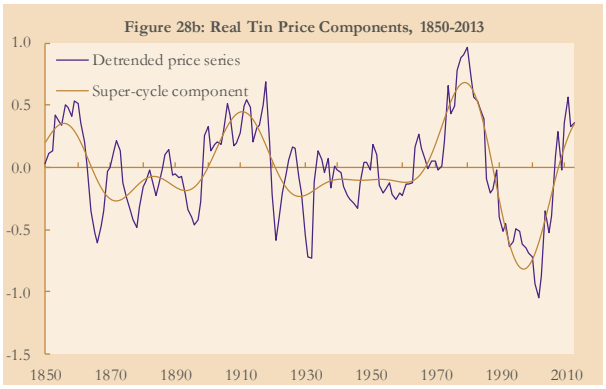


Figure 28b: Real Tin Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
-1.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

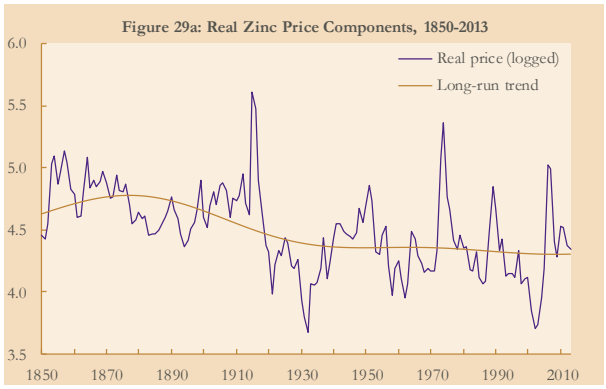


Figure 29a: Real Zinc Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

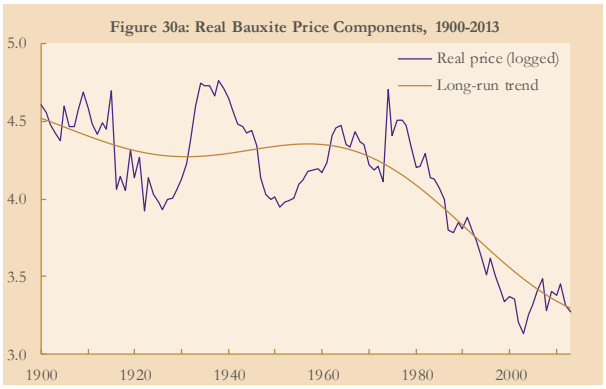


Figure 30a: Real Bauxite Price Components, 1900-2013
Real price (logged)
Long-run trend
5.0
4.5
4.0
3.5
3.0
1900
1920
1940
1960
1980
2000

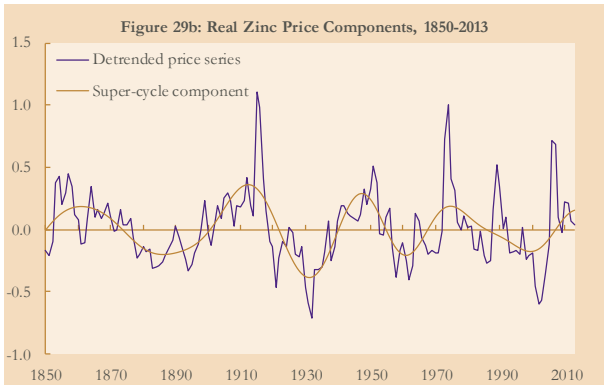


Figure 29b: Real Zinc Price Components, 1850-2013
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

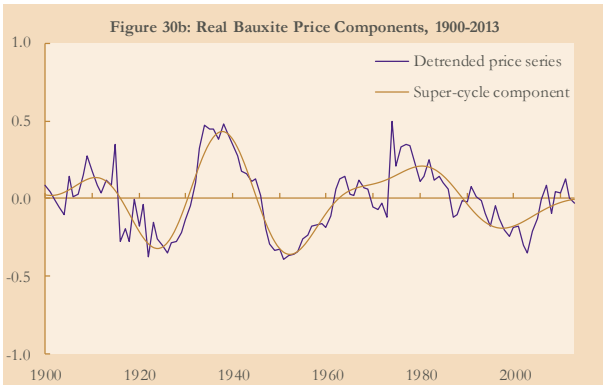


Figure 30b: Real Bauxite Price Components, 1900-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

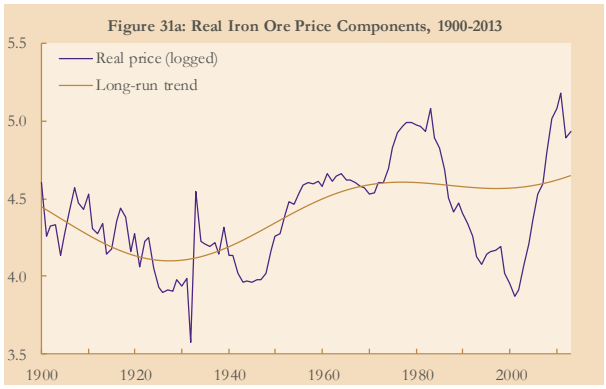


Figure 31a: Real Iron Ore Price Components, 1900-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
1900
1920
1940
1960
1980
2000

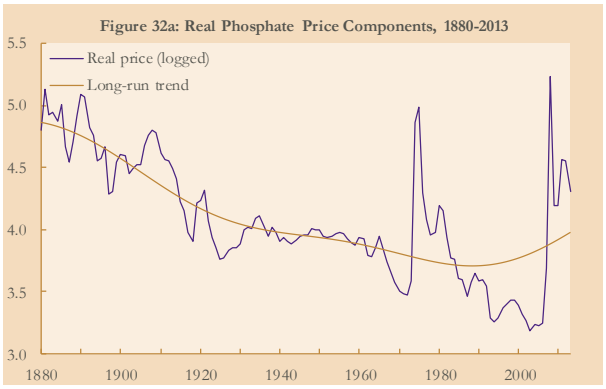


Figure 32a: Real Phosphate Price Components, 1880-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1880
1900
1920
1940
1960
1980
2000

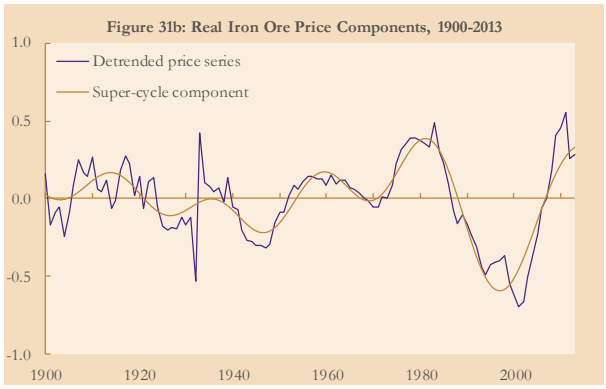


Figure 31b: Real Iron Ore Price Components, 1900-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

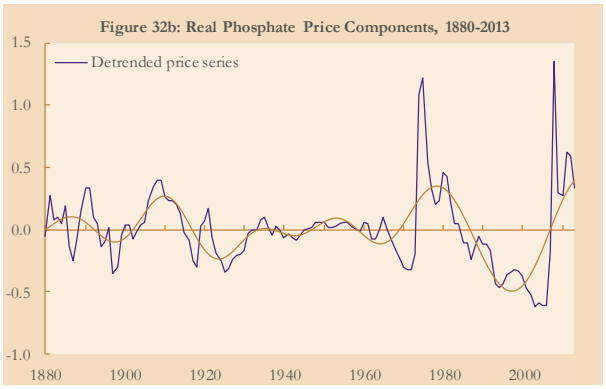


Figure 32b: Real Phosphate Price Components, 1880-2013
Detrended price series
1.5
1.0
0.5
0.0
-0.5
-1.0
1880
1900
1920
1940
1960
1980
2000

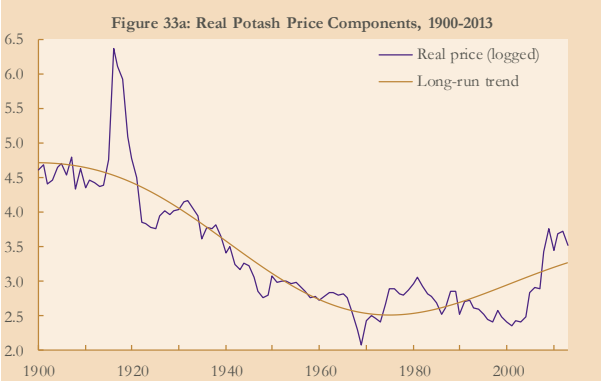


Figure 33a: Real Potash Price Components, 1900-2013
Real price (logged)
Long-run trend
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1900
1920
1940
1960
1980
2000

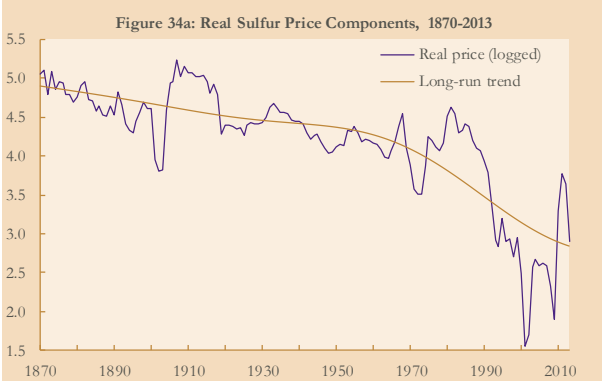


Figure 34a: Real Sulfur Price Components, 1870-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1870
1890
1910
1930
1950
1970
1990
2010

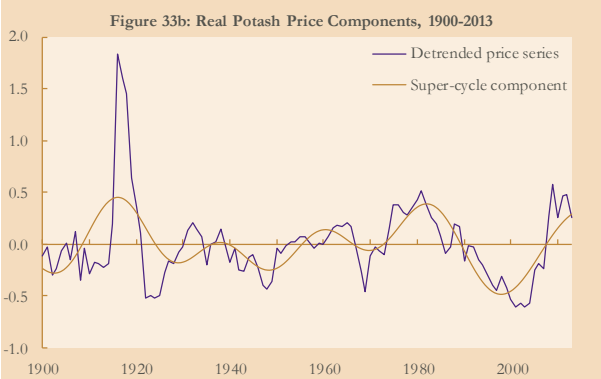


Figure 33b: Real Potash Price Components, 1900-2013
Detrended price series
Super-cycle component
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1900
1920
1940
1960
1980
2000

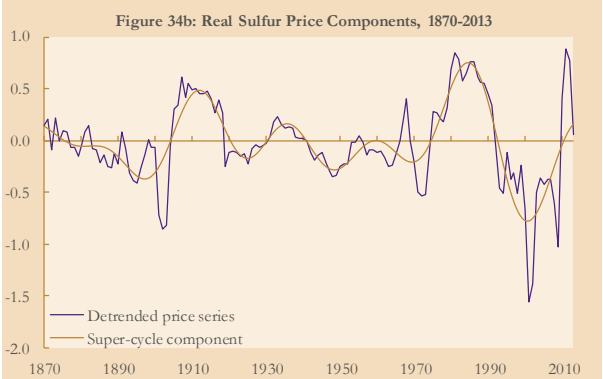


Figure 34b: Real Sulfur Price Components, 1870-2013
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Detrended price series
Super-cycle component
1870
1890
1910
1930
1950
1970
1990
2010

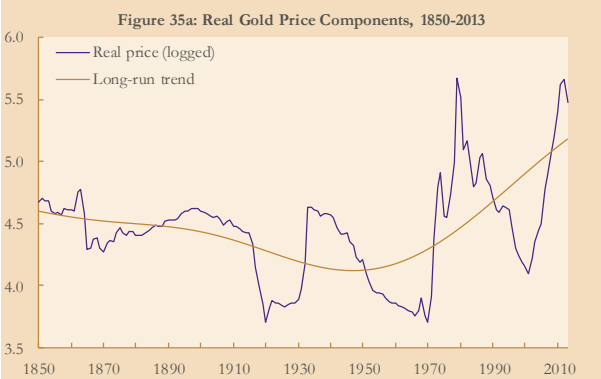


Figure 35a: Real Gold Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

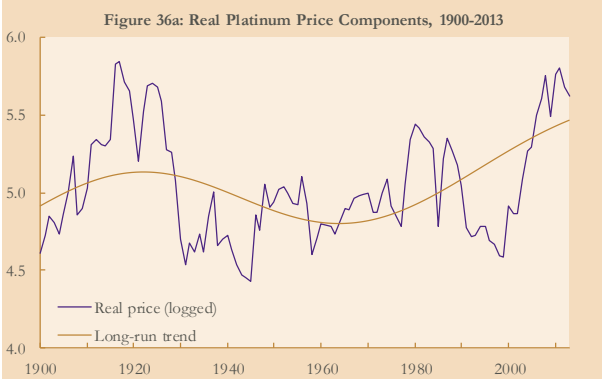


Figure 36a: Real Platinum Price Components, 1900-2013
6.0
5.5
5.0
4.5
4.0
Real price (logged)
Long-run trend
1900
1920
1940
1960
1980
2000

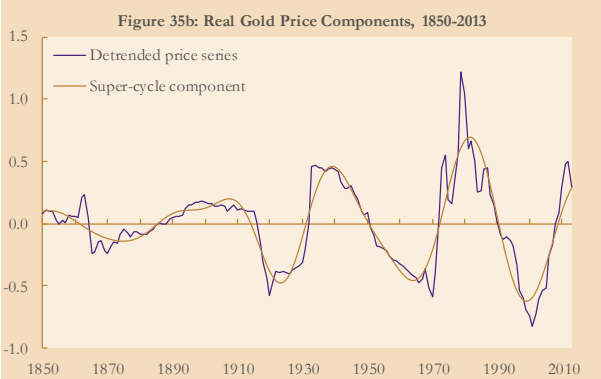


Figure 35b: Real Gold Price Components, 1850-2013
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

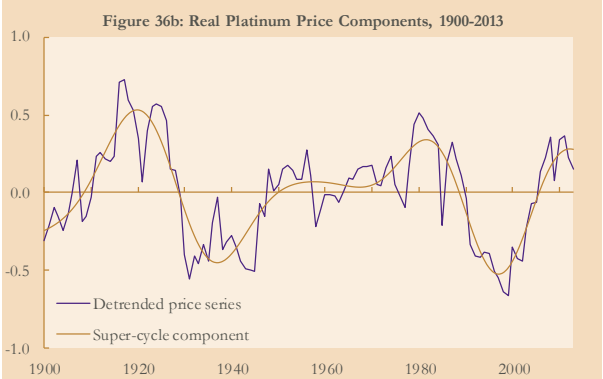


Figure 36b: Real Platinum Price Components, 1900-2013
1.0
0.5
0.0
-0.5
-1.0
Detrended price series
Super-cycle component
1900
1920
1940
1960
1980
2000

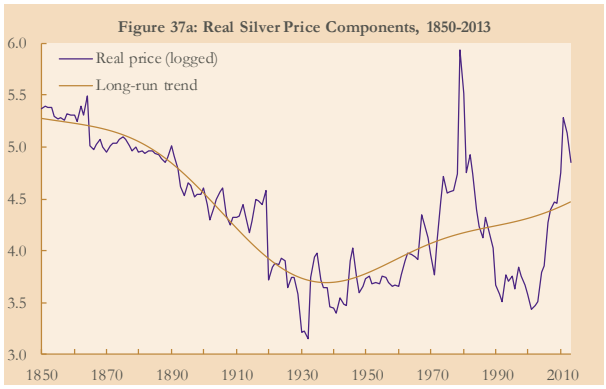


Figure 37a: Real Silver Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

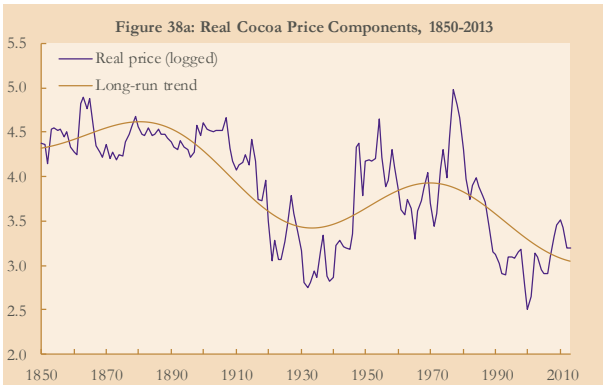


Figure 38a: Real Cocoa Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

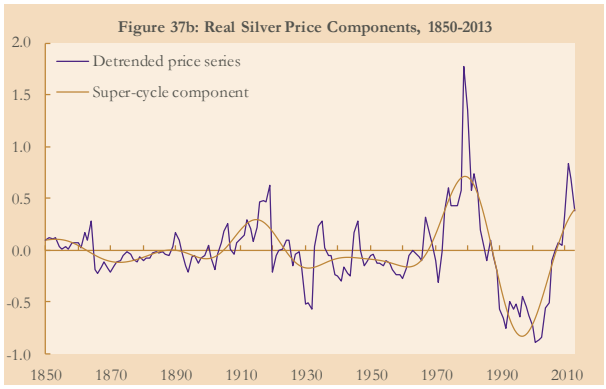


Figure 37b: Real Silver Price Components, 1850-2013
Detrended price series
Super-cycle component
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

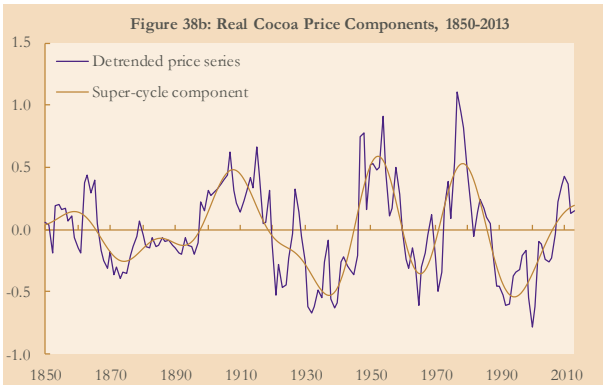


Figure 38b: Real Cocoa Price Components, 1850-2013
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

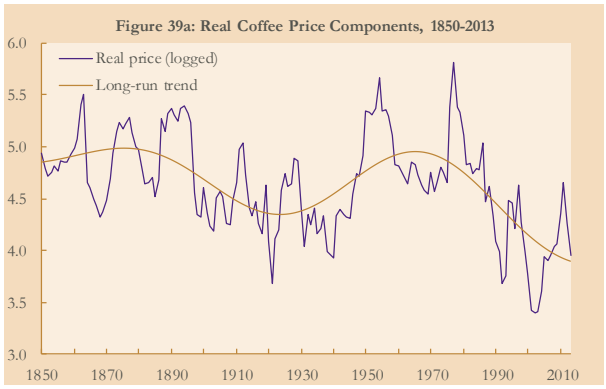


Figure 39a: Real Coffee Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

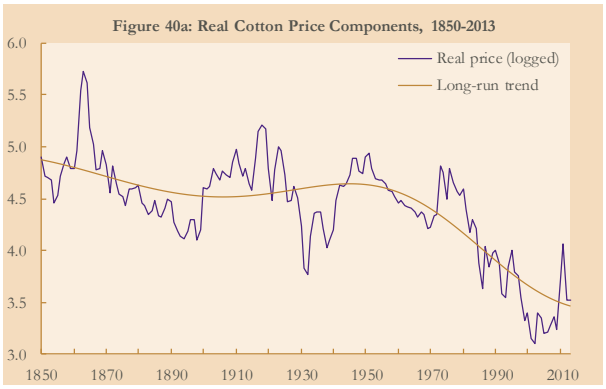


Figure 40a: Real Cotton Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

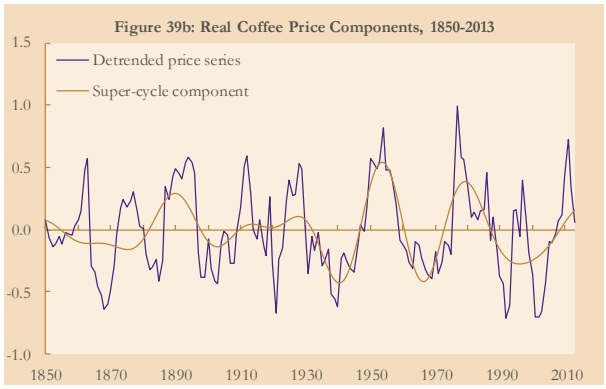


Figure 39b: Real Coffee Price Components, 1850-2013
Detrended price series
Super-cycle component
1.5
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

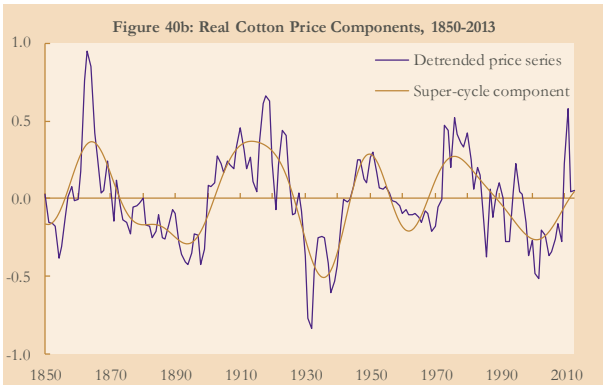


Figure 40b: Real Cotton Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

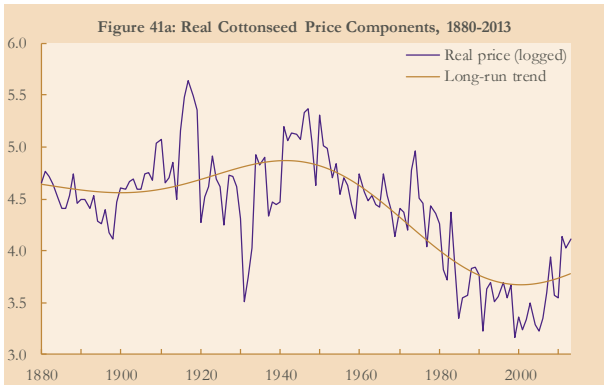


Figure 41a: Real Cottonseed Price Components, 1880-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1880
1900
1920
1940
1960
1980
2000

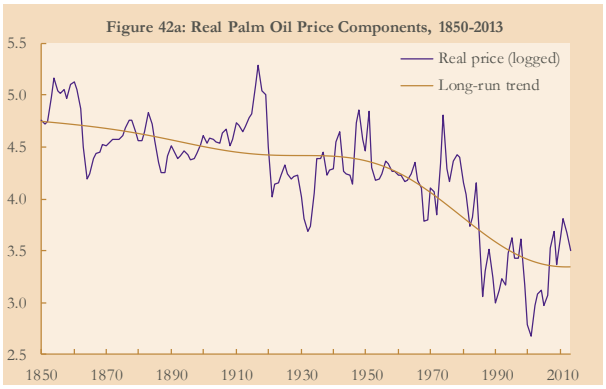


Figure 42a: Real Palm Oil Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

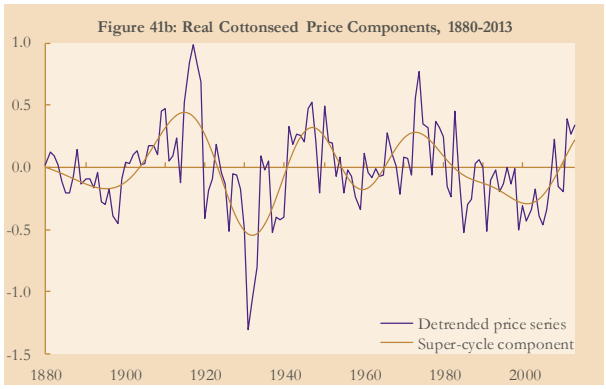


Figure 41b: Real Cottonseed Price Components, 1880-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
-1.5
1880
1900
1920
1940
1960
1980
2000

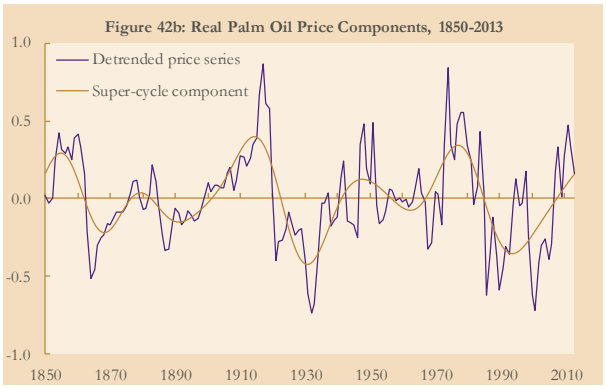


Figure 42b: Real Palm Oil Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

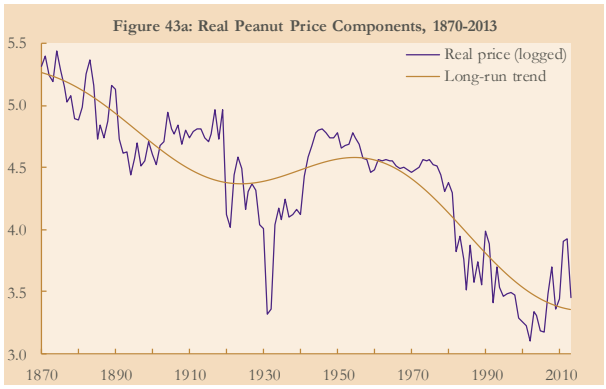


Figure 43a: Real Peanut Price Components, 1870-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1870
1890
1910
1930
1950
1970
1990
2010

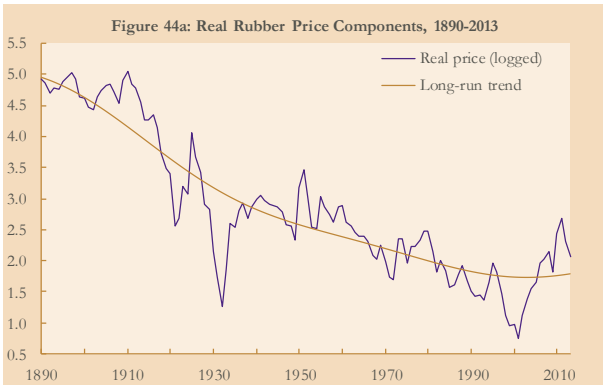


Figure 44a: Real Rubber Price Components, 1890-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1890
1910
1930
1950
1970
1990
2010

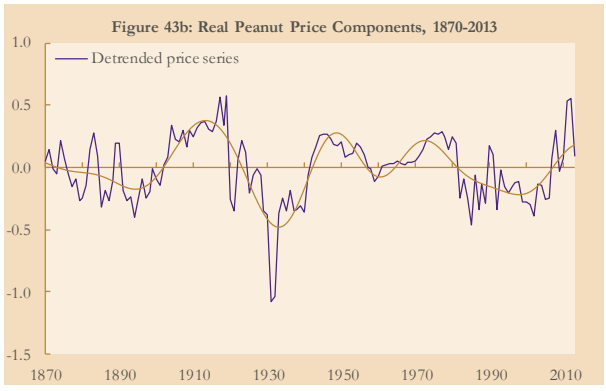


Figure 43b: Real Peanut Price Components, 1870-2013
Detrended price series
1.0
0.5
0.0
-0.5
-1.0
-1.5
1870
1890
1910
1930
1950
1970
1990
2010

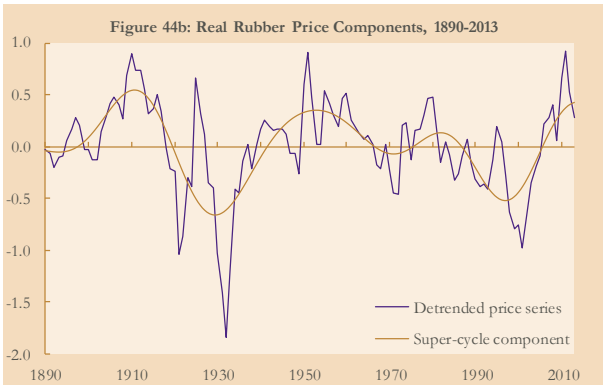


Figure 44b: Real Rubber Price Components, 1890-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
1890
1910
1930
1950
1970
1990
2010

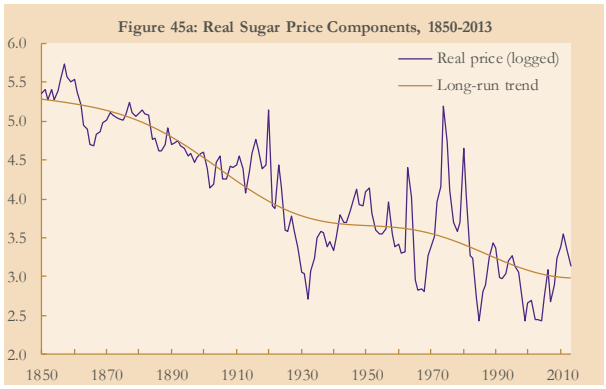


Figure 45a: Real Sugar Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

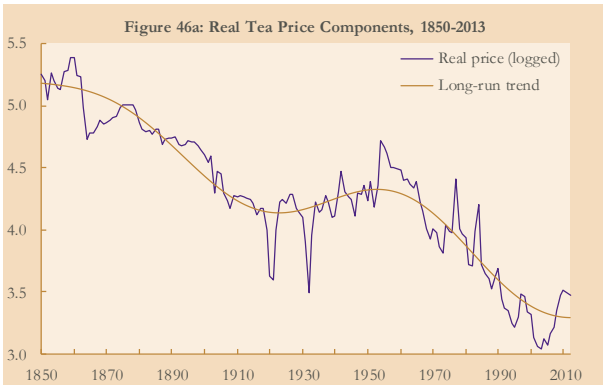


Figure 46a: Real Tea Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

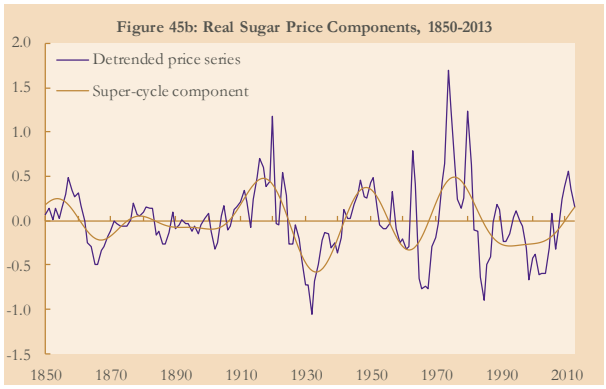


Figure 45b: Real Sugar Price Components, 1850-2013
Detrended price series
Super-cycle component
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

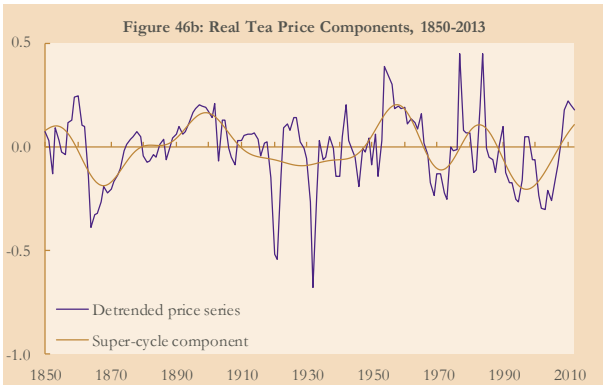


Figure 46b: Real Tea Price Components, 1850-2013
0.5
0.0
-0.5
-1.0
Detrended price series
Super-cycle component
1850
1870
1890
1910
1930
1950
1970
1990
2010

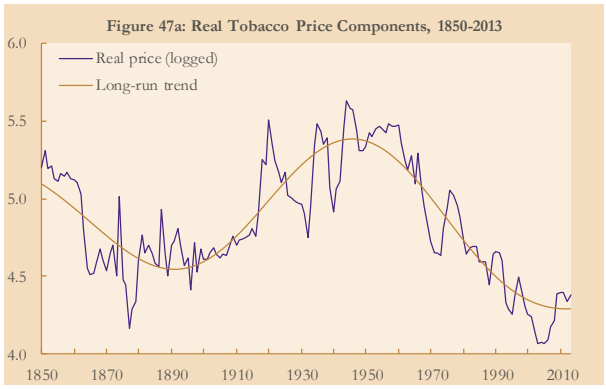


Figure 47a: Real Tobacco Price Components, 1850-2013
Real price (logged)
Long-run trend
6.0
5.5
5.0
4.5
4.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

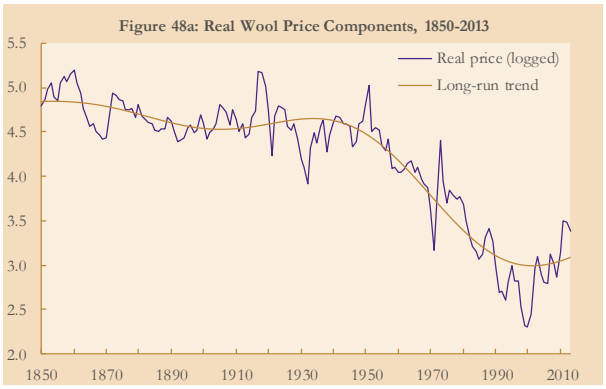


Figure 48a: Real Wool Price Components, 1850-2013
Real price (logged)
Long-run trend
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

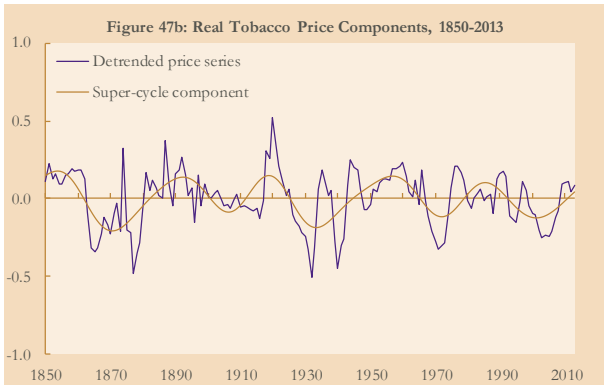


Figure 47b: Real Tobacco Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

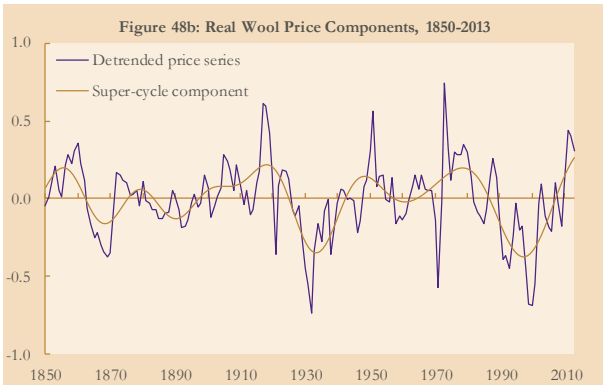


Figure 48b: Real Wool Price Components, 1850-2013
Detrended price series
Super-cycle component
1.0
0.5
0.0
-0.5
-1.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

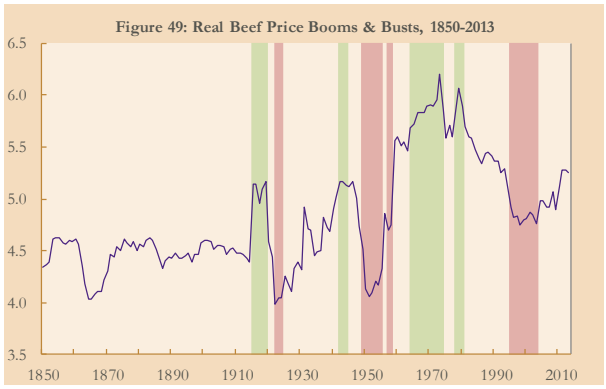


Figure 49: Real Beef Price Booms & Busts, 1850-2013
6.5
6.0
5.5
5.0
4.5
4.0
3.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

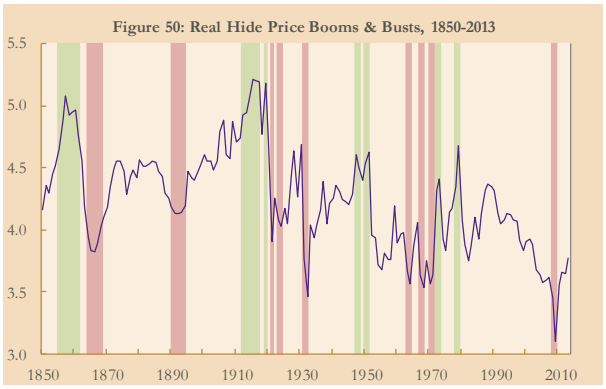


Figure 50: Real Hide Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

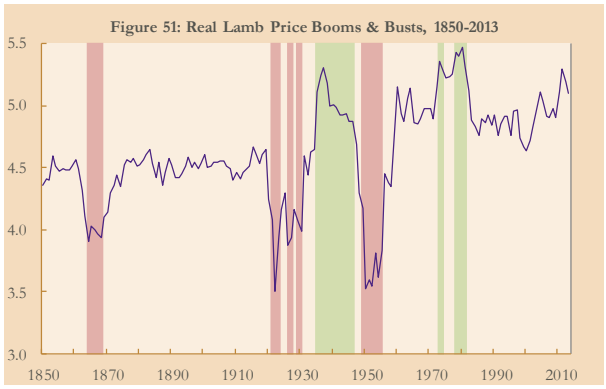


Figure 51: Real Lamb Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

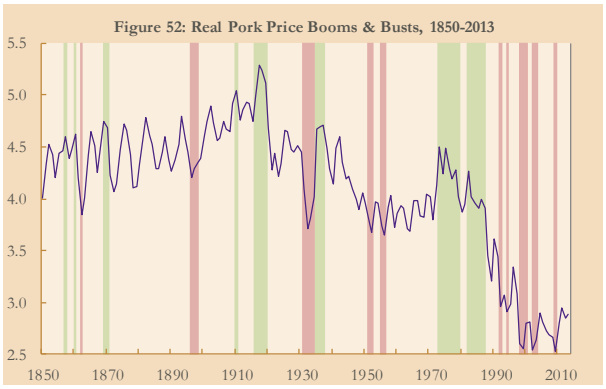


Figure 52: Real Pork Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

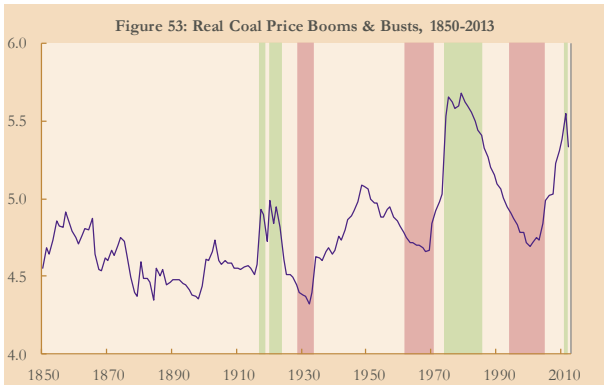


Figure 53: Real Coal Price Booms & Busts, 1850-2013
6.0
5.5
5.0
4.5
4.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

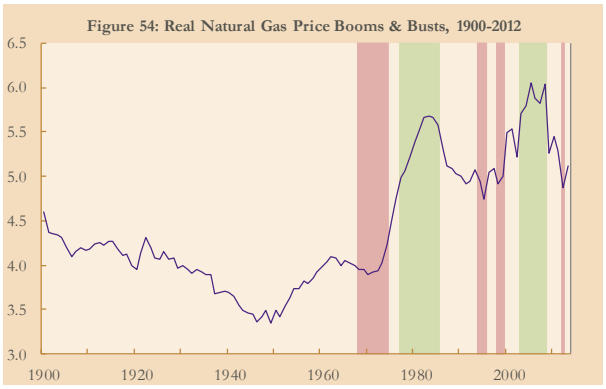


Figure 54: Real Natural Gas Price Booms & Busts, 1900-2012
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1900
1920
1940
1960
1980
2000

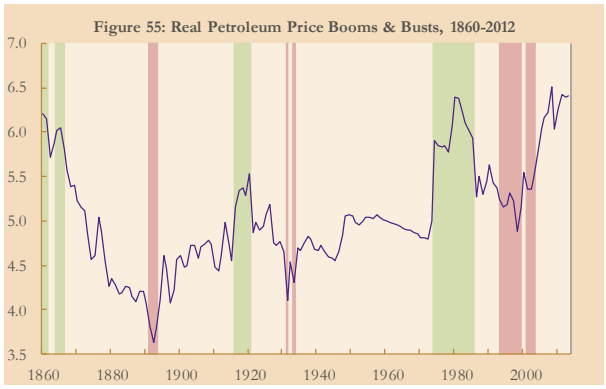


Figure 55: Real Petroleum Price Booms & Busts, 1860-2012
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
1860
1880
1900
1920
1940
1960
1980
2000

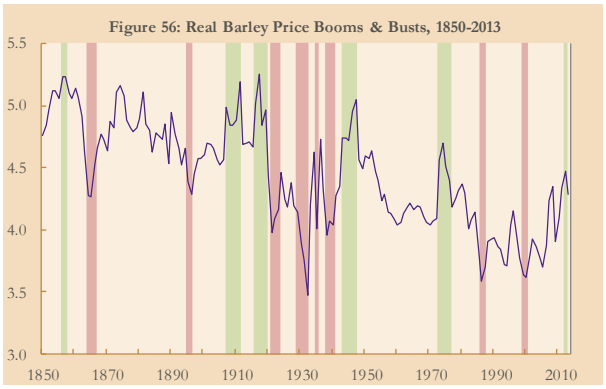


Figure 56: Real Barley Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

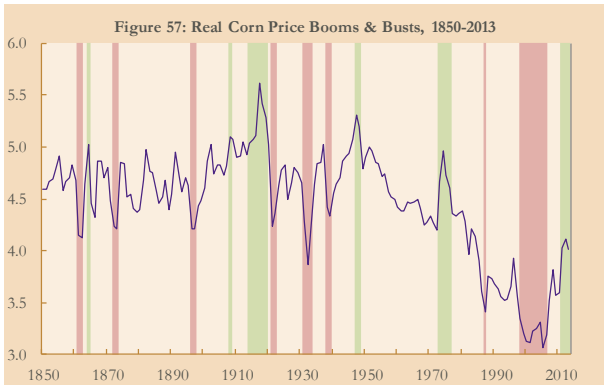


Figure 57: Real Corn Price Booms & Busts, 1850-2013
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

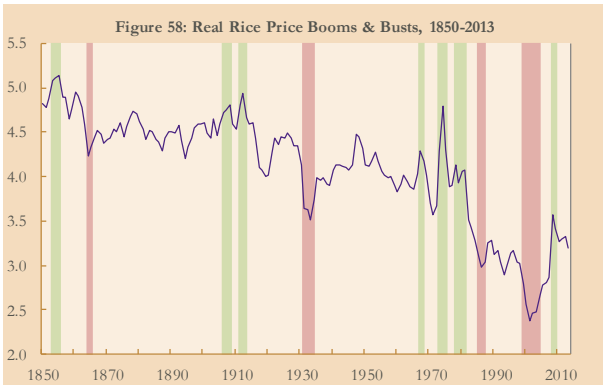


Figure 58: Real Rice Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

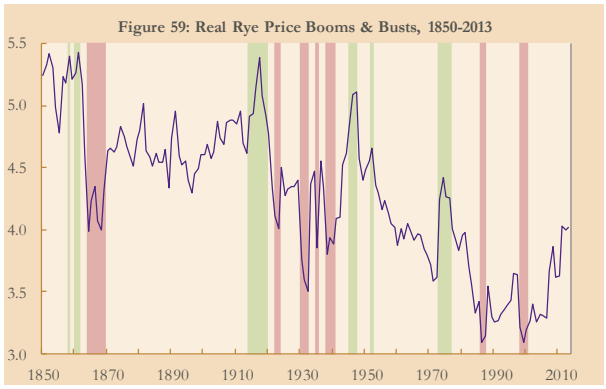


Figure 59: Real Rye Price Booms & Busts, 1850-2013
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5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

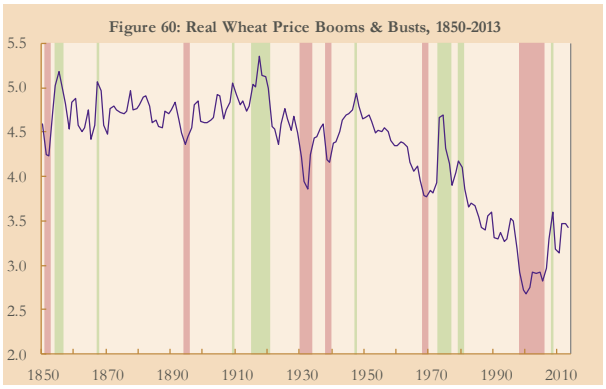
Figure 60: Real Wheat Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

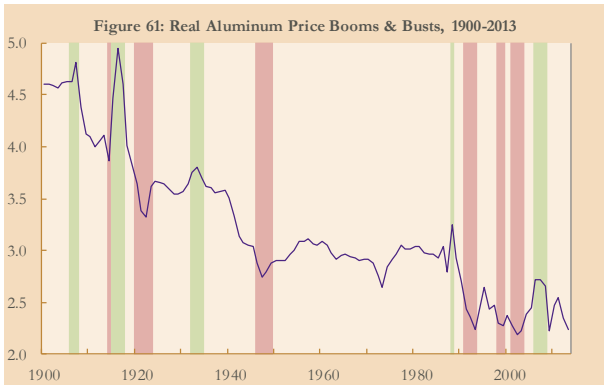
Figure 61: Real Aluminum Price Booms & Busts, 1900-2013
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1900
1920
1940
1960
1980
2000

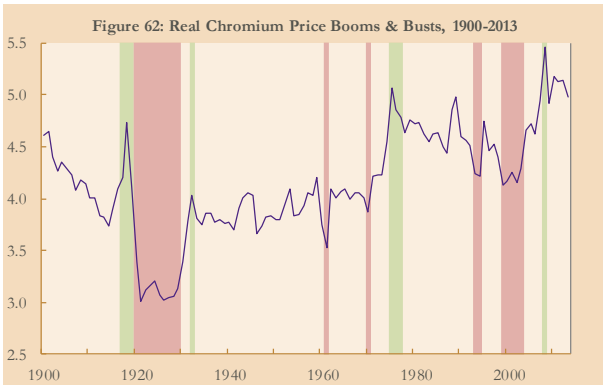
Figure 62: Real Chromium Price Booms & Busts, 1900-2013
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1900
1920
1940
1960
1980
2000

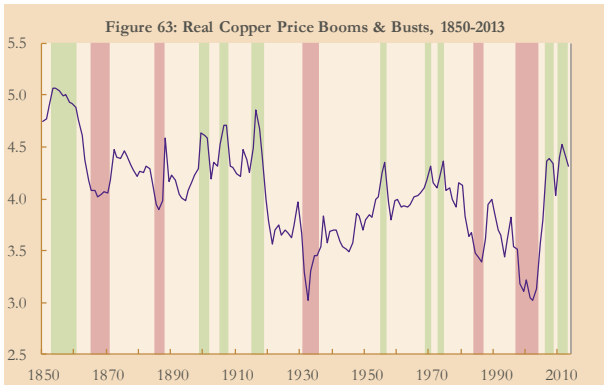
Figure 63: Real Copper Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1850
1870
1890
1910
1930
1950
1970
1990
2010

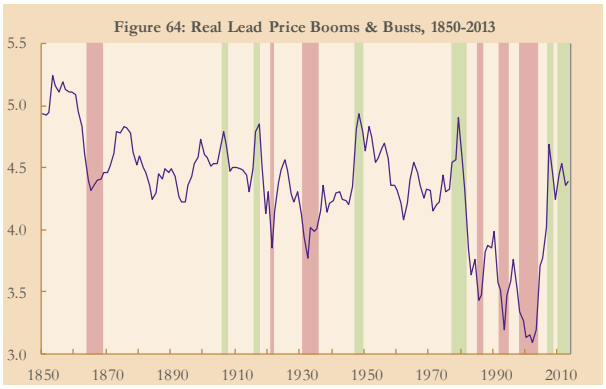
Figure 64: Real Lead Price Booms & Busts, 1850-2013
5.5
5.0
4.5
4.0
3.5
3.0
1850
1870
1890
1910
1930
1950
1970
1990
2010

Figure 65: Real Manganese Price Booms & Busts, 1900-2013

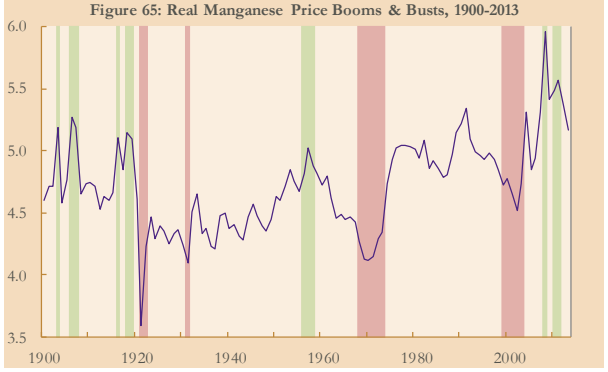

Figure 66: Real Nickel Price Booms & Busts, 1850-2013

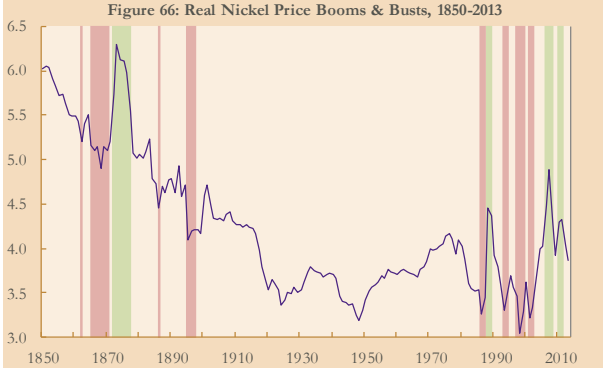

Figure 67: Real Steel Price Booms & Busts, 1900-2013

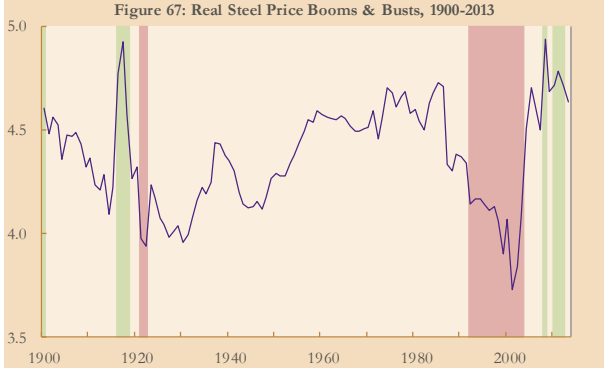

Figure 68: Real Tin Price Booms & Busts, 1850-2013

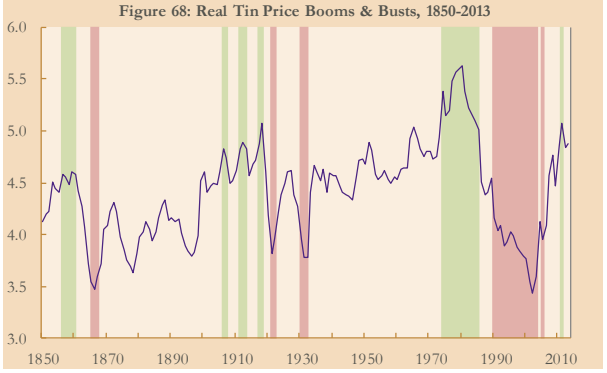

Figure 69: Real Zinc Price Booms & Busts, 1850-2013

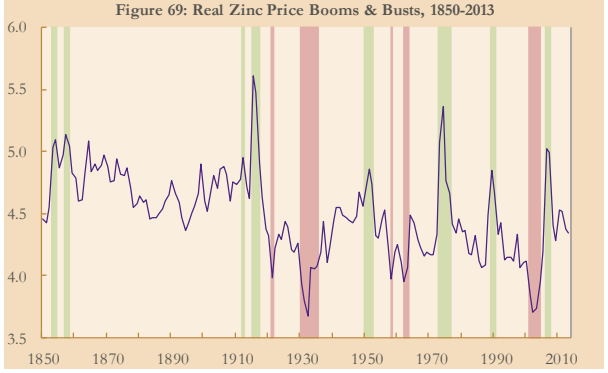

Figure 70: Real Bauxite Price Booms & Busts, 1900-2013

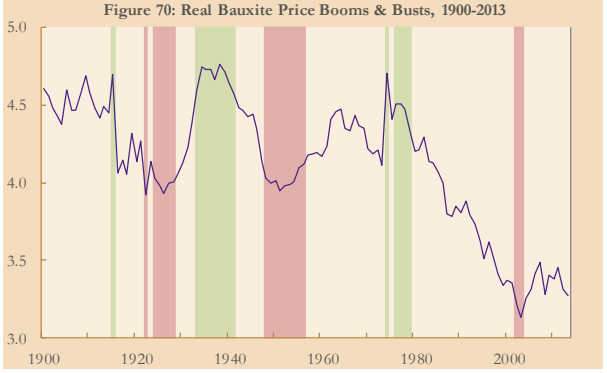

Figure 71: Real Iron Ore Price Booms & Busts, 1900-2012

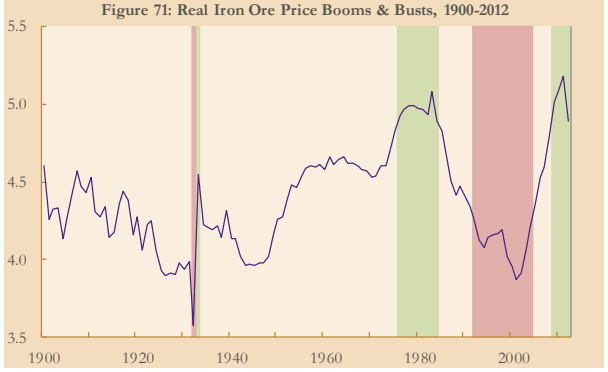

Figure 72: Real Manganese Price Booms & Busts, 1880-2013

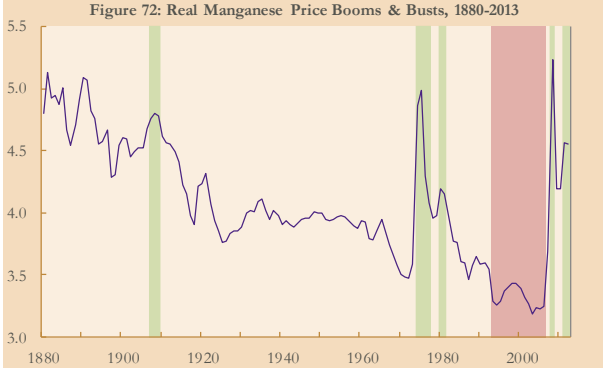

Figure 73: Real Potash Price Booms & Busts, 1900-2013

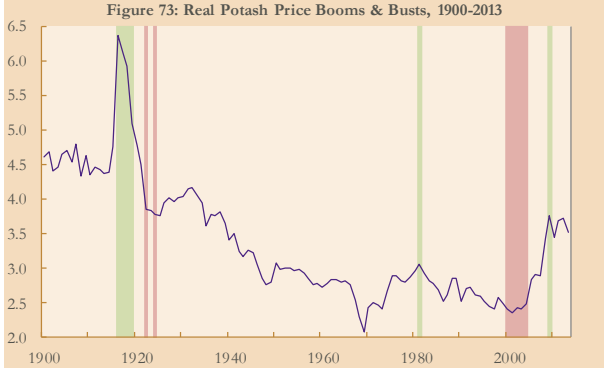

Figure 74: Real Sulfur Price Booms & Busts, 1870-2013

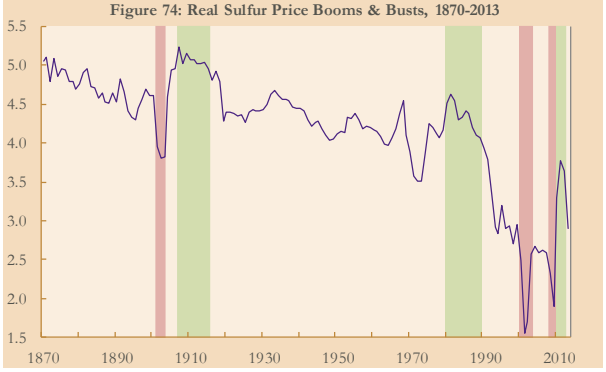

Figure 75: Real Gold Price Booms & Busts, 1850-2013

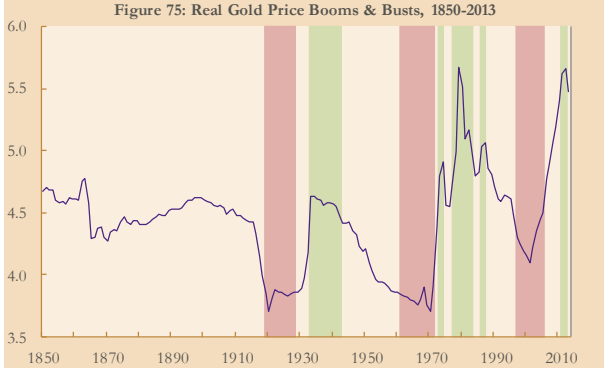

Figure 76: Real Platinum Price Booms & Busts, 1900-2013

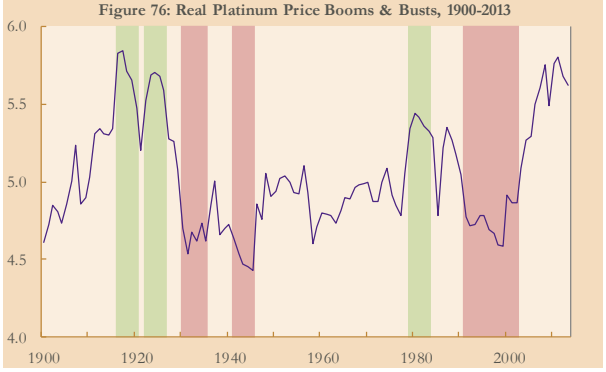

Figure 77: Real Silver Price Booms & Busts, 1850-2013

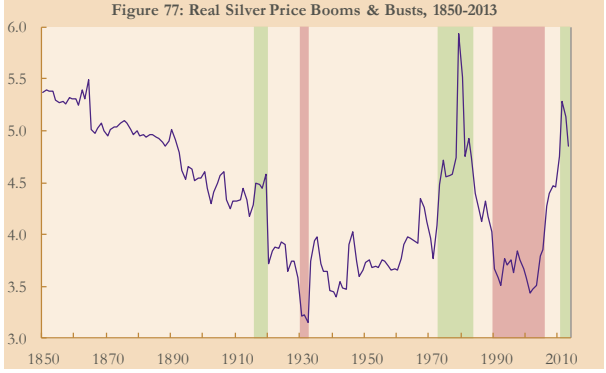

Figure 78: Real Cocoa Price Booms & Busts, 1850-2013

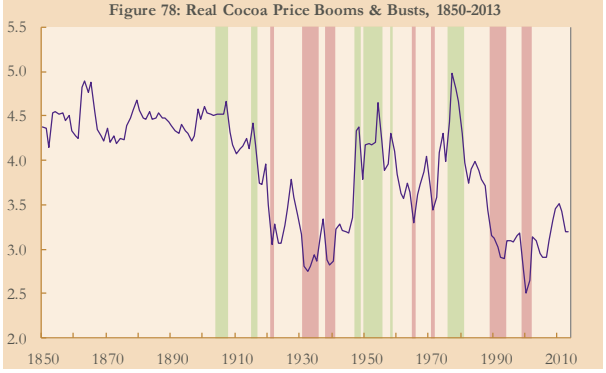

Figure 79: Real Coffee Price Booms & Busts, 1850-2013

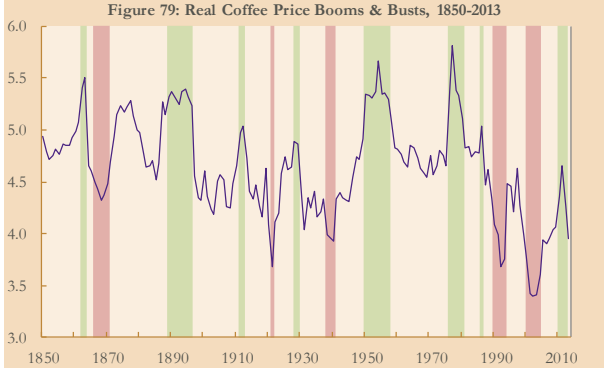

Figure 80: Real Cotton Price Booms & Busts, 1850-2013

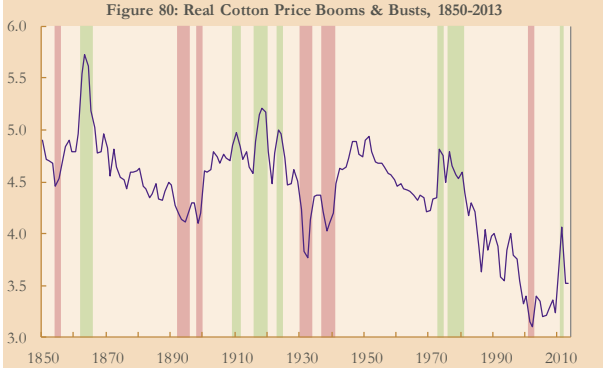

Figure 81: Real Cottonseed Price Booms & Busts, 1880-2013

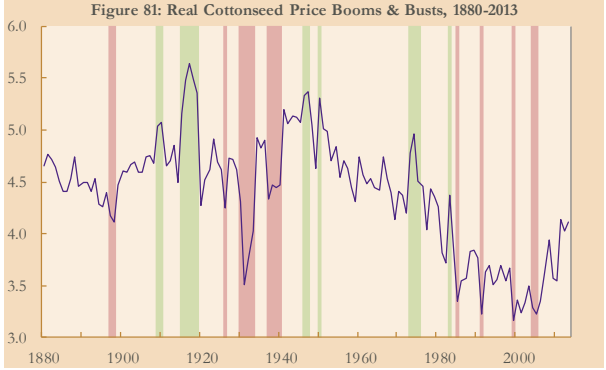

Figure 82: Real Palm Oil Price Booms & Busts, 1850-2013

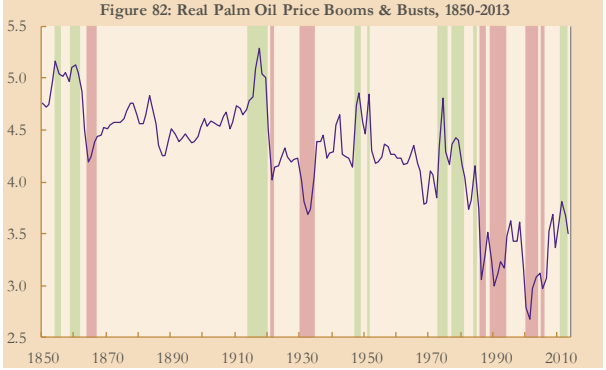

Figure 83: Real Peanut Price Booms & Busts, 1870-2013

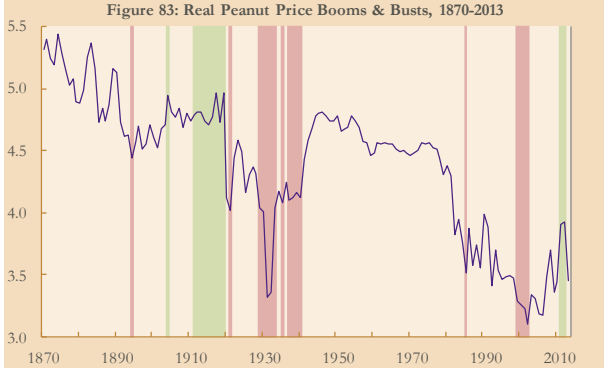

Figure 84: Real Rubber Price Booms & Busts, 1890-2013

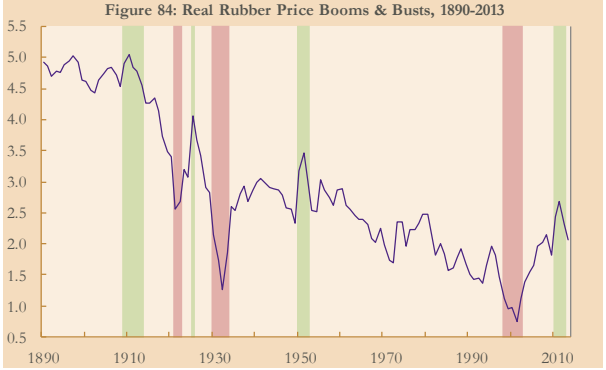

Figure 85: Real Sugar Price Booms & Busts, 1850-2013

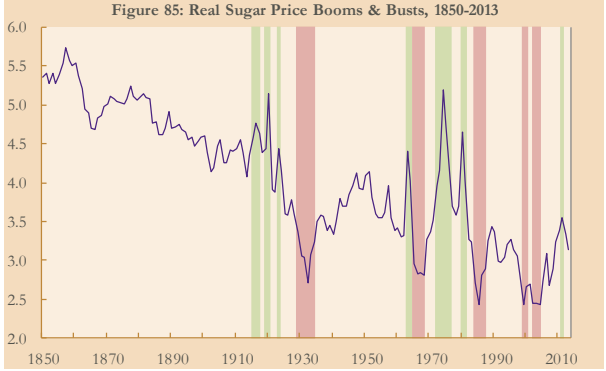

Figure 86: Real Tea Price Booms & Busts, 1850-2013

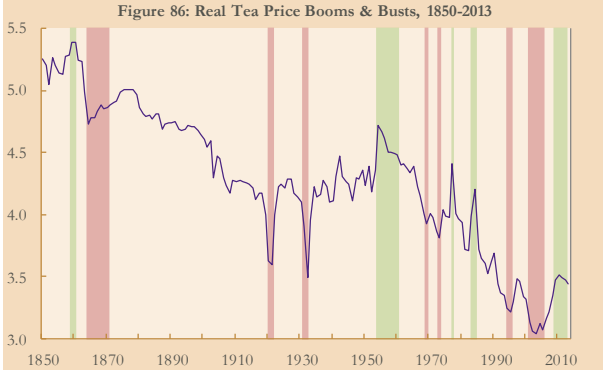

Figure 87: Real Tobacco Price Booms & Busts, 1850-2013

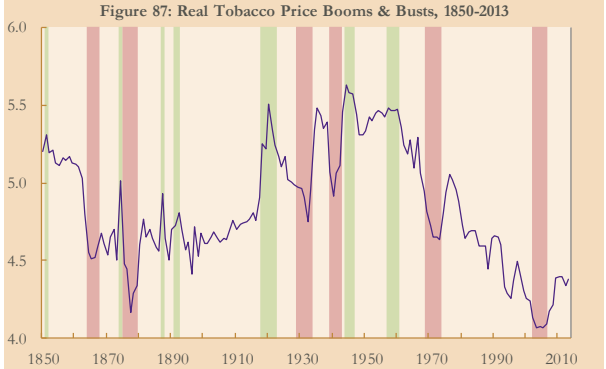

Figure 88: Real Wool Price Booms & Busts, 1850-2013