The Economist

GUIDE TO COMMODITIES

Producers, players and prices, markets, consumers and trends

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Introduction

WE LIVE OUR LIVES surrounded by products made, in part at least, using the world's natural resources – from the clothes we wear and the food we eat to the cars we drive, the houses we live in and the electronic devices we use. We depend on commodities, and commodity consumption increases with per-head incomes as countries become more developed.

Steadily rising, although at times volatile, prices in the past decade have underlined the economic importance of commodities and how dependent we are on them. The price of gold has soared to new peaks as currencies have endured a crisis of confidence; demand from China has pushed metal prices up; instability in the Middle East and North Africa has had its effect on the oil price; and food prices have been increasing in parallel with worries about whether there is enough to feed the world.

The exploitation and refinement of natural resources have been an integral part of human and economic development. The discovery of metals and subsequent experiments that determined their potential use were the catalyst for leaps in economic development and productivity. For thousands of years, people have been exchanging and trading natural resources – agricultural products in particular – largely in marketplaces throughout the world. Traders would often go far afield to bring back goods that were not produced domestically and so would command a high price. The first formal commodity exchanges started to emerge in the mid-19th century to meet the growing demands of a rapidly industrialising United States.

Commodities have a number of unique qualities. They are typically uniform in quality and lack product differentiation. For this

reason, and unusually, there is a global price or benchmark for most commodities. Industrial commodities are usually used as inputs in the production of other goods and services, following some refining process on the raw material after extraction. Agricultural commodities are also often refined or processed in some way and are used as ingredients to make food and feedstuffs or textiles. Thus commodities are rarely bought directly by consuming households but are typically intermediate goods bought by manufacturing companies.

In its broadest sense, the word "commodity" can be used to describe any traded good (it is usually used for goods rather than services, but can be applied to both). Historically, it was also used to describe something of quality or value, but this interpretation has become largely obsolete – although it does still apply to some precious metals. In recent years, the word has spawned a number of verbs, including "commodify" and "commoditise". The former is to make something commercially viable, while the latter is more about reducing the power of producers as goods become hard to differentiate.

This book focuses on the narrower, or perhaps purer, definition of commodities: natural resources or raw materials, whether mineral or agricultural. It looks at trends in the consumption and production of, and markets for, these goods, and at how prices have changed over the years and how they are likely to change in future. In short, it is a comprehensive guide that provides a concise explanation of everything that people need or will find helpful to know about commodities.

About this book

This book discusses commodities primarily from an economic perspective. Chapter 1 outlines the main economic issues, such as the finite nature of some commodities, whether natural resources bring economic benefits and what determines price movements. Chapter 2 expands on the recent growth in commodities as an investment asset, outlining the main financial instruments and looking at why investors would want to invest in natural resources and raw materials.

Parts 2 to 4 cover the three main types of commodities: industrial

(primarily base metals, but also some precious metals), energy and agricultural. As far as is possible, coverage of the principal commodities in each category follows a consistent pattern and includes their characteristics, how they are used, the main consumers and consumption trends, the main producers and production trends, where the commodities are traded, price developments and the broad outlook.

The book concludes with a glossary of terms and a list of the main sources of statistical information and research.

PART 1

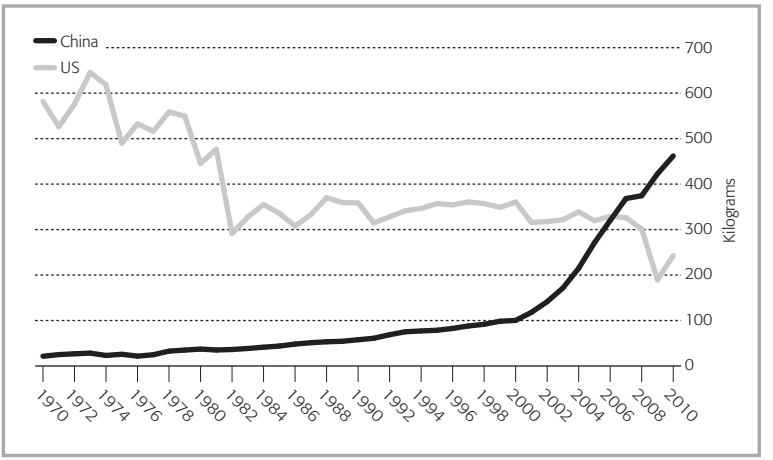
Market fundamentals

The economics of commodities

TYPICALLY, COUNTRIES NEED INCREASING AMOUNTS of industrial raw materials (particularly base metals) and energy as they industrialise and urbanise, and then decreasing amounts when they have reached a certain level of development and are becoming more service-sector oriented. This has undeniably been the pattern of commodity consumption in the United States and Europe. Figure 1.1 shows the quantity of steel production in the United States and China between 1970 and 2010, reflecting their different stages of development. Commodity prices and demand were weak or falling as economic growth at the time was largely concentrated in the developed world, particularly the United States, and was increasingly being driven by growth in the service sector rather than manufacturing or construction. While recent history suggests the theory holds, it is a crude maxim for estimating future trends in commodity consumption and production as it suggests that all countries will follow the same route to economic development.

In the past decade there has been rapid economic development in the developing world, particularly in China. These countries need to build transport networks, electricity grids and housing, so global commodity demand has soared. Furthermore, China opted for the traditional industrialisation route, in the process becoming the world's manufacturing centre and the largest consumer of nearly all industrial commodities (with the notable exception of oil).

FIG 1.1 **Steel production per head in the US and China, 1970–2010**



Sources: China's National Bureau of Statistics; US Census Bureau; World Steel Association

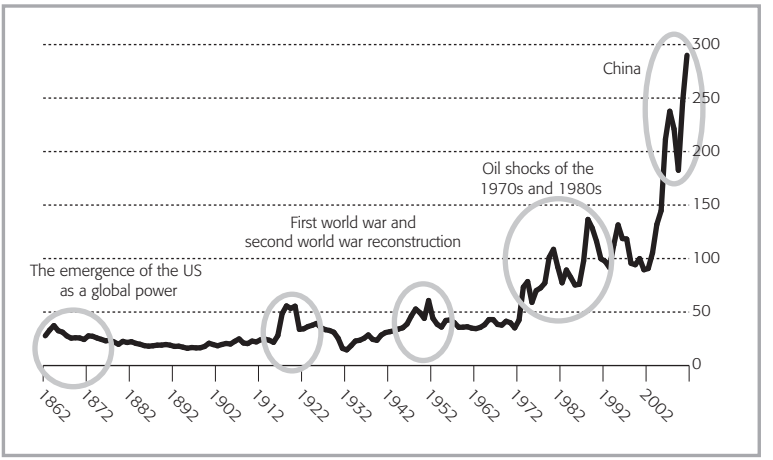
Another supercycle?

One theory that is often used to describe the recent surge in commodity demand is that we are in the midst of another commodity supercycle, one of those long waves – maybe 15–20 years or even longer – in which we move from a trough in commodity prices to a peak and back to a trough again. Typically, such waves are characterised by a fundamental or structural change in the global economy or by wars, revolutions or major technological innovations, for example in transport or communication.

Figure 1.2 shows *The Economist* industrial raw materials commodity price index going back to 1862 in nominal terms. Periods of commodity price inflation are highlighted. They coincide with structural change in the global economy starting with the industrialisation of the United States, the reconstruction of Europe and Japan after the first and second world wars, the oil shocks of the 1970s and 1980s, and ending with the industrialisation of China.

The analytical framework for supercycles was developed and expounded by two economists, among others, working separately, Nikolai Kondratiev in Russia and Joseph Schumpeter in the United

FIG 1.2 ***The Economist*** **industrial raw materials commodity price index**



Source: *The Economist*

States. Kondratiev outlined long waves or cycles spanning 40–60 years using commodity prices, interest rates, industrial production and external trade. His cycles involved a steady increase in economic activity coupled with low interest rates and rising prices. However, an inflexion or turning point is reached where asset price bubbles start to form, interest rates rise and economic growth slows. A final phase of the cycle involves recession or depression and an unwinding of the excesses of the earlier economic boom.

Within a supercycle you can have periods of short-term volatility, often in response to some exogenous (that is, outside the variables being considered) or unpredictable factors such as the weather or war, which can change the otherwise overriding trend in commodity prices. Schumpeter's work focused on these shorter cycles within the large supercycle.

The theory, as applied to commodities, suggests that a structural or fundamental change in the global economy – say, a war or a revolution or a major innovation in transport or communications – leads to soaring demand for natural resources. Supply fails to meet the unanticipated increase in demand, and prices rise. Supply of raw

materials then plays catch-up with demand. With most industrial raw materials, such as metals or energy, it can take years to bring new supply on stream, so there is a period of relatively high prices. By the time supply starts to meet demand, consumption may be tapering off, because following a period of rapid expansion demand growth starts to stabilise at a more sustainable level.

While economists undeniably like a theory to explain what is going on in the global economy, the theory – if you accept it – does serve a purpose. Investment decisions, particularly in the mining and energy industries, are based on a long-term outlook for demand and prices. Furthermore, countries that are rich in natural resources need to be aware of likely trends in commodity prices. However, it is easy to look back and analyse a 30-year period of high commodity prices, but much more difficult to look ahead and determine the next peak or trough.

Sceptics of the supercycle theory argue that periods of high prices are just a cyclical phenomenon, akin to the wider cycles based on fiscal and monetary policy followed by all economies. In looking at the recent decade of booming prices, it could be argued that excessively loose monetary conditions generated inflation and led to a bull market in commodities.

"Peak oil"

Another theory used to explain commodity market developments, but with a less benign outcome, focuses on the oil market and the fact that oil is a finite resource. It evolved from a paper published in 1956 by M. King Hubbert, a geologist working at a Shell research laboratory in Houston, Texas. The theory is that annual world oil supply has peaked and will be in terminal decline from now on leading to permanent upward pressure on oil prices.

Any finite resource such as oil, copper or coal follows a bell-shaped production curve, so that at some point a peak is reached and thereafter production declines. The decline mirrors the rise in production and is based on the extent of available reserves.

Implicit in this theory is that the world will engage in a scramble for these ever scarcer resources that will lead to conflict and even

wars. Until recently, it was claimed that Hubbert had successfully predicted the rise and subsequent fall of American oil production, but this can now be disputed. American oil production has started to rise again, albeit primarily from unconventional sources, and is expected to increase steadily over the next ten years. Furthermore, Hubbert's assertion that American oil production would peak in 2000 proved to be false.

One of the problems with the peak oil theory has been that both technology and prices were held constant in the original model. High oil prices and technological advances have made the extraction of oil from unconventional fields technically possible and economically viable. Breakthroughs in technology are also making it possible to exploit conventional resources that were previously impossible to extract.

Nevertheless, there is increasing awareness that many industrial raw materials are finite resources, which has led to increases in the recycling of metals and efforts at energy conservation. The peak oil theory is perhaps the most extreme manifestation of security of supply fears related to the world's relationship with commodities (see below).

Security of supply fears

Geopolitical tensions throughout history can often be traced back to efforts to secure natural resources, and the rise of resource nationalism (countries seeking to ensure that national resources are not exploited by foreign powers or multinational companies) has added to worries about a reliance on imported natural resources. Since the second world war, many countries have sought to be as self-sufficient as possible; this was evident in the 1950s development model in South America and still prevails in China, which seeks self-sufficiency in most basic foods. Compounding these "security" fears is the fact that many natural resources – notably all hydrocarbons and metals – are finite. Standard trade theory may suggest that countries should produce the goods in which they have a comparative advantage and then trade with other countries, but nation states feel vulnerable when they have to import what they consider essentials.

As a result, both food security and energy security are highly politicised and, in the case of the latter, have been an active component of foreign policy in some resource-scarce countries. In the past decade, countries exporting agricultural commodities have imposed trade restrictions when they have had bad harvests; Middle Eastern countries with limited water supplies have bought tracts of land or invested in countries with agricultural potential; and China has made massive investments in resource-rich countries, particularly in Africa. These are all attempts to ensure supplies of essential natural resources for domestic consumption. Fears about disruption to supply can have a strong influence on commodity prices.

Producer action

The often geographically concentrated nature of supply of many of the world's resources, for example the massive silver and copper belt spanning the Americas and the tin-producing region of South-East Asia, means there is considerable scope for the small number of producers to be powerful players in determining prices. During the 20th century, however, numerous attempts by producing countries to set prices, such as the International Coffee Agreement and the International Natural Rubber Agreement, fell apart. The only cartel-like body that has managed to survive and wield considerable power in the market is the Organisation of Petroleum Exporting Countries (OPEC), which now accounts for about 40% of global oil supply.

OPEC tries to set a target for output that it deems will meet oil-market needs but not lead to a fall in prices (unless oil prices are soaring unsustainably). The organisation has had a chequered history and mixed success. It cannot penalise member states that flout their targets and choose to free ride on the prevailing OPEC policy, and only one member state, Saudi Arabia, has the capacity to act as a swing producer and raise its output significantly in order to affect prices. Another problem is that producers can dictate only one side of the commodity trade: supply, a relatively blunt tool.

Are resources a blessing?

Resource-poor countries may fret about being reliant on the need to import what are deemed "strategic" goods, but economic history suggests that it is not always a blessing to be a resource-rich country. On the face of it, countries with sought-after resources have an advantage. They can use the resources for their own economic development (without fears about supply) and export the remainder, ideally at an attractive price. However, some of the wealthiest countries in terms of natural resources are the weakest in terms of gross national income or development.

One of the reasons for this is that the resource sector can crowd out the rest of the economy. Valuable resources, particularly if they attract a high international price (such as oil in recent years), may mean there is less incentive to develop other parts of the economy. Furthermore, the rich vein of commodity exports, and possibly the foreign investment that the country's resource attracts, may lead to exchange-rate appreciation, making the country's other exports less competitive and encouraging imports (again removing the incentive for developing domestic capacity). Another problem is that, aside from agriculture, the resource sector can be a small employer (mining, forestry and energy), and thus the sector does not contribute significantly to wider economic growth. During the 1970s, this phenomenon was labelled "Dutch disease" by *The Economist* in an article examining the decline in the Netherlands' manufacturing sector as a result of exchange-rate appreciation following a massive natural gas find in the 1950s.

Developing countries also worry that the economic benefits of the exploitation of their resources will go disproportionately to the foreign firms whose expertise is necessary to exploit them. Hence the rise of "resource nationalism" and an awareness of the pitfalls of being commodity rich, which has led many resource-rich countries to operate large sovereign wealth funds, keeping excess liquidity out of the domestic economy and preventing all the receipts from going into government current expenditure. Efforts are also being made to invest windfall revenue in human and physical capital.

A further problem for resource-rich countries is starting to be

addressed. In the past, countries that produced raw materials just exported them and the profits went mainly to those towards the end of the chain: intermediaries, traders, processors or retailers. This was the case particularly with some agricultural commodities; for example, West Africa exported cocoa beans to Europe and the United States and all the grinding and blending (or adding of value) took place in the destination countries. This trend was sometimes exacerbated by difficult access to importing countries as a result of tariffs (on higher valued-added goods), a proliferation of standards or public support policies including subsidies. Now processing is increasingly taking place in the countries that produce the raw materials.

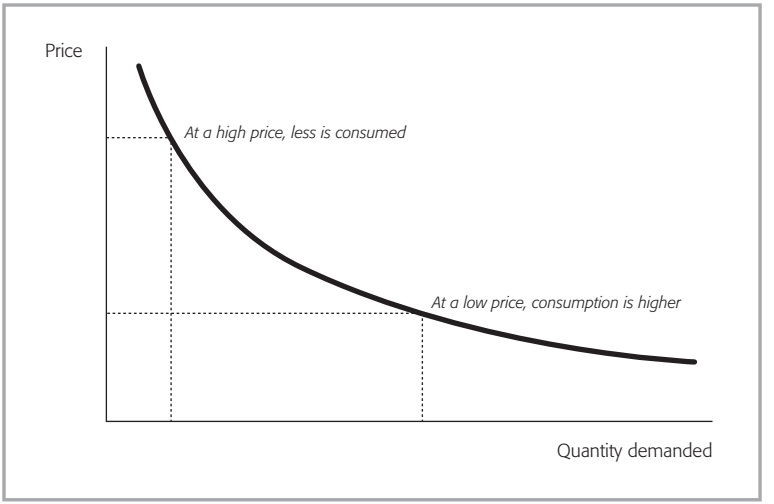
What determines the price of a commodity?

The cost of producing a commodity provides a floor for prices. In particular, producers look at the marginal cost of production – the total cost of producing an additional unit of output – to determine whether a project is viable. If the price of a commodity falls below the marginal cost of production, producers can be expected to scale back output. However, in reality producers sometimes continue to produce the good, hoping that the price will rise, or there are market distortions – such as subsidies – which mean production will continue.

The macroeconomic approach to commodity prices is broader, seeing price as a function of demand and supply and the behaviour of inventories (stocks). For example, if stocks are falling, there is typically upward pressure on prices as it suggests demand is growing faster than supply. Falling stocks also make the market more vulnerable to an unanticipated disruption to supply. If the demand for a commodity increases relative to its supply, the equilibrium price (or market-clearing price – the one at which both buyers and sellers are happy with price and quantity) moves up.

In theory, demand should have a positive relationship with economic growth and rising incomes but this is not always the case (see Figure 1.3). Demand is not always met; there may be demand for ever larger amounts of copper, for example, but the price may be too high or supply may be insufficient. To predict the level of consumption, we need to know something about the price elasticity

FIG 1.3 **Demand curve**



of demand (the responsiveness of consumption to a change in the price). As prices rise, will consumption start to wane or will it stay constant (called perfect elasticity of demand)?

This has been much discussed in recent years as commodity prices have risen. Typically, if a good is seen as a staple or a necessity, the price elasticity will be low, but what is considered a necessity in the United States (gasoline, for example) may be considered a luxury in other parts of the world. Other factors that influence price elasticity include the availability of (presumably cheaper) substitutes and the duration of the change in price. For example, a short, sharp spike in the price of fuel is unlikely to lead to a change in habits or consumption levels, but an enduring increase in prices might lead to permanently lower consumption.

Another relationship to be considered is income elasticity of demand. Do rising incomes lead to higher, lower or unchanged consumption of a good? Although you would expect higher incomes to lead to increased consumption, for commodities such as basic grains it could mean that consumption shifts in favour of more expensive foods, such as meat.

The supply side is also difficult to predict. Agricultural and some

mining industry output can be affected by unpredictable weather or, in the case of agriculture, the prevalence of disease. Geopolitical events, labour unrest and changes in government policy on taxes, trade or ownership can disrupt supply. The speed of supply response should also be considered. Producers of some agricultural products (sugar, soybeans) can respond quickly, within a season, to a change in demand or price; other agricultural commodities take longer (a coffee or rubber plantation). In mining and energy sectors, it can take a decade for production to come on stream. These industrial commodities face additional constraints including the need for skilled labour and high capital investment in developing the necessary infrastructure.

There is also uncertainty over stock levels, mostly to do with a lack of transparency over size and quality. Countries may build strategic reserves or stockpiles in some commodities, and if the level of their stocks is not divulged, physical consumption of the commodity will appear much higher in a country than it is. Stocks, however, can be stabilising in that they can smooth out the availability of a commodity when there are one-off disruptions to supply.

It is no longer possible just to assess the market fundamentals in order to determine the likely trend in a commodity's price. The dramatic rise in investment interest in commodities means that other factors have to be considered, including:

- global liquidity levels (high liquidity or loose monetary policy is generally believed to lead to higher commodity prices);
- the value of the dollar (most commodities are priced in dollars and thus the two typically have an inverse relationship, as commodities can, for example, provide a hedge against dollar weakness);
- movements in alternative assets (bonds, stocks);
- interest rates (unlike most financial investments, commodities do not pay interest – if interest rates are low, returns on other investments will be low and it will be easier for commodities to outperform other asset classes);

- investor behaviour or sentiment (investors are sometimes accused of following the herd);
- changes in the commodity-related financial products available;
- the oil price (other commodity prices sometimes follow the behaviour of the oil price).

Over the past century, commodity prices fell in real terms. One reason for this was that global growth was being driven by already well-developed economies. Unfair trade practices favouring the developed world, such as high tariffs, could also have been a factor. However, after years of low prices and underinvestment, when the surge in demand that was part and parcel of China's industrialisation during the 2000s came, commodity producers were not ready to meet it and so prices rose strongly. While demand and supply fundamentals undeniably appeared to have justified the recent price rises, the extent of the rise was compounded by investment inflows into commodity markets.

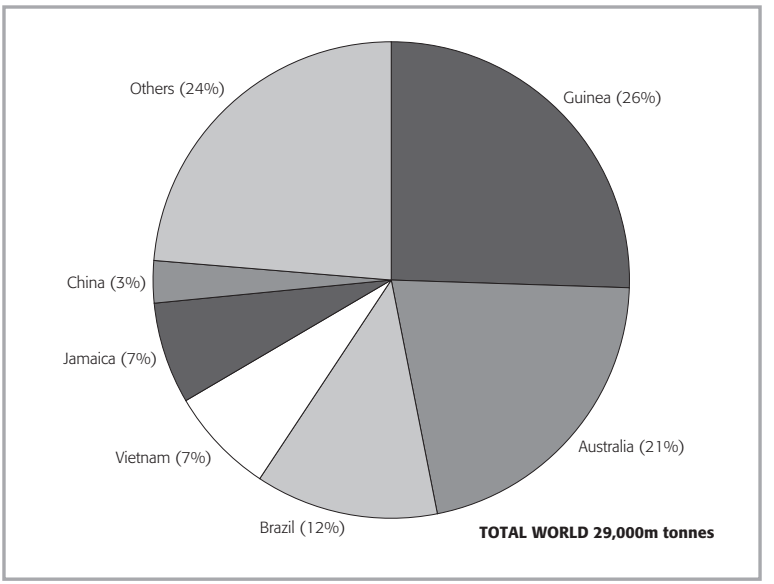
Aluminium

ALUMINIUM IS THE MOST ABUNDANT metallic element in the Earth's crust. It is found in large quantities in bauxite, an ore that contains aluminium oxide or alumina. Alumina has to undergo a complex smelting process that results in aluminium, the metal. Aluminium is lightweight but strong and these qualities are making it an increasingly attractive alternative to steel, particularly in cars. Its other properties include good conductivity, resistance to corrosion, elasticity and a low melting point (which makes it easily recyclable). It has a wide range of end-uses in, for example, the electronics industry, transport (particularly aircraft and vehicles), construction, cooking utensils and food packaging.

Bauxite: reserves and output

Bauxite typically contains about 30–35% aluminium and is mined primarily in tropical parts of the world. Guinea has the world's largest known reserves, followed by Australia and Vietnam (see Figure 2.1). Bauxite is plentiful and any supply shortages that emerge will be for economic (lack of profitability) or political (resource nationalism) reasons. However, in recent years, consumers have complained about a lack of availability of high-grade bauxite. Bauxite output rose by 6% year on year in 2011 as a result of increased production in Brazil, China, Guinea, India, Jamaica, Suriname, and Venezuela; Australia is currently the world's largest producer. In 2007, China overtook Australia as the world's largest alumina producer even though it has only limited bauxite reserves (about 3% of the world's reserves).

FIG 2.1 **Bauxite reserves, 2010**



Source: US Geological Survey

Processes and products

Alumina is extracted from the bauxite ore in a refinery using the Bayer process and is then smelted to produce primary aluminium. As a rough rule of thumb, 4–5 tonnes of bauxite produce about 2 tonnes of alumina, which is used to generate 1 tonne of aluminium. The production of aluminium is highly energy intensive (about 14,000kwh of electricity is needed to produce 1 tonne of aluminium) with the result that many smelters are located in energy-rich countries. The aluminium smelters use the Hall-Héroult process to produce ingot products (rolling slabs, extrusion billets, primary foundry ingots and remelt ingots) that are generally shipped in domestic or international trade for further processing – often within the same company – into semi-finished products such as sheet, extrusions, wire rod and castings.

Semi-finished products are used in the packaging, transport, construction, engineering and power industries, and are traded

mainly within regional markets. Such products are usually made from a combination of recycled (secondary) aluminium and primary metal.

Consumption and trade

Regional trends

The transport equipment industry is the largest consumer of aluminium in all forms, accounting for about 25% of consumption in 2008, followed by building construction (23%), packaging and electrical manufacturing (14% each). The most rapidly growing industry in the 1980s was packaging, but transport became the main growth industry in the 1990s. Data from the European Aluminium Association show that transport accounted for 37% of aluminium consumption in the EU in 2010, followed by building at 26% and packaging at 16%.

Aluminium consumption stood at just 18.7m tonnes in 1991, with the United States and the EU accounting for 30% and 22% respectively of the total. China's consumption accounted for just 5% of total consumption. Aluminium consumption subsequently grew at an annual average rate of 2.9% between 1992 and 1999 before accelerating to annual growth of 6.2% in 2000–07.

The principal driver of this growth was China, through urbanisation, infrastructure development, manufacturing growth and rising domestic vehicle ownership. China's apparent aluminium consumption growth was a robust 11.2% year on year in 2011 preliminary data suggest that it grew by a further 11% in 2012. (Apparent consumption includes aluminium that goes into stocks or is not used; real consumption is aluminium that is physically used.) Strong growth has also been recorded in India, Brazil and parts of South-East Asia.

Global consumption contracted by 7% in 2008–09, but strong growth has since resumed. In 2011, consumption of aluminium was 42.4m tonnes (see Table 2.1), with China accounting for 42% of the total, the United States 9.6% and the EU 16.7%. In Europe, consumption fell by nearly one-third in 2008–09, leaving only Germany, Italy and France among the top ten aluminium consumers in the world. European consumption has since recovered, led by Germany's

successful manufacturing industry. In the United States, consumption also fell sharply in 2008–09 and fell again in 2011 as the American automotive industry was hit by disruptions in the global automotive supply chain. Consumption bounced back in 2012 in conjunction with a recovery in vehicle production. However, consumption is still estimated to have been 17.1% lower than in 2007.

TABLE 2.1 **Leading aluminium-consuming countries**

	1991		2000		2011	
	'000 tonnes	% of total	'000 tonnes	% of total	'000 tonnes	% of total
China	938	5.0	3,499	14.0	17,629	41.6
US	4,137	22.1	6,161	24.6	4,060	9.6
Germany	1361	7.3	1,491	5.9	2,103	5.0
Japan	2,432	13.0	2,225	8.9	1,946	4.6
India	430	2.3	602	2.4	1,584	3.7
South Korea	384	2.0	823	3.3	1,233	2.9
Brazil	354	1.9	514	2.1	1,077	2.5
Italy	670	3.6	780	3.1	971	2.3
Russia	–	0.0	748	3.0	685	1.6
France	728	3.9	782	3.1	584	1.4
Others	7,310	39.0	7,434	29.7	10,526	24.8
Total	**18,743**		**25,059**		**42,398**	

Source: World Bureau of Metal Statistics

Trade

Demand in the former Soviet Union collapsed after 1990 and remains lower than in the 1980s, boosting export availability. Since 1992 Russia has become the world's largest exporter of primary aluminium and accounted for 26% of total exports in 2011. Canada is the next largest exporter with 11% of the market, with China some way behind with a 3.5% market share (see Table 2.2).

TABLE 2.2 **Leading exporters and importers of primary aluminium, 2011**

	Exports			Imports	
	'000 tonnes	% of total		'000 tonnes	% of total
Russia	5,582.7	26.1	US	2,695.7	13.0
Canada	2,486.1	11.6	Japan	2,692.7	13.0
Netherlands	1,895.2	8.9	Germany	2,554.9	12.3
Australia	1,680.3	7.9	Netherlands	2,070.6	10.0
Norway	1,428.9	6.7	South Korea	1,317.6	6.4
China	766.1	3.6	Italy	1,046.7	5.0

Source: World Bureau of Metal Statistics

Trade in aluminium has been falling as a share of world consumption from a peak of 66% in 2004 largely because China is self-sufficient. Exports accounted for 50% of total consumption in 2011. Imports of primary aluminium are typically duty-free but trade in semi-finished and finished products is more restricted. The exception to this is the EU, which imposes a 6% tariff on imports of primary aluminium.

Production and stocks

Refined production and smelting capacity

Aside from China, the greatest expansion in aluminium smelting capacity in recent years has been in energy-rich regions or countries with low-cost electricity such as Canada, Australia, Russia, Southern Africa and the Middle East. Nevertheless, it is China that has recorded the largest expansion in capacity, based mainly on coal-fired electricity.

China accounted for 41% of total aluminium production in 2011 and its output grew by 26% and 11% year on year in 2010 and 2011 respectively. Output was also growing at an average annual rate of 10% for much of 2012. Chalco, the state aluminium company, controls a large block of production, but there are numerous small smelters that are owned by local government and private interests. In recent years, the government has sought to curtail the expansion

of the aluminium sector as China is a net exporter of aluminium and because of the energy-intensive nature of production – the sector is estimated to account for about 6% of China's electricity use. The government has raised export tariffs and lowered value-added tax rebates, which, coupled with rising power and labour costs, is leading to a fall in the price competitiveness of China's aluminium (as well as hitting corporate profitability). Notwithstanding the government's efforts at consolidation, production has generally followed the trend in prices, reflecting the large number of small, marginal producers who raise production when prices are high. China's 20 largest smelters account for about 70% of China's capacity and about 30% of world output.

Until 2000, the United States was the world's largest producer of primary aluminium, owing to low-cost hydroelectric and coal-fired power (see Table 2.3). Since then problems with the availability and cost of power, as well as difficulties with alumina supply, have led to smelter closures so that in 2011 it accounted for less than 5% of global output and is a large importer of primary metal.

In Europe, consumption now greatly exceeds production – aluminium casting and semi-fabricating are labour-intensive operations and there has been considerable migration of activity to lower-wage countries – and dependence on imports is increasing. Norway and Iceland significantly expanded primary aluminium production in the 2000s, helping to meet the EU's large import requirement. The EU also imports from former colonial countries in Africa under duty-free import arrangements, supplemented by traditional exports from Russia to neighbouring EU member countries. High energy and raw material prices since 2005 have again brought into question the viability of primary aluminium smelting in western Europe, as have stringent legislation on reducing carbon emissions and the adverse economic conditions.

One region that has seen a significant expansion in aluminium production capacity is the Middle East, in particular countries in the Gulf Co-operation Council (GCC), and projects in progress suggest that their share of total output will increase. Production in the United Arab Emirates expanded by 31.4% in 2011 to just under 1.8m tonnes; in Qatar production reached 408,000 tonnes in 2011, compared with

TABLE 2.3 **Leading aluminium-producing countries**

	1991		2000		2011	
	'000 tonnes	% of total	'000 tonnes	% of total	'000 tonnes	% of total
China	962	4.9	2,794	11.4	18,062	40.5
Russia	–	0.0	3,247	13.3	3,992	9.0
Canada	1,822	9.3	2,374	9.7	2,983	6.7
US	4,121	21.0	3,668	15.0	1,984	4.5
Australia	1,229	6.3	1,762	7.2	1,945	4.4
UAE	239	1.2	536	2.2	1,765	4.0
India	504	2.6	649	2.7	1,660	3.7
Brazil	1,140	5.8	1,271	5.2	1,440	3.2
Norway	858	4.4	1,026	4.2	1,202	2.7
South Africa	169	0.9	683	2.8	808	1.8
Others	8,610	43.8	6,409	26.2	8,727	19.6
Total	**19,653**		**24,418**		**44,568**	

Sources: World Bureau of Metal Statistics

145,700 tonnes a year earlier; and Saudi Arabia is developing a bauxite mine and smelter operations (with a capacity of 740,000 tonnes per year) that are expected to come on line in 2013–14. Typically, electricity costs are highly subsidised in the GCC, significantly boosting the profitability of aluminium production.

India, which has ample reserves of bauxite and domestic coal, is also trying to raise aluminium production. However, there has been environmental and public opposition to the development of bauxite mines and India is struggling with domestic coal production and power supply.

Secondary production

The secondary aluminium industry comprises remelting operations that recycle specific grades of scrap, such as aluminium cans, to produce rolled and extruded products, and smelters that turn scrap

into ingot for castings. Some large aluminium companies participate in remelting, but many have left the secondary aluminium industry, which is dominated by small independent companies.

There has been rapid growth in demand for castings, but the profitability of secondary smelting fluctuates depending on the availability and price of scrap. In 2011, secondary production accounted for nearly 20% of total aluminium production. The United States dominates secondary production, accounting for 35% of total production in 2011; western Europe accounted for a further 30% and China for 13.6%. Secondary aluminium smelting uses only about 5% of the energy required for primary smelting, so it is likely to be encouraged as part of efforts to reduce carbon emissions and conserve energy.

Stocks and related issues

Although aluminium is a strategic metal, government stockpiles are insignificant and have no influence in the market. The most active government purchaser in the past was South Korea's Supply Administration, acting as a conduit for material to smaller domestic consumers. Periodically central and provincial governments in China purchase aluminium ingots as a support for domestic producers. These are then sold back to the market when prices are deemed attractive.

Commercial stocks of aluminium were high in 2011–12, partly because low interest rates made it cheap to hold stocks and partly because of sluggish demand growth. However, much of the metal was held by banks and traders and tied up in warehousing deals. The deals rely on a combination of low interest rates, financial incentives and the fact that spot aluminium was trading at a large discount to longer-dated futures. If interest rates start to rise, these stocks could be released. An additional problem is significant delays in accessing stocks. In 2012 the London Metal Exchange (LME) raised the minimum rate at which its biggest warehouses must deliver (to 3,000 tonnes/day from 1,500 tonnes/day previously) and increased the rental costs for users to store aluminium. However, reportedly there were still long delays in releasing stocks, so that it can take months to obtain

metal stored in, say, the Dutch port of Vlissingen, the Malaysian port of Johor and the American port of Detroit.

Principal corporate players

Many of the largest companies in the aluminium industry are integrated businesses, with operations at most stages from bauxite to semi-finished products. In the mid-2000s, there was widespread consolidation among the world's leading aluminium-producing companies, particularly in Russia and China. The result is that four large companies – Chalco (China), Rio Tinto (UK/Australia), UC Rusal (Russia) and Alcoa (United States) – now control about one-third (2011) of the world's aluminium production (see Table 2.4).

Despite the emergence of Western-style integrated companies in Russia and China, the huge rise in production by smaller enterprises in China has increased the capacity of independent producers and reduced the share of the largest companies. The 12 largest producers now control only 56% of world capacity.

TABLE 2.4 **Leading aluminium-producing companies, 2011**

Company	Country	Output, '000 tonnes
UC Rusal	Russia	4,127
Rio Tinto Group	UK/Australia	3,829
Alcoa	US	3,669
Aluminium Corporation of China (Chalco)	China	3,127
Norsk Hydro	Norway	1,705
Dubai Aluminium	UAE	1,386
China Power Investment Corporation	China	1,381
BHP Billiton	Australia	1,249
Shandong Xinfa Aluminium and Electricity Group	China	1,016
Aluminium Bahrain	Bahrain	881

Source: Bloomberg (data compiled by CRU Group)

The aluminium market

Although much metal is moved within integrated company systems, primary aluminium is widely traded. Market pricing has been made transparent by the LME, which has traded primary aluminium since 1978. Although metal is still sold directly between producers and consumers on prices fixed for various periods, the setting of those prices is now overwhelmingly influenced by the LME quotations, particularly the 3-months future quotation.

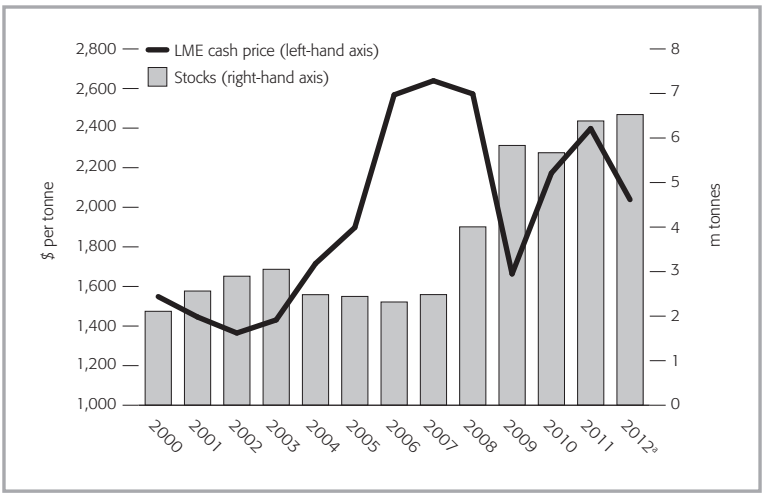
The LME quotation refers to aluminium in ingot form, import duty unpaid, in LME warehouses around the world. To receive physical delivery of the particular qualities of duty-paid metal that they require, consumers normally pay an additional charge (premium) above LME prices. There are also further charges for shapes and alloys other than 99.7% pure ingot. Since the late 1990s the pricing of semi-fabricated aluminium products has also moved steadily towards a method of pricing based on the LME price of primary aluminium plus a conversion charge. This has replaced specific negotiated prices for semi-fabricated products.

Aluminium is now traded on a number of exchanges around the world, notably the Shanghai Futures Exchange and the New York Commodity Exchange (COMEX) and also exchanges in Singapore, Rotterdam, Japan and Malaysia.

Price trends

Prices of aluminium soared from an annual average of $1,898 per tonne in 2004 to a peak of just over $3,200/tonne in early July 2008. However, the onset of the global financial crisis caused aluminium prices to plummet, with a low of $1,253/tonne reported in the first quarter of 2009. At this level aluminium producers were making a loss and subsequent cuts in output coupled with a bounce-back in consumption led to steady increases in aluminium prices during the remainder of 2009 and into 2010–11. But jitters about financial stability in the euro zone and global economic growth more generally coupled with weak automotive production meant that prices slipped again in the second half of 2011. Automotive production was particularly weak in 2011 because of the negative impact on global supply chains

FIG 2.2 **Aluminium stocks and prices**



a EIU estimates.
Sources: London Metal Exchange; World Bureau of Metal Statistics; International Aluminium Institute

of the damage caused by the March earthquake in Japan and severe flooding in Thailand later in the year.

Prices started to recover in early 2012, peaking in February before starting to slip once more, falling below $2,000/tonne in May. They rose above this critical level in September as part of a general rally in commodity prices, but fell back below $2,000/tonne in October. Prices oscillated around the $2,000/tonne level for the remainder of the year, so in annual average terms prices fell by 15.8% in 2012 (see Figure 2.2). The cause of the downturn was generally attributed to rising production in China at a time of weak demand.

The future

- Demand for aluminium will be supported by steady growth in car ownership in countries such as China and India. Alongside its use in construction, consumer goods and packaging, the metal's lightweight properties will ensure that it will be in considerable demand in the production of lightweight, fuel-efficient aircraft and cars. Its easy recyclability will also make it a greener option for end-users.

- The energy-intensive nature of aluminium production means that production is likely to become more polarised in energy-rich countries. It is also likely to move to lower-wage regions of the world. This combination suggests EU production is in structural decline.
- The policy of the Chinese government is to discourage such energy-intensive activities as smelting and to rely more on external sources of metal for the domestic semi-finishing industry. It has declared its intention to close 800,000 tonnes of obsolete aluminium capacity and to restrict its primary aluminium consumption to no more than 24m tonnes/year by 2015. However, progress on these goals is likely to be gradual as recent history suggests that every upturn in metal prices will prompt some new projects in China.
- High energy costs and environmental issues are limiting output growth both in China and globally. These restrictions and the high cost of inputs (both energy and bauxite) mean there will be an increased focus on boosting the use of recycled aluminium instead of refining new metal.
- Limited bauxite supply could constrain aluminium supply as importing countries are dependent on a few main exporters. In 2012, Indonesia (which accounted for 80% of China's bauxite imports in 2011) imposed a 20% tax on bauxite exports that led to a sharp drop in exports.