A Thorough Inquiry into Copper Super-Cycles

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Understanding super-cycles is crucial for stakeholders such as investors, policymakers, and industry leaders as it offers insights into long-term trends and dynamics in commodity prices. **Christopher Gilbert** plays a pivotal role in providing stakeholders with the foresight needed to navigate fluctuations in metal prices and volatile markets confidently.

What are Super-cycles?

Commodity prices exhibit volatility, oscillating between low and high values in a manner which is difficult to predict. Occasionally, these price-cycles transition into prolonged phases of elevated prices, referred to as super-cycles, with significant implications for global economies and industries. Lasting a decade or more, so-called super-cycles are driven by sustained demand fuelled by economic growth, industrialisation, and urbanisation. Unlike regular cycles, super-cycles reflect deeper structural changes in the global economy, exerting persistent upward pressure on commodity prices.

The term 'super-cycle' was first used by the Australian financial analyst Alan Heap in 2005 who saw periods of high prices as driven by materials-intensive economic growth. He identified two super-cycles, the first resulting from the rapid industrialisation of the US economy at the end of the nineteenth century and the second with rapid growth of the Japanese industrial sector in the 1960s and early 1970s. Heap's analysis predated massive expansion in demand for metals, driven by the rapid growth of the Chinese economy from 2004, which is often cited as a third super-cycle.

Why Understanding Super-cycles is Important

The mining industry is obliged to live with high price volatility. Investments are enormously expensive and very long gestation times – a new mine in a 'greenfield' site will take a minimum of ten years to generate revenues while a 'brownfield' mine extension will require at least five years. Profitability assessments will depend on price forecasts extending from ten to thirty years ahead. No-one can pretend to forecast accurately over horizons of this length but both mining companies and financial investors need to explore intelligent scenarios. Two crucial questions are whether prices return to their historical trend, and, if so, how rapid will be this reversion?

Economists see prices as reverting to long run production costs, but both skill shortages and constraints in the equipment supply industries result in a sharp escalation of costs during super-cycles. This makes it difficult to identify the historical trend and can result in the view that prices have moved up permanently. Super-cycles therefore tend to generate over-optimism on the part of mining companies, stock market investors, and the banks and other financial institutions that finance mine investment. Companies that invest in periods of very high prices often find that their new mines come on stream in a very different environment in which many are required to write-off large fractions of their investments.

Are Super-Cycles better termed 'Long Waves'?

According to the Oxford English Dictionary, a cycle is defined as 'a series of events that are regularly repeated in the same order.' In contrast, Gilbert's innovative approach to understanding super-cycles suggests interpreting them as waves. A wave can be defined as 'a shape regarded as resembling a breaking wave', highlighting the visual similarity between the form of a wave and other phenomena, such as patterns in sand dunes or price fluctuations. This is in line with Heap's view of sustained periods of high prices as episodic rather than regular and repeating.

In his 1926 work, 'The Long Waves in Economic Life', the Soviet economist Nikolai Kondratieff saw economies as subject to long waves and Joseph Schumpeter in 1939 coined the term 'Kondratieff waves' to honour Kondratieff's contributions. Kondratieff waves underscore that while a cycle typically implies a fixed periodicity, the intricate dynamics of social phenomena are better understood through internal generative principles rather than mechanistic laws of motion.

Statistical Models

The spectrum of a time series of observations, in this case annual metals prices, decomposes variability into a set of cycles of different frequencies in the same way that a prism decomposes light into waves of different frequencies – from high frequency blue waves to lower frequency red waves. The super-cycle view implies that there should be a spectral peak at the low frequency range. Instead, on the wave view, the metals price time series are more like white light in which no particular colour is associated with a spectral peak.

This would all be straightforward if it were not for the price trend, since spectra are only defined for 'stationary' (trendless) time series. The standard procedure, reflected in the use of the 'bandpass filter', involves deflating the (logarithmic) price series by a measure of the purchasing power of money and then detrending by removing a constant linear trend.

But there is no reason to suppose that trends are constant over such long periods, and every reason to suppose that this is not the case – technology evolves unevenly, and ore quality has declined through exhaustion of high-quality deposits. Linear trends are a special case of smooth trends in which the trend slope varies over time but there are no jumps. The alternative view is that the trend follows a random walk with drift, perhaps like a drunken sailor lurching down towards his ship in the port. On the random walk view, much of the metals price variation is permanent in the sense that there is no tendency to revert back to historical levels. The local level model posits an intermediate view in which there is some reversion, but part of the price variation is permanent. When prices are high, it is reasonable to suppose that they will remain higher than historical levels but perhaps not so high as currently.

The statistical challenge is that of simultaneously allowing for a variable trend and performing the decomposition into different frequency components. This task is difficult because low frequency sup-cycles are not easily distinguished from changes in the price trend. Gilbert uses the Unobserved Components Model (UCM), based on the Kalman filter, to analyse metals price data. The UCM approach allows alternative model specifications to be compared in terms of fit using information criteria.

Specifically, one can ask whether models which posit a super-cycle (low frequency cycle) together with a variable, but smooth trend fit better than alternative models in which the trend is a random walk with drift. The answer is negative – there is little evidence for long cycles but considerable evidence that much of the price variation is permanent. The best-fitting model tends to be the 'local level' model in which there is some mean reversion but much of the price variation is permanent. Super cycles are better thought of as long waves, in line with Kondratieff and Heap.

Copper Super-cycles

Copper has been the most actively studied of the non-ferrous metals with claims in the literature of super-cycles of around 60 years. These analyses generally use data from the start of the twentieth century which would currently give slightly more than 120 annual observations, sufficient to cover just two complete 60-year or three complete 40-year cycles. It is difficult to be confident of any regularity based on two or three observed cycles.

London and New York have been the historical centres for copper trading. Gilbert is able to extend the sterling-based London copper price series back to 1800 and the New York-based dollar series to 1850. Although we are now used to a single world price of copper, this was not always the case historically. Transport costs were substantial in the nineteenth century and the Atlantic trade was

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disrupted by the US Civil War. It is therefore preferable to examine the two series separately. Irrespective of the dataset used, the local level model gives the best fit. There is evidence of an 11-year cycle in the US data and weaker evidence of a five-year cycle in the London data. Neither of these would qualify as super-cycles.

The 60-year super-cycles identified by the standard bandpass filter methodology are the consequence of imposition of a constant linear long-term trend so that low frequency price variation is attributed to the supposed super-cycles. Once we allow for a variable trend, the super-cycles vanish. This view is corroborated by Monte Carlo analysis. Gilbert uses the random walk model to generate 10,000 replications of time series as if these were of New York copper prices. By construction, these series do not have any cycles, yet the bandpass filter methodology finds non-existent cycles with period of around 40 years (averaging across the 10,000 replications).

Investigating Super-cycles of Non-ferrous Metals

Gilbert's research delves into the applicability of insights gained from copper studies to other base metals, specifically lead, nickel, and zinc. These metals often share common price-driving factors and exhibit correlated movements in the market. Price data for these metals are available over a shorter period. The study covers a unified timeframe from 1885 to 2020 for the three metals with copper included for comparison.

The findings of the enhanced study mirror those observed for copper, suggesting a degree of cyclicality in the price behaviour of non-ferrous metals. Clearer patterns are discernible in lead and zinc with lead presenting the strongest evidence of cyclicality, with cycles spanning approximately 15 years, notably shorter than those proposed by advocates of super-cycles.

MEET THE RESEARCHER

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Christopher Gilbert is a non-executive director of the CRU Group. He is a graduate of Oxford University, where he received his doctorate, and the London School of Economics (both in the UK). He has consulted extensively for the European Commission, the Food and Agriculture Organization of the United Nations, the Inter-American Development Bank, the International Coffee Organization, the International Monetary Fund, the Organisation for Economic Co-operation and Development, UN Conference on Trade and Development, the UN Office of the High Representative for Least Developed Countries, Landlocked Developing Countries and Small Islands Developing States, and the World Bank. Prior to retirement in 2023, he held academic positions at the Universities of Bristol, Oxford, London (both Queen Mary and Birkbeck), the Free University of Amsterdam, Trento (Italy) and Johns Hopkins (SAIS Europe). His research has covered econometrics, agricultural, energy and metals markets, food security issues, and commodity futures markets.

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FURTHER READING

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