

Commodity Price Supercycles: What Are They and What Lies Ahead?

Bahattin Büyüksahin, Kun Mo and Konrad Zmitrowicz, International Economic Analysis Department

- Commodity prices tend to go through extended periods of boom and bust, known as supercycles. In general, commodity price movements are important for Canada because they help determine the country's terms of trade, exchange rate, employment, income and inflation.
- Bank of Canada research shows that there have been four broad-based commodity price supercycles since the early 1900s. The current supercycle started in the mid-1990s and is now in its downswing phase.
- One potential driver of these supercycles is the interaction of large, unexpected demand shocks and slow-moving supply responses. This interaction is widely accepted as the source of the current supercycle, which was driven by rapid growth in China and other emerging-market economies.

Global commodity prices greatly influence Canada's terms of trade, employment, income and ultimately inflation. Canada's commodities trade has grown substantially over the past 15 or so years. In 2015, commodities constituted 43 per cent of Canada's nominal exports, up from 34 per cent in 1999. This increase was particularly concentrated in crude oil, whose share rose from 3 to 9 per cent over the same period. While increased commodity exports have made Canada richer, they have also made the economy more vulnerable to shifting price cycles. In particular, the sharp fall in commodity prices that occurred after mid-2014 has led to a decline in Canadians' income and wealth and triggered a complex and costly adjustment in Canada's economy (Champagne et al. 2016; Lane 2015). While Canada cannot do much to prevent these global resource price shocks, Canada's inflation-targeting framework and floating exchange rate support necessary adjustments to mitigate their effects (Poloz 2015).

In this article, we examine why commodity prices tend to go through multi-year periods of boom and bust, known as supercycles. We present evidence showing that extended swings in commodity prices have been occurring since the early 1900s. While economists continue to debate the reasons behind these movements, many believe that the upswing phase in supercycles results from a lag between unexpected, persistent and positive shocks to commodity demand in conjunction with slow-moving supply responses. Eventually, as supply finally expands and demand growth moderates, the cycle enters a downswing phase. This article focuses on the

current commodity price supercycle, which we estimate started in the mid-to late 1990s and has been in its downswing phase since 2011. Finally, we discuss factors that could prolong or shorten the current downswing phase.

How Are Commodity Price Supercycles Identified?

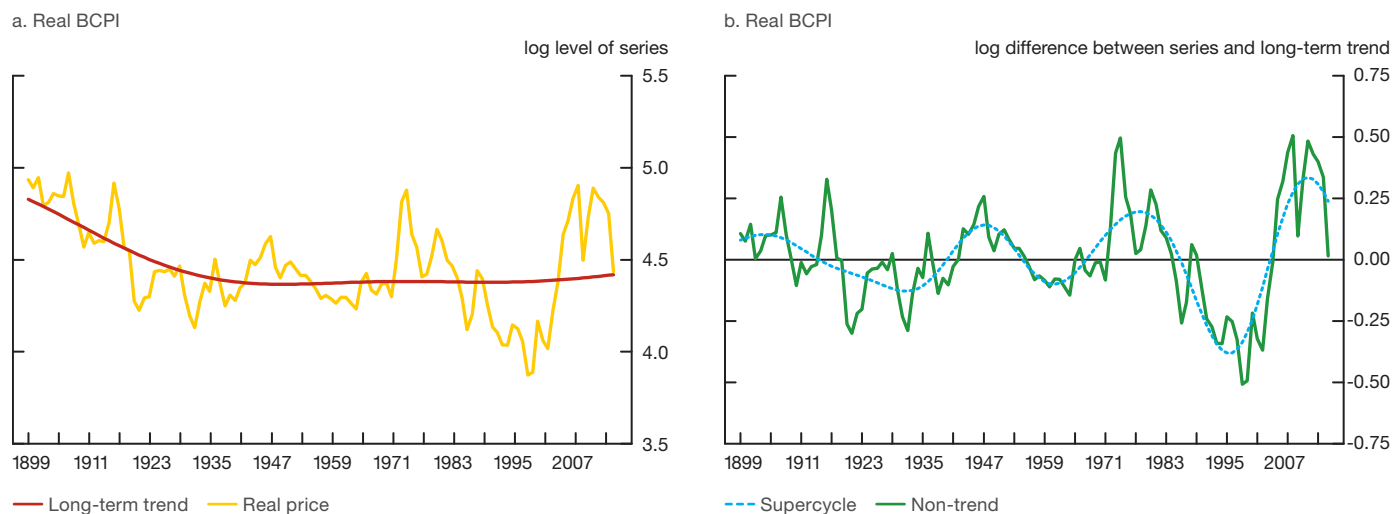
Commodity price supercycles are extended periods during which commodity prices are well above or below their long-run trend. They are expected to last much longer than business cycles, which, in Canada and the United States, have lasted six years on average in the post-war period.¹ Indeed, these supercycles are generally thought to take decades to complete a trough-to-trough movement. A growing number of economists are conducting research to find ways to better identify supercycles. One technique used in this article, an asymmetric band pass filter, was developed by Christiano and Fitzgerald (2003). Their technique is to identify regular fluctuations in commodity prices that occur over a horizon of between 20 and 70 years.

◀ This article uses an asymmetric band pass filter to identify regular fluctuations in commodity prices that occur over a horizon of between 20 and 70 years

Chart 1 shows the results of this filter when applied to a fixed-weight version of the Bank of Canada commodity price index (BCPI) going back to 1899.² The left panel displays the log of the real BCPI as well as its long-term trend as produced by the filter. The difference between these two series is shown in the right panel. If we remove the short-term oscillations from this detrended component, we are left with the supercycle of the real BCPI (represented by the blue line in the right panel). This chart shows that supercycles can vary by up to 40 per cent from their long-term trend at peak.

Studies that adopt the asymmetric band pass filter generally find four distinct commodity price supercycles since 1899. Four supercycles also appear in the real BCPI, as shown in Chart 1, with summary statistics presented in Table 1. On average, a full trough-to-trough supercycle in commodity prices takes 32 years (the current supercycle is excluded from this calculation

Chart 1: Supercycles in the Bank of Canada commodity price index (BCPI)



¹ Data related to recessions in the United States are from the National Bureau of Economic Research; data for recessions in Canada are from Cross and Bergevin (2012).

² This version of the BCPI is deflated by the US Producer Price Index and is based on the work of Coletti (1993).

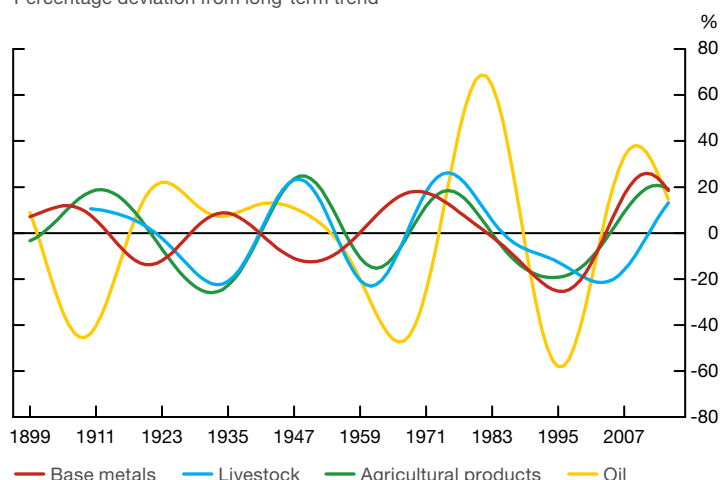
Table 1: Supercycles in commodity prices (BCPI weights)

	1899–1932	1933–61	1962–95	1996–present
Peak year	1904	1947	1978	2011
Peak of supercycle from long-term trend (%)	10.2	14.1	19.5	33.5
Trough of supercycle from long-term trend (%)	-12.9	-10.0	-38.1	23.7
Length of cycle from trough-to-trough (years)	33	29	34	20
Upswing (years)	5	15	17	16
Downswing (years)	28	14	17	ongoing

Note: BCPI means Bank of Canada commodity price index

Chart 2: Supercycles across major commodity groups

Percentage deviation from long-term trend



Source: Bank of Canada calculations

Last observation: 2015

because it is ongoing). No two supercycles are the same, however, and the length of the upswing and downswing phases can vary considerably from cycle to cycle. It can take anywhere from 5 to 17 years, for example, for the cycle to reach its peak and another 14 to 28 years to reach its trough. Note that this technique has some limitations. However, testing suggests that these results are relatively robust to different specifications.³

Chart 2 shows the supercycles of major subcomponents of the BCPI, including base metals, agricultural products, livestock and oil. Much like the BCPI, each major subcomponent shows four distinct peaks and troughs, with the exception of oil, which only has three. What sets the current supercycle apart from its predecessors is that the prices of all subcomponents start increasing at roughly the same time, whereas previous ones tended to only show a large degree of overlap.

◀ No two supercycles are the same, and the length of the upswing and the downswing phases can vary considerably from cycle to cycle

³ These limitations include the “end-of-sample problem” known to most filters as well as the appropriate periodicity that the filter should use (i.e., the minimum and maximum amount of time over which a supercycle can occur). Robustness tests show that the BCPI continues to exhibit four supercycles even if the periodicity is adjusted by 13 years on either end. Beyond that, the BCPI starts to show only three supercycles, with the periods before and after the Second World War merging into a single supercycle.

What Causes Commodity Price Supercycles?

It is generally accepted that commodity price supercycles are likely triggered by unexpected increases in demand. Table 2 presents regressions that examine the relationship between global economic growth and real commodity prices.⁴ In all cases, the immediate effect of a change in global gross domestic product (GDP) on commodity prices is fairly large. The results show that an increase in global economic growth of 1 percentage point leads to a rise in oil prices of 14 percentage points. The increase in oil is higher than the rise of 9 percentage points in base metal prices or the rise of 7 percentage points in agricultural prices.

Table 2: Sensitivity of real commodity prices to a change in real global economic growth, 1991Q1–2015Q4, percentage points

	Price elasticity of global output growth
Oil	14.0
Base metals	9.2
Agricultural products	7.2
BCPI	9.9

Note: Generalized method of moments reduced-form regression, 1991Q1 to 2015Q4, all coefficients significant at 5 per cent level

Many researchers (Erten and Ocampo 2012; Cuddington and Jerrett 2008b) note that supercycles tend to roughly coincide with periods of rapid industrialization in the global economy. The first cycle, for example, generally coincides with the industrialization of the United States in the late 19th century; the second, with the onset of global rearmament before the Second World War in the 1930s; the third, with the reindustrialization of Europe and Japan in the late 1950s–early 1960s. The current commodity price supercycle began in the mid- to late 1990s, the same time as a series of important reforms were occurring in China, including its eventual accession to the World Trade Organization (WTO) in 2001.

There are a number of ways in which long periods of industrialization can have long-lasting effects on commodity prices. If the increase in demand is unexpected, then prices should temporarily rise above their long-run equilibrium until new production capacity is built. For commodities, the delay is further exacerbated by the high start-up costs for many projects. These can cause firms to delay investments until they have a better sense of the sustainability of the unexpected demand shock and the long-term profitability of new projects (Majd and Pindyck 1987). Small forecasting errors on the part of firms have been found to have large consequences for prices in other industries with high start-up costs and long-lived projects, such as shipping (Greenwood and Hanson 2015).

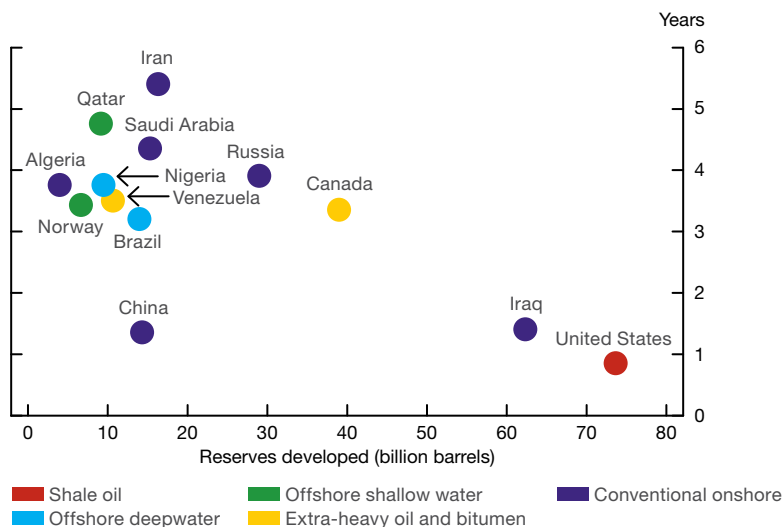
It is important to note that not all commodity supply will react in the same way. Start-up costs are generally higher for oil and base metal projects than they are for agricultural products. It can take more than five years for a new mine to generate cash flow after initial spending (Radetzki et al. 2008), for

◀ *Not all commodity supply will react in the same way. Start-up costs are generally higher for oil and base metal projects than they are for agricultural products*

⁴ The price elasticity of global output growth encompasses both the income elasticity of demand (i.e., the effect of stronger global economic growth on commodity prices) and the price elasticities of demand and supply (i.e., the effect of commodity price changes on demand). The relationship is estimated on a quarterly basis from 1991 to 2015. The regressions are estimated using generalized method of moments. Up to four lags of both global growth and the dependent variable are used as instruments. Note that GDP growth is an imperfect proxy for commodity demand, so these results should not be seen as definitive. Other estimation techniques have found similar results. Cuddington and Jerrett (2011), for example, find similar price elasticity by regressing real metal and oil prices on the cyclical and trend component of GDP using simple regressions.

Chart 3: US shale versus other oil investment, by country

Average lead times after final investment decision (FID) announcement (2000–14)



Source: International Energy Agency

example. In contrast, the supply of most agricultural products can generally react much more quickly, usually within the next growing season. Start-up costs can also change over time as a result of technological advances. The maturation of technologies for producing shale oil has significantly reduced the time needed to develop new oil production capacity. As shown in **Chart 3**, most oil projects, including unconventional sources such as the Canadian oil sands, take between three and six years to construct after a firm's final investment decision. In contrast, shale oil projects in the United States can take less than one year to develop (International Energy Agency 2015). Shale's advent means there is now a sizable portion of the oil supply that acts more like a standardized manufacturing process than a traditional high-fixed-cost project (Dale 2015).

There is a growing body of empirical work that supports this broad narrative. Erten and Ocampo (2012) show that supercycles in non-oil commodities follow supercycles in global GDP. Jacks and Stuermer (2015) provide evidence that demand shocks strongly dominate supply shocks in driving the real prices of 14 different commodities between 1850 and 2012. A historical analysis by Radetzki (2006) notes that most post-war commodity price booms were preceded by sharply accelerating macroeconomic activity (though other factors, such as tight production capacity and relatively small inventories, were also necessary). Other research that focuses on specific commodities also finds an important role for demand factors. Stuermer (2014) presents a model of mineral commodities where demand shocks have lasting effects on prices for approximately 7 to 12 years. Kilian (2009) finds that once movements in the demand and supply curves have been properly identified, the biggest contributions to oil price movements are due to both aggregate and oil-specific demand shocks. Unfortunately, there has been less empirical investigation thus far on whether the downswing phases of supercycles reflect the delayed supply response to past (positive) demand shocks.

Nonetheless, commodity-specific supply-side shocks have also played a role in commodity price supercycles and, in many cases, likely act in tandem with demand factors. One prominent example is the oil embargo imposed by the Organization of the Petroleum Exporting Countries (OPEC)

that led to a surge in oil prices in the 1970s. Cuddington and Jerrett (2008a) and Radetzki et al. (2008) speculate that supercycles could actually be primarily supply-driven, resulting from a “race” between rising commodity depletion rates and new, cost-reducing technologies. There is not yet enough evidence to judge how important this mechanism is in practice.

Triggers of the Current Commodity Price Supercycle

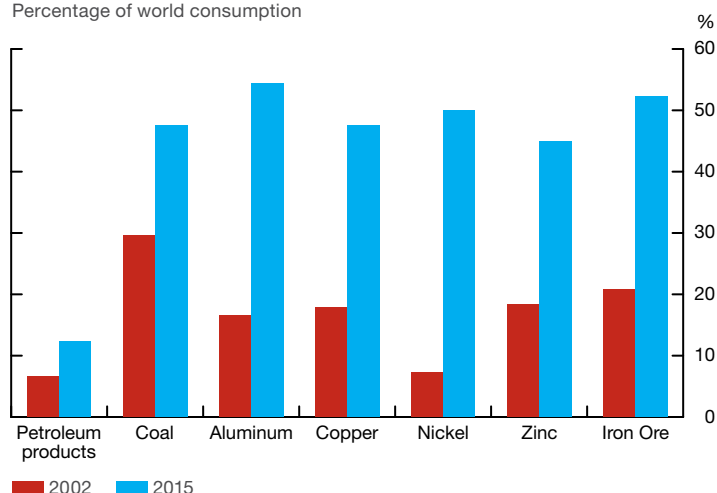
The simultaneous price increase across commodities at the beginning of the current supercycle coincided with rapid economic growth in China and other emerging-market economies (EMEs). The evidence suggests these two events are closely linked. Between 2002 and 2014, the increase in Chinese demand was large enough to account for all of the increase in global metals consumption and more than half of the increase in global oil consumption. **Chart 4** shows that China accounted for roughly 50 per cent of the world’s consumption of most base metals in 2015, compared with 18 per cent in 2002. In contrast, agricultural commodity demand, which has been found to be sensitive to population growth as well as income growth (World Bank 2016), has been underpinned by EMEs as a whole rather than by any particular country.

As noted in **Table 1**, commodity prices reached their peak in the current supercycle in 2011, rising 33 per cent above their long-run trend. Since then, they have started to decline and, as of 2015, are now only 23 per cent above trend. The recent decline has been driven by the forces outlined in the previous section, particularly a delayed supply response from commodities to higher prices.

Technological innovation in the resource industry, particularly in crude oil production, has also played an important role. **Chart 5** and **Chart 6** show that future oil production in both the United States and Canada was underpredicted over the course of the past decade because forecasters persistently underestimated the sectors’ capacity for technological innovation.

Chart 4: Consumption of industrial commodities in China

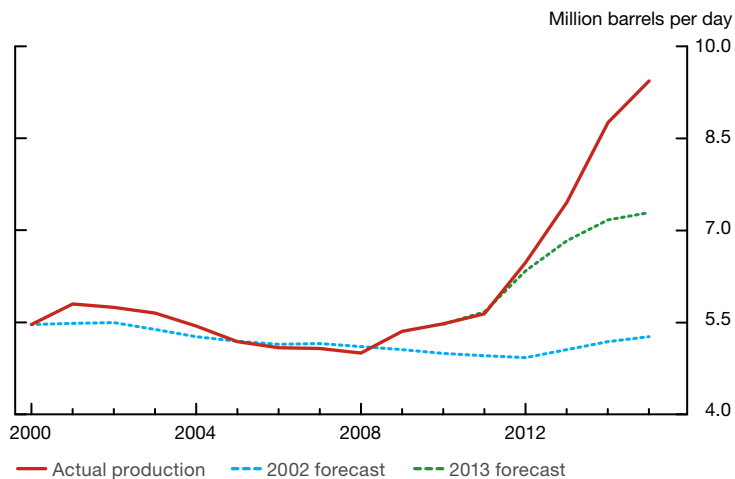
Percentage of world consumption



Note: Latest coal consumption data are for 2012.

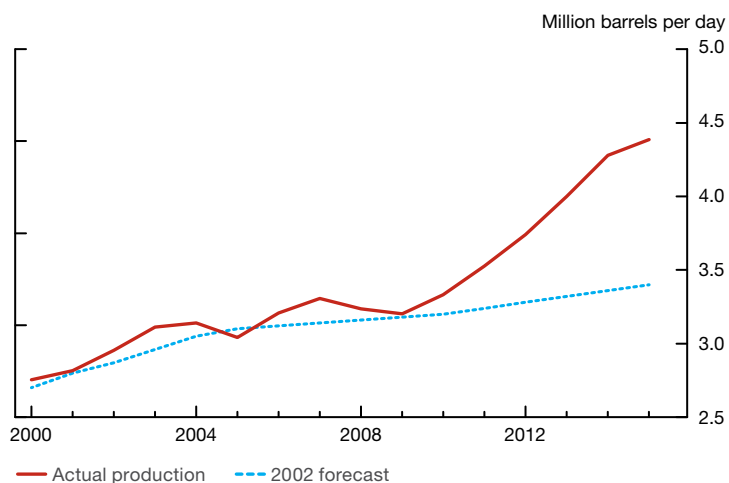
Source: World Bureau of Metal Statistics, US Geological Survey, Haver Analytics and Bank of Canada calculations

Last observation: 2015

Chart 5: US oil production

Source: US Energy Information Administration

Last observation: 2015

Chart 6: Canadian oil production

Source: International Energy Agency

Last observation: 2015

Growth in commodity demand has also declined as a result of a reduction in global economic growth. In the same way that unexpected positive demand shocks boost commodity prices, a string of negative demand shocks have the opposite effect. Since 2011, many economic forecasters, including the Bank of Canada, have systematically overestimated the level of global economic growth (Guénette et al. 2016). In addition, commodity demand growth has been decreasing even faster than the recent slowdown in global GDP would suggest. Developments in China play an important role in explaining this change. In China, the economy is rebalancing away from investment-driven growth toward less commodity-intensive sectors like domestic consumption, especially services consumption. Furthermore, growth in Chinese spending on residential investment, which is base-metal-intensive, is expected to slow in the near future because of a substantial overhang in housing inventories (Kruger, Mo and Sawatzky 2016).

What Lies Ahead for Commodity Prices?

If commodity price supercycles are driven by unexpected movements in demand or improvements in technology, it will be difficult to assess their starts and turning points in real time. Note that in the past, the downswing phase of a commodity price supercycle has generally taken 14 to 28 years. Since we are currently into the fifth year of the downswing phase of the current supercycle, it could be argued that, on average, there is still some time for prices to fall further. Each cycle is different, however, and below we outline some factors that could either prolong or reduce the length of the current downswing phase.

◀ *While the downswing phase of the current supercycle is only into its fifth year, there are a number of factors that could either prolong or reduce the length of the current phase*

How will the slowing and rebalancing of the Chinese economy affect commodity demand?

As growth in China's industrial economy slows and rebalances, its pattern of commodity consumption will change. Demand growth for industrial commodities (iron ore, copper and coal) should slow from the robust pace of the past decade. However, a new stream of demand-side pressures could emerge for high-value consumer-related commodities such as meat, dairy and gasoline. Whether this will merely lead to a shift in demand across commodities rather than an overall slowdown in demand remains to be seen. Note that the Chinese economy is six times larger now than it was when the current commodity price supercycle began.⁵ As a result, China's contribution to demand for commodities should still remain elevated, even if its future GDP growth is materially slower than it has been over the past 10 years (Roberts et al. 2016). China's copper imports are an illustrative example. In 2015, China imported an additional 1.46 million tonnes of copper ore and concentrates compared with its level in 2014. That growth is actually higher than China's total level of imports in 1999, which was only 1.24 million tonnes.

Will economic growth in other EMEs create new commodity price pressures?

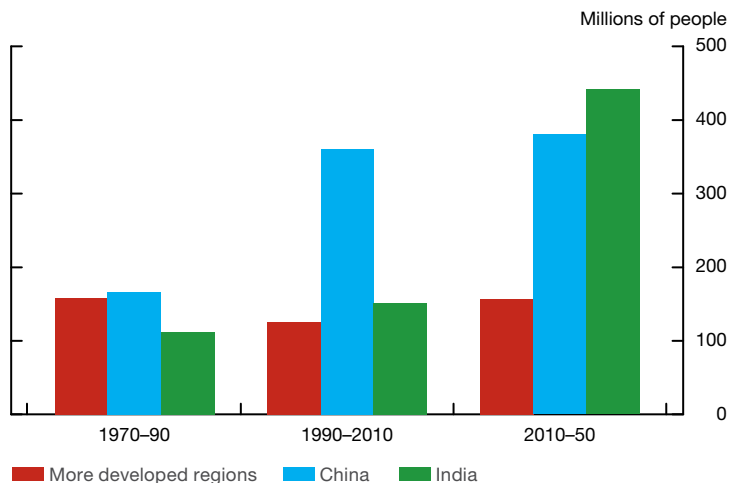
Infrastructure and construction projects are very commodity-intensive. Commodity demand growth in India and other EMEs could strengthen, given the infrastructure deficit in these countries compared with their more developed peers. In particular, India shares many similarities with China before its economic liftoff, notably its large population and relatively closed economy. India's urbanization rate is currently slightly above 30 per cent, well below that of advanced economies (more than 80 per cent) or China (55 per cent). **Chart 7** shows United Nations estimates for Indian urban population growth, suggesting it will rise by almost half a billion through 2050—about 20 per cent higher than the increase in China over the past two decades.

There are significant challenges before commodity demand in EMEs outside of China reaches the critical levels needed to support a new supercycle. Structural reforms will likely be necessary to sustain rapid economic growth, and these can be politically difficult to implement (Bailliu and Hajzler 2016). Even if successful, these countries will be starting off from a relatively small commodity consumption base. **Chart 8** shows that, for early stages of economic development, GDP per capita and base metal consumption per capita tend to increase in tandem. This points to a strong upside to metal demand in India and Brazil. That said, we also note that metal consumption per capita in India and Brazil is below what one would expect, given their current level of economic development.

◀ *Structural reforms will likely be necessary to sustain rapid economic growth in emerging-market economies outside of China*

⁵ Real GDP, 2010 dollars.

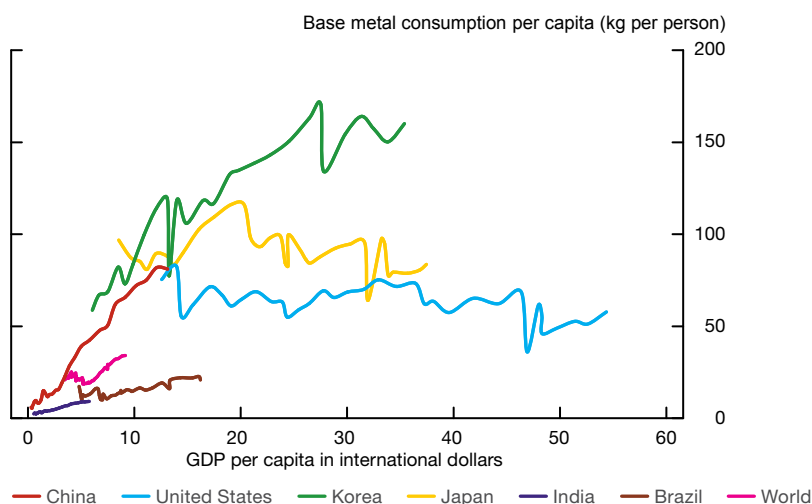
Chart 7: Expected change in urban population



Source: United Nations, *World Urbanization Prospects*, 2014

Last data plotted: 2050

Chart 8: Base metal consumption versus GDP per capita



Note: Data spans from 1968–2014 for world, 1980–2014 for all countries except Korea, and 1988–2014 for Korea.

Sources: Bloomberg, Angus Madison, International Monetary Fund *World Economic Outlook* and Bank of Canada

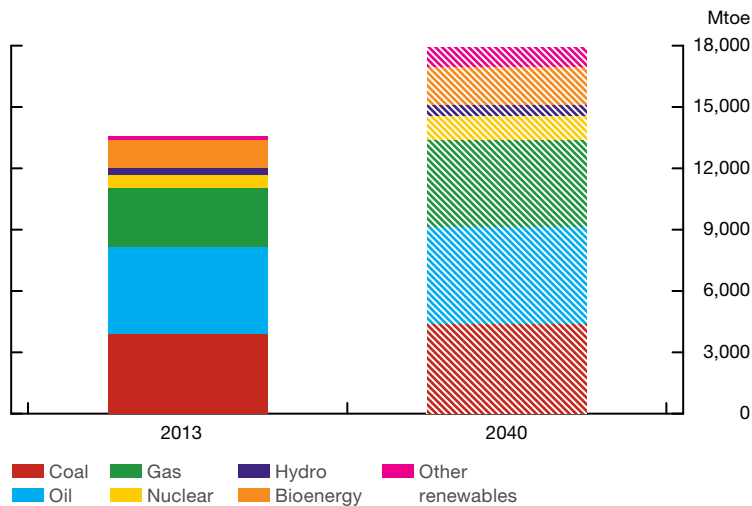
Last observation: 2014

How could environmental policies affect commodity prices?

A growing focus on environmental concerns should affect the future demand for energy commodities. Most countries are now committed to slowing or even reversing the adverse effect of commodity consumption on air and water quality and the climate, especially after the 21st Council of the Parties agreement on climate change signed in December 2015.

The International Energy Agency (IEA) expects most energy demand over the course of the next two decades will be driven by EMEs (IEA 2015) and, at present, alternative energy resources to fossil fuels (coal, petroleum, etc.) are not cost-competitive substitutes. As a result, the IEA still expects that fossil fuels will make up the majority of primary energy demand by 2040, compared with 81 per cent in 2013 (Chart 9). However, it also expects a significant shift toward less carbon-intensive fossil fuels, with a rising share of natural gas rather than oil or coal.

◀ *The International Energy Agency expects that fossil fuels will make up 75 per cent of energy demand by 2040*

Chart 9: Projections of primary energy demand by fuel according to the International Energy Agency

Note: Mtoe means million tonnes of oil equivalent

Source: International Energy Agency *World Energy Outlook*

Last data plotted: 2040

How quickly will supply capacity react to future commodity price changes?

The outlook for commodity supply is subject to two-sided risks. On the one hand, technological improvements, such as the US shale revolution, continue to unlock previously inaccessible resources, lower the cost of production and reduce the time needed for supply to adjust to a shift in demand. These developments should help sustain robust supply growth and limit commodity price growth. On the other hand, the current low level of commodity prices reduces the incentive to invest in new projects. The capital expenditure budgets of major oil producers, for example, have fallen for the second consecutive year and are now down by half, relative to their peak in 2014. Given the long lead times needed to build most conventional oil projects, this could limit future supply and lead to a spike in oil prices (Büyüksahin et al. 2016).

Conclusion

In this article, we examine the notion that commodity prices tend to experience extended periods of boom and bust, often referred to as supercycles. The results from our analysis support the view that there have been four broad-based commodity price supercycles since the early 1900s, likely as a result of large, unexpected demand shocks interacting with slow-moving supply responses. The current supercycle fits this view. In the mid- to late 1990s, commodity demand was driven by rapid growth in EMEs, especially China. After an important increase in supply capacity and faltering global growth, the current supercycle has entered its downswing phase. How long this current downswing phase will last depends on a number of factors, such as the industrialization of India, that are currently very uncertain.

Literature Cited

- Bailliu, J. and C. Hajzler. 2016. "Structural Reforms and Economic Growth in Emerging-Market Economies." *Bank of Canada Review* (Autumn): 47–60.
- Büyükhahin, B., R. Ellwanger, K. Mo and K. Zmitrowicz. 2016. "Low for Longer? Why the Global Oil Market in 2014 Is Not Like 1986." Bank of Canada Staff Analytical Note No. 2016-11.
- Champagne, J., N. Perevalov, H. Pioro, D. Brouillette and A. Agopsowicz. 2016. "The Complex Adjustment of the Canadian Economy to Lower Commodity Prices." Bank of Canada Staff Analytical Note No. 2016-1.
- Christiano, L. and T. Fitzgerald. 2003. "The Band Pass Filter." *International Economic Review* 44 (2): 435–465.
- Coletti, D. 1993. "The Long-Run Behaviour of Key Canadian Non-Energy Commodity Prices (1900 to 1991)." *Bank of Canada Review* (Winter 1992–1993): 47–56.
- Cross, P. and P. Bergevin. 2012. "Turning Points: Business Cycles in Canada Since 1926." C.D. Howe Institute Commentary No. 366.
- Cuddington, J. and D. Jerrett. 2008a. "Broadening the Statistical Search for Metal Price Super Cycles to Steel and Related Metals." *Resources Policy* 33 (4): 188–195.
- . 2008b. "Super Cycles in Real Metals Prices?" IMF Staff Paper 55 (4): 541–565.
- . 2011. "Business Cycle Effects on Metal and Oil Prices: Understanding the Price Retreat of 2008-9?" Manuscript, Colorado School of Mines.
- Dale, S. 2015. "New Economics of Oil." Speech to the Society of Business Economists Annual Conference, London, 13 October.
- Erten, B. and J. A. Ocampo. 2012. "Super-Cycles of Commodity Prices Since the Mid-Nineteenth Century." DESA Working Paper No. 110. February. ST/ESA/DWP/110.
- Greenwood, R. and S. G. Hanson. 2015. "Waves in Ship Prices and Investment." *Quarterly Journal of Economics* 130 (1): 55–109.
- Guénette, J.-D., N. Labelle St-Pierre, M. Leduc and L. Rennison. 2016. "The Case of Serial Disappointment." Bank of Canada Staff Analytical Note 2016-10.
- International Energy Agency (IEA). 2015. *World Energy Outlook 2015*. Organisation for Economic Co-operation and Development (OECD).
- Jacks, D. and M. Stuermer. 2015. "What Drives Commodity Prices in the Long Run?" Working paper. Available at <http://www.banqueducanada.ca/wp-content/uploads/2015/05/what-drives-commodity-prices-long-run-stuermer.pdf>.

- Kilian, L. 2009. "Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market." *American Economic Review* 99 (3): 1053–69.
- Kruger, M., K. Mo and B. Sawatzky. 2016. "The Evolution of the Chinese Housing Market and Its Impact on Base Metal Prices." Bank of Canada Staff Discussion Paper No. 2016-7.
- Lane, T. 2015. "Drilling Down—Understanding Oil Prices and Their Economic Impact." Speech to the Madison International Trade Association, Madison, Wisconsin, 13 January.
- Majd, S. and R. Pindyck. 1987. "Time to Build, Option Value, and Investment Decisions." *Journal of Financial Economics* 18 (1): 7–27.
- Poloz, S. S. 2015. "Riding the Commodity Cycle: Resources and the Canadian Economy." Speech to Calgary Economic Development, Calgary, 21 September.
- Radetzki, M. 2006. "The Anatomy of Three Commodity Booms." *Resources Policy* 31 (1): 56–64.
- Radetzki, M., R. Eggert, G. Lagos, M. Lima and J. Tilton. 2008. "The Boom in Mineral Markets: How Long Might it Last?" *Resources Policy* 33 (3): 125–128.
- Roberts, I., T. Saunders, G. Spence and N. Cassidy. 2016. "China's Evolving Demand for Commodities." Presentation to the annual conference of the Reserve Bank of Australia, March.
- Stuermer, M. 2014. "Industrialization and the Demand for Mineral Commodities." Federal Reserve Bank of Dallas Working Paper No. 1413.
- World Bank. 2016. "Commodity Markets Outlook." January.