

*A Handbook of*  
Primary  
Commodities  
*in the*  
Global  
Economy

MARIAN RADETZKI

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## *A Handbook of Primary Commodities in the Global Economy*

The world is going through an exceptional commodity boom triggered by a global demand shock largely caused by the sudden emergence of China and India as sizeable raw material importers. Prices of numerous commodities tripled between 2003 and 2006, resulting in huge windfalls for producers and a financial squeeze on consumers. *A Handbook of Primary Commodities in the Global Economy* is a guide to the ins and outs of this increasingly crucial part of the world economy. Assuming nothing more from readers than a basic understanding of economics, Marian Radetzki introduces and explains pertinent issues surrounding international commodity markets such as the global geography of raw materials, price formation, price trends, the role of commodity exchanges, the threat of depletion, cartel action, state ownership and the new commodity nationalism.

MARIAN RADETZKI is Professor of Economics at Luleå University of Technology, Sweden. He is the author of over 20 books and has undertaken a number of consulting assignments for multinational corporations, governments of developing countries, and international organizations like the World Bank and the UNDP.





# A Handbook of Primary Commodities in the Global Economy

MARIAN RADETZKI



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No less than three of my current and/or former professional bases have been instrumental for the initiative to write this book. I spent the spring semester of 2007 as a visiting professor of mineral economics at the Mining Center of the Catholic University in Santiago de Chile. As I presented my research results from several decades of work in a graduate seminar, my colleague professors and doctoral students made strong efforts to convince me about the need for an overview publication on the subjects I treated, to be used as a substitute when I was not available in person. At the time I was less than entirely convinced, but further strong enthusiasm was expressed about the project when I returned to the Economics Division at Luleå University of Technology in northern Sweden, my permanent academic base, where I have held a chair in economics for more than fifteen years. Only then did I approach Cambridge University Press, still with considerable hesitation about the endeavor, to explore their interest to publish. My remaining doubts dissipated when, soon after, I was approached by SNS (Center for Business and Policy Studies), a Swedish think tank with which I had been associated for many years on a part time basis. SNS wanted to bring out a Swedish edition of the manuscript I had proposed to Cambridge. Additionally, SNS was prepared to approach its associates in the business community and to generate a package of financial support for the project.

While the work went on, between June 2006 and May 2007, I often cursed those who had persuaded me to undertake it, and wondered if my decision to go ahead was right. Now that the project has been completed, I am grateful to them all.

Many people have contributed intellectually to the endeavor. I wish to acknowledge my gratitude for the numerous valuable comments, some very substantive and requiring considerable labor inputs to handle, others related to detail, but all helpful in improving the manuscript that follows. I list the individuals involved, all

professional colleagues, many also close personal friends, in straight alphabetical order, hoping that no one has been overlooked. They comprise Phillip Crowson, Carol Dahl, Graham Davis, Magnus Ericsson, Torbjörn Fredriksson, Chris Gilbert, Alfonso Gonzalez, Jim Griffin, Juan Ignacio Guzman, David Humphreys, Torbjörn Iwarson, Alexandra Laurent, Olle Östensson, and John Tilton. Additionally, parts of the manuscript have been constructively discussed at graduate seminars in Luleå. Fredrick Otterheim has painstakingly collected and organized the statistics. It is as if the work were the result of a collective rather than individual effort, but while my commentators should be credited with the improvements that have been implemented, I am solely responsible for the errors and deficiencies that still remain.

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Marian Radetzki

# Introduction

## Background

My book *A Guide to Primary Commodities in the World Economy*, published by Blackwell in 1990, is the antecedent to the present work. International commodity issues have been the focus of my professional attention ever since the 1960s, and that book, a broad review of the subject, summarized what I had learnt over the preceding decades. I was pleased with the interest that the book generated and with the positive reviews it received, but its publication clearly had an inopportune timing.

The decades of the 1980s and 1990s can be characterized as a period of indifference, insofar as raw materials go. Real prices of non-fuel commodities had a clear downward trend from as early as 1974 and until 2002. Despite the efforts of the OPEC cartel, long-run fuel prices experienced a trend decline from 1981 to 1998, with a recovery to somewhat higher levels in the following four years, quite modest in the perspective of what would follow.

Through this extended period of doldrums, the supply conditions for most commodities were quite relaxed most of the time. The advanced economies were in a process of dematerialization, where decreasing volumes of raw materials were needed per unit of value added. This suppressed demand growth and reduced the significance of commodities in their macro-economies. While these circumstances prevailed, security of supply assumed a low priority for users. The major problem among producers was to cope with excessive capacity and weak profitability. The speculators' interest was muted by the relative calmness and declining prices in commodity markets. For the same reason, non-commercial investors like pension funds and mutual funds had little incentive to engage in longer-term placements in commodities. These actors, instead, directed their investments to fields like information technology or sophisticated services, where markets

appeared to provide a better profit potential. Against this background, interest in commodities dwindled also in the academic community. Researchers found more fertile ground for their efforts in other sectors of the economy, while students lost interest. Commodities were simply not a rewarding career area.

Circumstances have been radically different in the first decade of the twenty-first century. Between 2002 and 2006, the prices of all fuels and many metals doubled or rose even more. Numerous agricultural raw materials also experienced a sharp price increase. Primary commodities became truly hot stuff, with current events in the commodity markets regularly displayed on the first pages of newspapers and magazines, and figuring prominently on TV screens.

Fast global economic expansion provides the major explanation for the demand shock that has pushed up commodity prices. A special role has been played in this context by China and India, two countries with a record-breaking growth that have recently emerged as very sizable commodity importers.

Earlier attitudes of commodity complacency among consumers shifted towards worries about security of supply with the realization that commodity supply is indispensable, and that even prosperous dematerializing economies cannot function without safe raw material inputs. This resulted in increased demand for inventories, and efforts to establish priority positions for supply. Heavy users of commodities in the manufacturing sector have seen their profits fall in consequence of the rising prices. This has been particularly true for producers of automobiles and white goods, which are intensive metal users.

Producers of primary commodities, in contrast, have experienced an unexpected profit surge. Investments in capacity growth have been stimulated by the high prices, to the extent of exhausting the immediate availability of investment inputs. Capacity expansion has also been restrained by fears among commodity producers of a forthcoming price decline, for serious doubts remain about the widespread claim that a vaguely defined “structural change” will assure the sustainability of high price levels.

The rising commodity prices have galvanized the managers of hedge funds, pension funds and other capital portfolios to invest in commodities both as a means of diversification and for the prospect of significant profit opportunities. Persevering low inventories in some markets along with political uncertainties about future supply have

destabilized prices and attracted speculators to the commodity world. The financial investments and the intensified speculative activity have pushed up prices even further than warranted by commodity market fundamentals.

For all the above reasons, primary commodities have come to attract accentuated attention from many quarters, after decades of indifference and neglect. In my view, this situation will remain for some time, because the current commodity boom will prove more durable than its predecessors of 1950–1 and 1973–4. The earlier boom events were short-lived, and collapsed as the world economy went into recession. In mid-2007, as this is being written, no recession is in sight, so the commodity boom is likely to persevere until the ongoing investments in new capacity become productive, and that will take several more years. In the meantime, commodities will remain in the limelight.

### **An opportune time to publish**

The present, therefore, is a period of strong interest in commodity-related issues, making it an opportune time for launching the publication of a broad-based book on primary commodity markets in the international economy. This is especially so since, to my knowledge, no such book has been published since 1990, when my old opus appeared.

The text which follows provides a comprehensive overview of pertinent issues relating to primary commodities in the global economy. The basic structure of the old book has been retained because I believe that it continues to be valid and appropriate. Major components in that structure cover:

- The geography of commodity production and trade;
- The distortions of production location and comparative advantage caused by protectionist trade policies;
- The institutions of price formation; the causes to short-run price instability and long-run price trends; the role of commodity exchanges;
- Fears for, and measures to ensure, the importers' supply security;
- Prospects for successful monopolistic producer collusion;
- Trends in, and implications of, public ownership;

- Issues raised by a very high national dependence on commodity production and exports.

So much has changed over the past twenty years that a mere updating of the old text was completely inadequate. All the above themes have therefore been thoroughly rewritten.

New portions have been added to cover what I formerly overlooked or to explore newly emerging phenomena. The additions comprise:

- A historical framework, covering (a) the declining role of the primary sector in the national economy in the course of economic development; (b) the falling transport costs and the globalization of primary commodity markets; and (c) the pendulum swings between public intervention and free rein of market forces in the commodity industries;
- The shift of the center of gravity of the world economy and of primary commodity consumption from the prosperous OECD nations towards populous, developing Asia;
- The changing directions of the global trade flows, with developing countries greatly expanding their exports of manufactures and losing their dominance as net exporters of raw materials;
- The recent role played by China and India as consumers of imported primary commodities;
- The increasing reliance on commodity exchanges, providing valuable opportunities for stabilizing hedging, but at the same time widening the scope for speculative activity;
- The widespread fears, accentuated by the most recent commodity boom, that depletion will compromise human welfare by constraining the supply of critical materials, prominently manifested by the claims that “peak oil” (and “peak gold” or “peak copper”) is impending;
- The revival during the 2000s decade of the popularity of nationalization and state ownership in some resource-rich countries and industries.

The subject of primary commodities in the global economy is vast, and not all its aspects can be treated within the confines of a single tome. The focus is on the economics of commodity production and trade in a somewhat narrow sense, while issues related to, e.g., employment, regional development and the environmental impacts

of commodity production and trade do not receive any detailed attention in the following chapters.

## **The readership**

The subject treatment is firmly based on standard economic theory and economic logic, but I have consciously avoided technical jargon and algebra. Readers with only basic training in economics should therefore find the text fully accessible.

Despite the omissions mentioned above, the book offers a comprehensive exposé of the commodity world in the international economy, and I am aiming at a broad readership. While experts in a particular aspect of that world will probably not gain any substantive new insights in their specialization, I am convinced that reading this book will provide them with a valuable context from which to pursue further work in their chosen field.

The categories of readers that should find the book of interest comprise:

- Students in economics, finance, business administration and related disciplines, with an interest in primary commodity markets. Researchers who have chosen a specific commodity or a specific commodity-related issue as their area of specialization, who desire a snapshot overview of the entire commodity economics field.
- Executives responsible for marketing or investment decisions in firms that produce and export primary commodities.
- Executives responsible for purchase management strategies and their execution in firms whose production relies heavily on raw materials inputs.
- Members of the financial community with an interest in primary commodities for the purpose of speculation or as an object for financial investment. Such individuals would be found on the commodity exchanges and in organizations that manage capital portfolios, like hedge funds, pension funds and mutual funds, but also in financial institutions that develop and market instruments for commodity placements.
- Government officials, in nations heavily dependent on primary commodity production and exports – Chile, Peru, Botswana, Ghana, Mongolia and Papua New Guinea provide examples.

Government officials in countries that rely heavily on commodity imports should have an equally strong interest in the analyses presented below. These would comprise China, the EU, Japan and the US.

- Finally, the book should find many additional readers among the broad general public concerned about rising energy prices and the future availability of commodities.

# 1 | *The historical framework*

This chapter treats three themes, intended to provide a historical framework for the analysis of commodities in the rest of the book. The *first* theme reviews the significance of primary commodities in the overall economy at different stages of economic development. The *second* tracks the long-run decline in bulk transport costs, and explores the implications of this decline for the establishment of markets with a global reach for an increasing group of raw materials. The *third* theme focuses on the twentieth century. It demonstrates the greatly expanded role of public intervention and control, in primary commodity production and trade from the early 1930s until the late 1970s, and the subsequent retreat of government involvement in favor of market forces.

## 1.1 Primary commodities in the economic development process

For the purpose of the present section, I derive a definition of primary commodities from the national accounts, to equal the value of output from the primary sector, comprising agriculture (including hunting, forestry and fishing), mining and utilities. These are the activities which supply unprocessed raw materials of agricultural and mineral origin, along with fuels, electricity and potable water, for use by other sectors of the economy. An alternative and somewhat wider definition, derived from foreign trade statistics, appears to be more appropriate for most of the subject treatment in the rest of the book. It is discussed in chapter 2.

The significance of primary commodities in a national economy is reduced in the process of economic development. Long historical series to vindicate this statement are hard to come by, given that national accounts were not prepared prior to the twentieth century, and reconstructions of a more distant past lack common standards.

Simon Kuznets (1966) presents the following assessments of the shares of agriculture and mining (but not utilities) in GDP in selected countries over extended periods of time. The contraction in the primary share emerges starkly from his figures:

Australia	c:a 1860	36%	c:a 1940	26%
Italy	c:a 1860	55%	c:a 1950	26%
UK	c:a 1905	41%	c:a 1950	13%
USA	c:a 1870	22%	c:a 1960	5%

Data on a more systematic basis do not become available until the late 1930s, and I have extracted in table 1.1 time series (again excluding utilities) for selected countries for which these series are reasonably complete. As in the numbers provided by Kuznets, the primary share exhibits a dramatic decline as the economies develop over time. The table additionally reveals far lower primary shares at each point in time for rich, advanced countries like Canada, Italy, Japan and the USA, compared to poor ones, e.g. India, Thailand and Turkey. A closer look reveals that in most cases agriculture predominates in the primary sector. In Kuznets' assessments, for instance, the agricultural sector exceeded four-fifths of the total for the initial year, except for Australia, where the share was more than three-fifths. Because of its dominance, agriculture also accounts for most of the recorded decline of the primary share over time. The decline in the much smaller initial share accounted for by mining is much less accentuated. In some cases (Italy, USA) that share appears to have remained relatively stable through the economic development process (Kuznets, 1965).

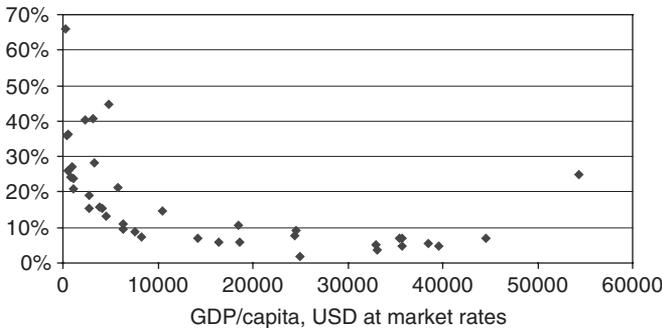
Concurrent cross-section data confirm the findings derived from the time series: There is a strong reverse correlation between the level of economic development, measured by GDP/capita, and the share of the primary sector in the economy. Figure 1.1, which comprises utilities, provides a clear-cut demonstration.

Exceptions to this regularity require mention, and Norway is an illustrative example. Its primary share has shown no decline over time in table 1.1, and the country represents the extreme outlier position in figure 1.1, combining a very high income level with an equally high primary sector share. The traditional importance of fishing in the

**Table 1.1** Share of agriculture and mining in GDP, percent. Time series, 1938–2002

	1938	1955	1975	1995	2002
Argentina	25	19	15	8	8 (2001)
Canada	19	14	10	7	8 (2000)
India	–	45	40	31	25
Italy	28	25	9	3	3
Japan	23	24	7	2	1
Norway	15	16	12	16	24 (2001)
South Korea	–	46	27	7	4
Thailand	48	46	34	14	13
Turkey	48	43	29	17	16 (1997)
USA	11	7	8	3	3 (2001)

Source: UN (annual b).



**Figure 1.1** Share of primary sector in GDP in 2004

Note: 38 countries selected to assure a wide spread in per capita GDP. Primary sector defined as agriculture, hunting, forestry, fishing, mining, and utilities.

Source: United Nations Statistics Division, National accounts main aggregates database, <http://unstats.un.org/unsd/snaama/dnllist.asp>.

country’s economy explains the high weight of the primary sector until the 1960s. The subsequent development of offshore oil and gas has made Norway exceedingly rich, while expanding the primary share even more.

The data show clearly that the dominant pattern is a decline in the primary share of the economy as nations develop. In rich market

economies the primary sector seldom exceeds 5% of GDP. Even in sparsely populated Australia and Canada, with an abundant export-oriented agriculture and a rich mineral endowment, the primary sector contributes less than 10% of overall national value added.

The finding that the primary sector exhibits declining importance as economies develop is not particularly surprising. Simply expressed (and abstracting from the possibilities offered by foreign trade), a key element in the economic development process is rising productivity, which permits the satisfaction of raw materials needs with ever lesser factor inputs. Labor and capital can then be switched to the secondary sector, i.e., production of manufactures whose sophistication typically increases over time. As manufactures demand, too, is eventually saturated, the factors of production can migrate again, now to the service sector. The overall economy expands, but the secondary and tertiary sectors more than the primary one, leaving the latter with a declining share of the total.

With this perspective, the path of economic development can be seen as a process of dematerialization. Since all material inputs originate in the primary sector, and since this sector accounts for a shrinking share of the total, it follows that each dollar's addition to GDP will carry a material weight that declines over time. Table 1.2 illustrates what is involved. It presents the value in US\$ (2000) per kilogram of a set of goods and services, listed in an ascending order. The higher the value, the less primary material inputs will be needed per dollar value represented by the items. The essence of economic development is to move the center of the economy's gravity down the list, towards goods with ever higher value per kilogram. In consequence, the raw materials input needs will grow more slowly than the overall economy, as countries grow richer. Materials savings will be further boosted by technological progress, which is typically weight reducing. It is conceivable that the need for primary materials inputs could stagnate and plausibly even shrink, as growing rich economies become increasingly dematerialized.

It is easy to become complacent about the role and importance of the primary sector when its share of the economic activity settles at no more than a few percentage points, as is the case in many advanced nations. Complacency may be in place so long as commodity markets function smoothly, and existing needs can be satisfied without serious hurdles. Complacency may also be encouraged by the fact that

Table 1.2 Value in US\$ per kg at prices in 2000

Iron ore	0.02
Steam coal	0.03
Wheat	0.12
Crude oil	0.21
Standard steel	0.25
Newsprint	0.40
Supertanker	2
Motorcar	15
Dishwasher	25
TV set	60
Submarine	100
Large passenger aircraft	600
Laptop computer	1000
Mobile telephone	2000
Jet fighter	6000
Windows 2000 Software, CD Rom	20000
Telecom satellite	40000
Banking service	almost $\infty$

Source: Own computations.

sophisticated modern economies have become masters of substitutability, permitting them to do without a particular material. But the ability to substitute will be of no help against a general constraint on supply for raw materials in aggregate, for it is overwhelmingly clear that not even the most modern economy can function without assured raw materials availability. The population will die if food supplies fail. The manufacturing sector is critically dependent on raw materials inputs, even if the volumes needed have shrunk impressively compared to the value of manufactured output. The service sector may require quite insignificant inputs of raw materials, but it clearly cannot function if these supplies fail. The classical Paley Report (Paley, 1952) puts it quite succinctly:

The Materials Problem now demands that we give new and deep consideration to the fundamental upon which all employment, all daily activity, eventually rests: the contents of the earth and its physical environment.

Primary commodities are indispensable, just like an ordinarily inconspicuous glass of water that acquires an immense value in the desert.

This is easily forgotten, given the economic insignificance of raw materials in “normal” times when their availability is taken for granted.

## 1.2 Declining transport costs and the emergence of global commodity markets

Prior to the mid-nineteenth century, freight rates on long hauls were prohibitively high except for goods with very high unit prices. In consequence, global commodity trade at the time was small in volume and consisted in the main of highly valued luxuries like coffee, cocoa, spices, and precious or semi-precious metals, imported predominantly to industrializing Europe (Landes, 1980). The main subsequent changes in transport technology and transport costs for bulk materials, it seems, occurred in two spurts. The first took place in the latter half of the nineteenth century; the second began in the 1950s, but its effects came to fruition only in the 1970s. Each involved the globalization of numerous additional markets for commodities which until then had had no more than a local or regional reach. Globalization involves not only trade flows across oceans and between continents, but also, importantly, a convergence of prices across regional markets.

In the latter half of the nineteenth century, the application of steam power to transport revolutionized the economics of moving goods on land as well as across oceans. A large group of raw materials produced at increasing distances from the coast in overseas territories became economically accessible to the world’s industrial centers as overland transport by oxen, horses and camels was switched to railways, and as metal steamships replaced wooden sailing vessels. This becomes dramatically evident in Paul Bairoch’s (1965) numbers for the cost of shipping cotton and wheat from New York to Liverpool in constant (1910–14) dollars per ton:

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1825:55.1	1857:15.7	1880:8.6	1910:3.5
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Shipping costs are akin to tariff barriers. Little trade will typically take place when the transport charges account for a dominant share of delivered price. Trade will be encouraged as this share declines.

The evolution of cereals imports into (Western) Europe provides vivid illustrations of the evolving impact of transport cost decline on

the widening of production sources. Odessa's short-run glory as a leading European port in the mid-1800s was based on booming shipping of Russian and Ukrainian rye and wheat to Western Europe. Much of this trade was lost in the 1870s, first because of a flood of steam-shipped American wheat after the end of the US Civil War, and then the extension of Russian railways which took over the transport of remaining Russian cereals exports (*Economist*, 2004). At the same time, new rail connections from the prairies around Chicago to New York made the US cereals even more competitive in Europe. The bulk transport revolution continued during the following decades. Between 1880 and 1910, the transatlantic shipping cost declined from 18% to 8% of the price of wheat in the USA (Bairoch, 1965).

The 1880s also saw the introduction of refrigerated ships, permitting long-distance transport of meat and fruit. The globalization of the markets for many food products speeded up European industrialization by assuring cheaper food supplies to the growing numbers of urban industrial workers. But it involved painful adjustments for European farmers, who lost out in many food products and agricultural raw materials like cotton and wool to overseas supplies. The impact was profound: in the 1850s, two-thirds of British bread consumption was based on domestic cereals; by the 1880s that proportion had shrunk to 20% (Dillard, 1967).

The second spurt in transport technology was far more specific, and it was importantly triggered by the Suez crisis in the mid-1950s. The shipping industry's response to the canal closure was to opt for specialized huge bulk carriers, along with the concomitant loading and unloading facilities in the harbors, to permit economic transport of low-value products like iron ore, steam coal, bauxite and oil across vastly extended distances. The impact of the effort began to be felt only in the 1970s. The result was a further dramatic decline in the cost of shipping, particularly accentuated for the truly extended, trans-oceanic transport routes.

Between 1960 and 1988, the average size of the bulk carrier fleet had more than doubled. In 1960, virtually all internationally traded iron ore and coal was shipped in vessels of less than 40,000 dwt, but this proportion had declined to 10% or less by 1988. Carriers in excess of 100,000 dwt did not exist in 1960, but by the latter year they accounted for 70% of iron ore and 40% of coal shipments (Lundgren, 1996).

The economic impact of the new bulk transport technology was very substantial, and especially so for the mining industries. Many European miners faced problems akin to those experienced by the farmers 120 years earlier. Freight rates for Brazilian iron ore to Europe declined from \$24 per ton in 1960 to \$7 in the early 1990s. At the same time, the much shorter shipping costs for iron ore from Narvik in Norway to Germany were reduced from \$8 to \$4. The geographic protection afforded to the Swedish supplies shipped through Narvik thus shrank from \$16 to only \$3 (Lundgren, 1996). The freight rate as a proportion of total price for US coal in Western Europe was reduced from more than 30% to less than 15% in the thirty-year period. The consequence was a fast evolution of global markets for these low-cost products. Long-distance maritime iron ore trade rose from 23% of world production in 1960 to 36% in 1990, and for coal from 2% to 9% (Lundgren, 1996). These shares continue to grow. In 2003, transoceanic trade in coal accounted for 13% of global output (EIA, 2006).

The market for natural gas is the most recent to be subjected to the forces of globalization. Gas is an extremely bulky product (prices in the range of \$0.1–0.2/m<sup>3</sup>), with transport costs constituting a very high proportion of delivered price. Until at least the 1980s, transport by pipe was the completely dominant delivery mode. The lowest-cost gas sources had a limited geographical reach, because the transport cost was proportional to distance, and higher for piping under the sea. Three regional markets developed around the main consumption centers, viz., North America and Europe (including Russia), both predominantly supplied by pipe from internal sources, and Japan, Korea and Taiwan, supplied exclusively by liquid natural gas (LNG)<sup>1</sup> from Australia, Indonesia and Malaysia. Each of the three markets was, by and large, isolated from the others, with prices evolving along separate levels and patterns. Until the mid-1990s, the East Asian market recorded prices that were twice the level of those in the US and 50% higher than in Europe (BP, 2006) primarily because of the high cost of liquefaction and shipping. Since then, however, prices have been equalized in the three markets in consequence of a combination

<sup>1</sup> Approximately 1.4 m<sup>3</sup> of natural gas equals 1 kg of LNG, with prices in the range of 0.2–0.4\$/kg. The substantial compression makes LNG economically transportable by ship.

of rising prices of piped supply and substantial cost reductions in the LNG production and transport technology. Both developments have stimulated a very fast growth of additional LNG sources, providing an extended web of long-distance supply routes, in effect establishing a truly global market for natural gas. In 2005, 26% of global natural gas production was traded internationally, more than a quarter of this as LNG (BP, 2006).

The successive technological revolutions have gradually reduced the transport costs of bulk commodities by a total of almost 90% between the 1870s and 1990s (Lundgren, 1996). This, in turn, has increased the number of globally traded primary commodities, from selected high-priced luxuries before 1850, to encompass virtually all products with perceptible values by 2005. Even waste, e.g., metal scrap or rejects from forestry and agriculture, or packaging material after use, valued as sources of energy extraction or of recycling, are increasingly subject to international trade. Chinese stone for garden decoration is being successfully marketed in Europe.

An important repercussion of the globalization of primary commodity markets has been a growing dependence of the world's manufacturing centers, initially Europe, then Japan and the US, and most recently China, on imported supply. I will revert to this subject in chapter 2.

### **1.3 The fifty-year wave of public intervention and control in the primary commodity markets**

There has been a clear and strong fifty-year wave of far-reaching public and political intervention in primary commodity markets, beginning in the early 1930s. Since the late 1970s, the wave has been waning, with market forces assuming increasing roles in shaping commodity market developments. Before studying the content and consequences of the wave, it may be instructive initially to ask what brought about the government involvement in the first place. For if we look further back in time, say to the beginning of the twentieth century, it is clear that the government was hardly there at all.

I see four major and two subordinate factors explaining and/or motivating the deep public intervention in global primary commodity production and trade. The *1930s depression* led to a price collapse for many primary materials, so deep that it warranted public intervention

to rescue the farmers and miners, mainly in the rich world. The *Second World War* created havoc in many supply lines so worrisome that the governments thought it opportune to take action aimed at restoring order. The *breakup of colonial empires* established numerous independent nations, many of which had economies dominated by raw materials production. Their governments thought it imperative to gain control over the commodity sector, especially in minerals and energy, where ownership had traditionally rested in colonial or other foreign hands. The fourth factor had ideological connotations. The second and third quarters of the twentieth century were a period characterized by strong *beliefs in collective action* as a means to come to grips with the numerous purported fallacies of the market system (Skidelsky, 1996).

The subordinate factors comprise (a) the *ascendancy of the Soviet Union* into prominence in the international economy, and its interventions in international commodity trade; and (b) the worries and concerns raised by the *emergent import dependence of the USA* in an increasing number of raw materials.

Sometimes, one factor worked in isolation in prompting public action. Quite often, several of these factors worked in combination and reinforced each other in complex ways in encouraging state intervention in the commodities field.

In the 1930s depression, falling prices triggered several public involvements. The governments of Canada and the US interfered jointly in the wheat markets, to cut export supply and save their farmers from further price falls. Cuba collaborated with Java in launching export quotas in sugar. The colonial administrations of Malaya and Ceylon instituted export restrictions on rubber, but this scheme met resistance from consuming interests in the US, and soon collapsed (Rowe, 1965).

In the 1945–65 period, with the scarcities and price spikes of the Second World War and the Korean conflict fresh in the memory, commodity agreements were launched by the governments of exporting and importing countries to keep prices within bands that both groups would find acceptable. Export controls, sometimes combined with buffer stock operations, were the instruments used. The markets for sugar, wheat, coffee and tin were interfered with in this manner, but after some time, the efforts disintegrated, usually due to internal tensions, sometimes also because they failed to deliver the desired results (Radetzki, 1970).

The decade after the Second World War involved a painful experience for the USA, as the country became dependent on imports of a widening group of commodities of critical importance in war and peace (Paley, 1952). This prompted the government to build strategic stocks, in many cases of very significant size. On occasion, the acquisition of these stocks and their subsequent disposal created serious instability in the commodity markets. In 1962, when the International Tin Agreement held a buffer stock of 51,000 tons, the US government declared that its strategic stock, 350,000 tons, equal to two years' world production, was 150,000 tons in excess of what was considered US strategic needs. US disposals in 1963–6 amounted to 69,000 tons, adding 10% to global mine supply in these years, obviously complicating the operations of the international tin agreement (International Tin Council, annual and monthly). In December 1973, the US government again declared substantial excess strategic stocks of metals and rubber, and the very sizable sales in the following year contributed to the price collapse in the international market (Cooper and Lawrence, 1975).

The early 1970s also experienced commodity price and export controls in several countries, to assure supplies at low prices to domestic users. In the US, price ceilings on many commodities were instituted, and export restrictions for i.a. metal scrap and soybeans were introduced to assure domestic availability (Cooper *et al.*, 1975). The gasoline queues in the US in 1974 were a direct consequence of the gasoline price caps. The Canadian government, for its part, implemented severe constraints on uranium exports in the mid-1970s, purportedly to assure national needs (Radetzki, 1981).

Foreign aid became common after numerous nations in Africa and Asia gained independence in the 1950s and 1960s, and since many were heavily dependent on commodity exports, schemes were launched to extend existing commodity agreements by adding elements of foreign assistance. One such extension was the “multilateral contract” with guarantees by the importing member countries to buy predetermined quantities of the commodity from exporting members at above market prices. Another was “food aid,” under which huge amounts of surplus cereals, edible fats and other agricultural products were dispatched to developing countries, undoubtedly improving nutritional standards, but at the same time making life harder for Third World farmers (Radetzki, 1970).

Altruism was certainly not the only motivation for the arrangements. Security of supply was also important. And in the case of the Coffee Agreement, the virtually explicit reason to pay the Latin American producing countries more than the market price was to prevent the spread of non-capitalist political systems on the continent, an important issue at the time (*Commodity Yearbook*, 1964; Rowe, 1965).

The Soviet Union was also actively intervening in the international commodity markets. It signed a number of “bilateral agreements,” in a few cases involving the entire commodity export of individual developing countries for a number of years to come, in exchange for manufactures, often on a barter basis. These agreements were regularly biased in favor of the exporting nation, and their implicit aim was to gain political influence. Sometimes it did not work so well, for the “beneficiaries”, as when the Soviet Union resold large quantities of Cuban sugar and Indian cloth in Western Europe, suppressing prices for the exporters’ sales outside the “agreement” (Radetzki, 1970).

Despite this courtship of developing countries by capitalist and communist commodity importers, there was a massive wave of nationalizations of foreign-owned resource industries, primarily in the minerals and energy fields, in the 1960s and 1970s. Compensation was meager and sometimes completely absent in these takeovers. The US and UK lost most in the process, being the largest foreign direct investors in these sectors. The Soviet Union and Japan did not suffer much from the nationalizations, since their ownership positions were insignificant. The resultant state enterprises in minerals and energy brought in yet another tool for public intervention in primary commodities.

The tide of public intervention and control started to subside in the 1980s. A shift in beliefs played a crucial but by no means exclusive role in this turnaround. The confidence in the ability of markets to solve problems experienced a strong surge in consequence of the ideological revolution launched by Margaret Thatcher and Ronald Reagan. “Political failure” replaced “market failure” as the main problem to handle, according to the emerging credo. Far-reaching consequences have followed from this ideological shift. The crumbling of the communist system in the Soviet Union and Eastern Europe is perhaps the most important result. The commodities sector has seen a wholesale privatization of state-owned positions in minerals in all parts of the world, but a contributing explanation of this development was the disappointing performance of state

entrepreneurship. In contrast, state ownership continues unabated in the oil industries of the developing countries, perhaps because of laxer performance requirements so long as the OPEC cartel continues to maintain monopolistic prices (chapter 9).

The institution of international commodity agreements in which governments meddle for whatever objective has completely lost appeal. Price stabilization is instead attempted with the help of hedging on commodity exchanges whose futures market services have been greatly extended in time and across commodities since the 1970s. Publicly controlled strategic stocks in advanced countries in the present century are by and large limited to petroleum, and at less than 5% of global annual consumption (IEA, monthly), they represent a trifle of the strategic stock ambitions of earlier decades. Government price controls have not been considered despite threefold price increases of materials like copper and oil between 2002 and 2006. The market is seen as an adequate instrument for establishing the value of most commodities and for assuring the satisfaction of the most urgent requirements. No queues have been seen at the petrol stations or at the strategic metal warehouses in the rich world of late. Attempts in China, India, Indonesia and other countries to shield consumers from the oil price rises in 2004–6 did result in queues in some cases, but have proved unbearably costly to the public budgets, and are being dismantled (IEA, monthly).

The governments' abdication from involvement in primary commodity markets has been quite impressive, though it is far from complete. The most important exception relates to the rich world's agricultural policies, which continue to seriously distort the markets for a number of food products (chapter 3). In 2003–5, farm subsidies represented 34% of the value of overall farm receipts in the EU, and 58% in Japan (*Economist*, 2006a). For some products, subsidies exceed 100%. OPEC represents the other important remnant of public involvement in international commodity markets. Governments of the cartel's member countries have remained the dominant owners of the oil industry (UAE is an exception). The governments, not their companies, in most cases shape policy in terms of output and prices, as well as with regard to exploration and the volume and direction of investments. The governments appoint the management, often on political merit, and they also control the financial resources available to their oil industry.

Events in Bolivia, Russia, and Venezuela in the mid-2000 decade suggest that the temptation to nationalize oil and gas remains, especially when prices and profits are high. Later chapters will have more to say on the market distortions caused by remaining public policy in the commodities field, and on the implications of persevering state ownership in some of the primary resource industries.

Despite these important exceptions, it is reasonable to claim that the era of state interventionism in commodities is well past its peak, and that market forces have been allowed to play a greatly increased role in the international commodity markets since the later 1980s. But one should not be too sure. The recently ascending popularity of state control in some places may be a harbinger of a new wave of public intervention in the resource industries, after a thirty-year withdrawal. However that may be, it is instructive to be aware of the perspective of the fifty-year flood of state involvement between 1930 and 1980, followed by an ebb in the most recent decades, as the subject matters of the following chapters evolve.

## **1.4 Conclusion**

The main findings of this historical overview of some aspects of commodity markets are easily stated:

1. Economic development almost invariably reduces the role played by commodities in the macroeconomy. Poor, undeveloped economies produce raw materials and consume them after only limited processing. As economies advance, the scope for further and more sophisticated processing increases, as does the scope for the expansion of activities with limited raw material input needs, notably the service sector. But while, with few exceptions, the primary share of GDP shrinks as economies develop, it is essential to keep in mind that commodities are indispensable, and that no society, however economically advanced, can survive without their assured supply.
2. Historically the production and consumption of commodities was basically a national affair. Excepting expensive luxury goods, like coffee and precious metals, commodities were simply too expensive to transport across borders and oceans. The secular fall in transport costs has greatly increased international trade in commodities, making it possible to move production to locations which offer the

lowest cost opportunities. In the twenty-first century, imports of commodities throughout the world account for a very sizable share of consumption. This holds even for cheap bulk products like iron ore and natural gas.

3. The fifty-year period between 1930 and 1980 was one characterized by deep nationalist state intervention in the resource sector. This period was preceded and followed by periods of highly liberal government attitudes, with substantial scope for market forces in commodity production and trade. Recent efforts in some countries to increase the government's grip over natural resources may be a harbinger of a new wave of state involvement, but currently one cannot be sure. The efforts could alternatively be a response to the mid-2000s commodity boom, and could dissipate as commodity prices fall when the boom comes to an end.

## 2 | *The geography of commodity production and trade*

The agenda for this chapter comprises four items. The first section defines primary commodities and classifies them into a variety of distinct groups. These distinctions are indispensable for some of the analyses performed in the following chapters. The second section attempts to determine the significance of commodities in the international economy, at both the aggregate and individual product level. The third section paints a broad picture of the current geography of traded commodity production and consumption. The import dependence of the major industrial regions on overseas commodity supply is explored and quantified, and the most important commodity-exporting countries are identified in the process. Section four, finally, assumes a historical perspective and considers briefly the forces that have led to the increasing dependence of Western Europe, the US and Japan and, more recently, China, on commodity imports in the course of the twentieth century.

### 2.1 Commodity groups and their characteristics

The subject matter of this book is the world of raw materials, alternatively referred to as primary commodities and, for short, commodities. A first important task is therefore to distinguish commodities from other goods. This distinction may sound straightforward and clear, but however one proceeds, substantial ambiguities remain. Some of these were briefly touched upon in the preceding chapter.

The national accounts statistics of individual countries divide the GDP in accordance with the International Standard Industrial Classification (ISIC) of All Economic Activities, as designed by the United Nations Statistical Office. The GDP is obtained by aggregating the value added from the primary sector, comprising agriculture

(including hunting, forestry and fishing), mining, and utilities; the secondary sector, basically manufacturing; and the tertiary sector, consisting of public and private service activities. The outputs from the primary sector can be unambiguously classed as commodities, but this definition is far more narrow than the everyday concept of primary commodities. Also, the definition is ill suited for the analyses of commodities in international trade, a lead theme in the present book. The point at issue is that the line between the primary and secondary sectors drawn by the ISIC is often quite early in the production process, before the product has reached its main marketable stage. For instance, meat, paper pulp and refined copper are important primary commodities in international trade, but a significant proportion of their value has been added by the manufacturing sector through the activities of slaughterhouses, pulp mills and copper smelters and refineries. For this reason, the national accounts statistics are of limited use in determining the value – or volume – of commodity production and trade, as commonly understood.

The Standard International Trade Classification (SITC, also designed by the United Nations), employed to distinguish between different categories of goods in international trade, provides an alternative and, for my purposes, somewhat more appropriate tool for defining commodities, and I will employ the SITC for classification purposes in the rest of the book. Thus, my definition of commodities includes the SITC section 0, live animals and all unprocessed and processed food products; section 1, beverages and tobacco; section 2, inedible crude materials except fuels (edible oil raw materials, division 22, are also included); section 3, mineral fuels, lubricants and related materials; section 4, animal and vegetable oils and fats; division 67, iron and steel; and division 68, non-ferrous metals. This definition is statistically tractable and hence convenient. It is also shared, by and large, by bodies like the United Nations Conference on Trade and Development (UNCTAD) and the World Trade Organization (WTO). At the same time, it should be noted that this definition is somewhat broader than the everyday concept of primary commodities, since it includes products like cheese, spaghetti and chewing gum, and sheets, foils, angles and pipes made of metal.

By itself, the SITC classification is not particularly useful for subdividing commodities into analytical groups. Nevertheless, a

major and commonly used categorization at least starts out from the SITC sections and divisions. It classes commodities into:

- (a) food in a broad sense (SITC 0 + 1 + 22 + 4);
- (b) agricultural raw materials (SITC 2 – 22 – 27 – 28);
- (c) minerals and metals (SITC 27 + 28 + 67 + 68); and
- (d) mineral fuels (SITC 3).

Several broad characteristics based on this categorization can be identified. The distinction between (a) food, on the one hand, and (b), (c) and (d), raw materials used by industry, on the other, is of great practical significance when it comes to demand. A majority of the food items, having a more indispensable character, are likely to experience lesser variations in demand over the business cycle than the other commodity groups. Excepting foods of a luxury character like coffee, chocolate or beef, one can also expect that food has a lesser income elasticity of demand, and hence a lower trend in demand growth in an expanding economy, where consumers tend to spend decreasing shares of their income on basic necessities (Engel's Law).

The distinction between (a) and (b), agricultural products, on the one hand, and (c) and (d), mineral products, on the other, is relevant in that the supply of the former is dependent on the vagaries of weather while that of the latter is not. The dependence on weather has had a particular relevance for products like rubber or cocoa, the output of which was geographically heavily concentrated, but this concentration has become less accentuated in recent decades. In general terms, one can say that the price instability of agricultural commodities is more often caused by supply side disturbances, while that of minerals – strikes and cartels notwithstanding – is more related to variations on the demand side.

Though each of the four groups contains many different materials, the major substitutes for individual products are likely to be found within the same group. This is probably most evident in (d), the fuels group. An important implication is that prices within each group will have a tendency to move in tandem. For instance, if the price of petroleum rises, the prices of coal and natural gas will tend to rise in sympathy, but there is little presumption that such changes will have a direct influence on the price of, say, copper or wheat.

Other commodity groupings can be constructed to bring out neater but important distinctions. For instance, as discussed in chapter 1, the unit price provides a rough measure of the transportability of

commodities. Products like coffee, wool or tin (average prices per ton in 2003–5, \$1,300, \$6,980, and \$6,920) have since long been globally traded, and even very long hauls involve costs that nowadays constitute only minute proportions of price. In contrast, products like phosphate rock, iron ore and steam coal (average prices per ton in 2003–5, \$40, \$58 and \$44), have until recently been traded in markets that have retained some regional character, on account of the high proportion of the transport cost in total delivered price.

Commodities can also be classed into those which are easily stored and the ones which are not. Refrigeration and preservation have rendered all commodities storable to some extent. The hard-to-store commodities are predominantly found in the perishable agricultural groups, but there are many agricultural materials (jute, rice) which are easily stored for long periods of time. Storability affects a commodity market in at least two ways. First, it commonly provides for an increase in the elasticity of supply. Draw-down of stocks makes it possible to vary supply beyond the feasible variations of production. And secondly, it increases the scope for speculative activity (chapter 5).

There are great variations among raw materials in terms of the time it takes to add to production capacity. The production of some commodities, e.g. bananas, sugar or wheat, can be expanded between two adjacent seasons, simply by extending the area on which the crop is grown. In other commodities, like coffee, palm oil, and most minerals, several years are commonly required between the decision to increase capacity and the start-up of production from that capacity. Even though the long-run price elasticity of supply for the two groups may be of the same magnitude, the short-run price elasticity of supply for the latter will be much lower. This distinction makes a great difference for established producers bent on monopolistic coordination of their market. Supply cuts will seldom be worthwhile to producers of the first group of commodities, because of the speed with which additional production can be established. The second group is much more amenable to monopolistic coordination, given that the producer benefits will ordinarily be far more durable (chapter 8).

For some materials, primary supply is supplemented by supply from secondary sources. This is importantly true for precious metals, but also for base metals like iron/steel, copper and lead, and for some agricultural raw materials, e.g. rubber and wool. The secondary supply has determinants and a cost structure that typically differ from those that apply to primary supply. The control of secondary

materials is usually out of reach of primary producers. The availability of secondary supply tends to increase the overall supply elasticity for the commodity. Where such supply is important it reduces the scope for monopolistic coordination by primary producers.

The level of the price elasticity of demand constitutes yet another important distinguishing mark between commodities. The ones with many close substitutes will have high price elasticities of demand. If the price increases, demand is redirected in favor of the substitutes. This is true, for instance, of bananas and lamb, the demand for which is easily shifted towards other fruits and meats. Commodities with important uses and without convenient substitutes will usually have very low price elasticities of demand. When the use of a commodity is in some way indispensable, demand will not be much affected by a change in price. Platinum and chromium are prime examples of indispensable materials with few substitutes in many uses and with very low price elasticities of demand. For a somewhat different reason, coffee, too, has a low price elasticity of demand. Though one can lead a comfortable life without it, a large part of humanity has become addicted to this beverage, and, as a result, the demand for coffee is not very sensitive to price. A low price elasticity of demand, too, is important in singling out commodities suitable for monopolistic intervention by producers.

One should note that the price elasticity of demand for any commodity is usually much higher in the long than in the short run. With time, users frequently find alternatives to a raw material the price of which has become excessive.

A distinction is often made between exhaustible and renewable materials, but in my view, an exaggerated importance has been attributed to this distinction. For example, contrary to the claims of exhaustible resource theory, there is little empirical evidence of a difference in the determination of prices between the two commodity groups (chapter 6).

## **2.2 The importance of commodities in the international economy**

In chapter 1 I established a very clear trend of declining commodity importance in the macroeconomy, as nations develop. Table 2.1 confirms this tendency looking at global trade patterns over an

Table 2.1 *Global exports by commodity group over forty years*

	\$ billion		of which, %			
	Total exports, all goods	Total commodities	Food	Agricultural raw materials	Minerals and metals	Fuels
1965	186	48.5	18.3	8.1	12.4	9.7
1986	1924	39.9	10.5	3.4	7.3	18.7
2005	10160	28.8	6.7	1.7	6.6	13.8

Source: WTO on the internet.

extended period during which the global economy experienced considerable expansion. In 1965, commodities accounted for almost 50% of global goods trade, but by 2005 this share had been reduced to less than 30%, despite forceful commodity price increases in both 2004 and 2005, as the world went through one of the strongest commodity booms since the Second World War (chapter 4).

The table additionally reveals sharply declining shares accounted for by food and agricultural raw materials in total goods trade over time and a sizable though somewhat less dramatic reduction in the metals and minerals share of global visible trade. This observation does not imply any absolute declines, not even in constant money terms. Instead, it reflects an increasing dominance of manufactures in total goods trade over time. The fuels group represents an exception from the above observations. By the mid-1980s, fuels had doubled their share of overall visible trade as oil prices in real terms hovered around their peak, after the oil price increases of the 1970s. Oil exports have since accounted for about three-quarters of the value of overall fuels exports. The share of fuels fell in the subsequent twenty-year period, but it was still substantially above that recorded in 1965. Fuels alone represented almost one-half of overall commodity trade in 2005.

Table 2.2 provides a more detailed insight into the performance of individual commodities over the same period as that covered by table 2.1. The twenty-two entries in the table have been selected to comprise the most important commodities in the international economy, and they have been ranked according to their export values in 2003–5. In aggregate, the twenty-two account for about one-half of the total commodity export values recorded in table 2.1.

Table 2.2 *Global export value for individual primary commodities, annual averages, billion dollars*

	1963–5	1983–5	2003–5	SITC Rev. 1
Petroleum	9,1	212,7	699,7	33
Iron and steel	8,6	59,9	249,3	67
Natural gas	0,2	27,2	121,3	341
Precious stones	1,0	11,8	73,9	667
Timber	2,3	13,3	41,1	24
Copper	1,2	5,7	34,9	2831 + 6821
Hard coal	1,1	13,1	32,8	3214 + 3215
Aluminum	0,8	7,2	29,6	2833 + 6841
Beef	0,9	6,7	18,9	0111
Iron ore	1,3	5,1	18,7	2813
Wheat	2,9	15,2	17,5	041
Maize	1,1	9,8	11,3	044
Sugar	0,9	4,4	11,1	0611 + 0612
Coffee	1,8	9,3	9,4	0711
Cotton	1,9	4,9	8,6	2631
Rice	0,8	3,3	8,2	042
Natural rubber	1,5	4,0	8,1	2311
Cocoa	0,6	3,7	8,1	072
Zinc	0,4	2,8	7,7	2835 + 6861
Tobacco	0,8	3,8	6,5	121
Wool	2,1	4,9	4,7	262
Tin	0,7	2,2	2,2	2836 + 6871

Sources: UNCTAD; UN COMTRADE on the internet, <http://unstats.un.org/unsd/comtrade/>; World Bank.

Petroleum emerges on the top of the table for the three periods shown. Ever since the price increases of the 1970s, this material alone (crude and petroleum products) has accounted for more than 50% of the aggregate value of the twenty-two items. In the early 1960s, in contrast, petroleum accounted for only one-quarter of the total.

The rank of the other individual commodities differs for the three periods shown in the table, depending either on shifting price levels or volume growth, or both in combination. The rank of coffee has declined from 8 in the 1960s to 14 in the 2000s, primarily because of the elevated coffee prices in the earlier period, while coal and,

even more, natural gas owe their higher recent ranking primarily to the opening up of international trade on a massive scale in these commodities.

An additional perspective on the significance of commodity trade is to compare the export values given in the table with those for some manufactured products, even though it must be underlined that the latter are far more heterogeneous than the listed raw materials, and that this heterogeneity may add to the values they represent. Thus, in 2003–5, the global average annual export value of passenger motor vehicles, at \$440 billion, was of the same order of magnitude as that for oil. Export sales of aircraft was \$116 billion, ships and boats as well as footwear about 60 billion each, television receivers 46 billion, and watches and clocks 23 billion.

The importance of primary commodity trade can alternatively be measured by weight, and when that is done, a distinctly different ranking emerges (table 2.3). Six commodities had 2003–5 average export volumes of 100 million tons or more. These were petroleum (2,461 million tons), hard coal (794 million), iron ore (719 million), natural gas (527 million), timber (133 million) and wheat (121 million). Other commodities with a large volume of exports comprise maize, iron and steel and edible oils. The commodities listed in the table comprise three-quarters or more of the volume of commodities in international trade. Hence, the developments in these commodity markets constitute heavy determinants for the business conditions in bulk transport by sea. Many high-priced products with large export values, coffee and copper metal, for example, represent very small volumes in international trade.

Table 2.3 additionally provides the volume of global production for selected commodities, and this permits an assessment of the total output that enters international trade. In some cases, a major proportion of global output is traded. This is especially so for tropical products on which the temperate rich world is dependent, e.g. rubber, coffee or cocoa. The same applies to tin (Southeast Asia) and niobium (Brazil), two minerals whose deposits are heavily concentrated to the tropics. Petroleum (Middle East and Russia) and platinum (South Africa and Russia) are similar in this respect in that a few countries with an exceptional resource wealth supply the rest of the world with most of its imported needs. This contrasts with rice and hard coal, two important raw materials in terms of both volume

Table 2.3 *World production and exports of selected primary commodities, 2005*

	Production 000 tons	Exports 000 tons	Exports in % of production
Petroleum	3 894 001	2 461 300	63%
Hard coal	5 852 001	793 748	14%
Iron ore <sup>1</sup>	1 320 000	718 700	54%
Natural gas	2 016 990	526 666	26%
Timber <sup>2</sup>	2 582 907	132 712	5%
Wheat	629 565	121 372	19%
Maize	701 345	89 193	13%
Iron and steel in primary shapes	1 955 000	64 657	3%
Edible oils and their raw material	117 599	49 835	42%
Sugar	105 138	28 988	28%
Phosphate rock	147 000	26 306	18%
Rice	620 366	24 041	4%
Aluminum	31 895	15 814	50%
Copper	15 008	12 939	86%
Bauxite	169 000	12 353	7%
Natural rubber	9 124	7 068	77%
Cotton	37 154	6 618	18%
Coffee	7 772	5 156	66%
Tin	330	356	108%

*Notes:*

<sup>1</sup> Gross weight. <sup>2</sup> Converted from cubic meters to tons by multiplication with the factor 0.74.

*Sources:* BP (2006) on the internet; FAOSTAT on the internet, <http://faostat.fao.org>; World Bureau of Metal Statistics, 2006; US Geological Survey on the internet, <http://minerals.er.usgs.gov/>; UN COMTRADE on the internet, <http://unstats.un.org/unsd/comtrade/>; UNCTAD, 2006, "The Iron Ore Market 2005–2007," May.

and value, where virtually all output is domestically consumed. Taste appears to be the main explanation for the consumption patterns for rice, while coal deposits are geographically widespread, and since this material represents a low value per ton, supplies from faraway sources tend to lose competitiveness to domestic sources. I should add that the traded shares probably exaggerate the importance of trade, since

large quantities of the commodities listed are re-exported, either in unchanged form, or after some limited degree of processing. This is obviously true for tin.

### **2.3 The provenance and destination of traded commodity supply**

Table 2.4 paints a broad picture of the exports and imports of broad commodity groups by major regions in the 2003–5 period. Several noteworthy observations emerge from the matrix.

The numbers confirm the traditional relationship in which the rich world is a large net importer of commodities. EU25 + Norway, US + Canada and OECD Asia Pacific each recorded very sizable deficits in their commodity trade. Their fuels deficits dominated the total, but their imports were larger than exports also for the non-fuels aggregate. Surprisingly, the US and Canada, traditional cereals exporters, even recorded a deficit in their food trade. Only two surpluses are on record in the compilations, the first for the US and Canada in agricultural raw materials, the second for metals and minerals in OECD Asia Pacific, the latter importantly a result of Australia's sizable exports of coal and iron ore.

Latin America (including Mexico) and Africa south of the Sahara constitute counterpoints to the rich world in that the two regions record surpluses in all the categories shown, even though the African surpluses in agricultural produce are quite small. However, Africa has lately emerged as a net exporter of fuels, though with quantities that are only half as large as those of Latin America, but nevertheless substantial.

The most noteworthy and well-known characteristics in the commodity trade of Middle East + North Africa and the Former Soviet Union (FSU) are their very sizable surpluses in the fuels trade, the former almost exclusively the result of oil exports, while the FSU exports of oil are importantly supplemented by the sales of natural gas. Both regions are substantial net importers of food, while the FSU, but not the Middle East, contributes significantly to the world needs of minerals and metals.

The Other Asia region is dominated by China and India, and on account of the spectacular growth of these countries, it has recently emerged as a sizable net importer of both minerals and fuels. However,

**Table 2.4 Commodity and total goods trade by region, annual average 2003–5, billion dollars**

	EU 25 + Norway	USA + Canada	OECD Asia Pacific	FSU	Other Asia	ME + North Africa	Africa South of Sahara	Latin America	Global total
<b>Food</b>									
Exports	63.1	57.4	22.6	4.2	55.9	6.9	11.3	67.4	288.9
Imports	79.9	59.7	59.0	14.3	41.2	29.5	10.2	20.4	314.2
Net exports	-16.8	-2.3	-36.5	-10.1	14.8	-22.6	1.1	47.0	
<b>Agric. raw materials</b>									
Exports	12.5	22.2	8.6	6.1	11.8	1.6	3.7	9.0	75.6
Imports	23.2	11.0	15.4	1.0	28.9	4.0	1.0	4.4	89.0
Net exports	-10.7	11.3	-6.8	5.2	-17.2	-2.4	2.7	4.6	
<b>Metals and minerals</b>									
Exports	49.3	24.7	51.2	38.9	35.6	5.8	16.1	43.9	265.4
Imports	69.3	46.2	42.4	4.0	101.0	19.7	4.1	13.1	299.9
Net exports	-20.0	-21.5	8.8	34.9	-65.4	-13.9	11.9	30.8	
<b>Fuels</b>									
Exports	46.7	15.8	20.7	108.5	48.1	268.8	27.5	74.1	610.3
Imports	197.2	188.2	151.8	1.3	134.3	14.3	9.3	25.1	721.4
Net exports	-150.5	-172.4	-131.1	107.2	-86.2	254.5	18.2	49.0	

### All commodities

Exports	171.5	120.2	103.1	157.7	151.4	283.1	58.7	194.3	1240.1
Imports	369.5	305.1	268.7	20.5	305.3	67.5	24.7	63.0	1424.5
Net exports	-198.0	-184.9	-165.6	137.2	-153.9	215.6	34.0	131.3	
<b>Exports of all goods</b>	<b>1160.3</b>	<b>673.8</b>	<b>781.5</b>	<b>211.5</b>	<b>1025.1</b>	<b>383.6</b>	<b>80.9</b>	<b>384.0</b>	<b>4700.6</b>

*Note:* At the time of writing some countries have not yet reported their foreign trade figures. That is the main explanation for the discrepancies between global exports and imports.

*Source:* UN COMTRADE on the internet, <http://unstats.un.org/unsd/comtrade/>.

Table 2.5 Share of world exports for selected countries and commodities in 2003–5, percent

	Cocoa	Coffee	Copper	Cotton	Hard coal	Iron ore	Natural gas	Natural rubber	Sugar	Tin	Tobacco	Wheat	Wool
Argentina			2.1	0.1			0.8		0.6		2.8	6.8	3.6
Bolivia		0.1					0.5		0.2	5.3			
Brazil	2.6	20.0	0.9	4.0		27.6			26.1	1.6	20.9	0.4	0.4
Chile			38.0			1.1				0.1		0.4	
Colombia	0.2	11.7			5.7				2.1		0.2		
Mexico	0.2	2.2	0.8	0.5		0.3			0.5		0.4	0.4	
Peru	0.3	2.8	6.9	0.1		0.8			0.1	7.0	0.1		0.6
China	0.5	0.2	1.0	0.6	11.0		0.2		0.5	10.8	3.9	0.8	9.6
India		2.0	1.3	3.4	0.2	14.2	0.1	0.8	1.3	0.3	3.1	1.8	0.4
Indonesia	7.2	3.7	8.2		9.3		4.6	25.9		27.9	1.3		
Malaysia	4.6						4.1	15.9	0.8	9.9	0.1		0.2
Thailand	0.5	0.1	0.1				0.2	41.0	7.3	5.5	1.0		0.7
Viet Nam		5.4			0.6	0.1		4.7	0.1		0.3		
Egypt				4.9			0.1		0.2				
Ivory Coast	26.2	0.9		1.8				2.0	0.2				
South Africa			0.3	0.2	7.6	3.5			2.2		0.6	0.1	3.8

Australia	0.1	6.1	8.1	34.1	28.7	2.1	0.3	0.4	0.2	13.2	37.4
Canada	0.3	4.5	5.2	5.0	16.1	0.1	0.1	0.3	1.0	13.2	0.1
New Zealand				0.1			0.1				9.9
USA	2.7	3.6	44.8	7.6	2.1	2.3	0.9	1.9	15.7	25.7	1.1
France	5.6	1.1	0.1			1.1	0.3	11.7	2.0	13.7	4.4
Russia		2.5		8.4	2.9	20.4		0.3		4.7	0.2
Total	50.8	55.2	74.4	68.7	89.6	86.3	91.5	55.1	71.4	53.6	80.8
Total											72.7

*Sources:* Natural gas for Canada and Russia from BP (annual), several issues; other commodities and countries from UN COMTRADE on the internet, <http://unstats.un.org/unsd/comtrade>.

despite its relatively high population density, the region continues as a net exporter of food.

In contrast to the aggregate picture in terms of countries and products presented in table 2.4, the matrix contained in table 2.5, demonstrates the importance of a group of individual selected countries as suppliers to the world market of a set of important individual commodities. The commodities are by and large the same as those displayed in the earlier tables of the present chapter. The countries have been chosen to include significant contributors to the world supply of at least one of the listed commodities, and have been subdivided into Latin American, Asian, African and “Western Offshoots” groups, with France and Russia added to complete the picture. The warning issued in relation to table 2.3, that re-exports may exaggerate a country’s true importance as a supplier to the world market, applies to table 2.5 in equal measure. Note that the table is not exhaustive, its purpose being to provide a broad overview of the main countries and commodities.

To limit the size of table 2.5, and given the dominance of oil in world commodity markets, the major oil-exporting countries and their importance in global export supply are displayed in table 2.6.

When looking at individual countries and focusing on shares above the 10% level, I note Brazil’s significance in coffee, iron ore, sugar and tobacco, where the country’s share exceeded 20%. Chile is a dominant exporter of copper, with Colombia being a bit less so in coffee.

A look at the Asian country group shows that China accounts for high shares of the global exports of coal, tin and wool, while India is an important supplier of iron ore. Indonesia records very high shares in natural rubber and tin, but it is also significant in the copper and coal markets, while Malaysia is sizable in natural rubber and tin. Thailand accounts for more than 40% of global exports of natural rubber, a truly exceptional proportion.

Australia records very high shares in the international markets for coal, iron ore and wool, and its share in wheat, 13.2%, is highly significant too. Canada happens to account for the same 13.2% proportion in wheat, while its exports of natural gas, exclusively to the US, correspond to 15.7% of world trade. The US, in turn, is the world’s largest exporter of cotton and wheat, and second only to Brazil in the tobacco market.

**Table 2.6 Country share of world oil exports in 2003–5, percent**

Saudi Arabia	15.4%
Russian Federation	10.8%
Norway	5.6%
Iran	5.0%
Venezuela	4.6%
United Arab Emirates	4.3%
United Kingdom	3.8%
Canada	3.8%
Mexico	3.3%
Total	56.5%

*Source:* UN COMTRADE on the internet, <http://unstats.un.org/unsd/comtrade>.

Russia's exports of gas to Europe correspond to 20% of world trade, and it is also an important contributor to the world's coal supplies. The role of France is somewhat peculiar in this context. Re-exports account for its significance in the cocoa market, while its above-10% shares in sugar and wheat are primarily due to the agricultural support policies of the European Union.

Those with a special interest can alternatively use the matrix table to clarify the export concentration in individual commodity markets, but I will not pursue this somewhat tedious task here (however see chapter 8 for a further discussion of the significance of export concentration).

Table 2.6 exhibits a relatively low concentration by exporting country in the petroleum market, when compared with the products exhibited in table 2.5. Out of the thirteen products listed in table 2.5, eleven had a lead exporter accounting for 20% or more of the global total. In petroleum, in contrast, the largest exporter, Saudi Arabia, supplied no more than 16% of the internationally traded supply.

## **2.4 The expansion of the rich world's dependence on commodity imports, and the recent emergence of China as a globally dominant importer of commodities**

The increasing dependence of the rich world on faraway supplies of raw materials is a phenomenon that has emerged, in the main, during

the twentieth century. Two factors explain the strength and timing of this development. The first is the very impressive secular decline in bulk transport costs, discussed in the preceding chapter. The second is the speedy pace of industrialization in the rich world, and in particular the impressive expansion of its infrastructure and heavy industries in the course of the century. These activities have absorbed huge quantities of raw materials, and foreign sources regularly offered supplies at lower costs than those of domestic producers. My focus of attention is on Western Europe, the US and Japan, and I disregard the commodity import needs of rich but thinly populated Australia and Canada, which continue to generate very sizable net commodity exports. Several distinguishing features relating to different products and importing regions need to be brought out for a better understanding of the process.

The first observation is that the consumption of tropical agricultural products, notably coffee, cocoa and tea, but also natural rubber, has always depended virtually entirely on imports. With increasing prosperity over the twentieth century, the volume of these imports has grown impressively, in line with consumption. In contrast, the prosperous regions have maintained far-reaching measures to protect domestic food production (see chapter 3). Imports of, e.g., cereals, sugar, meat and fruit have therefore accounted for only limited shares of consumption. Differences between the three regions under review in this regard should be noted. There has always been a vast difference in their population density. In 2000, population per km<sup>2</sup> was 336 in Japan, 166 in Western Europe, but only 30 in the US. Abstracting from differences in climates and soils, the extent of policy measures to maintain a certain level of self-sufficiency in food must be greater where the population density is high. Agricultural protection has also been extreme in Japan, but less so in Europe, while in the US production of most foods has been internationally competitive with little need for protective measures. In fact, the US has been a sizable agricultural exporter over most of the twentieth century. Agricultural support has nevertheless been practised, for instance in sugar against more competitive cane sugar supply from the tropics, or in cotton, the latter making the country a dominant supplier to the international market (table 2.5).

Population density should also make a difference for the ability to remain self-sufficient in mineral materials. The prospects for satisfying

the domestic mineral requirements should improve if there are fewer people per km<sup>2</sup> of potentially mineral-productive land, assuming away differences in the mineral productivity of different lands. This relationship, too, is clearly apparent in the imports/consumption trends in the three regions, though in the mineral context the expansion of import needs is also strongly related to the timing of the major industrialization thrust.

Thus, the sparsely populated USA, which industrialized relatively early, still covered its entire needs of metal minerals in the first decade of the twentieth century, but the self-sufficiency had fallen to 70% at the time of the Second World War (Borenstein, 1954). By the middle of the century, the US had become the world's largest importer of copper, lead and zinc, amongst other metals (*Resources for Freedom*, 1987). As the century ended, the US depended on imported supply for 100% of its nickel requirements, 52% of refined copper, and 40% of primary aluminum. More densely populated Western Europe, where the intensive phase of industrialization also occurred early, was reasonably self-sufficient in metals as late as the middle of the century. By 2005, however, the import dependence in copper and nickel was virtually complete.<sup>1</sup> Japan, finally, industrialized much later than the other two areas. In 1950, its metal usage was only a minuscule fraction of the levels recorded in Western Europe and the US, and could still be fully satisfied by domestic supply. However, in the course of the country's exceedingly fast industrialization and growth between 1950 and 1975, its needs for metals exploded. Japan's 1990 consumption of aluminum was 127 times the 1950 level, that of copper had grown to a multiple of 131, while its nickel consumption over the period had risen 160-fold, all historically truly remarkable increases over a unique forty-year period of this nation's development. Since there was little scope for increasing domestic production within the country's geographic confines, the import dependence for these and other metals had become virtually complete by the end of the century.

For the purpose of the following deliberations about the consumption developments and import needs in China (population density 133 per km<sup>2</sup> in 2000, i.e., slightly below Western Europe's, and far below

<sup>1</sup> The metals data for Western Europe relate to five major countries, viz, Germany, France, Italy, Spain and the UK.

Japan's), a noteworthy observation is that Japan's metal consumption growth virtually ceased after 1990, and in some cases even turned into a contraction. Metal demand generally stagnated at about the same time in Western Europe and in the US too, as virtually all economic growth in these mature economies occurred in sectors like services and information technology, with very small metal needs. Demand stagnation is not limited to metals. Oil consumption in Western Europe has remained virtually unchanged between 1998 and 2005, while Japan's demand reached a peak in 1996 and has since been declining. Oil consumption in the US, however, continues to expand.

China's industrialization thrust evolved in all seriousness only in the 1990s, and the pace has been at least as breathtaking as that in Japan between 1950 and 1975. This has set clear marks on the consumption growth for numerous commodities intensively used in the heavy industrialization phase. Thus, in the fifteen-year period between 1990 and 2005, demand for aluminum, nickel, and copper increased six- to eight-fold (table 2.7). At this pace, the consumption levels would multiply by 190 over a forty-year period, which is even more than the Japanese metal consumption performance between 1950 and 1990, quoted above.

A possible interrelationship between stagnating or falling demand for industrial commodities in the mature, rich economies and the very fast growth of demand in China must be elucidated. China has evolved into a leading global exporter of raw-material-containing manufactures. As the global center of gravity of the production and exports of raw-material-containing manufactures shifts towards China, it must by necessity result in a speed-up of Chinese raw materials demand and a concomitant slowdown in the rich economies towards which the Chinese manufactured exports are directed.

Here are some figures from the beginning of the twenty-first century, demonstrating the emerging role of China in the world of commodities. In 2005, the IMF (2006b) assessed China's share of global GDP (PPP-terms) at 15.4%, and its recorded and projected annual growth between 1998 and 2007 was 9.1%. The share of the US in global GDP was 20.1%, and the 1998–2007 growth performance was 3.1%. At the quoted growth rates, China's GDP will surpass that of the US in 2010. I have noted above the stagnant or even falling demand for many industrial commodities since the 1990s in the rich mature economies. At the same time, China is currently passing through a

Table 2.7 Consumption developments for four important industrial commodities in four regions

	Thousand tons				Average annual percent change (compound)		
	1950	1970	1990	2005	1951–1970	1971–1990	1991–2005
<b>Primary Aluminum</b>							
USA	823	3488	4331	6114	7.5	1.2	2.4
Eur5*	342	2050	3493	2850	9.4	2.7	–1.3
Japan	19	911	2415	2276	21.1	5.0	–0.4
China	2	180	861	7120	25.0	8.1	15.1
World	1584	9981	19090	31260	9.6	3.4	3.4
<b>Nickel</b>							
USA	91	149	128	140	2.6	–0.9	0.8
Eur5*	28	137	219	262	8.2	2.4	1.0
Japan	1	99	166	163	25.8	2.7	–0.1
China	0	20	28	191	–	1.8	13.5
World	158	709	856	1249	7.9	1.0	2.5
<b>Copper</b>							
USA	1073	1860	2144	2320	2.8	0.7	0.5
Eur5*	613	1958	2444	2831	5.9	1.0	1.0
Japan	12	821	1578	1198	23.2	3.3	–1.8
China	5	180	580	3830	19.0	6.0	13.4
World	2411	7293	10790	16890	5.6	2.0	3.0
<b>Oil</b>							
USA	317	695	782	945	4.0	0.7	1.2
Eur5*	39	451	442	459	13.1	–0.4	0.2
Japan	3	200	248	244	23.1	1.0	–0.1
China	0	28	110	327	–	7.1	7.5
World	505	2253	3140	3837	7.8	1.8	1.2

Note: \*France, Germany, Italy, Spain, and the UK.

Sources: Merallgesellschaft (annual); Darmstadter, 1971; BP (annual).

stage of its economic development that is highly commodity intensive, just as Japan did in the 1950–75 period. Against this background, China's share of recorded global demand growth in 2000–5, 28% for petroleum (IEA Monthly), 50% for aluminum, 84% for steel and 95% for copper (Albanese, 2006), are impressive, and (excepting the

copper figure, which implies that global demand outside China in the five-year period was virtually nil), not particularly surprising.

Even after this impressive consumption growth, China's import dependence is less extreme than that of Western Europe and Japan. The lesser density of China's population provides part of the explanation, but I believe that a more important reason is that China's industrialization still has to run its course. In 2005, the country managed to generate a surplus in primary aluminum, but it imported almost 70% of its nickel and more than 80% of its copper needs. Table 2.8 demonstrates that China has until the present been able to satisfy virtually all its needs of primary energy from domestic resources. This is mainly due to hard coal, with which the country is richly endowed, to the extent that it still generates an export surplus of this commodity. Coal also explains why the consumption of oil has risen only by a factor of 3 over the period from 1990 to 2005 (table 2.7).

The growth of raw materials demand, the intensification of commodity needs, and the increasing importance of imported supply are typical of the stages of development when infrastructure and heavy industries are established. The US, Western Europe, and Japan all went through similar phases of economic progress, but at a pace that was much slower than that experienced in later periods in Japan and China. There are no indications of an impending slowdown in China's pace of industrialization. Ongoing economic progress will accentuate the country's commodity import needs, and will, in all likelihood, make it more import dependent. For one or two coming

**Table 2.8 Commercial energy at the primary stage: ratio of production to consumption**

	1925	1950	1965	1985	2005
<b>Western Europe<sup>1</sup></b>	1.03	0.87	0.52	0.61	0.54
<b>USA</b>	1.07	1.01	0.93	0.89	0.69
<b>Japan</b>	1.08	0.97	0.33	0.16	0.17
<b>China<sup>2</sup></b>	0.95	1.01	1.00	1.19	0.92
<b>FSU</b>	1.07	0.96	1.13	1.24	1.67

Notes: <sup>1</sup> EU25 + Norway in 2005. <sup>2</sup> Communist Asia in 1925, 1950 and 1965.

Sources: Darmstadter (1971); BP (annual) on the web.

decades, at least, China's share of global commodity consumption and global commodity imports is likely to continue its expansion.

Table 2.7 reports the consumption developments since 1950 in the major consuming regions for a set of industrial commodities. The findings of the above discussion about a historical increase in the dependence on imported metal supply are corroborated by the content of table 2.8, which tracks the changing degrees of self-sufficiency in primary energy in the three mature regions, with China and the FSU thrown in for comparison. In 1925, Western Europe, the US, and Japan had an excess of primary energy production over domestic needs, and even in 1950 they were virtually self-sufficient, but the time trend in all three has been clearly down over the entire eighty-year period with one single exception, Western Europe in the 1980s, where the expansion of nuclear power and the rise of exploitation of fossil fuels in the North Sea led to a temporary increase in self-sufficiency.

## **2.5 The main findings summarized**

Before concluding the chapter, it may be useful to summarize the main findings from the overviews of the international commodity trade flows analyzed here:

1. Trade in commodities currently accounts for nearly 30% of global goods trade, but this share has been declining. In 1965 commodities accounted for almost half of global trade in goods. Fuels are the most important commodity group, measured in export values. Minerals and metals and food each generate about half, agricultural raw materials barely more than one-tenth of the trade values generated by fuels.

2. Oil is, without comparison, the most important traded commodity. Total oil and oil products exports in 2003–5 represented an average value of \$700 billion, more than the entire global exports of passenger motor vehicles (\$440 billion), and twenty times as much as the global exports of copper. Iron and steel (\$250 billion) and natural gas (\$120 billion) come next to oil in the ranking of commodities by export value. Oil exports are also by far the biggest when measured in tons, followed by hard coal and iron ore.

3. The OECD area records substantial deficits in its commodity trade, while Latin America generates surpluses across all major commodity groups. The Middle East cum North Africa along with the

FSU account for a completely dominant proportion of the global exports of fuels.

4. The US, Western Europe, and Japan exhibit limited import dependence for food products. For Western Europe and Japan, this is the result of deep agricultural protection. On the other hand, all three areas have become heavily dependent on imports of industrial raw materials in the course of the twentieth century, as the domestic needs spurted in response to the respective regions' industrialization. The import dependence developed earlier in the US and Western Europe than in Japan, but in the latter country the reliance on imported supply has become far more accentuated, mainly due to its high population density.

5. The consumption of most industrial commodities in the three rich, economically mature regions has been stagnant, or even falling in some cases, since 1990. This is because most of their economic growth is occurring in sectors with little industrial commodities needs. In contrast, heavy industrialization in China gathered pace in the early 1990s, and this country has experienced an historically unprecedented growth in the demand for industrial commodities, increasingly satisfied through imports.

Table 2A.1 World exports, volume and value

	1975	1980	1985	1990	1995	2000	2005
<b>Aluminum metal (SITC 684.1)</b>							
Volume (million tons)	2.6	4.0	5.4	7.4	9.3	14.6	18.6
Value (\$ billion)	2.0	6.6	6.8	13.2	17.9	23.4	32.7
<b>Coffee (SITC 071.1)</b>							
Volume (million tons)	3.0	3.0	3.8	4.2	4.0	5.2	5.2
Value (\$ billion)	3.7	10.1	9.7	6.6	12.5	9.5	10.7
<b>Copper (SITC 283.11, 283.12, 682.11, 682.12)</b>							
Volume (million tons metal content)	3.2	3.4	3.9	3.3	7.0	11.2	14.1
Value (\$ billion)	4.0	7.5	5.1	12.9	20.9	20.7	46.5
<b>Cotton (SITC 263.1)</b>							
Volume (million tons)	2.8	3.9	3.4	4.1	4.1	4.4	6.6
Value (\$ billion)	3.4	6.4	4.5	6.7	7.4	5.8	7.7
<b>Crude petroleum (SITC 333)</b>							
Volume (million tons)	1273	1610	1220	1566	1813	2112	2485
Value (\$ billion)	102	436	246	272	226	442	993
<b>Hard coal (SITC 321.4, 321.5)</b>							
Volume (million tons)	121.7	160.0	222.0	313.4	323.1	535.3	793.7
Value (\$ billion)	6.1	9.9	10.9	14.5	17.8	16.7	45.2
<b>Iron ore (SITC 281.3)</b>							
Volume (million tons iron content)	204.9	200.8	182.2	196.3	239.1	308.3	320.2
Value (\$ billion)	4.3	6.1	5.0	6.7	7.5	9.0	27.2
<b>Natural gas (SITC 341)</b>							
Volume (million tons)	10.2	107.8	112.7	140.9	142.5	355.2	526.7
Value (\$ billion)	4.7	24.3	27.6	22.6	26.2	81.0	131.2
<b>Natural rubber (SITC 231.1)</b>							
Volume (million tons)	3.8	4.4	4.3	4.7	4.9	5.7	7.1
Value (\$ billion)	2.2	5.8	3.3	4.0	7.3	3.8	8.9
<b>Precious stones (SITC 667)</b>							
Volume (million tons)	n/a						
Value (\$ billion)	5.6	19.0	10.8	26.7	38.1	53.0	83.0
<b>Sugar (SITC 061.1, 061.2)</b>							
Volume (million tons)	17.3	20.0	64.9	17.9	25.8	33.4	29.0
Value (\$ billion)	11.1	13.2	3.1	7.7	11.3	7.9	12.7

**Table 2A.1 (cont.)**

	1975	1980	1985	1990	1995	2000	2005
<b>Tobacco (SITC 121)</b>							
Volume (million tons)	0.9	1.1	1.3	1.3	1.6	1.9	2.3
Value (\$ billion)	2.2	3.2	3.8	4.6	4.9	5.4	6.6
<b>Wheat and wheat flour (SITC 041, 046)</b>							
Volume (million tons)	66.9	88.1	94.0	99.8	103.2	108.4	130.9
Value (\$ billion)	11.6	17.5	14.1	16.7	19.6	15.9	19.9

Sources: UN COMTRADE on the internet, <http://unstats.un.org/unsd/comtrade>; BP (annual), several issues.

# 3

## *Comparative advantage and the trade policy distortions*

### **3.1 Protectionism in raw materials: of great significance but mainly limited to agriculture**

Protection could well be the greatest deterrent to a full realization of the potential for global economic growth and its welfare yields. The main detriment of protection is that it induces production to be located in high-cost venues. Liberalization permits production to move to its lowest-cost locations, involving savings that can be very large at times. In a recent study Kym Anderson (2004), a prominent specialist on the economics of protection, assesses the present value of the gains that could be reaped between 2010 and 2050 from the removal of one-half of existing man-made barriers to trade. Considering both the static and dynamic gains, deducting the friction costs of the proposed liberalization and applying a 5% discount rate, he comes to the stunning conclusion that the net present value of the proposed policy change would amount to some \$22,000 billion (constant 2005 dollars), half of which would accrue to the developing countries. The assessed net gain can be compared to the global foreign assistance flows, which amount to less than \$100 billion per year, or the global and developing country GDPs in 2005, which were assessed, using current exchange rates, at \$42,400 billion and \$8,800 billion, respectively (IMF, 2006b; UNCTAD, 2005). The proposed liberalization would “roughly double the annual increment to global GDP” during the forty-year period under consideration, according to the study.

Given the extreme uncertainties underlying the assessments, and the wide range of results that emerge depending on the specification of the model used, the above conclusions are somewhat heroic. But even when very sizable margins of error are taken into account, the magnitudes of the numbers underline that existing protection seriously distorts the location of production and that huge gains can be reaped by removing the distortions, permitting production to relocate to the

lowest-cost venues, and maintaining a balance between production and consumption by freeing up international trade.

A closer look at the figures reveals (Anderson, 2004) that almost two-thirds of the distortions (and hence of the potential gains) arise from measures to protect agriculture, and that almost one-half of the global total is due to agricultural protection by the rich world. Further costly distortions originate from protective measures in textiles and clothing (7% of the global total) and other manufactures (27%), but, in these cases, measures maintained by the developing world dominate the totals. Intriguingly, the figures reveal that there is very little trade-distorting protection for non-agricultural raw materials. Since the scope of my investigations is limited to primary commodities, agriculture will be strongly the focus of the present chapter's deliberations, with special attention devoted to the protective measures maintained by the rich OECD country group.

This chapter looks first at the national policies that affect commodity production and trade, and explores the reasons for their establishment. I then provide some quantitative measures of the extent of trade-restricting policies affecting commodities. There follows an assessment of the distortions to the location of production and to the trade flows in different commodity groups, caused by the restrictions to trade. A final section looks more closely at commodity processing and explores how the location of this activity has been distorted, not only by trade-restraining policies in a strict sense, but also by a broad array of surviving colonial legacies.

### **3.2 What policies, by whom, and for what reasons?**

Protection takes a multitude of forms. Not all of it is clearly visible. The original rationale for establishing protective measures has sometimes been forgotten and is often hard to establish. Importing countries account for a completely dominant share of the overall constraints and distortions of trade, and I begin by considering the menu of protective measures adopted to reduce commodity imports.

Traditional analyses of trade policy distinguish between tariff barriers to trade, which restrict imports by raising the domestic price, and non-tariff barriers comprising all other protection measures. It is useful to make a further distinction by subdividing non-tariff barriers into the ones that restrict imports directly and those that do it

indirectly by promoting domestic production. The tools to be enumerated are not exclusive to commodity trade. Most of them are equally employed to restrain manufactures trade as well.

*Import tariffs*, which raise the imported price, and so reduce the volume of imports, constitute the classical measure for protecting domestic production from more efficient foreign competition. Tariffs can come in different forms and under different names. One form that has been frequently used in the EU and elsewhere is the *variable import levy*. Its purpose is to keep domestic production and imports stable over the price cycle in the international commodity markets. It involves the maintenance of a domestic price which is high enough to assure an adequate and stable profitability to domestic production, primarily with the help of a levy on imports which varies inversely with the international price, so as to always equate the total import price with the domestic price.

Among the non-tariff barriers, a straightforward measure to restrict imports is to establish *import quotas*. Imports are then permitted only up to the level of the quota, and any remaining demand has to be satisfied from domestic output. When quotas are effective in reducing imports, their allocation among importers regularly raises controversies, as each tries to maximize his allotment. Even when no specific limit on the imported quantity has been set, the institution of *import licenses* often involves a bureaucratic hassle that in effect leads to a restriction of the import flow. *Voluntary export restraints* are a special type of quotas. The concept is a misnomer: the restraints are typically not voluntary at all, but are adopted by the exporting country under threat from the importing government of even more severe suppression of trade. Restrictions of the import volume are often implemented with the help of *national standards*. In primary commodities, this tool would be most common for agricultural products. On health grounds, the importing country can impose a prohibition on imports of food from areas claimed to be infested by disease, or where a particular insecticide has been used. Alternatively, the importing government can require elaborate and costly veterinary inspections as a precondition for import.

Instead of reducing the competitiveness or availability of imports, the protective measures can aim at inducing expanded domestic output, by improving its competitiveness, or by directing demand specifically towards that output. Overt subsidies involving *direct*

*payments, concessional lending* or the *write-off of loans* will reduce the domestic production costs. *Tax concessions* can have a similar effect. *Public procurement* exclusively from domestic sources will add to the demand for domestic output, to the detriment of imported supply.

Several rationales are put forth in justification of the importing countries' restrictive policies related to commodity imports. The most important is probably an urge to assure a reasonable self-sufficiency of indispensable goods, whose supply, it is felt, cannot be entrusted to foreigners. That would explain why the highest protection is afforded to food products, while the protective measures for non-food commodities of agricultural and mineral origin are much more relaxed. Energy materials are indispensable too, but the protective measures have so far been restrained, perhaps because many importing countries have little prospect of replacing imports by domestic supply, and, where such prospects exist, the expansion of output within the country would be very costly.

Another rationale for protection is a concern about the labor and capital employed in existing domestic installations. Where uncontrolled imports threaten to annihilate an uncompetitive domestic commodity industry, the consequence will be an uneconomic destruction of capital and skills. In such situations, it is argued, temporary import barriers are needed so that imports are expanded only gradually, in line with the depreciation of existing assets and the ability to shift the labor force to alternative occupations. In practice, once protection is established, it tends to become a permanent feature.

In numerous industrialized countries, agricultural producers have a vocal lobby whose political support for the government in power is conditioned on continued agricultural protection. In other cases, import restrictions have been used as a way to ease a strained balance of payments situation. Finally, especially in developing countries, import tariffs and/or taxes on foreign trade have often been an important source of public revenue.

While trade policy is predominantly the preserve of the importers and invariably aims at restricting the import flows, commodity exporters, too, sometimes use policy to affect the volume of their export supply. However, the exporting countries' policies differ in their objectives. Some aim at promoting exports, to expand the availability of scarce foreign exchange or to create a level playing field by

countervailing the protective measures of the importers. Subsidies, tax concessions, and favorable treatment of foreign exchange earnings frequently come into use in export promotion. Other countries adopt policies to discourage sales abroad, to assure domestic availability, or in pursuit of higher prices. Export licenses and quotas or taxes on exports are employed for this aim. The OPEC countries along with Russia have restrained exports through these means for the purpose of raising prices and assuring public revenues. The global cost of oil production could be substantially reduced by allowing a much larger share to take advantage of the unique resource wealth in the Middle East. Export taxes on commodities with price inelastic supply additionally assure the government budget of valuable revenue. In 2006, China increased its export taxes substantially, to better assure domestic metal availability. Earlier tax rates of 5% for aluminum, 10% for copper and 2% for nickel were all raised to 15% (Macquarie, 2006). In 2007, India introduced a 7% export tax on iron ore (*Financial Times*, 2007).

### 3.3 Measuring the extent of trade restrictions in international commodity trade

The protectionist arsenal has undergone substantial change since the late 1980s, primarily involving a dismantling of many non-tariff barriers with unclear consequences. This facilitates somewhat the complex measurements of the overall level and impact of protection, since most of such impacts have recently come from the application of tariffs (Anderson, Martin and van der Mensbrugghe, 2006). Even so, assessments of the degree of protection against imports of primary commodities raises a number of methodological and practical difficulties, and yield a variety of outcomes, depending on assumptions and models used.

The results of one estimate of global agricultural protection (Anderson, Martin and Valenzuela, 2006) indicate that 75% of overall support has the form of tariffs, and that two-thirds of such support has been mounted by the OECD nations. Another estimate (Anderson, 2006) of weighted average applied tariffs in 2001 yields global figures of 16.8% for agriculture and 2.6% for other primary commodities. Average tariff rates in high-income countries work out at 16.1% for agriculture but only 1.1% for other primaries; in developing countries, the corresponding figures are 17.5% and 6.7%,

respectively. These results in combination yield important insights: protective measures against imports of non-agricultural raw materials by the rich world can for all practical purposes be ignored. An analysis of trade distortions focusing on *agricultural tariffs in the rich world* should catch a major part of overall trade policy distortions in the primary commodity sector. Additionally, data on agricultural protection in the Third World as a whole is not easy to obtain.

The OECD regularly publishes the level of (agricultural) *Producer Support Estimates* (PSE) for its member nations and for a few important non-member countries (OECD, 2005). PSE has become a widely used yardstick that measures the overall size of the many disparate policy instruments in support of agriculture (OECD, 2004). In 1986–8, such support had an annual value of \$243 billion and corresponded to 37% of gross farm receipts (%PSE). By 2002–4, the absolute support in nominal money had risen to \$254 billion per year, but the %PSE had declined to 30%. National subdivision of the numbers reveals the European Union as the largest agricultural supporter in the latter period, the total amounting to \$114 billion per year, followed by Japan (\$47 billion) and the US (\$40 billion). The leaders in %PSE were Iceland, Norway and Switzerland (all three above 70%), Korea (63%) and Japan (58%). The %PSE was 34 in the EU and 17 in the US. New Zealand and Australia had the lowest %PSEs at 2 and 4, respectively, but non-OECD members Brazil, China, South Africa and Russia also recorded low levels of agricultural protection, all with %PSEs within a range of 3.3–7.5.

The PSEs in the OECD area are also calculated by agricultural commodity. The most recent numbers available at the time of writing refer to 2001–3 showing total PSE at \$238 billion per year and %PSE at 31. The pride (or shame) of place in percentage terms goes to rice, where total support was \$22 billion and %PSE was 78. Such high levels of protection go a long way to explain why only a minuscule proportion of global rice production is being traded (see table 2.3). Other highly protected commodities among the ones reviewed in chapter 2 comprised beef (\$26 billion, 33%), wheat (\$15 billion, 37%), and sugar (\$6 billion, 51%). Wool, on the other hand, was very lightly protected (\$0.1 billion, 5%), while data on cotton were not provided separately in the OECD data compilations.

Assessments of the likely relocation of production and provenance of exports in consequence of discontinued agricultural protection

should be taken as no more than rough indicators of likely events. One study (Anderson, Martin and van der Mensbrugge, 2006) presents a set of highly uncertain but profoundly thought-provoking results for 2015, comparing a persevering protectionist status quo with what would occur if agricultural protection were immediately and completely dismantled by all countries.

In this thought experiment, liberalization is shown to increase global agricultural trade by some \$310 billion. This is a very substantial figure, given that total agricultural exports in 2005 amounted to \$850 billion. The OECD's agricultural imports would be 66% higher in the liberalized scenario; its exports would be augmented by 16%, resulting in a deterioration in the region's agricultural trade balance by \$60 billion. Dismantling of protection would permit the developing countries to increase their agricultural exports by 67%, but they would import 55% more, with a net trade balance improvement corresponding to the rich world's deterioration.

Global agricultural output is shown to decline by 1.3%, a consequence of higher international prices as agricultural subsidies are discontinued. The sharpest reductions in output, in both dollar and percentage terms, are recorded in Europe (−\$186 billion, −12%) and in Japan (−\$92 billion, −18%), but China, India and Russia also record significant declines. The biggest gainer is Brazil (\$66 billion, 34%), while output in the US and Australia + New Zealand rises by some \$30 billion in each case.

### **3.4 Commodity processing: tariff escalation**

It was noted above that dislocations of commodity production and trade due to distorting protectionist policies are, by and large, limited to agricultural products, and notably to food. But there is a further policy stance, widely applied to all kinds of commodities, and causing considerable dislocation, which requires discussion. This is tariff escalation along the processing chain from the crude material to the finished commodity product, and its precise purpose is to assure the location of commodity processing in the country that imports the crude material.

A number of factors would determine the globally optimal location of commodity processing in the absence of trade policy intervention. These comprise transport costs that are related to the weight

reduction accomplished by the processing activity and the relative ease of transporting the crude and processed product, respectively. The weight of copper falls by two-thirds as one moves from concentrates to the refined stage, thus reducing the cost of shipping. The weight of tomato concentrate may not be vastly different from that of fresh tomatoes, but the former are less fragile, so reducing the cost of shipping. In some cases, the processed product is more expensive to transport. Crude oil is predominantly shipped in highly economical very large crude carriers (VLCCs), while gasoline is typically moved more expensively in specialized and much smaller ships. Processing costs will not be the same in all locations. The transformation of bauxite into primary aluminum metal requires huge amounts of electrical energy. If the bauxite-producing country does not have ample and cheap power supplies, it will be economical to ship and process the bauxite elsewhere. Substantial economies of scale in processing may favor location in the raw-material-producing country in some cases, and in the consuming nation in others.

Trade policies by the commodity-importing countries may distort these optimal patterns in favor of location in the commodity-importing nations. A variety of arguments has been used in justification of such policies by the importers. The importing nation may be anxious, on mercantilist grounds, to reap the benefit of the value added created by commodity processing. Alternatively, it may be felt that processing is an activity of strategic importance. Such views have been forwarded, e.g., to motivate the refining of crude oil. Or, there may be vocal interest groups eager to defend the colonial status quo, under which virtually all processing took place “at home.”

Tariff escalation is the most important, but by no means the only, policy tool to accomplish these desired ends. Even in cases where the nominal tariff on the processed commodity is only modestly higher than that on the crude material, the escalation of tariffs may nevertheless provide a prohibitive deterrent against processing in the country of original production, as is apparent from the example summarized in table 3.1. If processing increases the value of the product from \$80 to \$100, and if the nominal tariff is 10% on the crude material but 20% on the processed product, then the effective tariff imposed on the value added created at the processing stage works out at a prohibitive 60% ( $\$12/\$20$ ), likely to make processing before exports an uneconomic proposition.

**Table 3.1** *An illustration of tariff escalation: nominal versus effective tariff rates*

	Value \$	Value added, \$	Nominal tariff, %	Nominal tariff, \$	Effective tariff, %
Crude commodity	80	80	10	8	10
Processed commodity	100	20	20	20	60

Instances of tariff escalation in agriculture from about the turn of the century are easy to quote. The US, EU and Japan apply a zero tariff on soybean seeds, cocoa beans, unprocessed coffee and raw hides. In contrast, the tariff on soybean oil is 20%, 5%, and 23%, respectively, on cocoa paste 0%, 10%, and 9%, on roasted coffee 0%, 9%, and 13%, and on tanned hides 3%, 5%, and 15% respectively in the three importing regions (FAO, 2004). If processing accounts for 20% of the value of the processed products, as is the case in the example of table 3.1, then the effective tariff will be even higher than 60% in several of the instances just quoted. UNCTAD (2003) provides data on tariff escalation in mineral commodities which suggest a less pronounced distortion in these commodity markets. The tariff for metal raw materials is zero for the US, EU, and Japan, but amounts to 2.2%, 2.9%, and 0.9% for finished metal imports to the three regions. Trade deterrents of similar magnitude apply to fertilizers at different levels of processing.

The numbers presented above relate to tariff escalation applied by the rich world. But the sources quoted state that even more accentuated tariff escalation is practiced by many developing countries. Furthermore, other instruments also come into use to protect commodity processing in rich as well as poor countries. UNCTAD (1999) recounts the sad story of how an emerging tomato concentrate industry in Senegal, producing 73,000 tons in 1991, and generating substantial exports, was forced to contract its production levels to less than 20,000 tons by 1998, in consequence of a package transferring \$300 million in subsidies in the EU to domestic tomato processors. Senegal was not alone in suffering. Other West African countries such as Burkina Faso, Mali, and Ghana faced similar experiences of the EU subsidies.

In China, value added taxes are used to assure domestic metal processing even beyond what is required to satisfy domestic metal consumption. Thus, a 17% VAT has to be paid for refined copper imports to China, while the imports of copper concentrates are not subject to this charge. Chinese smelters can offer very low processing charges to foreign suppliers for toll smelting and re-exports, in consequence of the VAT policy, with an ensuing expansion of the smelting industry, and a corresponding stagnation or decline in other countries, notably in Chile, the globally dominant producer of copper concentrates (private communication with Alfonso Gonzalez, Santiago de Chile).

Further location distortions arise when the raw-material-producing countries counter the tariff escalation measures by introducing incentives to local forward integration through export taxes at rates that decline with the level of processing. Indonesia is reported to have introduced such variable export taxation for crude logs, sawn wood and processed wood products, e.g., plywood. In other instances, quantitative restrictions have been imposed on the unprocessed materials exports. Political pressures have also been employed as a counter measure. The involvement of foreign direct investors is regularly looked upon much more favorably by the host government, if the investments include not only the extraction and export of the raw material, but also its processing.

The impact of the distortions due to tariff escalation and other measures to protect commodity processing is hard to establish unambiguously. I have not seen any overall assessment similar to the one related to agricultural protection in general that was presented in the preceding section. There is little doubt, however, that this impact is significant, and that the world economy could reap substantial economic gains from a move towards economic optimality in the location of commodity processing.

# 4 | *Price formation and price trends in commodities*

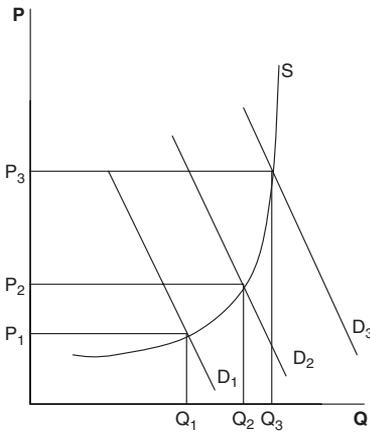
## 4.1 Factors determining price levels in the short and long run

Commodity prices in unregulated competitive markets are basically determined at each point in time by the intersection of the short-run supply and demand curves.<sup>1</sup> In figure 4.1 price will settle at  $P_1$  if  $S$  and  $D_1$  represent the supply and demand schedules, respectively. There is nothing special about commodities in this regard; all unregulated competitive markets behave in this way. In the short run, the capacity to produce (or the area of land under a specific crop cultivation) is given, and the supply schedule depicts the variable cost levels in existing production units, ranked in ascending order. Natural advantage, managerial efficiency, or a high proportion of fixed costs will yield low variable cost levels, and vice versa.

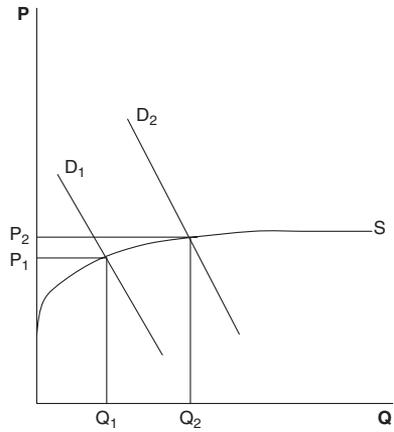
Capacity will be used to produce so long as the variable costs are covered by price. A rise in demand, demonstrated in figure 4.1 by a rightward shift of the demand schedule from  $D_1$  to  $D_2$ , will require the employment of additional production units, and their higher variable costs will push up the price to  $P_2$ . Such a shift could be caused by the secular economic growth from one year to the next, by a cyclical upturn in business conditions, which increases the demand for current consumption as well as for user inventories. or simply by the expectations, rational or irrational, of an impending price increase, which result in a surge in inventory demand for speculative purposes.

A similar upward push in price will result from a temporary leftward shift in the supply schedule (not shown in figure 4.1), as part of the existing supply capacity becomes unavailable due to, e.g., a pest- or weather-related harvest failure, a strike, or an accident immobilizing an important mine or mineral-processing installation.

<sup>1</sup> The following discussion draws heavily on Tilton (2006).



**Figure 4.1** Short-run price determination



**Figure 4.2** Long-run price determination

At low levels of capacity utilization, the short-run supply schedule tends to be relatively flat, and the price elasticity of supply, defined as the percentage change of supply in response to a 1% change in price, will be high. As full-capacity utilization is approached, the supply schedule will become increasingly steep, and the price elasticity of supply will decline. Additional increases in demand will then be harder to accommodate by rising output, so they will result in accentuated price reactions, as shown by the move of the demand schedule from  $D_2$  to  $D_3$ . At full capacity, the short-run supply schedule becomes vertical.

The high prices that typically arise when existing production capacity is fully used will strengthen the incentives to invest in capacity expansion. The capacity additions that will eventually emerge will extend the new short-run supply schedule to the right. Capacity change, however, is part of the long-run price determination, for the long run is defined as a period long enough to permit variations in capacity.

Figure 4.2 provides a gist of the long-run analysis. As in the short run, long-run price is determined by the intersection between the supply and demand schedules. The long-run supply schedule depicts the average total cost of marginal units at different levels of global output, as capacity is allowed to vary over time, again ranked in ascending order. This curve rises at first, reflecting the limited mineral deposits and agricultural land with exceptionally low costs, but then

levels off and becomes relatively flat. The rationale for the flattening is that the economically exploitable agricultural and mineral resource wealth tends to become more ample at higher cost levels.

Juxtaposed against the possible cost rise as long-run demand is expanded is a tendency for the entire supply curve to shift downward due to cost-reducing technological progress. The two forces, the rising cost as more expensive marginal resources have to be used to satisfy growing demand, and the cost reducing technological progress, shifting the entire curve downwards, could well cancel each other out, making supply expansion possible at unchanged cost. The history over the past 100 years suggests that technological progress has had the upper hand most of the time, so that increasing quantities could be exploited at a falling cost in the marginal project. This is reflected starkly in the long-run price trends discussed in section 4.3 below. Furthermore, at a high enough price, the availability of a back-stop resource is conceivable, permitting unlimited supply at unchanged cost. Note that a flat supply curve implies that the equilibrium price level will remain unchanged irrespective of the pace of demand growth since the long-run nature of the curve entails adequate time for capacity adjustments. Nevertheless, the supply curve in figure 4.2 assumes, perhaps pessimistically, that a certain degree of economic depletion does occur, so that costs and prices will rise as volumes increase with economic growth over time. The depletion issues are dealt with in chapter 6.

Actual price setting occurs only in the short run as described in figure 4.1. The long-run price, in contrast, is a conceptual artifice, indicating the level towards which market prices are moving at each point in time. The intensity of investments in capacity expansion explains why this is so. If the market price is above the long-run equilibrium, like  $P_3$  in figure 4.1, investments will be strongly stimulated, and the expanded capacity will in time result in a decline of prices towards the long-run equilibrium level. A boost of investments will tend to raise costs, especially if such a boost is widespread in the resource industries. This is what happened between 2002 and 2006 during the latest commodity boom (IMF, 2006b), importantly because investment inputs became scarce and their prices were bid up. It must be underlined that this cost increase is temporary. Costs will decline as the input supply is adjusted to the higher demand, or as the investment bonanza subdues.

Conversely, if the market price is below the long-run equilibrium, like  $P_1$  in figure 4.1, investments will be restrained, capacity will expand by less than demand, and prices will rise towards the equilibrium level. The greater the discrepancy between the market price and the long-run equilibrium price, the stronger is the likely investor reaction, and the more powerful the subsequent price adjustment.

Though there will always be market forces driving actual prices towards the long-run equilibrium, that equilibrium is unlikely ever to be reached. In practice, as discussed in the following section, it is even uncertain if the level can be unequivocally identified.

More complex price determination processes are involved when production results in the output of more than one commodity.<sup>2</sup> This is frequently the case in the exploitation of polymetallic ore bodies (copper and nickel; lead and zinc; gold and copper), but also in agriculture, where hides are produced along with beef, and wool along with mutton. Where one commodity dominates the revenue, it will tend to be produced on its own merit, irrespective of the price of the byproduct. Silver is predominantly supplied as a byproduct in non-ferrous base metals production, and its price tends to be depressed by excessive availability when the demand and price for the base metals is booming. Palladium presents a similar case, for it is a byproduct in South African platinum production *and* in Russian production of nickel, and hence dependent on the conjuncture of the South African and Russian producers.

Monopolistic pricing is sometimes rewarding and practiced in international commodity markets. Chapter 8 analyzes in some detail the price-setting issues that are involved. At this stage it suffices to note that a complete monopoly rarely, if ever, occurs in the international markets for primary materials, so formal analysis of pure monopoly has little relevance. What occurs is jointly implemented and crudely determined cuts in capacity utilization by the leading producers in markets where such action is believed to result in higher aggregate revenue and profits. In terms of figure 4.1, an ocular inspection suffices to reveal that when demand equals  $D_2$  and the competitively supplied quantity is  $Q_2$  at price  $P_2$ , it would pay, at least

<sup>2</sup> Most microeconomic textbooks can be consulted for a formal treatment of joint production, e.g., Layard and Walters (1987).

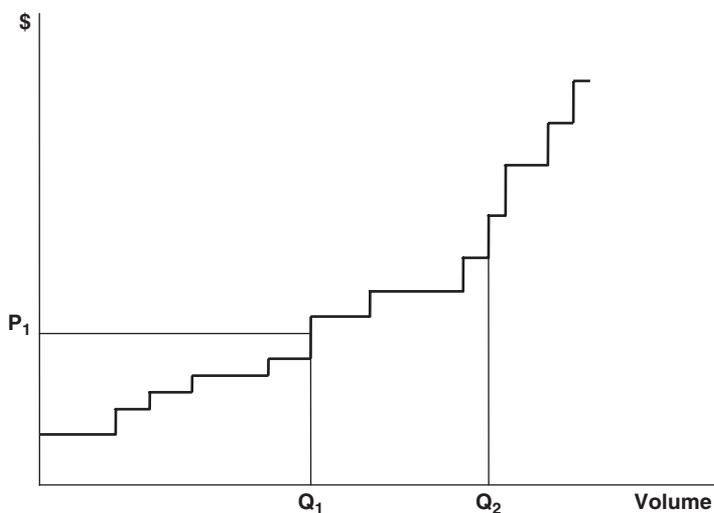
in the short run and in total revenue terms, to reduce supply to  $Q_1$  in order to reap price  $P_3$ .

## **4.2 The blurred nature and instability of the short-run supply schedule**

The neat conclusions from the analysis in the preceding section may be a useful guiding rod to price analysis, but its precision does not apply in practice. In the real world both the demand and supply schedules will appear as ill-defined and unstable broad bands, making it hard to use them for price determination. The following discussion focuses on the short-run supply schedule and tries to explain why it is blurred and unstable, but it should be emphasized that a similar imprecision applies to the demand schedule too.

Figure 4.3 depicts a short-run supply curve for profit-maximizing producers in the format regularly employed by resource industries and their consultants. The horizontal distances on the curve represent the production capacity of individual plants, while the vertical position indicates the average variable costs of production in each (cash costs in industry parlance), in an ascending order. After a price decline to  $P_1$ , production should contract to  $Q_1$ , because at that price level the cash costs will not be covered in units to the right of  $Q_1$ . Yet, it is a common experience that production will persevere at a level like  $Q_2$ , resulting in losses for the units between  $Q_1$  and  $Q_2$ , since variable or out-of-pocket costs exceed the market price. A number of reasons can explain this counter-intuitive behavior.

One important explanation is that closure and subsequent reopening involve a cost. If the price depression is deemed to be short, it may be more economical to suffer temporary losses from continued operations than to incur the costs resulting from closure. There is a related ambiguity about the distinction between variable costs, which are part of the short-run supply schedule, and fixed costs, which are not, and here, too, the time horizon is of consequence. The cost of labor, for example, is typically assumed to vary with the level of operations, but in a very short time perspective, the firm may not be able to sack workers, so this cost category becomes fixed. A similar argument applies to the servicing of installations, ordinarily a variable cost category, but avoidable, and hence fixed in the very short run. The greater the proportion of costs classed in the fixed category, the



**Figure 4.3** Industry cash cost curve

lesser will be the variable costs, and the lower will be the supply schedule, making it economical to continue operations at depressed prices. None of the behaviors discussed so far is counter to profit maximization.

Public policy, too, may have an impact on production maintenance when prices are low. Policy actions can either shift the supply schedule downwards, or induce deviations from profit-maximizing behavior. Reductions of fiscal dues, outright subsidies or devaluation of the currency, motivated by the desire to avoid production cuts, will all contribute to the public goal by instantly reducing the level of the supply schedule. Alternatively, public policy may take the form of social or political pressure exerted by public bodies on private firms to continue operations even when maintenance of production is not dictated by the profit motive.

Deviations from the profit maximization norm by the firms themselves provide a further possible explanation for continuing loss-making operations. In some firms, return on capital is only one of several criteria that guide operations. This is true of the many state-owned corporations in the minerals and energy sectors (see chapter 9), or in the agricultural cooperatives that process raw materials supplied by their members. Goals other than profit maximization (e.g. maintenance of employment) could then motivate continued operations

even when price does not fully cover operating costs. Even in firms that profess the profit maximization goal, such deviations could nevertheless result from the managers' short-run urge to secure their own jobs.

Standard microeconomic analysis usually assumes that costs are determined independent of price, by factors like technology, quality of the exploited resource and scale economies, and that costs, in turn, determine prices. This view must now be qualified, for as posited by the behavioral theory of the firm (Cyert and March, 1992), prices have a substantial influence on costs. High price and profit levels tend to push up costs and increase the organizational slack. Obversely, low prices and profits induce pressures to reduce costs.

This has a clear application to the industries producing raw materials. Using copper as an example, table 4.1 reveals a remarkable increase in the level of the non-socialist global industry's average operating costs of production between 1950 and 1972. In the 1970s, the major explanation for this increase was widely held to be resource exhaustion. At the end of the twentieth century this explanation has lost credibility, for the cost increase had been followed by an even more remarkable reduction in cost levels during the following decades.

Price developments provide a more credible reason for the reversal in cost trends. The downward-directed real price trend since the early 1970s has constituted a survival threat to many producers, and forced them to take draconian measures to cut slack that had been built up during the preceding high-price period. A substantial part of the cost decreases was based on pushes for technical advance and improved managerial efficiency, factors that had been less than fully utilized while prices were high. The eventual closure of production units that were not successful in reducing their costs contributed further to the industry's cost decline. During the 1980s, the entire supply schedule for copper in the non-socialist world declined dramatically (Crowson, 1987). The efforts of the US producers yielded particularly impressive results (Tilton and Landsberg, 1999). Table 4.1 reveals that the cost declines have continued into the present century, right until the commodity boom of the mid-2000s, when the cost trend was suddenly reversed.

Copper is not exceptional. Similar stories could be told for many other commodities. A high price relaxes the cost discipline, so costs will tend to rise. The survival threats imposed by a low price work wonders on the producers' cost performance.

**Table 4.1 Average operating costs in the non-socialist world copper industry, and LME copper prices, constant 2005 \$/lb**

	Costs	Prices
1950	96	168
1960	125	181
1972	163	205
1982	126	116
1992	108	137
2002	64	98

*Note:* UN's MUV index of manufactured exports used as deflator.

*Sources:* 1950 through 1982, Radetzki (1990a); 1992 and 2002, Guajardo (2006).

Cost pressures are not alone in cementing the causal relationship between prices and costs. Rising prices make it economical to bring high-cost operations into production, while, when prices fall, high-cost operations are closed, all of which causes costs to go up and down as prices go up and down.

The discussion in this section has brought out a number of reasons for the blurred nature of the supply schedule. I have shown that categorizations of costs tend to be fuzzy, that many suppliers do not pursue profit maximization as their sole goal, that public policy can alter the level of the supply curve, and that price changes have an impact on costs. For all these reasons, the traditional supply schedule will be ambiguous within wide ranges. One has to proceed with great caution when using it for determining volumes supplied and prices.

### 4.3 Price fluctuations in commodity markets, and long-run price trends

#### *Short-run instability*

“Rapid, unexpected and often large movements in commodity prices are an important feature of their behavior” (Cashing and McDermott, 2002). This is a well-known and oft-repeated statement, as is the observation that the prices of manufactures tend to be more stable.

Illustrations of violent commodity price gyrations, up as well as down, over relatively short time spans are easy to produce, even when the major commodity boom periods are excluded (UNCTAD Commodity Statistics Online; all prices are annual averages in US\$ per ton): coffee (mild arabicas) went down and up and down again from 4,256 in 1986, to 1,411 in 1992, 4,080 in 1997, and 1,370 in 2001. The palm kernel oil price fluctuated between 433 in 1976, 1,049 in 1979, and 458 in 1982. Rubber prices rose from 830 in 1993 to 1,600 in 1995, and then fell to 620 in 1999. Nickel prices varied between 4,870 in 1987, 13,300 in 1989, and 5,300 in 1993.

It is equally easy to point to the main reasons for the sharp commodity price instability. The price elasticity of demand for raw materials is usually quite low, given that the cost of such materials usually constitutes a small proportion of the finished product price. The price of bread and car batteries will be only marginally affected by a doubling of the wheat and lead prices, so the demand for these raw-materials-absorbing products will remain by and large unchanged. Furthermore, a given increase in demand for finished products will regularly give rise to a more accentuated increase in the demand for the raw materials employed, as the desired inventories are augmented from the finished product marketing stage back through the production chain. Say that there are three downstream stages in the production chain beyond the raw materials supplier, and that the desired inventories at each stage equal one-half of one period's sales. A 5% increase in the finished product demand will then result in an almost 17% increase in the demand for the raw material, due to the cascade of inventory adjustment at each production stage to the higher finished product demand.<sup>3</sup> *Ceteris paribus*, this will result in a much larger price adjustment for the raw material than for the finished product. The same applies in reverse when the finished product demand declines.

Fluctuations in supply, too, contribute to price instability. Weather is an important cause of supply variations in agricultural crops, even though geographical diversification of production in recent decades

<sup>3</sup> Stage 4, handling the finished product, raises its purchases by a total of 7.5% (5%, for sales, 2.5% for inventory increase). Stage 3 raises its purchases by 11.25% (7.5% for sales, 3.75% for inventory increase). Stage 2 raises its purchases by 16.9% (11.25% for sales, 5.65% for inventory increase), so the demand for the raw material at stage 1 is increased by 16.9%.

has reduced the importance of this factor (IMF, 2006b). Mineral supply can be caused to shrink due to strikes or technical accidents, but such failures would have to be widespread to significantly dent the global total. As noted in the preceding section, the price elasticity of supply would also be quite low, at least when capacity is fully utilized, which is normally the case in competitive markets. With the exception of annual crops, it takes an extended period of time to change the supply capacity, and in the meantime even small variations in demand will result in sharp changes in price.

The above, then, are the main explanations to the short-run price instability observed in most primary commodity markets. Such instability is believed to cause serious macroeconomic problems to countries that are heavily dependent on the exports of one or a few commodities. These problems and their remedies are dealt with in some detail in chapter 10.

### *Commodity booms*<sup>4</sup>

Commodity booms are defined for the purpose of the present analysis as sharp simultaneous increases in the real price of a broad group of commodities. Using this definition, it is possible to detect three such booms in the period since the Second World War, beginning in 1950, 1973 and 2003, respectively (see figure 4.4). They were all triggered by demand shocks caused by exceedingly fast macroeconomic expansion. In all three cases, commodity producers were unable to satisfy the fast growth in demand, and prices exploded in consequence.

The statement that demand is the typical cause of broad commodity price moves should not surprise, even if analysts have attempted alternative explanations (Pindyck and Rotemberg, 1990; Labys *et al.*, 1999). After all, alterations in supply are specific to individual commodities. Booming or slumping macroeconomic conditions, in contrast, will impact on demand across most commodity groups. I can think of two exceptions to this general rule. The first is widespread crop failures caused by extreme weather events. The second is strong simultaneous additions to production capacity stimulated by a period of high prices.

<sup>4</sup> This section draws heavily on Radetzki (2006).

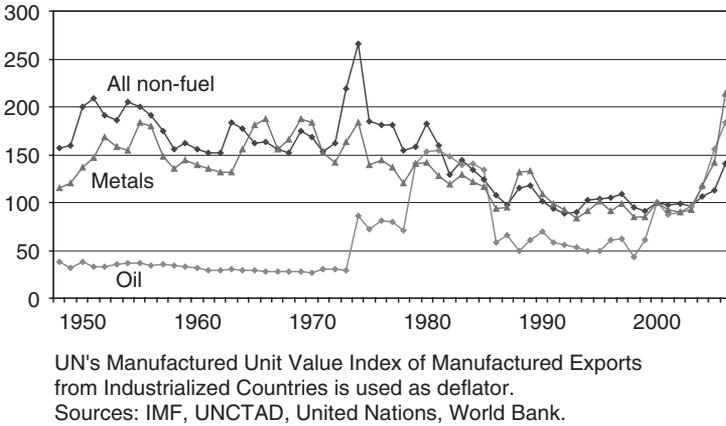


Figure 4.4 Commodity price indices in constant US\$. 2000 = 100

The importance of the macroeconomic conditions in explaining the commodity booms is clearly apparent from the numbers in table 4.2. The years marking the beginning of the respective commodity booms were characterized by very high growth rates in GDP and industrial production. It is also noteworthy that the commodity booms collapsed in 1952 and 1974, as the world economy experienced a sharp growth deceleration, and commodity demand shrank in consequence, but that the boom that began in 2003 is persevering through 2007, for much longer than its predecessor, all while the global economy continues to expand at a very fast pace.

Table 4.3 details the timing and level of the peak prices for broad commodity categories during the three booms. The *first* boom was strongly related to the Korean War, which broke out in June 1950, with an armistice reached in July 1953. The *direct* impact of the war on commodity markets arose from the insecurity felt about industrial materials supply, amplified by the painful shortages of the Second World War fresh in memory. This prompted a widespread build-up of strategic inventories, which added to demand and pushed up prices. The *indirect* impact arose from the boost to economic growth and industrial output that resulted from the war operations.

Agricultural raw materials and, to a lesser extent, metals and minerals carried the first commodity boom. As is apparent from table 4.3, the first group peaked at an index of 187 early in 1951, the latter at 134 somewhat later. In contrast, the war and the macroeconomic spurt of

Table 4.2 *Growth patterns during three booms, percent*

	1949	1950	1951	1952
<b>North America and Western Europe</b>				
GDP	2.6	9.2	7.2	2.1
Industrial production	-0.3	8.1	9.3	3.2
	1972	1973	1974	1975
<b>OECD</b>				
GDP	5.4	6.0	0.8	-0.2
Industrial production	6.5	8.1	-1.5	-4.3
	2002	2003	2004	2005
<b>World</b>				
GDP	3.1	4.1	5.3	4.8
Industrial production	0.4	3.4	6.3	4
<b>OECD</b>				
GDP	1.6	2	3.3	2.7
Industrial production	0.1	1.1	4.1	1.9
<b>Developing Asia</b>				
GDP	7	8.4	8.8	8.6
Industrial production	6.3	6.8	10.2	9.1

*Notes:* OECD represented 68% of world GDP in 1973. OECD represented 52% of world GDP in 2005, while Developing Asia represented 27%, both in PPP terms.

*Sources:* IMF (2006a, 2006b); *Monthly Statistical Bulletin of the United Nations*; OECD *Historical Statistics*; OECD (monthly); Radetzki (1974); UNCTAD (1976).

the years had little impact on the prices of energy and food. The constant dollar index for energy never reached 120, while that for food attained 125 during two quarters of 1950. An important explanation to these weak reactions is that the major consuming countries were relatively self-sufficient in energy and food. The OPEC cartel had not yet come into existence, the US was still a net oil exporter, while domestic coal dominated Western Europe's energy needs (Darmstadter, 1971). No significant harvest failures were reported at the time. The aggregate commodity price index, too, peaked early in 1951 at 145, making it the weakest of the three booms.

Neither was the boom particularly durable. By the second quarter of 1952, the price increases had, by and large, petered out as it became

Table 4.3 Peaks in constant dollar commodity price indices during three booms

	First boom, 1949 = 100		Second boom, 1971 = 100		Third boom, 2002 = 100	
	Peak	Date	Peak	Date	Peak	Date
Aggregate index	145	Q <sub>1</sub> 51	207	Q <sub>1</sub> 74	201	Q <sub>3</sub> 06
Metals and minerals	134	Q <sub>4</sub> 51	155	Q <sub>2</sub> 74	270	Q <sub>3</sub> 06
Energy	117	Q <sub>4</sub> 51	326	Q <sub>1</sub> 74	227	Q <sub>3</sub> 06
Food	125	Q <sub>3</sub> 50	140	Q <sub>4</sub> 74	108	Q <sub>2</sub> 04
Agricultural raw materials	187	Q <sub>1</sub> 51	159	Q <sub>1</sub> 74	109	Q <sub>3</sub> 06

Sources: Radetzki (2006); IMF, commodity prices on the internet.

clear that the Korean War would not spread into a worldwide conflict, and with the sharp slowdown in economic growth recorded in that year. In addition, dramatic strategic destocking added to supply, and so contributed to the ensuing price weakness (Rowe, 1965). By the end of 1952, the only remaining real impact of the commodity boom was a metals and minerals price level 20–30% higher than in 1949. All other commodity prices, measured in constant dollars, were roughly the same in 1952 as they had been in 1949. For all practical purposes, the boom was a transient phenomenon.

The *second* boom was much stronger than the first. It was also much more pervasive. The prices of all commodity groups rose sharply. As in the first boom, a very strong macroeconomic performance during 1972 and 1973 constituted an important trigger to the rising commodity prices. But there were two additional triggers. One was that the boom had been preceded by two consecutive years of widespread crop failures. The scarcity of food led to substitution in land use, e.g., from cotton or jute to grains, which cut the agricultural raw materials supply. The final trigger was that the OPEC cartel went into action by raising prices late in 1973. This had a strong repercussion on the aggregate commodity index. The speculative demand for commodity inventories as a “safe” store of value was a further contributory factor to the commodity boom, as investors fled from the chaos of the time in the markets for currencies, shares, and bonds (Cooper and Lawrence, 1975).

The constant dollar index reached a maximum at 207 in the first quarter of 2004. The individual commodity groups all attained their constant dollar peaks early in 1974, the energy index at about 330, and all the other commodity indices around 150. In the course of 1974, under the weight of the recession, importantly prompted by the oil crisis, the constant dollar metals and agricultural raw materials indices fell back sharply, to end the year at 100. They remained at that level through 1975, when the recession deepened. The metal prices were additionally depressed by large sales between mid-1973 and mid-1974 from the US government's strategic stockpiles, and in late 1974 from excessive commercial stocks in Japan that had been built up in the preceding year (Cooper and Lawrence, 1975). The food prices fell too, though less steeply, given their lower sensitivity to the business cycle.

The energy price index stands out from the other commodity groups. Energy prices rose significantly only at the end of 1973, later than the prices of other commodities, but by early 1974 they had increased by much more than any other commodity group, and they remained 150–200% above the base year through 1975 and beyond. The machinations of the oil cartel explain the difference. Oil dominates the energy price index, and the members of OPEC adjusted supply to the falling demand in 1974 and 1975, caused by the combination of deepening recession and the price shock (Radetzki, 1990a and 1990b).

The *third* commodity boom started in 2003 and has not yet run its course as this is being written in mid-2007. Like the preceding booms, it was importantly triggered by a demand shock. This can be illustrated by the demand increases for oil and copper in 2004, the highest on record for over twenty years. Producers were caught unaware, with little spare production capacity, so prices in many markets exploded.

As in the earlier booms, the demand shock was importantly due to fast macroeconomic expansion (table 4.2). OECD growth rose forcefully in 2004, but the growth performance in Developing Asia was of even greater significance. For although the latter area accounted for only 27% of global GDP in 2005, compared with OECD's 52%, it is presently in a development stage much more intensive in primary materials use than the dematerializing mature OECD economies. China especially stands out in this respect. The country's

share of global GDP in 2005 (PPP terms) was assessed by the IMF (2006b) at 15.4%, but its share of global demand growth between 2000 and 2005 was 28% for petroleum (IEA, monthly), 50% for aluminum, 84% for steel and an incredible 95% for copper (Albanese, 2006).

If a dollar added to the GDP in Developing Asia absorbs twice the quantity of commodities as does a corresponding dollar's growth in the OECD countries, the two regions would contribute about equally to commodity demand growth provided that both expanded at the same rates. But since Developing Asia's economies expanded at more than twice the OECD rate, it follows that its contribution to commodity demand growth overwhelmed that of the OECD. The importance of Developing Asia in this respect is a new phenomenon.

The aggregate commodity price index experienced a steady increase, and reached a peak at 201 in the third quarter of 2006 (2002 = 100). Metals and energy moved even stronger, to attain 270 and 227 at that time (table 4.3), while the food and agricultural raw materials prices hardly budged until mid 2007. China, again, offers a plausible explanation for the selective nature of the boom. The country's impressive growth in 2002–6 has been importantly driven by construction, a sector that is a heavy user of metals and energy, but not equally dependent on materials of agricultural origin (private communication with John Tilton).

I have asserted above that accelerating and/or high economic growth has been an important trigger behind all three commodity booms. I have also suggested that near-recessionary conditions and the ensuing destocking quickly punctuated the first two booms but that the third boom perseveres because of continued fast growth with no recession in sight. Two unresolved issues require clarification.

*First*, not all events of sharply accelerating macroeconomic performance give rise to booming prices in commodity markets. Other preconditions have to prevail, e.g., a tight production capacity situation and relatively small inventories. Such preconditions typically emerge after prolonged periods of weak commodity prices which discourage investments in capacity expansion and instill a sense that supply is secure, and that there is limited need for inventory holding.

*Second*, what can be expected to punctuate the third boom, and when, if world economic growth continues at a fast pace? The booming metals and energy prices are far above their long-run equilibrium,

and have prompted a strong response from investors, as discussed in section 4.1 above. Given the regulatory, decision, and implementation lags for investments in these branches of industry, it may be five years or even more after the prices rose before the new capacity becomes operational. But it is clear that the planned capacity additions are greater than the anticipated demand growth, so one can reasonably suppose prices in the competitive metal markets to move back to their much lower long-run equilibrium levels no later than at the end of the 2000s decade. OPEC, of course, has the power to protect the oil producers from price falls even in the event of an emergence of excess capacity (chapter 8). The third boom will be far more durable than its predecessors, if my suppositions prove correct.

### *The long-run price trends*

Attempts to track the long-run price trends for commodities in international trade have a long and confusing tradition. To be meaningful, the nominal price series have to be converted into real ones, expressed in constant money. A number of approaches can be employed to make such conversions, e.g., (a) the implicit deflator of the GDPs for the OECD area as a whole, expressed in US dollars; (b) the implicit GDP deflator for the United States; (c) the US producer price index; (d) the US consumer price index; and (e) the index of dollar prices of manufactured exports (c.i.f.) from major industrialized countries (the MUV index). Each of these deflators has its advantages and shortcomings and the real price developments can differ substantially depending on which is used. One has to think carefully about the purpose of the real price series before choosing the deflator.

I employed the MUV index earlier in the chapter in my discussion of commodity booms. This index seems to me to be more appropriate than the others for deriving constant dollar prices of commodities. Simply expressed, it provides the (inverse) size of the basket of manufactured exports that could be obtained for one US dollar at different times. It overcomes the problem of exchange rate changes not immediately reflected in export prices that would arise with the use of a national price index. And since it relates to manufactured exports, it provides an appropriate counterpoint for measuring the price changes of raw materials in international trade. In the 1950s and

1960s, the World Bank among others referred to the MUV index as an “index of international inflation.” In more recent times the index has become less representative of global inflation trends, since it does not cover the increasingly important manufactured exports from non-OECD countries, nor the sharply expanding trade in services.

Many attempts at establishing the long-run commodity price trend have been made, and they have yielded very varied results. Depending on the end points of the series, the countries whose trade is covered, the deflator used, and the commodities included, the outcomes of these investigations have ranged between stagnant and substantially declining developments for real commodity prices.

Grilli and Yang (1988) at the World Bank undertook a painstaking study of the real commodity prices. It covers the period 1900–86. Though somewhat old, the study is still frequently quoted.

The real prices are measured as an index of the dollar prices of twenty-four major commodities in international trade, accounting for 54% of total non-fuel commodity trade in 1977–9, deflated by the US index of wholesale prices of manufactures. The results reveal a statistically significant trend rate of decline of 0.59% per year, corresponding to a cumulative trend fall of some 40% over the eighty-six years covered by the study. Elaborate tests in which the weights of the commodity basket are varied, and the impact of the end points of the period studied explored, confirm the stability of the negative trend and the size of the decline.

Additional insights are obtained when the material is disaggregated into major commodity groups. The annual trend decline during the eighty-six-year period is 0.84% for metals, 0.82% for agricultural non-food, and 0.54% for food excluding tropical beverages. This is, intriguingly, the only group exhibiting a positive price trend. The real prices of coffee, tea and cocoa have been rising by an average of 0.63% a year between 1900 and 1986.

A more recent study by Cashing and McDermott (2002) covers the more extended period 1862–1999. The commodities considered include metals and minerals and agricultural raw materials, but food and fuels are not comprised. The US GDP deflator is used to convert nominal into real commodity prices. Despite the differences, the authors note a close correlation of their results with those of Grilli and Yang. The main result of this study is the finding of a trend decline in the real price for the aggregate commodity group of 1.3%

per annum for the entire 140-year period. After being somewhat stable over the first four decades, the index falls by four-fifths over the twentieth century. Cashing and McDermott note that this decline is steeper than that reported by Grilli and Yang, and attribute the difference to the exclusion of food and beverages from the commodity sample under investigation.

How can one explain the long-run price performance of commodities versus manufactures? It is first worth noting that the evidence of falling relative commodity price trends revealed by numerous studies including the ones quoted here is contrary to the theories and expectations of the classical economists. These economists postulated rising relative price trends for raw materials in consequence of the productivity loss caused by the need to employ increasingly more meager land and mineral deposits in commodity production. Elaborating on the works of Adam Smith and David Ricardo, John Stuart Mill (1848) synthesized the classical argument for rising real commodity prices:

The tendency, then, being to a perpetual increase of the productive power of labour in manufactures. While in agriculture and mining there is a conflict between two tendencies. The one towards an increase of productive power, the other towards a diminution of it, the cost of production being lessened by every improvement in the process, and augmented by every addition to population: it follows that the exchange value of manufactured articles, compared with the products of agriculture and of mines, have, as population and industry advance, a certain and decided tendency to fall.

The notions about rising raw materials prices due to increasing pressures on land and mineral depletion remained out of vogue for a long period of time. From the early 1970s, however, they attracted intensive concern as a result of the second commodity boom, and the concurrent publication of the Club of Rome reports about an impending general depletion of resources (see chapter 6).

Fears of price-raising scarcity were subdued in the following decades as all commodity prices resumed their long-run real declining trend, but they have resurfaced again in the proclamations of impending “peak oil” and “peak copper” for that matter, as the third boom evolved early in the present century.

The first attempts to explain the falling real commodity price trend were mounted by Singer (1950) and Prebisch (1962), who argued that

there is an asymmetry in the response of prices to productivity gains between commodities and manufactures. The markets for the former are highly competitive, so any productivity improvement leads to a price decline. The monopolistic organization of the labor and capital employed in manufactures production, in contrast, enables the factors of production to reap the benefit of productivity gains in the form of higher income. The Prebish/Singer explanation of falling commodity price trends aroused an extended debate. The critics remained unconvinced.

There are several other, less controversial, reasons that could explain the observed long-run decline in real commodity prices. *First*, the income elasticity of demand for most commodities (defined as the percentage change in demand due to a 1% change in income) is commonly lower than for manufactures, and so, with expanding income, the lower growth of commodity demand is likely to result in a weaker commodity price development. In fact, Singer himself used this argument in support of his theory. The *second* reason is that transport costs ordinarily constitute a higher proportion of the delivered price of commodities than of manufactures. The secular fall in transport costs discussed in chapter 1 should therefore have resulted in a stronger decline in commodity price quotations. This argument would apply with particular force to bulk commodities with low prices per ton. *Third*, and probably most important, the manufactures price index is tricky to construct and interpret because of the continuous shifts in its product composition and the quality changes over time of individual products. The increasing size and efficiency of, say, harvesters or mine loaders during the past fifty years has involved a much greater improvement than any quality change of the cereals or ores in whose production these machines are employed. It is quite possible that the relative shifts in quality are enough to explain why manufactures prices have risen in relation to commodity prices. This is demonstrated in a recent path-breaking study (Svedberg and Tilton, 2006) which tries to adjust the consumer price index to take full account of manufactures quality change, and then employs the new and lower inflation data to obtain a real price series for copper. While earlier real copper price series showed a falling price trend, the adjusted ones demonstrate a rising trend.

*Finally*, it seems that the classical economists exaggerated the detrimental impact on productivity from the need to employ inferior

lands and mineral deposits in commodity production. Improvements in agricultural productivity have assured rising global supply without the need to employ increasingly unfertile lands. On the contrary, there have been tendencies to stop using the least productive land so as to avoid burdensome surpluses. Advanced methods of exploration for minerals have not only expanded the quantity of reserves, but in some cases also ameliorated the quality of the exploited resource base over time.

#### **4.4 Alternative trading arrangements and their implications for price formation**

A myriad of arrangements are being practiced in cross-border commodity trade, and the discussion in the present section must be selective. My ambition is to classify the trading arrangements into a few major forms, to indicate some of the markets in which they are practiced, and to point to the major implications of each form. The logical order of my classification is from the most public and transparent arrangement to the most private and opaque one.

##### *Commodity exchanges*

The [next chapter](#) is devoted entirely to commodity exchanges, so they can be treated quite briefly in the present context. Commodity exchanges are markets where many buyers and sellers meet simultaneously, and enter into numerous transactions relating to the products traded there. The commodities traded on exchanges are characterized by a sizable number of sellers and buyers, and by relatively few quality grades. The exchange typically provides the opportunity for spot transactions, as well as futures and options trade. Transaction costs are quite low, and the widespread introduction of electronic trade is lowering them further. Price determination is a key function of an exchange. The uniformity of the price facilitates transactions. The need for price haggling is virtually eliminated. The prices are monitored and published, and are regularly used to determine price levels in deals outside the exchange. The prices on the exchanges are instantaneously influenced by events in the outside world. Hence, there tends to be much greater short-run price volatility in the exchange-determined prices than under most other trading arrangements.

Commodity exchanges have proliferated, as has the number of products traded there. Reasons for this comprise declining concentration of production, more competitive market conditions, and the reduction of government interventions in commodity markets. Exchange prices have added greatly to the price transparency in commodity markets.

### *Auctions*

Auctions commonly also accommodate many sellers and buyers, but unlike exchanges which operate continuously, business is transacted only at irregular intervals. In distinction from exchanges, where the double auction principle is applied, i.e., buyers and sellers are equally active in trade, the auction markets apply the principle of single auction, with a more passive role assigned to the sellers (ordinary auction) or to the buyers (Dutch auction). In ordinary auctions, the practice is to deal with the sellers consecutively, and to offer the supply of each at a time. Normally, the buyers make successively higher bids, with the transaction priced at the highest bid. In Dutch auctions, the procedure is reversed; the seller makes successively lower offers, with the transaction priced at the first accepted offer. As in the case of exchanges, auction prices are public and transparent, but they may lack continuity if auctions are irregularly held.

A key reason for trade at auctions rather than at fully fledged exchanges is the great variety of grades across producers and over time in which these commodities are sold, but auctions appear to be going out of fashion in favor of exchanges as modes of commodity trade. Coffee, tea, and flowers are sold at auctions in some East African countries, as is tea in Kolkata and Colombo (World Bank Commodity Price Data). An important auction market has recently been established on the internet for steam coal.

### *Bilateral contracts*

This is probably the predominant arrangement in international commodity trade. It involves a pair of agents who independently agree on the terms that will apply to the trade between them. The crucial terms on which all contracts have to be explicit concern the commodity specification, the quantity, the time and place of delivery,

and the price. Other than that, bilateral contracts come in many different forms. Thus, some contracts can relate to a single immediate transaction, while others concern repeated deliveries stretching over periods from a few months to a decade or more.

Bilateral contracts often employ the price levels set by commodity exchanges as a guiding rod for their price determination. Price setting becomes more tricky for commodities that are not traded on exchanges, e.g., alumina or copper concentrates. In principle, each bilateral pair has to negotiate and agree on the price that will apply in each contract. This will be arduous and time-consuming. Since prices of contractual agreements are not regularly published, the negotiations may result in a wide range of price levels at a particular point in time.

In practice, there are often conventions which simplify the procedure and help avoid blatant deviations from the average price level. In manganese, for instance, where most trade is transacted through annual bilateral contracts, a commercial practice has developed where a major supplier enters into preliminary discussions with a major customer, while the rest of the industry defers its contract negotiations. As soon as this pair reaches an agreement, all other suppliers and users adopt the agreed price as a guideline for their own negotiations. Very similar practices apply to the annual contracts under which a large proportion of the international iron ore trade is transacted. Until the 1970s, the annual contractual arrangements between the Swedish iron ore exporter and the steel mills of Germany set the pace for other contract negotiations. From then on, the Brazilian company CVRD has taken over the Swedish role. On the buyers' side, the lead role has been taken sometimes by European companies and sometimes by Japanese ones, but in 2007, the benchmark deal involved the CVRD and Chinese Bao Steel for the first time (*Financial Times*, 2006).

In other cases the price transparency in bilateral contract markets is quite limited. This is true, for instance, of the international markets for sisal and jute or of phosphates, chromite and uranium, though in all these cases there are trade associations or specialized journals which publish prices or price ranges purported to reflect the levels of actual transactions. In the case of uranium, the published series relates to the small volumes sold in the spot market, while the evidence of

prices applied in the long-term contracts that dominate uranium trade is scattered and less systematic.

In some cases, the true price may not even be clearly apparent from the content of the bilateral contract. This would be the case when the contracted price is preferential, to take account of the provision of long-term investment finance, or equity participation, by the buyer. Similarly, barter deals make it very hard to determine the true commodity price contained in the contract.

Especially in cases lacking transparency, there is a likelihood that small parties with less access to information and with weaker bargaining power will get a worse deal in bilateral contracts than they would in the more transparent and impartial arrangements characterizing exchanges and auctions.

### *Producer-dictated prices*

Producer-dictated prices occur in commodity markets where the number of producers is relatively small, and where each sells to many customers. Producer pricing implies some degree of monopoly power; it also affords the producer a certain degree of convenience. The commodity is sold on a take it or leave it basis, and, at least in theory, the need to bargain with each customer is obviated. The example par excellence is the De Beers arrangement for the sale of uncut diamonds.

Producer price quotations can coexist with prices set by commodity exchanges or the prices monitored by trade journals from bilateral contracts, but such coexistence tends to dilute the pricing power of producers. Thus, the former existence of regional producer prices for copper and zinc has gone into oblivion. Producer prices typically react with a lag to market developments, and alter less frequently and less violently than prices on commodity exchanges. Producers have to introduce rationing when their price is below the exchange price, and are forced to offer hidden rebates when the exchange price falls below their quotations. A time series of producer prices therefore tends to give a distorted picture of transaction prices.

The pricing power in cobalt of the Central African producers has been taken over in some measure by Norilsk Nickel in Russia, while Western Mining Corporation (now part of BHP Billiton) operates a mixture of producer pricing-cum-auctions on the internet for its

cobalt sales. A very large share of world molybdenum used to be produced by Amax Inc. (now part of Phelps Dodge) in the United States, and the company was regularly announcing producer prices for this material. This habit was discontinued as Chilean producers came to dominate production, and quotations are currently provided by traders. A few South African mining companies account for a large share of world platinum production, and were also setting the price for their production, but the price setting has been effectively transferred to NYMEX, the metals exchange in New York.

In earlier times, prices set by producers could remain for extended periods of time. The proliferation of commodity exchanges has forced the price-setting producers to alter their prices more frequently and to adjust more fully to the exchange quotations. The introduction of petroleum, aluminum and nickel on commodity exchanges in the 1970s and 1980s greatly reduced the relevance of the producer price systems that traditionally dominated the trade of these products.

### *User-driven prices*

One could think of identical arrangements, but with the roles reversed, with the buyers being few and able to dictate prices to prolific producers. Such arrangements are not very common. An old example is the military procurement of uranium by the US and UK authorities, whose complete dominance of demand until the early 1960s permitted them to set the terms of their purchases. User-dictated prices prevail in some markets for food products, where heavily concentrated food processors encounter many scattered farmers.

### *Transfer prices*

Transfer pricing in international commodity trade occurs when the producer/exporter and the user/importer are part of the same vertically integrated corporation. The prices in such trade are internal to the firm, and can be set at any level. They appear only in the accounts of the firm and are ordinarily not published. In principle, they do not affect the corporate profit before tax.

The profit-maximizing firm will have an interest in setting the transfer prices so as to minimize the sum total of profits tax, export tax and import duty. Import duties on raw materials are usually low,

so ordinarily the major corporate concern is with profits and export taxes. If the transfer price is set low, profits will be shifted to the importing country. This will reduce the tax burden, if the profits tax in the importing country is lower. Governments of exporting countries desirous of maintaining their tax income have instituted “posted prices” in many cases, to be applied for the purpose of tax assessment in the exporting unit of the integrated firm. These prices have sometimes been derived from production costs; in other cases they have been based on perceptions of prevailing price levels in trade between independent parties. The institution of posted prices has reduced the corporate benefit from transfer price manipulation.

Where transfer prices dominate a market, the price transparency will usually be quite low. Even if the prices were known, it is unclear whether they would at all reflect the costs of production or the price levels that would emerge in arm’s length transactions. Bauxite trade probably offers the best example of a commodity market based predominantly on transfer prices. The extent of vertical integration from bauxite to alumina and aluminum is still quite high, and a major share of the bauxite and alumina that enter international trade is internal corporate deals. Transfer price arrangements account for minor shares of all international transactions in, for example, iron ore, tea, rubber, and some edible oils, where the processors in industrialized countries still own some of their sources of primary supply. Transfer prices were far more common in the 1950s and 1960s, for example in petroleum, iron ore, copper, and many food products. Since then, there has been a wholesale vertical disintegration of the industries producing and processing these materials. The disintegration resulted from the widespread nationalizations of the raw-material-producing industries in developing countries. In consequence, the significance of transfer pricing has been greatly reduced.

#### **4.5 The actual price quotations**

Commodity price data may appear confusing and mystifying to the uninitiated. The purpose of this section is to clarify some of the concepts used and point to the sources where current quotations and long-time series may be found.

Commodity price quotations come in many different formats, and one has to be clear about the precise information they convey, in order

to evaluate them or compare alternatives. At the most basic level, one must be careful to note the **currency** in which the quotation is made. The **unit of measurement** is equally important, but can be more tricky to clarify. Tons used to come in at least three varieties, even though metric tons have become dominant in recent times. Ounces, bushels and gallons differ depending on country and product, so it may be useful to refer to a handbook of weights and measures. For unprocessed metal minerals, e.g., iron ore, conventions differ between quotations per unit of gross weight on the one hand and per unit of metal content on the other. In the case of some mineral concentrates, e.g., chromite, the quotation could be (a) per unit of gross weight, (b) per unit of metal oxide ( $\text{Cr}_2\text{O}_3$ ), or (c) per unit of metal content.

The **stage of processing** at which the material is sold is of course crucial for the price. Sugar is alternatively traded as raw or refined; uranium comes either as uranium oxide ( $\text{U}_3\text{O}_8$ ) or uranium hexafluoride ( $\text{UF}_6$ ), and the additional processing costs explain existing price differences. The **quality** of the product will obviously make a difference to price, and one must clarify the specific quality to which the price quotation refers. Coffees are divided into robustas and arabicas, with the latter commanding a price premium over the former. In cotton, long fibers usually command a higher price. And the price of chrome ore is strongly influenced by its carbon and iron content.

The **time of delivery** is very important for the price level. When supplies for immediate delivery are ample, the prices for future delivery, quoted on commodity exchanges, will be higher than prices for spot transactions, the difference (*contango*) providing for the cost of carrying inventories. When the supplies for immediate delivery are scarce, spot transactions may be priced higher than deals with later delivery times, and the difference (*backwardation*) can be quite large.

The **delivery place** is equally important. From one extreme to the other, the places of delivery can be ex garden, ex mine, or ex works (EXW) for agricultural products, minerals, and metals respectively; free on rail (f.o.r.); free on board (f.o.b.); and cost insurance freight (c.i.f.). The price differences are most important for commodities with low values per unit of weight and long transport distances. The price of iron ore f.o.r. in Brazil or manganese ore f.o.r. in South Africa is much less than one-half of the c.i.f. price in the user country. Depending on the point of delivery, the price may or may not include export taxes and import duties. These range from insignificant for

many commodities to very high for heavily protected agricultural products in industrialized countries. The point of physical delivery for transactions on commodity exchanges is usually from the exchange warehouses. Most of these have traditionally been located in the major industrialized countries, but this tradition is weakening.

Daily quotations from the most important commodity exchanges are regularly published by business-oriented newspapers in major business centers. The *Financial Times* (internet edition) and the *Wall Street Journal* give a wide coverage of prices from the exchanges. To track the non-exchange commodities, one has to go to specialized journals, newsletters, or government publications which provide, for example, producer and trader quotations, or price ranges from bilateral deals for specific commodities. Thus, *Metal Bulletin* in the United Kingdom and *Metals Week* in the United States contain a wealth of price information on ferrous and non-ferrous metals and minerals, while Platt's news service provides detailed price data on both metal minerals and energy. *Public Ledger* (UK) is the lead journal for agricultural price intelligence. The internet is increasingly used for publishing pricing information. The US Department of Agriculture or of the US Energy Information Administration publish a variety of price data on agricultural and energy raw materials. Current quotations on many commodities are easily accessible on the home pages of the major investment banks, and on the web pages of news agencies, e.g., bloomberg.com and reuters.com.

More extended time series for prices of a wide range of commodities in international trade, as well as price indices for major commodity groups, are contained in *International Financial Statistics*, issued monthly by the International Monetary Fund, accessed on the internet at [www.imf.org/external/np/res/commod/index.asp](http://www.imf.org/external/np/res/commod/index.asp), or in *UNCTAD's Monthly Commodity Price Statistics*, [www.unctad.org/Templates/Page.asp?intltemID=1889&clang=1](http://www.unctad.org/Templates/Page.asp?intltemID=1889&clang=1), the latter on a free or subscription basis, depending on the status of the applicant.

#### 4.6 Exchange rates and commodity prices

A majority of the commodity price quotations in international trade are expressed in US\$. When other currencies are used, such as the UK£ or euro, their equivalents in US\$ at current exchange rates are often quoted alongside. An issue which has often been raised is

whether suppliers to an international market reap an advantage by quoting their prices in an appreciating currency, or a disadvantage by having quotations in a currency which tends to depreciate against others. The issue may be highly relevant in less than fully competitive markets with coordinated producer pricing, or where prices are set in bilateral contracts after arduous negotiations, and once established are hard to change. In such circumstances, the producers will tend to gain from having set their quotations in an appreciating euro rather than in a depreciating US\$, as has been the case most of the time since 2001.

In contrast, when price can change flexibly, for instance when it is set on a commodity exchange, the forces of demand and supply will determine the level, with automatic adjustments for any exchange-rate change of the currency in which the price is quoted, so it should not matter which currency is used. The mechanics of the price adjustments to exchange-rate changes are subject to considerable confusion, and claims are often made that suppliers will benefit by quoting in an appreciating currency, even when prices are fully flexible and changes are frequent.

To isolate the problem under scrutiny, I assume that everything else remains constant while the dollar's exchange rate shifts. At least in the short run, this is not a serious distortion of reality. Furthermore, I simplify by assuming that there are only two currencies, and that the euro is used throughout the world outside the United States.

The following proposition appears to have general validity: the greater the economic weight of the US\$, the less US\$ prices of commodities in international trade will be affected by US\$ exchange rate changes. This is easily demonstrated by considering two extreme cases. In both the value of the dollar is assumed to increase by 100% against the euro. In the first extreme, 99% of world economic activity takes place in the US\$ area. Given the unimportance of the rest of the world (ROW) and the euro, the dollar appreciation will have an insignificant effect on global supply and demand. Hence, the dollar price of commodities will remain virtually unchanged. In the second extreme, only 1% of world economic activity takes place in the United States. A doubling of the value of the dollar will double the Euro commodity price. Since virtually all production and consumption takes place in the ROW, the old Euro price has to be restored, given that the initial demand and supply conditions for commodities

have remained unchanged. Hence, the dollar price of commodities must be halved.

In the 1950s, the US reined supreme in international trade. Since then, the weight of the US in the world economy has been reducing, and the international significance of the US\$ has shrunk in consequence. It follows from the above argument that commodity prices in international trade, expressed in US\$, have become gradually more sensitive to the exchange-rate changes of the US currency.

# 5 | *The commodity exchanges, commodity investments, and speculation*

## 5.1 The commodity exchanges and the commodities traded there

Throughout this book, the concept “international commodity markets” is being used in a very loose sense, to describe the buyers and sellers and the transactions they enter into. Commodity markets can be much more strictly defined as places where buyers and sellers of commodities meet to conduct their trade. In all countries there are many such markets of various sizes and levels of sophistication. Local rural markets provide a place for the exchange of food and other agricultural commodities. Nationwide and international markets for specific products or groups of products are also common. Spot transactions with immediate physical delivery usually dominate the trade activities of commodity markets, but there may also be forward deals, involving delivery some time in the future.

The commodity exchanges that are the subject of the present chapter form a small subset of commodity markets. As was made clear in the preceding chapter, this market form has proliferated greatly, both in terms of places where the trade is conducted and in terms of products being subject to trade.

Commodity exchanges are distinguished from other types of markets by having developed particular features in response to a variety of specific needs. They exhibit several distinct characteristics:

- Trade is exclusive to a limited membership, but the members of the exchange can conclude deals both on their own behalf and on behalf of their clients. The latter are usually far more important.
- Trade used to have the form of open outcry, but in recent times most exchanges have adopted electronic trading. The price of bids to buy is gradually raised, that of offers to sell reduced, until a commonly agreed price is reached.

- There is a strict standardization of trade practices with regard to, for example, volumes, qualities, delivery times, margins, and payment terms. Some exchanges stipulate a maximum permitted price change from the previous day.
- Futures transactions with a high degree of transferability dominate trade. Physical trade has a subordinate position, as a majority of the futures contracts are liquidated through the issue of opposite contracts before delivery falls due.
- A clearing house, established and financially guaranteed by its members, is regularly attached to the exchange. All futures contracts issued by the members have the clearing house as the opposite party. The net position of the clearing house for a particular commodity and delivery date must always be zero.

During most of the twentieth century, the dominant commodity exchanges were located in London, New York, and Chicago, but, as can be seen in table 5.1, that dominance is currently shared by exchanges in China, India, and Japan. The table lists the most important exchanges, specifies when they were opened, and provides information about types of commodities traded, instruments used, and recent volumes of trade. Some of these exchanges have operated for over a century; others are of more recent vintage. The specialization in terms of commodity coverage, usually the result of historical accident, varies considerably. Some exchanges predominantly serve the nation where they are located, while others have a truly international character.

Not all commodities are suited for trade on exchanges. A number of conditions must be satisfied for futures markets in a commodity to function reasonably.

1. There must be many buyers and sellers providing sufficient liquidity for continuous market quotations.
2. There must be a preparedness among those who trade the physical commodity to use the market for hedging, and speculators must provide matching deals.
3. The inherent price variability in the commodity must be considerable, i.e., its supply and demand schedules should experience a significant instability and have a low price elasticity.
4. The commodity must be easy to grade, or else it will be difficult to specify the quality covered by futures contracts.

**Table 5.1 The major commodity exchanges (the exchanges are ranked by number of futures and options contracts combined)**

Country	Founded	Exchange	Type and number of commodities traded	Number of contracts traded in 2005	
				Futures	Options
USA	1872	New York Mercantile Exchange (NYMEX, COMEX)	Energy (8)	106,087,523	25,851,854
			Metals (6)	26,104,403	4,165,628
China	1993	Dalian Commodity Exchange (DCE)	Food (corn, soybeans)	99,174,714	
USA	1848	Chicago Board of Trade (CBOT)	Food (5)	75,518,067	16,353,965
			Metals (gold, silver)	1,266,251	
UK	1877	London Metal Exchange (LME)	Metals (8)	70,421,269	7,921,064
			Plastics (2)	23,396	
Japan	1984	Tokyo Commodity Exchange (TOCOM)	Agriculture (rubber)	7,156,225	
			Energy (4)	26,732,003	
India	2003	National commodity & Derivatives Exchange (NCDEX)	Metals (5)	27,892,218	33,843
			Agriculture (5)	1,752,746	
UK	2000	Intercontinental Exchange (ICE)	Energy (2)	132,023	
			Food (27)	41,534,497	
			Metals (4)	7,278,496	
			Electricity	14,200	
			Energy (3)	41,827,976	118,476

China	1999	Shanghai Futures Exchange (SHFE)	Agriculture (rubber) Energy (fuel oil) Metals (copper, aluminum)	9,503,158 9,809,550 14,477,046	
USA	1870	New York Board of Trade (NYBOT)	Agriculture (cotton, pulp) Food (4)	3,869,490 20,616,472	1,715,823 6,947,647
China	1990	Zhengzhou Commodity Exchange (ZCE)	Agriculture (cotton) Food (wheat)	10,870,825 17,601,745	
Japan	1952	Tokyo Grain Exchange (TGE)	Food (5)	25,570,378	27,101
Japan	1996	Central Japan Commodity Exchange (C-COM)	Energy (3)	21,799,959	
USA	1898	Chicago Mercantile Exchange (CME)	Food (eggs) Agriculture (4) Food (5)	65,142 236,478 11,321,774	25,171 918,206
UK	2000	Euronext London International Financial Futures Exchange (EURONEXT)	Food (6)	8,054,116	444,754
USA	1856	Kansas City Board of Trade (KCBT)	Food (Wheat)	3,682,919	263,511
USA	1881	Minneapolis Grain Exchange (MGEX)	Food (3)	1,389,922	32,470

*Source:* Home pages of the exchanges.

5. The commodity must be storable so that a comprehensible relationship between cash and futures prices can be established. With the development of preservation and refrigeration, virtually all commodities have been storable in recent times.

For successful introduction on an exchange, it is important that the contract specification suits the needs of those who buy and sell the physical commodity. At the same time, the contract should be attractive to the speculators and investors whose business provides continuity and liquidity to the market. For example, the size of the contract, and hence the margin payments, should not exceed the financial capacity of individual investors.

The group of commodities traded on the exchanges is being continuously widened. New arrivals on the exchanges since the 1970s comprise gold (1975), nickel and aluminum (1979), crude oil (1983), and steel (2006). A number of commodities are still not traded on the exchanges. This exclusion may be due to one of several different reasons: (a) Standard grades are hard to establish. This applies to tea, iron ore, steam coal, and ferrochrome. (b) A dominant producer maintains a high degree of market control and can dictate prices. This was true for aluminum and nickel until a few decades ago, and is still true of, e.g., chromium, uranium<sup>1</sup>, molybdenum, and niobium, the latter with an extremely concentrated world supply. (c) The inherent price fluctuations may be small, or else a price stabilization scheme may be operated by major importing or exporting governments, reducing the incentive of producers and consumers to hedge. The large stockpiles and price-support schemes maintained by the US government in the markets for groundnuts and tobacco over long period of time (see the US Farm Service Agency and the US Commodity Credit Corporation home pages on the internet) is an important reason why these products are not traded on the exchanges.<sup>2</sup>

## 5.2 Instruments and functions

Broadly, the commodity exchanges have the following functions:

- They constitute authoritative mechanisms for price determination.

<sup>1</sup> Uranium trade was introduced on NYMEX in mid 2007.

<sup>2</sup> The same argument applies to trade in currencies, where there was no futures trading until the exchange rates started to fluctuate after the breakdown of the Bretton Woods system in 1971.

- They provide an opportunity for hedging.
- They greatly facilitate both very safe and highly speculative investments in commodity inventories and commodity-related trade instruments.
- They usually establish a physical trade outlet.

Before discussing what the exchanges do, however, it is necessary to describe the instruments with the help of which they perform their roles. The present discussion of the instruments as well as the following one on the exchange actors and their behavior is no more than a brief introduction, aimed to bring out the bare bones of what is involved. The activities going on at and around the commodity exchanges involve a plethora of derivatives tailored to specific needs, and high levels of complexity and sophistication, described in a voluminous specialist literature to which the interested reader is referred.<sup>3</sup>

There are basically two instruments, namely: futures contracts covering a continuum in time, and options on such contracts.

### *Futures contracts*

A *futures contract* is an agreement to buy or to sell a specified quantity of a commodity for the agreed price, with delivery at a particular future time. The quantities covered by a contract, and the periods when futures contracts fall due, are determined by the trade practices of the exchange, and vary across commodities and exchanges. A few examples will illuminate the contract volumes and approximate values as they prevailed in December 2006: coffee on EURONEXT, 5 tons, \$7,500; wheat on CBT, 5,000 bushels, \$25,000; crude oil on NYMEX, 1,000 barrels, \$63,000; copper on COMEX, 25,000 lbs, \$75,000; copper on LME, 25 tons, \$165,000. The standard features of futures contracts make them highly liquid. The owner of a contract can dispose of it at any time at the going price for that commodity and delivery month.

It is important to distinguish futures contracts from *forward contracts*. The latter involve a wider concept that comprises futures

<sup>3</sup> For an introduction, look up some of the titles displayed on <http://www.futuresource.com/education/index.jsp>. For further reading, German (2005) and Kleinman (2004) may prove useful.

contracts. Any contract that stipulates delivery in the future is a forward contract. Forward contracts need not have standardized provisions regarding quantities, grades, and dates when they fall due. Since each forward contract is unique, it is much less easy to trade. A transfer of a forward contract is dependent on finding a party interested in its particular specifications.<sup>4</sup>

A member of the exchange entering into a futures contract to buy does not need to pay for his purchase at the time, but he is required to provide a *margin*, usually representing 10%–20% of the purchase value, as his commitment to the deal. This margin is held by the clearing house of the exchange, formally the opposite party to the contract. If the price declines after the buyer has signed the contract, a need arises to top up his payments, so that the margin always stays at some 10%–20% of the current contract value. Suppose that the buyer has committed to purchase a commodity for \$10,000, and has paid a margin of \$1,500. If the price falls by 20% before the stipulated delivery time, the buyer will have no incentive to fulfill the contract. It will be financially preferable to him to lose the margin and buy the commodity at the lower price, for \$8,000. Hence, to ensure contract execution, the buyer will be asked to make additional margin payments before his margin has been depleted by the price fall. Failing such additional payments, the contract will be liquidated. This will take the form of issuing a futures sales contract to the buyer with the same delivery date but at the going, lower price. The two contracts will cancel out each other, and the loss, amounting to the difference between their values, will be recovered from the original margin payment. If, on the other hand, the price rises, payments can be made to the futures buyer, since he is not required to hold margins above the 10%–20% level. Analogous conditions apply when members of the exchange enter into futures contracts to sell.

In any normal circumstances, the margins will provide a complete financial guarantee for the commitments entered into by the clearing house. In principle, therefore, commodity futures trade involves no risk that the opposite party defaults. This adds considerably to the fungibility of futures contracts.

<sup>4</sup> The distinction between the tradability of the two contract forms is akin to the distinction between trade with the use of money and barter trade.

The tin debacle on the London Metals Exchange (LME) in 1985 is a rare though spectacular instance of futures contract holders defaulting on their obligations, though it should be added that the LME did not have any clearing house at the time. The defaulter was no less than the International Tin Agreement, dominated by its producing country members, and operating through a combined use of buffer stocks and export restrictions. Through a series of events in the early 1980s, the Agreement came to defend a price substantially above long-run equilibrium, applying export restrictions and yet forcing the buffer stock manager to buy increasing quantities of the metal. To stretch the financial resources available for the purpose, the manager employed the stock, which had grown to an enormous size, as collateral for loans which were then used for margin payments in futures transactions. By October 1985, the manager's resources had been completely exhausted, so he ceased operations, defaulting on his futures purchase commitments and leaving behind a total debt in excess of \$1 billion. Tin trade on the LME was suspended, and when it reopened in June 1989, the price settled very substantially below the level before the default. The debacle led to a fundamental reorganization of the LME, including the establishment of a clearing house.

In practice, the existence of a clearing house does not offer an iron-clad guarantee against default. When price movements are very fast, the call for additional margin payments may not be speedy enough to assure that margins are positive on all contracts at all times. The possibility of default will be there as soon as margins reach a zero level.

Today's quote for future delivery is usually not the same as today's spot price. Depending on current market conditions and expectations about the future, there will ordinarily be a difference between the two. The term *contango* refers to a situation where the futures price exceeds the spot price, while *backwardation* involves a futures price below the spot level.

The majority of futures contracts are entered into for the purpose of hedging, speculation, or investments, with no intention to provide or take physical delivery at the contract's expiry. In fact, some exchanges do not offer any facilities at all for physical trade. A major proportion of the futures contracts are voluntarily liquidated through the procedure described above, before delivery falls due. The liquidated futures purchase transaction will yield a loss if the price for the

contracted delivery date has fallen between the issuance of the original contract and liquidation. The transaction will yield a profit if the price has risen. The reverse will be true for futures sales transactions.

### *Options*

The *options* dealt with on commodity exchanges are directly related to the futures contracts. One must distinguish between the *issuers* and *holders* of options, since their involvements are highly asymmetrical. There are *call* and *put* options. A call option gives the holder the right (but not the obligation) to buy a futures contract at a predetermined price, the *strike price*, at any time until the option's expiry. Analogously, a put option gives the holder the right to sell a futures contract at a predetermined price. The issuer of the option is obliged to comply with the holder's rights.

Options are freely transferable. The price of the option is called the *premium*. This is what the issuer charges when he first issues the option and what the holder is paid when he transfers the option to another holder.

Options have a limited life and lapse on their expiry. The life can extend over several years. The premium will fluctuate through the life of the option in a pattern determined by two factors: the "time value," which depends on the remaining time until expiry (the shorter the remaining time, the lesser the value), and the "intrinsic value," which depends on the relationship between the strike price and the underlying futures contract price. The intrinsic value will fluctuate in parallel with the futures price development. At the time of expiry, the time value will be zero, and the intrinsic value will represent the entire premium.

The option holders' only obligation is to pay the premium. To them, options are distinctly different from futures contracts, in that they do not carry any responsibility for taking or making deliveries. From the issuers' point of view, the option carries a strong resemblance to a futures contract in that their obligation is precisely to issue such a contract whenever the option holder chooses to exercise his right.

The holder will reap a profit if the option premium rises from the time he acquired it and until he exercises his right. He will lose if there is a decline in the premium. The holder's loss cannot exceed the

premium he paid, for he can always choose to do nothing and to let the option lapse. The issuer's gains and losses are opposite to those of the holder. The gains are limited to the initial premium received, but the potential losses are infinite.

As in the case of futures contracts, the issue of options is guaranteed by the clearing house of the commodity exchange. Also, in a majority of cases, the option rights to acquire futures contracts are not exercised. Instead, the options are sold at the going premium when it is positive, or not exercised at all when the premium is zero.

After having described the instruments employed by the commodity exchanges, I now proceed to discuss the major functions that the exchanges perform, as specified earlier in this chapter. I begin by exploring the role of the exchanges as mechanisms for setting commodity prices; the remaining functions are discussed in the following section.

### *Price formation*

The following several paragraphs clarify the dominant role played by exchanges in setting the prices for physical transactions in the commodity industries. Two circumstances must initially be clarified. *First*, as noted, only a limited part of the trade that takes place on the exchanges is physical trade. Most of the action involves paper transactions in which physical material never changes hands. *Second*, a predominant proportion of physical trade occurs outside the exchanges, in transactions directly between the producers and users of the commodity. The point to be elucidated is that this predominant physical trade regularly occurs at prices tightly related to those that prevail in spot and futures transactions on the exchanges.

Whenever an international commodity exchange succeeds in establishing a broad-based and continuous trade in a commodity, the price quotation in that trade is usually adopted, with required modifications, throughout the commodity industry. The price-setting mechanisms on the exchange are, of course, far from perfect in reflecting market fundamentals. For instance, where the market is thin, a few transactions may unduly influence the price developments in an ad hoc manner. With a thin market, there is also the likelihood that gaps will occur in the time series of futures prices, because there are no contracts expiring in some of the months covered by the

trading period. An example of a thin market is EURONEXT's European Milling Wheat No. 2 contract, even though its liquidity and trading volumes have been increasing in the 2000s.

Different prices may be quoted when a commodity is traded on several exchanges. Ordinarily, the prices will run in parallel. Also, the possibilities for arbitraging will prevent the price difference from widening beyond what is warranted by differences in the specified quality that is traded, and to reflect the transport costs from the point of delivery to the major consuming centers.

Claims are sometimes made that the price quotations on commodity exchanges are distorted through intentional manipulation, including attempts to corner the market, such as occurred in silver in the Hunt Brothers' episode of 1979, and in copper during the Sumitomo scandal in 1996 (Gilbert, 1996). These shortcomings of commodity exchange prices notwithstanding, it should be underlined that the alternative price setting mechanisms suffer from other, often more serious, deficiencies, so the influence of commodity exchange quotations on the prices at which trade takes place in a commodity industry is not surprising.

A great attraction is that the prices set by the exchanges are instantaneously available and widely published. This contributes significantly to the influence they carry in trade and industry. Where trade in a commodity has been successfully established on an exchange, its prices tend to replace other price quotations and dilute the price-setting power of producers. Since the late 1950s, *Metal Bulletin* regularly quoted a price for aluminum in Europe, entitled "Certain Other Transactions," which at times differed substantially from the dominant Alcan quotation. After the introduction of aluminum on the LME in 1979, the *Metal Bulletin* price became superfluous and was discontinued (Crowson, 1998). In the course of the 1980s, the LME quotation was generally accepted as the authoritative reference price. The developments have been similar in the case of nickel. Oil used to be Platt's or Argus, but is now Brent on ICE or WTI on NYMEX, while quotations for steel futures introduced on the LME in 2006 are likely to soon replace the trader prices hitherto published by Metal Bulletin.

The OPEC oil producers have ceased posting their sales prices after crude oil trade was introduced, first on NYMEX in 1983, and then on ICE in London in 1988. With the lively oil trade on the exchanges,

the cartel's ambitions have been shifted to the defense of a price band, with the desired prices to be attained not through producer dictate but through market forces on the exchanges, with the actions of the cartel limited to adjustments in supply.

Producers find it hard to exceed the widely quoted exchange price levels for long and by more than the narrow margins that buyers are prepared to pay for the increased convenience and security offered by a long-standing trade relationship. Where producers continue to quote their own prices, these quotations tend to change much more frequently and more tightly in line with the market, once an exchange starts to provide a pricing rod, and in the end the producer quotes tend to become an irrelevance.

The exchange prices are influenced instantaneously by events both in the commodity market and in the outside world. Their daily fluctuations can therefore be considerable, and sometimes they are claimed to be seriously exaggerated by speculation. Prices in transactions outside the exchange tend to be more stable, either because producers maintain their own quotations for much longer than a day or an hour, or because they employ, for example, monthly averages of exchange quotes when they sell to their customers. Price stability may of course be desirable, but such stability can gloss over pent-up imbalances which could cause severe disruptions in the market, once they become visible. Instantaneous price adjustment to emerging market fundamentals instituted by trade on the exchanges can help in avoiding such disruptions.

### 5.3 The actors and their objectives

I distinguish between three categories of actors on the exchanges, each characterized by the pursuit of a separate objective in his deals on the exchange. The *first* category comprises those who depend on the commodity as such for their livelihood, primarily its producers, processors and users. They do not necessarily seek to profit from their transactions on the exchange. The livelihood of this group may be threatened by unexpected price fluctuations, so their primary interest is to avoid the price risk, and they do it through hedging, a kind of price insurance. The *second* category, the speculators, come to the exchange with no initial risk. On the contrary, they seek to assume the price risk for the purpose of profit. So, when hedgers enter the futures

market to assure themselves of the prevailing price, speculators enter that market on the opposite side, thereby providing the liquidity without which hedging would not be possible. The *third* category of actors on the commodity exchanges embraces the investors who place money in commodities either because such placements offer a safe rate of return or as a means of portfolio diversification, but nevertheless with the expectation of a return. The latter type of investors operate with a far longer time perspective than that typically assumed by the speculators. The distinction between speculators and investors is not always crystal clear.

### *Hedging*

The general principle of hedging is to open a futures position opposite to that confronting the hedger in the physical market at a future time. The hedger is interested in safeguarding against one of two fundamental price risks.

The *first* is that the value of unsold products will decline if the commodity price falls.

An owner of a commodity inventory (wholesaler, processor) can assure himself against the risk of price decline by making a *short hedge* at the time he acquires his inventory, i.e., by futures sales involving quantities and due dates that correspond to the planned disposal of his physical holdings. In this way he assures himself of the current commodity price on the futures market for these future disposals. When a physical disposal comes due, the owner will buy a corresponding amount spot on the exchange. The initial futures and later spot transactions on the exchange cancel out each other. If the price has fallen in the period between physical acquisition and disposal, there will be a loss from the physical transactions, but a compensating gain from the futures sale and spot purchase on the exchange. If the price has risen, the exchange transactions loss will be compensated by the gain in the physical trade. The cost of this hedge will be the interest on the margin payment, the brokerage fee plus any contango, or minus any backwardation that prevails in the market at the time the futures contract is signed.

The wholesaler can alternatively acquire a put option with a strike price close to his physical purchase price, and expiry about the time of his planned physical sale. If the price falls, the wholesaler will

compensate his physical loss by the gain on the option premium. If the price rises, there will be a gain from the physical trade, but the premium of the option may fall to zero. The cost of these transactions will be the premium paid for the option and the brokerage fee for its purchase and sale.

The specific circumstances of each case will determine which of the two hedges provides the best and cheapest price insurance. The futures hedge will involve an expanded financial cost of additional margin payments, and an ensuing temporary need for more cash, if a loss is incurred in the exchange transaction. The options hedge can yield a speculative gain if rising prices result in a profit from physical transactions that is larger than the premium initially paid for the option.

Commodity producers often make short hedges when they consider the current price quoted in futures transactions to be attractive. The commodity exchanges provide them with a means to lock in that price for their future output. Metal producers are known on occasion to have sold their entire anticipated output over several years into the future, thus securing the price of that output. New gold mines have sometimes used such extensive futures sales as collateral for loans to finance the development of the mine, and CODELCO, the state-owned Chilean copper corporation, has recently done so with the anticipated output of Gaby, a new mine (*Platts Metals Week*, 2006).

The *second* risk is that the cost of future commodity purchases will increase if the commodity price rises.

A direct user of a commodity or a manufacturer of goods with a high content of the commodity might avoid the risk of a forthcoming price rise by locking in the current prices in the futures market through a *long hedge*. This involves futures purchases on the exchange timed to coincide with his physical commodity needs in the future, cancelled through spot sales on the exchange at the time of the physical purchase. Alternatively, a call option can be acquired to make a long hedge. The assurance against price risk, as well as the cost of the transaction and the relative merits of the futures versus options instruments, are analogous to those in the short hedge. Users could alternatively make a long hedge to secure an uncertain physical availability.

The possibility of hedging a specific commodity is not entirely contingent on it having a developed futures market. An imprecise,

but often satisfactory, hedge can be attained with the help of a closely related commodity whose price is likely to move in parallel with the one on which the hedger is dependent. An edible oil not traded on any exchange can be approximately hedged through the futures market of another closely related edible oil. Arabica coffee futures can in most cases provide a satisfactory hedge for robustas, while crude oil is a reasonably close hedging substitute for bunker oil. The natural gas futures contracts provide acceptable hedging facilities also for deliveries in geographical markets out of the reach of the exchanges.

### *Speculation in commodity markets*

The high level of standardization and the ensuing liquidity of the futures contracts and options makes it very easy to move funds in and out of commodity markets. This characteristic is a precondition for the widespread interest of the financial sector in commodity placements. As noted earlier in this section, there are two different actors, each with his distinctly different investment objective, and the instruments employed on commodity exchanges can be used to provide the satisfaction of either. The next several paragraphs explore the behavior and objectives of the commodity speculator. I subsequently turn to the investors who see the commodity markets primarily as an additional asset class providing prospects both for inherently safe placements with returns only marginally above the “normal,” or for riskier but profitable investments, with the added benefit of offering means for portfolio diversification.

Speculation is a broad and amorphous concept. In the context of commodities and in the broadest sense, it involves all actions that aim at profiting from a move in commodity price. Buying a futures contract on the exchange, or prematurely filling a half-full automobile tank, both in anticipation of an impending price rise, can be classified as speculative activity, even though the latter action is undertaken by a commodity consumer (the car driver). A narrower definition, in which the speculators have no intrinsic interest in the commodity as such, is common. According to the *Shorter Oxford English Dictionary*, speculators buy and sell “in order to profit by the rise or fall in the market value, as distinct from regular trading or investment.”

The speculators' typical objective is to reap very high profits in return for taking very high risks. With the narrower definition, the difference between hedgers' and speculators' behavior can be explained either by a difference in risk aversion or by the greater ability of speculators to diversify their positions. The role of speculation can therefore be seen as a means for the transfer of risk among agents with different preferences.

The commodity exchanges provide the speculators with attractive opportunities for highly geared investments. The limited margin payments on futures contracts stretch the speculators' money at least by a factor of five, as compared with speculation in physical commodity deals. The potential return – and loss – for a given investment is multiplied in equal measure. The issue of options involves speculators in a risk of unlimited losses. But although there is an upper limit on the gains from the issue of options, these gains can be massive in relation to the small capital that needs to be committed.

Combinations of futures contracts and options permit the speculator to set the degree of risk in accordance to his desire. For example, he can enter a futures contract to sell, if he expects prices to decline. If, instead, prices rise, he will lose, and there is no limit to the size of his loss. Such a limit can be established at, say, 50% of the value of the contract, by the speculator acquiring a call option with a strike price 50% above the futures sales price.

Since the clearing house of a commodity exchange must maintain a balanced position in any commodity for any future date, the minimum role that the speculators must play is to establish futures contracts that fill the imbalance between short and long hedges (Ghosh, Gilbert and Hugh Hallet, 1987). Because, by definition, they do not hold any offsetting positions on these minimum investments, the speculators carry the entire risk of loss or potential for gain from price movements.

Speculators are always there to respond to hedgers' needs regarding volume and timing of futures and options, at a price. Ordinarily, however, their actions go far beyond the satisfactions of hedgers' requirements. A large part of the positions they assume constitute bets against other speculators. In these ways, speculation improves the continuity and increases the liquidity in commodity exchange trade.

### *Commodity investments*

The relationship between the spot and futures prices (contango and backwardation, respectively) provides considerable scope for rewarding commodity investments by the financial community. It is appropriate, therefore, to begin by discussing this relationship.

A contango market results from an abundance of immediate supply relative to the expected future supply. The current abundance will depress the price for immediate delivery, as compared to delivery in the future. Notice, however, that the possibility of arbitrage limits the level of the contango to the cost of storing the commodity between now and the time of future delivery. For example, the twelve-month futures price cannot exceed the spot price by much more than 7% when the cost of physical storage, including deterioration, is 3% per year, and the rate of interest is 4%. A higher contango will make it profitable to buy spot, take physical delivery, incur the cost of storage while immediately making a twelve-month futures sale. Such action will increase spot demand and raise spot prices until the contango declines to just above the 7% level.

The contango is a blessing to producers in over-supplied markets, for it provides a neat mechanism for financing excess inventories without risk to the investors. This investment opportunity has been regularly employed by banks and other financial agencies. Strictly speaking, the deals represent long hedges. However, the different nature of the agents and of the basic purpose for their action warrants their classification as investors, not as hedgers.

A market in backwardation indicates a shortage of immediate supply and a perception of more ample supplies in the future. In contrast to the contango, there is in theory no maximum in the difference between spot and futures prices when the market is in backwardation, since arbitrage is not possible. A shortage today can cause spot prices to explode, irrespective of what is expected of the future. The futures price could remain at only a fraction of the inflated spot price, despite the knowledge that the current shortage will soon be overcome, e.g., because new production facilities are being opened up. In practice, inventories almost always establish a tie between the high spot price and the low, backwardated futures price, and it has to do with the convenience yield of inventory holdings. Inventories typically exist at many levels throughout the production-processing-wholesale-retail

chain, and they yield a benefit to the holders through the convenience of being immediately available, should a need for their use arise. The inventories will be held so long as this benefit is valued more than the net gain from selling spot at the high price, buying futures at the low price, and accepting the inconvenience of doing without until the futures purchases are delivered. At some level of backwardation, the inconvenience is overwhelmed by the gain from an inventory release. This constitutes a link between the spot and futures price, and a cap to the extent of backwardation.

The twenty-first century has seen the emergence of commodity index futures as a spectacular addition to the instruments used by portfolio managers, comprising pension funds, mutual funds and hedge funds. Goldman Sachs, the investment bank, was one of the first to establish such an instrument and to launch its trading on the exchanges (Goldman Sachs, 2005a). Investments in commodity index futures have experienced an explosive expansion in the course of the present century, rising about tenfold to \$75 billion by 2006 (Kat, 2006). The Goldman Sachs Commodity Index is heavily weighted in energy. In fact, three-quarters of the total comprise energy materials. Its futures have been traded since 1992 on the Chicago Mercantile Exchange. The major alternatives comprise the Commodity Research Bureau Index, which includes seventeen commodities, traded on NYMEX in New York; and the Dow Jones AIG Commodity Index, weighted on world production values and trade liquidity, traded on the Chicago Board of Trade (Iwarson, 2006). With many variations, investments in these instruments are expended on buying nearby futures which are rolled over, i.e., sold just before expiry, with a matching purchase of new nearby futures.

Calculating the performance of hypothetical investments in the futures of these indexes several decades back in time yields remarkable conclusions: both the total returns and the risks to investors in these instruments would have been on a par with those on equity investments. Returns would have been much higher than those from investments in bonds. There is little correlation in the annual return from equities and commodities, so the addition of the latter stabilizes the overall portfolio performance. Furthermore, commodity investments provide a better protection against inflation than do investments in equities and bonds, and are far superior in terms of returns to investments in physical commodities or in the equity of

commodity-producing firms (Center for International Securities and Derivatives Markets, 2006). Even more remarkably, in a careful academic study, Gorton and Rouwenhorst (2006) come to the same conclusions after playing around with a well-diversified commodity futures price index stretching as far back as 1959! On such evidence, it is not surprising that commodity index investments have exploded.

An obvious question to ask is how and why investments in the futures commodity indexes can have performed so well in the face of a long-run commodity price decline, as depicted in figure 4.4.

Iwarson (2006) provides an answer to this question by sub-dividing the backdated returns from 1970 to 2005 yielded by hypothetical investments in the Goldman Sachs index. When measured in nominal SEK (Swedish currency), the total annual average return over this thirty-five-year period works out at 15%, compared with a 17% annual return on the holding of Swedish equities and 10% on the holding of Swedish bonds (however, the commodity futures index investment has slightly outperformed a portfolio of US equities, measured by the S&P 500 index). The commodity index returns consist of the following elements:

- an annual average 6% return on rising spot prices of commodities, primarily an effect of the heavy dominance of oil in the Goldman Sachs index, and the strongly appreciating oil prices over the period, so it cannot be precluded that an equally weighted index would have shown a zero or even negative yield on this count;
- a roll return of 2% per year, implying backwardation most of the time for most of the commodities comprised in the index; and
- a collateral return: since investments in the futures commodity index require no more than a small margin payment, most of the committed capital can be used to purchase treasury bills, with the interest received attributed to the commodity investment. This collateral return has averaged 7%, almost one-half of the total return.

In my view, the claims that the total return on investments in commodity index futures is on a par with that of holding stocks is fallacious, and greatly exaggerates the attractiveness of commodities versus stocks as investment classes. This fallacy arises from the comparison of investments in commodity index futures, which benefit from a large collateral return, with investments in holding stocks, which don't. The correct comparison should be with investments in

stock index futures, where both investment instruments benefit from collateral returns. I have not seen such a comparison presented by those who market investments in commodity index futures, but, given the significance of the collateral return, the investments in commodity futures are unlikely to match investments in stock futures.

Despite the fallacy identified above, investments in commodities may well continue to grow if their positive attributes are confirmed by extended evidence over time. But, given the recency of such investments, and the limited practical experience of their behavior, some doubts remain. For instance, how will these investments fare when the 2004–7 commodity boom comes to an end and commodity prices experience a substantial decline?

### *A physical trade outlet*

Most exchanges do offer a convenient facility for physical trade to the buyer or seller who needs it, for instance because he has no developed trading connections. The exchanges always stand ready, in principle, to absorb and release the commodity on a spot basis, at the going price. The importance of this function should not be underrated. In 2005, physical transactions on the LME involved about 800,000 tons of aluminum, 250,000 tons of copper and some 50,000 tons of nickel (private communication with Phillip Crowson).

Socialist countries used to be particularly important users of the exchanges for their physical trade. Much of the somewhat irregular supply of USSR aluminum and nickel was disposed in the 1970s and 1980s through the LME. Similarly, Chinese requirements for metal imports were for long importantly satisfied through purchases on the LME. Producers who for some reason have been unable to place their entire output directly with clients are known to dispose of their marginal supplies on the exchanges. The inventories held by the exchanges provide a convenient supply of last resort when other supply sources dry up.

## **5.4 Impact on price formation and other influences**

How is a commodity market, and for that matter, a commodity industry, affected by the introduction of exchange trade for that commodity? The impact attracting the greatest attention is that on

prices, caused by the ease of entry for speculators to the exchanges. The following paragraphs are predominantly devoted to this issue. Several other plausible impacts may follow from exchange trade, and these will be mentioned briefly, as the chapter ends.

A problem running throughout the present discourse is the direction of causality: particular features characterizing the commodities traded on the exchanges may be the consequences of exchange trade; but these characteristics may equally be inherent to the commodity markets, and be the very reason for the introduction on the exchanges. Unreflected belief that exchange trade has always been the cause of the characteristics that can be observed must be avoided.

### *Impact on prices*

Speculators make their bets on the futures markets. Their purchase of futures pushes up the futures price, and this will impact on spot prices too, through the possibility of arbitrage if the market is in contango and through the convenience yield in backwarddated markets. Liquidation of speculators' long positions will have an analogous depressing impact on futures and spot prices, as will an initial speculator entry through futures sales. Given the huge turnover in the futures markets (in 2005, futures trade in crude oil on NYMEX was \$3,120 billion; copper on LME \$1,971 billion; aluminum on LME \$1,663 billion; and wheat on CBOT \$210 billion), the speculators' positions would have to be very sizable to make a dent on these markets. But then it is important to realize that the resources of the financial markets potentially available to speculators are huge too, and that the limited margin payment requirements provide for a considerable stretch of these resources. Also, the speculators' impact can be greatly augmented by a focus on selected markets, and not necessarily the biggest ones.

The numbers just quoted also give a perspective on the plausible impact of the \$75 billion so far invested by portfolio managers in commodity index futures. These investments, built up over a five-year period, could hardly have had a perceptible influence on prices. Such influence could be quite strong, however, if most of these investments were suddenly liquidated.

The basic theoretical presumption is that under normal circumstances, speculation will even out price variations (Telser, 1981). After harvest, when the price is low, speculators will bid up futures prices until the contango is sufficient to make investments in inventory holdings worthwhile. The demand for inventories will strengthen the spot price level. At the height of an industrial boom, the speculators will bid down futures prices, and so make stockholding unprofitable. The liquidation of stocks will reduce the inflated spot price. In this way, speculator foresight stretching across seasons or phases of a business cycle generates profits to their actions and at the same time evens out the inherent commodity price instability.

The theoretical analysis may seem to be contradicted by the observation that commodities traded on the exchanges tend to have less stable prices than commodities which are not. But then the causality could be the other way round. Exchanges perform especially valuable functions for commodities with inherently volatile prices, and their services are simply not needed for materials whose prices are stable. I noted early in the chapter that the stabilization schemes maintained by the US government in the groundnuts and tobacco markets is the probable reason why these commodities are not traded on the exchanges. Exchange-traded commodities can in fact constitute a kind “adverse selection” so far as price stability is concerned.

The speculators’ activities would destabilize commodity markets only if their forecasts proved persistently wrong. Say that the industrial boom and the high metal prices were not followed by a recession and low prices, but by a strike and even higher prices. Then, the depletion of existing inventories caused by the wrong speculator expectations would amplify the ensuing price rise and the speculators would lose wholesale from their investments.

If, in fact, speculators lose on average, and so destabilize prices, there may nevertheless be a positive consequence of their activity in that the losses would correspond to a lowering of the average price paid by users and/or an increase in the average price received by producers (Friedman, 1969). The net social effect of such destabilizing speculation would depend on whether this benefit is greater or smaller than the discomfort of greater price instability. It may be that producers would feel the need to insure themselves against the higher price volatility, and that the cost of the measures would absorb their price gain.

Even if commodity speculation were to normally yield a gain, and so to stabilize prices most of the time, this does not preclude the existence of speculative bubbles, which on occasions could drive prices to extreme highs or lows. Bubbles have to do with the fact that speculators are often more interested in what others believe and do (herd behavior) than in the fundamentals of the commodity market.

Keynes (1936) distinguished between large, professional, and well-informed speculators, on the one hand, and small, amateur speculators, on the other. It could be that the former profit from speculation, while the latter lose. Speculators who are successful become large, and those who are not leave the market and are replaced by other small speculators. This distinction provides an interesting mechanism for the emergence of speculative bubbles.

Commodity markets are occasionally invaded by amateur speculators. Their entry results in a strong price boost, even when the fundamentals for higher prices are not there. The professionals will then tend to follow the amateurs and amplify the price increase in the confident belief that they can profit from the price moves. Once the amateur money inflow has been exhausted and the price ceases to rise, the professionals sell out, and the bubble bursts. In such circumstances, profitable speculation by the professionals will have a destabilizing impact on prices (Stein, 1981).

Speculative bubbles have been seen by serious observers as an important factor behind the sharp increases in commodity prices that occurred during the 1973–4 and 2003–5 commodity booms (Cooper and Lawrence, 1975; Société Générale, 2006), but this perspective has been refuted by other equally serious commentators. Thus, Houthakker (1975) asserts that Cooper and Lawrence's use of the concept "speculation" is imprecise and that the data to prove its importance are inadequate. The IMF (2006b) observes that there is little relationship between the size of net long non-commercial positions, a measure of speculation intensity, and prices during the 2003–5 boom. In some markets (copper in 2005) net positions fell steadily while prices ascended to record highs.

Can empirical analysis provide unequivocal support to the diverse assertions made above? Houthakker's (1975) observations continue to have validity. Data are still a major problem in the analysis of the impact of speculative activity, and so is the definition of speculators.

The Commodity Futures Trading Commission (CFTC) in the US collects data on the composition of open interest across all futures and futures options contracts in the US. These data are made available to the public, but only in highly aggregated form, i.e., short and long positions held by commercial and non-commercial traders respectively. Assuming that commercial traders are hedgers and non-commercial are speculators, only inferences can be drawn from the publicly available numbers on the price impact of speculation.

Given the difficulties in defining speculation and speculators in a strict manner and the dearth of exhaustive data, only rare studies exist to illuminate what speculation on the exchanges is doing to prices. An old study of a sample of grain futures speculators in the United States between 1924 and 1932 concludes that a majority incurred losses on average, and that total losses considerably exceeded total gains (Stewart, 1949). Using CFTC data, Hartzman (1987 and 1991) explored trader behavior in nine different markets over a 4½-year period and concluded that hedgers (commercials) made profits, while speculators (non-commercials) did not. His study also demonstrated the importance of pure luck, as distinct from forecasting ability, on the profitability of commodity traders.

Research conducted within the CFTC itself and using the data set not usually available to the public (Haigh, Hranova, and Overdahl, 2005) makes an effort to clarify the relationship between speculation and price levels and price variability. The data used relate to the crude oil and natural gas futures and options markets in the US over a thirteen-month period in 2003–4. Market actors are divided into “managed money traders” (MMT), a “dominant speculator category,” and all others, seen predominantly as hedgers. The analysis reaches some tentative, though striking and highly counterintuitive, conclusions. The most important is the assertion that speculators change their positions less frequently than the hedgers, and when they do, it is in response to price shifts that prompted changes in the hedgers’ positions in the first place. The causality, then, seems to run from fundamental market forces causing the initial price change, to the hedgers whose position shifts exacerbate the price change, and on to the speculators who react to, rather than initiate, the process. Even more remarkably, the study finds no positive relationship between change in prices and speculators’ positions.

The disappointing conclusion of this somewhat sprawling discourse about the impact of speculation on price levels and price fluctuations on commodity exchanges is that we don't know. This is succinctly summarized by the CBOT study (Haigh, Hranova, and Overdahl, 2005): "The role of speculators in the futures markets has been, and continues to be, the source of considerable controversy."

### *Other impacts*

Other impacts of commodity exchanges on commodity markets and commodity-producing industries have been suggested, although here, too, firm empirical evidence remains to be provided. For instance, it is plausible that producers will tend to adjust the quality of their output towards the standards adopted by the exchanges for the purpose of futures trading, even when the commodity is sold through other channels. This is because a correspondence with the exchange quality will normally make the commodity more widely marketable than it would otherwise be. In this way, the exchanges would tend to promote standardization and uniformity of quality.

Another plausible impact could be that by providing an assured outlet for physical trade, the existence of exchanges would reduce the incentive for vertical upstream integration by commodity users. Such integration has been a common response to potential threats to raw materials supply, for instance because of producers' monopoly power. This line of reasoning suggests a lesser extent of vertical integration in industries that use commodities that are traded on exchanges. Here, too, one can argue the direction of causality: commodities will not be traded on the exchanges until there is a reasonable degree of competition among vertically unintegrated producers.

## 6 | *The economics of exhaustible resource depletion*

The fears of depletion of the physical resources upon which human societies and their cultures build are as old as humanity itself. Maurice and Smithson (1984) provide examples from antiquity to modern times, so Thomas Malthus (1798) was by no way the first to express concerns about the inadequacies of the physical environment for human needs. Malthus, however, has had many followers. The dire predictions of the Club of Rome (Meadows *et al.*, 1972) and of the Association for the Study of Peak Oil (Campbell, 1997) are but two of the more recent influential examples of this strand of thought. The messages of an impending depletion of this or the other component of the human physical environment are usually accentuated and enjoy a wider hearing during periods of boom, when expansion in usage gathers pace and prices rise. Until recent times, however, the pessimistic messages have all proved wrong (Simon, 1996). The real prices of virtually all resource products traded in competitive markets have experienced a long-run decline (see chapter 4), while the physical environment has tended to improve, not deteriorate, in consequence of economic growth (Lomborg, 2001; Radetzki, 2001).

This chapter treats a subset of the above concerns. It is devoted exclusively to exhaustible resources, comprising metals, minerals, and fossil fuels. Outputs from agriculture, forestry, and aquaculture, all being renewable, are not part of the deliberations. Furthermore, as appears from the chapter's title, I deal predominantly, though not exclusively, with depletion in an economic, not in a physical sense. There is no economic depletion, in the way the concept is defined, if inferior deposits taken to use to replace rich and exhausted ones can provide output without an increase in cost.

In the course of my studies of the economics of natural resources over four decades, I have not come across a clear-cut case of economic depletion of an exhaustible resource. But I can quote examples of formerly sought-after exhaustible resources whose production has

declined not due to depletion, but because they have lost much of their value in consequence of new technology or change in demand. Progress and innovation in the chemical industry suppressed the value of guano, a raw material for fertilizer collected from the islands off the west coast of South America, to the extent that its production ceased. Asbestos and mercury appear to be going the same way, in consequence of their detrimental effects on health. And the instances of economic depletion actually occurring are found, ironically, among the renewable resources. Forests in ancient Rome were depleted by overuse, as was the case with the fish stocks in the oceans during of the second half of the twentieth century, both resulting in substantial increases in price.

Depletion is about an accentuated scarcity, and it can be measured in different ways, three of which are popular with economists (Tilton, 2003): (a) the trends in the adequacy of reserves from which the resource can be extracted provide an important physical insight into the seriousness of the depletion threat; (b) the progress of real prices of finished exhaustible resource products is seen by economists to reflect accentuating or subsiding scarcity; (c) the long-run change in the unit price in real terms of identified but unexploited resource still in the ground is an alternative measure of the extent of depletion; (d) finally, the development of the long-run marginal cost of supply, equivalent to the total average cost in the marginal project, is yet another economic indicator of scarcity. Since depletion is a slow, drawn-out process, long time series are needed to make measurement meaningful. In the following paragraphs, I document and discuss the available data on each of the measures, in turn.

## 6.1 The availability of reserves

A major concern of the Club of Rome in the early 1970s (Meadows *et al.*, 1972) was the limited amount of world reserves of metals and fuels. Its publications asserted that, since there were only thirty years' worth of reserves of copper and other exhaustible resource products, a growing world demand would be bumping against a binding resource ceiling by the end of the century, even when the prospects of additional finds were taken into account.

The authors of these gloomy forecasts apparently did not care to enrich their analysis by historical insights. In the seventy-five-year period 1925–2000, world production of coal increased 2.7 times, while that of iron ore rose by 5.1 times. World output of copper expanded ninefold, that of petroleum augmented twenty-four-fold. Natural gas and aluminum kept the record among major commodities; their output in 2000 was 68 and 133 times higher than 75 years before (Metallgesellschaft, annual; Darmstadter, 1971; BP, annual). And yet, remarkably, reserves of each of these materials developed roughly in parallel, so as to assure a relatively stable reserves/production multiple (R/P), often at a level of about 30.

No miracle is involved in the stability of the R/P ratio. Reserves are created through investments in exploration. A profit-maximizing firm will not invest in reserve creation beyond its perceived current needs, just as it will avoid investing in plant and equipment beyond its planning horizon. With growing output, an R/P ratio of 30 is usually deemed comfortable, since it will suffice for the next 15–20 years' production. This way of looking at reserves provides a convincing explanation of the amazingly stable R/P ratio observed over time. A quote by Morris Adelman (2002), the grand old man among oil market analysts, reveals the stunning flexibility of the process:

In 1944 world proved reserves were 51 billion barrels. In 1945–1998, 605 billion barrels were removed, leaving 1035 billion . . . As with any inventory, proved reserves increased not *despite* interim production but *because* of it.

Table 6.1 demonstrates that creation of reserves is continuing in recent times, and that the R/P ratios for the four minerals shown is comfortably above 30.

Representatives of the Association for the Study of Peak Oil have expressed depletion concerns by pointing to the fact that oil production has exceeded “new discovery” since the 1980s (Bentley, 2006). This concern is fallacious because it does not take into account the very substantial appreciation of mineral and fuel deposits after discovery. Historical evidence from oil suggests that the ultimate extraction from a deposit represents a quantity about six times greater than the initially recorded discovery (IEA, 2005b). The sum total of global oil discovery and appreciation has progressed well above global oil production, explaining the continued growth of reserves.

Table 6.1 *Proved reserves and R/P ratios for four minerals*

	Oil	Iron ore	Nickel	Copper
Proved reserves, million tons				
1995	138,000	151,000	47	310
2005	164,000	160,000	62	470
R/P ratio, years				
1995	41.3	151	47	31
2005	40.6	105	41	32

Sources: BP (annual); USGS (annual).

## 6.2 The evolution of long-run prices

The early 1980s saw the triumph and perversion of the so-called Hotelling rule, derived from a now classical paper in the exhaustible resource literature (Hotelling, 1931). Subject to a set of restrictive assumptions, such as a known, finite resource and constant technology, this rule states that the unit price of the unexploited resource will rise over time at the real rate of interest. Enthusiastic but not very thoughtful oil market analysts and political decision makers perverted the rule into stating that the prices of exploited exhaustible resources must rise at the (real) rate of interest. Though no theoretical foundation nor empirical support was provided for this assertion, the perverted rule caught wide attention among investors, policy makers and other interested groups.

When applied to oil, the rule appeared to vindicate that the price increases since the early 1970s were due to depletion, and represented the beginning of a permanent upward trend. Forecasts of future oil prices were formulated in the early 1980s by reputable organizations, including Exxon and the World Bank, gloomily predicting perpetual real-price increases from the then elevated levels (Exxon, 1980; World Bank, 1981). Since these forecasts were widely believed, there followed monumental policy mistakes, as the world tried to adjust to a continuously increasing price of oil.

Increases in the long-run real price of exhaustible resources can indeed reflect depletion. After all, prices are the ultimate indicators of the total costs of marginal supply in an industry. And an increase in these costs mirrors accentuated scarcity, i.e., economic depletion. But

when employing price series for measuring economic depletion, one has to carefully avoid periods when prices do not reflect cost conditions. This would be the case when there is monopolistic collusion (Herfindahl, 1959). Misinterpretation of OPEC's price manipulation for depletion, and use of the results for forward projections, were the major fallacy of the oil price analyses of the early 1980s. Other periods to be avoided when investigating depletion with the help of prices are the temporary price spikes, usually caused by demand shocks, such as during the booms in 1973–4, and again in 2004–7, as described in chapter 4, for then the price tends to settle far above the total cost of marginal supply.

In chapter 4, I did present some long-run trends of real prices, but these have to be reworked in the light of the above considerations, to fit the needs of the present analysis. For metals and minerals, where market conditions have remained reasonably competitive over most of the twentieth century, I link the Grilli and Yang's (1988) 1900–86 decline of 0.84% per year (see chapter 4) with the 0% change for 1986–2003 recorded in figure 4.4 to obtain an average of –0.70% for the entire 103-year period.<sup>1</sup> The most recent commodity boom prompts exclusion of the period after 2003. For oil, the relevance of prices as an indicator of depletion ends in 1972, for the following year marks the start of OPEC's monopolistic market management. In 1900–72, the oil price fell by an average of 0.70% (Radetzki, 1990b), i.e., at the same rate as did the price of metals and minerals group during the longer period quoted above. This price evidence from metals, minerals, and oil does not support the view that economic depletion has occurred.<sup>2</sup> I would have liked to review long-run price series for hard coal and natural gas, but given the recent emergence of the international markets for these products, such series are not available (Radetzki, 2002).

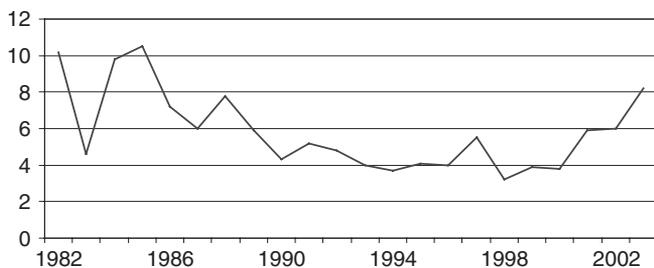
<sup>1</sup> One can argue that the shift between declining real prices until 1986 and the unchanged levels subsequently recorded is a harbinger of economic depletion.

<sup>2</sup> In a ground-breaking study, Svedberg and Tilton (2006) assert that the deflators in common use to obtain real commodity prices exaggerate inflation, and that, when this bias is rectified, the downward real price trend for many exhaustible resources may well turn around. They show that this is the case for copper. I revert to the implications of their assertion later in the chapter.

### 6.3 Evolution of the unit price of unexploited resources

It is worth remembering that the Hotelling rule, as originally stated, applies not to the prices of finished commodity products, but to the unit price of the resource still in the ground. Rising real long-run prices of unexploited resources would indeed be an indicator of depletion. The rule that such prices must rise at the (real) rate of interest is unobjectionable within the confines of Hotelling's analysis, but it has little relevance in practice, because the assumptions from which it is derived do not hold. The volume of ultimately exploitable resources is unknown, and what is known grows over time in consequence of exploration. Also, the progress of technology improves the efficiency and reduces the cost of exploiting a resource of a given quality. When these alternative assumptions are introduced in the Hotelling model, the rule of appreciating values of resources in the ground breaks down.

The record of unexploited resource prices is rare, but I have found a series of prices for oil deposits in the US. This is displayed in figure 6.1 below. It is not clear whether any conclusions about depletion can be drawn from the data. Indeed, the prices paid for the deposits do not show any upward trend during the twenty-two-year period. Instead, they appear, unsurprisingly, to fluctuate with the oil prices. But, like the oil prices during the period, the prices for oil reserves do not reflect the costs for establishing reserves. The monopolistic conditions that prevailed in the oil market created a fluctuating wedge between the costs of establishing the reserves and the prices at which they were sold.



**Figure 6.1** US oil reserve prices 1982–2003, constant (2003) US\$/bl (results from 1,500 transactions)

*Source:* Adelman and Watkins (2005).

## 6.4 The cost evidence

The direct indicator of depletion tendencies is a rising cost of output, including the cost of acquiring resources in the ground. More precisely, what is needed is a time series of the total average cost of an exhaustible resource from the marginal project taken into use at different times. The reason why I devoted so much attention to price, an indirect measure of depletion, is that the cost evidence, like that of the price of unexploited resources, is extremely meager. Where it exists at all, it commonly covers a limited period only, which makes it less useful for the purpose at hand. Additionally, cost data are regularly organized and presented in a different format than specified here, so it is hard to interpret them unambiguously for the purpose of measuring depletion.

For example, table 4.1 presents a series of copper costs covering more than fifty years. It exhibits an impressive rise over the first two decades followed by an even more impressive decline over the rest of the period. But since these are global *average industry* costs, they do not illuminate the developments over time of the total average cost of the *marginal project*.

IMF (2006b) has compiled cost data for three metals, and these are elaborated upon in table 6.2. The data are subdivided into costs of “typical” and “least efficient” units in the industry, the latter related to, though not identical with, the marginal projects of the respective industries. Quite significant reductions are recorded in the real costs of output in all cases. This is strongly suggestive of relaxed scarcity over the period under scrutiny, but the suggestion is hard to verify in a firm way, since the data do not comprise capital costs. However, the capital costs would need to rise by an unreasonably high rate to reverse the falling trend recorded in the table, so the suggestion appears to stand on firm ground.

The IEA (2001) has compiled some striking data on declining oil costs. It finds that the global average total cost of new fields taken into production (i.e., precisely the measure needed to track economic depletion) was reduced from \$29/bl in 1981 to \$9 in 1999, and proportionately even more if the numbers had been expressed in constant money. This is not the consequence of a wholesale geographical shift of production towards OPEC’s low-cost deposits, since OPEC’s share of world output was virtually the same in the two years (BP, annual). Nevertheless, the decline exaggerates the long-run cost

Table 6.2 Operating cash costs for three metals

	1985		2002	
	Typical <sup>1</sup>	Least Efficient <sup>2</sup>	Typical <sup>1</sup>	Least Efficient <sup>2</sup>
<b>\$/ton (nominal)</b>				
Aluminum	1000	1200	1000	1200
Copper	1000	1400	1000	1600
Nickel	3400	5300	3700	6100
<b>\$/ton (deflated by UN's MUV index,<sup>3</sup> 2002 = 100)</b>				
Aluminum	1380	1655	1000	1200
Copper	1380	1931	1000	1600
Nickel	4690	7310	3700	6100

Notes: <sup>1</sup> 50th percentile of the industry cost curve. <sup>2</sup> 90th percentile of the industry cost curve. <sup>3</sup> Unit value index of manufactures exports.

Sources: IMF (2006); UNCTAD, *Monthly Commodity Price Bulletin*, several issues.

trends. Some of the reduction can be attributed to a one-time restoration of order in the late 1980s from the inflated cost levels caused by a frenzied investment activity in the late 1970s and early 1980s, driven by a desire to benefit from the high prices at the time as quickly as possible. But a substantial part of the cost suppression is due to a remarkable technological progress over the eighteen-year period (Bohi, 1999).

A study by Goldman Sachs (2005b) completed late in the year before publication assesses the total cost of output from the 100 largest oil projects under development in 2004, intended to yield a total production of some 12 million barrels per day early in the 2010 decade. The study concludes that the total average cost in this new capacity is \$6.3 per barrel, substantially less than the 1999 cost given by the IEA. This would suggest that the cost decline recorded after 1981 has continued. Both the IEA and the Goldman Sachs cost assessments relate to new supply, so in a sense they reflect the total cost of marginal projects, the measure of relevance for assessing depletion. But then at least the Goldman Sachs study mirrors a huge additional output involving 100 projects, many of which are bound to have much higher costs than the average for the group. Again, the available cost data leave the depletion analyst on somewhat uncertain ground.

The cost data presented above are strongly suggestive of a declining cost trend for exhaustible resource outputs until 2003, but there are clear indications of a sharp upward cost move in the 2004–6 period. For example, the IMF (2006b) reports operating cash cost rises for the least efficient producers between 2002 and 2005, all deflated by the MUV index, at 28% for aluminum and 25% for copper (no change for nickel), while a more recent study by Goldman Sachs (2006) has estimated a stable investment expenditure per unit of oil and gas capacity until 2003, but a nominal rise of 25% up to 2005, which corresponds to 13% in deflated dollars. I argue that the increased costs are mainly due to the frantic investment activity in the resource industries, sparked off by the commodity boom of the mid-2000s, as producers have hurried to establish new capacity, and as the prices of virtually all investment inputs exploded in consequence (IEA, 2006; IMF, 2006b). I also assert that the investment-driven cost increase of the mid-2000s is temporary and has nothing to do with depletion. Costs will fall as the commodity boom ends and the investment activity subsides, in much the same way as occurred in the oil industry after the 1986 price collapse.

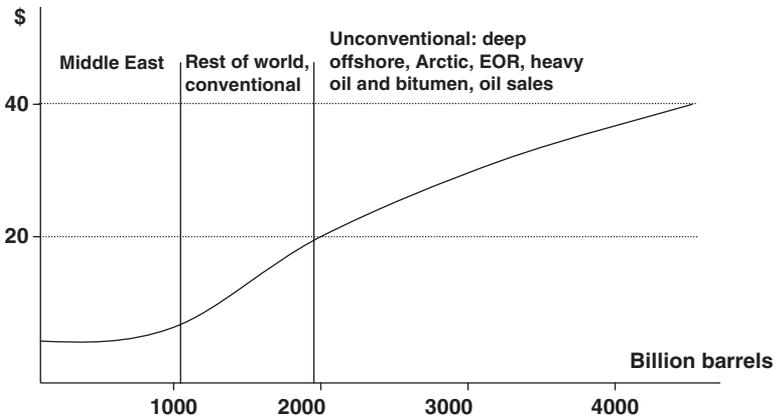
A hypothetical cost issue must be given consideration before this section is concluded. Economic logic posits that the most economical among known deposits will be exploited first, so over time there will be a tendency towards quality deterioration, even though new discovery could plausibly arrest or even reverse this tendency. The deterioration is behind the upward slope of the long-run supply schedule depicted in figure 4.2. I noted when that curve was discussed that although it may be gently upward sloping, its level has historically tended to shift downwards over time in consequence of cost-reducing technical progress, not the least in transport, making distant resources economically accessible. The technological accomplishments in the extractive industries are thoroughly described in Simpson (1999). The downward shifts in the long-run supply schedule would in turn explain the long-run decline in exhaustible resource prices discussed above.

However, as pointed out by Tilton and Skinner (1987), one cannot preclude a sharp upward jump in costs as cumulative output increases, if there is a discontinuity in the resource stock forcing the extractive industry to move to much leaner resources when the rich ones have been exhausted. Such discontinuities are indeed possible, and the resulting higher costs and prices would be an expression

of depletion. But the actual experience of two discontinuities suggests that their economic significance may not necessarily be grave, that in fact they could occur without leaving any economic mark at all.

The first discontinuity relates to copper and it took place early in the early twentieth century. It involved an extremely sharp decline in the grade of ores mined, as the limited availability of high-grade ores became inadequate. In the US, the average grade declined from almost 6% in 1890 to less than 2% in 1920. By 1960, the average grade had fallen further, to below 1% (Lowell, 1970). Worldwide data on grades are not available, but they undoubtedly followed those in the US, with a lag. Yet, real prices of copper declined by almost 40% between the 1890s and 1920s, as the industry adjusted and perfected its technology to the meager deposits in use (Radetzki, 1975).

The second discontinuity relates to oil and is currently occurring. It involves a shift from “conventional” oil deposits to “unconventional” ones, like deep offshore, arctic, bitumen, and oil sands. Until recently, this was widely believed to involve a quantum jump in costs, but as production from unconventional deposits has grown, it is increasingly evident that the shift is economically seamless, as is apparent from figure 6.2 below. Unconventional resources are continuously reclassified into the conventional category, as their



Source: IEA, 2005.

Figure 6.2 Oil resources and economic price, constant (2004) US\$/bl

exploitation expands, and the cost of their exploitation is falling. For instance, the cost of mining and upgrading of Canadian oil sands has declined from \$30/bl in 1985 to less than \$15 in 2003 (IEA, 2005b). Evidence from a recent study (Aguillera, 2006) suggests that figure 6.2 seriously underrates the potential of unconventional resources. Aguilera asserts that some 4,000 billion barrels of recoverable oil is available from heavy oil deposits at an average total cost of \$10 per barrel, while oil sands offer a recoverable quantity of 5,000 billion barrels at average costs of \$15. Costs will continue to decline even more as further exploitation experience is gained. The ultimate result may turn out to be not very different from that of copper 100 years ago.

#### **6.4 The evidence of depletion summarized**

Four types of evidence have been reviewed, viz., reserves; real prices of exhaustible materials; prices of unexploited resources; and costs of exploitation.

There is little sign of depletion in the reserve data. Reserve volumes are comfortably high and have grown in line with exploitation. A tendency for discovery to fall short of exploitation in some materials has been noted, but sizable appreciation of deposits in production has compensated for the discovery shortfall, permitting continued reserve expansion.

Real increases in the price of exhaustible resources would provide an indirect evidence of depletion in that they reflect marginal costs. Using prices to measure depletion requires care to avoid periods of monopolistic collusion and temporary booms, because then prices can deviate substantially from costs. Real prices for oil show a trend decline of 0.7% per year in the 1900–72 period. After 1972, oil prices have had a substantial monopoly element. Metals and minerals prices fell in line with oil prices, by 0.7% per year between 1900 and 2002. The decline was faster until 1986, but since then the trend has been flat. The break in 1986 may be interpreted as a sign of an impending accentuation of scarcity.

I presented a series of price quotations for oil in the ground, but no great significance can be attached to that series as a measure of depletion, since it covers a period of price-raising collusion in the oil market.

A variety of real cost numbers were reviewed, not all of which were fully relevant for the purpose at hand. The thrust of these data sets is towards a decline over time, in line with the real prices. A sharp increase in costs was observed after 2002, but this is interpreted as a short-run phenomenon, caused by the investment frenzy triggered by the commodity boom of those years.

Discontinuities involving sharp shifts to more meager deposits have occasionally occurred, and I review the cases of copper and oil in this respect. These two shifts have not left any perceptible mark on costs and prices, as technological progress compensated for the upward pressure on costs.

I conclude that the evidence is fuzzy and not very conclusive, but, if anything, it points to a relative relaxation of scarcity in the course of the twentieth century. Tendencies towards economic depletion have been compensated (or even overcompensated) for through cost-reducing technical progress in exploration, extraction, processing, and transport of the exhaustible resource materials.

## **6.5 Satisfying human needs**

The weight of the evidence summarized above points to declining real prices of exhaustible resource products, and suggests that the supply of such materials has become more ample in the past 100 years. Depletion has evolved into a gradually less immediate threat. At the same time, it needs underlining that the historical evidence is incomplete and ambiguous, sometimes pointing in directions opposite to the main thrust. Furthermore, history is not necessarily a reliable guide to the future. Benign past trends could well be reversed due to increasing volumes of exploitation, and/or a serious slowdown of the cost-reducing technological progress in the exhaustible resource industries, a development that is conceivable, though not likely.

The possibility of such a somber future outlook must be put into a proper context, however. How serious would be the problems arising from a sharp reversal of the real price trend for a number of exhaustible resources of  $-0.7\%$  per year over most of the twentieth century to, say, an annual  $+1.0\%$  in several coming decades, due to depletion of the resource base? Not very serious, I would claim, and for several reasons. The following arguments posit that, while a sharp slowdown in technological progress related to exhaustible resource

outputs is unlikely but not inconceivable, it would require an unreasonable stretch of imagination to assert that the technological slowdown would simultaneously apply to other economic sectors. And if it did not, then continued technical progress in all other areas of the economy clearly offers several avenues out of the depletion predicament.

*First*, all the “real” price developments reported above used various measures of inflation, e.g., the consumer price index, the producer price index, or the MUV index as deflators of nominal prices. While a 1% annual rise in the real price assumed above would certainly impose an economic burden on the exhaustible resource users, it would still involve a declining labor effort to earn a unit of the depleting resources,<sup>3</sup> given that hourly wages, deflated by the same indices, typically rise by more than 1%. Real wages in the business sector of the OECD countries increased by 2.1% per year between 1970 and 2002 (OECD, 2004). Without in any way belittling the results of the Svedberg-Tilton (2006) analysis, the same comment is applicable to their conclusions that the *real* real price of copper has increased in the course of the twentieth century.

Substitution in favor of cheaper and more abundant resources offers a *second* means to ameliorate the emergent strains due to depletion. The substitution of optic fiber for copper in telecom wiring is a striking example of how a cheap and almost infinite resource (silicon) was substituted for a much dearer and potentially scarce one. The substantial increase in productivity that resulted from this substitution (optic fibers can carry much more data than copper wires) may be seen as a beneficial side effect. This substitution took place in the face of a long-run fall in the price of copper. The incentive to substitute would have been much more pronounced if copper prices had been rising.

Access to an advanced broad-based technology platform facilitates the processes of substitution. The opportunities to resort to various types of substitution, related to both methods and materials, occur all the time and account for a significant proportion of economic growth in rich diversified societies. The post-industrial era has been appropriately termed “the age of substitutability” (Goeller and Weinberger, 1976).

<sup>3</sup> Barnett and Morse’s (1963) seminal work attaches considerable attention to the use of wages as deflator in deriving real commodity prices.

Our societies' increased capacity for substitution greatly reduces the dependence on any individual exhaustible resource material, or a group of such materials.

A *third* and related reason why depletion may be a burden but not a catastrophe is the gradual dematerialization of the advanced economies. This process was discussed at some length in chapter 1, and table 1.2 provides a stark illustration of the decline in the quantitative resource needs to create a unit of economic value. Access to a minimum quantity of physical resource inputs is indeed necessary. Collapse would follow in the hard-to-imagine situation where the supply of such inputs was completely arrested. But the consequences would hardly be dire from an unlikely but conceivable process of depletion that raised the real prices of exhaustible resources by 1% per year.

The history of the price of light vindicates the above statement. It is available in two versions that come to similar conclusions (Fouquet and Pearson, 2006; Nordhaus, 1997), and I choose the earlier and more straightforward one to make the case that the satisfaction of human needs is not particularly dependent on the real price movements of exhaustible resources, nor of finished goods, within a wide range. The central issue instead concerns the cost of satisfying human needs. The latter depends importantly on the human resource inputs. Nordhaus' study tracks the real cost of light over a 110-year period. On the basis of price indices for the United States (1883 = 100), Nordhaus shows that the real prices of kerosene and electricity in 1993 had fallen by 25 and 97 per cent respectively. He also demonstrates that linked price indices for lighting devices like kerosene lamps and electrical bulbs of various types do not indicate any significant real change. However, the index of the real cost of a lumen, a unit quantity of light, had fallen from 100 in 1883 to only 0.1 in 1993, importantly because of the enhanced efficiency in transforming inputs like kerosene and electricity into light. A given quantity of lighting in the latter year cost only one-thousandth of what the same quantity of lighting had cost in 1883!

The figures forcefully demonstrate the power of technical progress to generate light with ever-decreasing inputs of exhaustible resources and finished goods. The real cost of light would not have been notably affected if the prices of fossil fuels had doubled or trebled, or even increased tenfold, during the period, owing to accentuated resource depletion. Human ingenuity, rather than the price of exhaustible

resources, has been the completely dominant factor underlying the ability to satisfy human needs in this particular case.

The relationships brought out by Nordhaus' study undoubtedly apply in many fields. For example, the resource use and cost of a telephone call or dispatch of a written message from Stockholm to Santiago, say, early in the twenty-first century is only a minuscule fraction of what it was fifty years earlier. Human welfare would not be compromised, even if depletion led to substantial increases in exhaustible resource prices. Human inventiveness is a forceful and undepletable "ultimate resource" (Simon, 1996) to keep the threat of exhaustion at bay.

## 7 | *Fears of, and measures to assure, supply security*

The discussions in chapter 2 demonstrated how, in the course of the twentieth century, Japan, the United States, and Western Europe, the world's industrial centers, have become increasingly dependent on imported commodity supply. Expanded needs due to industrialization and income growth, a relative depletion of the domestic resource base, and the secular decline in transport costs, explain why it had become increasingly economical for the advanced nations to replace the domestic production of a multitude of raw materials by imported supply. Primarily on account of differences in resource endowments, the dependence on imported primary commodities is most pronounced in Japan and least in the United States, with Western Europe in between.

The apparent indispensability of many commodities, and the threat of international supply disruptions through wars and other disorders, has for long caused concern to the importing nations. Influenced by the autarkic tendencies that evolved during the Great Depression, even Keynes (1933) deviated from the gospel of comparative advantage. He expressed the view that the leading economies' reliance on far-away sources of raw materials supply had become excessive, so a greater self-sufficiency might be warranted on both political and economic grounds, even when local production costs more than imports. In more recent times, the major industrialized countries have launched a variety of actions to overcome the perceived problems of commodity imports insecurity. I say perceived, because the greater risks of relying on imported supply, as distinct from domestic supply, are not uniformly borne out by historical evidence. In fact, one can claim that the emergence of global markets, offering a wider potential diversity of import sources, may well make imports more secure than domestic supply. The breakdown of coal availability in the United Kingdom during the extended coal strike in 1984 would have been less accentuated with a greater role played by imports. Famines due

to a crop failure are easier to avoid when consumption depends on geographically diversified imports.

The purpose of the present chapter is to explore the ramifications of the issue of imported supply security, and to scrutinize the alternative measures that have been used for overcoming the difficulties that an unreliable import supply of raw materials could cause. Domestic supply is conventionally assumed to remain secure and stable.

Even though the analyses should be of relevance to any country heavily dependent on commodity imports, the subject will be treated mainly with reference to the major industrialized nations. The focus is on supply disruptions which are unanticipated, occur suddenly, and prevail only in the short-to-medium term. Monopolistic producer action, embargoes, wars, strikes, and natural disasters are cases in point. No attention is given to the gradual supply changes that stretch over time periods long enough to permit full economic and technical adjustments. The disruptions under consideration involve sizable cuts in the quantity supplied, resulting in violently rising prices, or physical shortages if the price is controlled.

The emphasis is on alleviating programs initiated or supported by the governments of the importing nations, although actions can of course also be taken by the commodity-using industries. Quite often the government actions are implemented in conjunction with the major importing firms.

In section 7.1, I consider the circumstances under which supply disruptions become especially serious. Section 7.2 explores the nature of the difficulties likely to emerge. The menu of policies to overcome the problems is discussed in section 7.3, while section 7.4 summarizes the main findings.

## **7.1 When will supply disruptions be particularly serious to the importing economy?**

The severity of a commodity supply crisis for an importing economy will depend on a number of factors. Some of these will be due to conditions in the importing country, while others will have to do with circumstances in the producing/exporting areas. I review these factors, starting out with the ones that originate in the importing country.

*Import dependence.* Everything else being equal, the severity of the supply crisis in a given commodity will vary with the share of imports

in total use in the importing country. An interruption of imported supply is unlikely to be serious if imports constitute a limited share of consumption, since in such a case the impact on total availability will be small, and only the less important, marginal uses of the commodity will be affected.

*Value of the commodity import in relation to the size of the importing country's economy.* Between two equally indispensable materials, a reduction in supply, and an ensuing increase in price, will be more painful if it involves the one representing the greater import value

*Substitutability of the commodity.* A supply crisis will have more severe consequences for materials with no close substitutes. Apart from the ease with which the functions of one material can be performed by another, substitutability has an economic and a time dimension. Easy substitution implies that the substitute material is available at a cost not much higher than the material in crisis. In this sense, palm oil is a good substitute for groundnut oil, since both have comparable costs and prices. In contrast, silver is not a good substitute for copper, for although silver has many of copper's desirable attributes, its cost per unit of weight is about seventy times that of copper. If there is a supply crisis in copper, copper prices can rise a lot before it becomes economical to substitute it with silver on a large scale. Easy substitution also implies that replacement can be introduced promptly. This may not be possible if there is capital equipment that is specific to the use of the original material, for then the need to rebuild that equipment will delay replacement.

*Indispensability of the final product in which the commodity is used.* A supply crisis will have more severe repercussions if the commodity is employed to make products vital to key functions in the importing nation. An import disturbance in nickel will raise greater complications than one involving imports of cocoa, because stainless steel, the finished product involving nickel use, is harder to forgo than chocolate.

The severity of a supply disruption will also be related to the circumstances characterizing the export sources.

*Concentration of export supply.* With geographically concentrated supply, the impact of natural or man-made disruptions, for example, droughts, earth-quakes, strikes, and political upheavals, will tend to be greater. Geographic proximity will also tend to facilitate the

launch of supply-cutting cartels, especially when this proximity strengthens the political and economic affinity among the producers.

*Difficulty in substituting new sources of international supply for current ones.* Disruption of supply from established import sources will be most severe when capacity utilization is high worldwide, leaving little prospect for switching to alternative sources. The severity of the disruption will also vary with the length of time it takes to develop new capacity, and the differential between the cost levels of this new capacity and that of the established suppliers

Circumstances on the supply side also permit some judgment about the risk that a supply disruption will occur. Indications of political instability are taken as a sign of an increased likelihood that a supply disruption will occur. The history of earthquakes, violent weather, or strikes in major supply centers can also help in assessing the risk.

This list of factors is helpful in singling out the commodities that may warrant special action to assure stable import flows. The degree of risk aversion among policy-makers will determine how many commodities will be included in this group and how much will be done about them. The risk aversion appears to be greater in the United States than in Europe and Japan. Despite its much lower import dependence for most commodities, the United States has been by far the most energetic among the three in launching efforts to assure its imported commodity supply.

A group of “strategic” metals with exceedingly concentrated sources of global production<sup>1</sup> probably come highest on the list of candidates for action to secure import supply. Some 93% of niobium (columbium in the United States) is produced in Brazil; 85% of tungsten originates in China; South Africa accounts for 77% of world platinum output, and the share rises to 91% if Russia is included; in palladium the two countries account for 83% of global output; while South Africa, Russia, and China together generate 95% of vanadium supply. There is very little production of these “strategic” metals either in Japan, the United States, or the European Union, so the import dependence is almost complete. These materials are very hard to substitute in the short to medium term, and they all satisfy vital needs in the production of indispensable alloys and catalysts.

<sup>1</sup> Production data from USGS (annual, 2007).

After the two oil crises of the 1970s, petroleum too has entered the list of products that warrant action to assure supply. In distinction from the strategic metals, whose trade values are quite small, petroleum trade weighs heavily in the importing countries' economies.

Other metals, for example, copper, nickel, tin, and uranium, have sometimes prompted action aimed at averting the risks of uncertain foreign availability. Iron ore and lead, in contrast, have attracted less attention in this respect, importantly because of a greater diversification of their sources of supply.

Among agricultural raw materials, natural rubber has been seen as a risk, on account of its importance for transport and other key industries, and the heavy concentration of its supply to Southeast Asia. However, the availability of synthetic rubber, a good substitute for many purposes, has reduced the fear of supply cuts. Wool and cotton have prompted fewer disruption worries. Import dependence and supply concentration are very high in the case of tropical beverages, but supply disruptions have not been seen as a serious threat, probably because these products are not regarded as indispensable.

Base foods like cereals, pulses, and meats have not been prominent among the materials causing worries about supply security, despite their nature as essential goods. The reason is a low degree of import dependence, in the US a result of strong comparative advantage, in Western Europe and Japan due to long-lasting and far-reaching agricultural protection (see chapter 3).

## **7.2 The nature and severity of the problems caused by disrupted commodity supply**

A price rise is the first consequence of disrupted commodity supply. Given the low price elasticity of demand for indispensable raw materials, the price reaction can be quite violent. For strategic metals, this elasticity is (absolute) 0.1 or less in the short run, so the price could easily double in consequence of a 10% supply shortfall.

The price rise will impact immediately on the importing country's macroeconomy. The current account will deteriorate and inflationary pressures will be accentuated. For these effects to be perceptible, however, the imports and consumption of the commodity must represent a high value in relation to the importing nation's economy.

This may be true of oil and possibly base metals, but hardly for any of the strategic metals.

The reduced supply will limit usage. Rationing of what is available can be done by price or by regulation. Price rationing is more efficient since it will favor discontinuation of the least economic uses. In both cases, some former users will have to do without the commodity, and may be forced to close down. Unemployment could rise in consequence. Closures will also have dislocating effects further down the production chain. Such effects can be severe if the output of the commodity-using industry is essential to important sectors of the economy. The commodity users who stay in business will make efforts to substitute in favor of other raw materials, or to invest in capital that saves on the disrupted commodity use. The cost of these adjustments will impact negatively on productivity, causing some slow-down in economic growth. These microeconomic dislocations will have a further negative effect on macroeconomic performance.

The consequence of a supply disruption to an importing country will be more severe if that country is hit in isolation, such as through a selective embargo, while other importers can obtain their needs without problem, for then that country's international competitiveness will suffer. Political regulation is a prerequisite for embargos to have such effects, for without regulation market forces will assure a reallocation of supplies in favor of the embargoed nations.

The negative consequences will be strongest in the short run, but will subside over time, even if the disruption continues. Economic forces will bring relief through substitution and savings in usage.

Attempts have been made to measure the economic costs of commodity supply disruptions on the basis of specific scenarios. The outcomes depend entirely on the assumptions underlying the scenario, viz. how large and lasting will be the supply shortfall; how fast can alternative supply be mobilized; how, and at what speed, will the importing economy affected by the shortfall react?

The arbitrariness of the results emerges starkly from two old studies on chromium (US Bureau of Mines, 1986). In the 1970s, analyses relating to (West) Germany concluded that the country's GDP would fall by about a third as a result of a complete unavailability of chromium supply. This drastic result must be due to the extreme assumption about supply, and equally extreme suppositions about

inflexibilities in the German economic system. A study from the 1980s concerning the United States assumed a complete three-year loss of South Africa's chromium supply and a 90% loss of Zimbabwe's, concluding that these shortfalls would reduce US GDP by 0.2% in the first year, 0.1% in the second, and by about 0.05% in the third year.

Significant efforts have been devoted ever since the mid-1970s to determine the macroeconomic impacts of disrupted oil supply. The latest in the series (IEA, 2004) notes the wide array of quantitative results reached by its predecessors, importantly due to the differences in the models employed for the task. In retrospect, its own results are less than entirely persuasive. The study asserts that a sustained oil price rise of \$10/bl (from \$25 to \$35) will reduce the OECD's GDP growth by 0.4% in the same and the following year, and raise the rate of inflation by 0.5% in the same and the following five years. In China, the GDP and inflation impact is assessed at -0.8 and 0.8%, respectively, while the corresponding figures for India are even higher, at -1.0 and 2.6%. Given the dramatic and sustained oil price increase since early 2004, when the study was published, one would expect to be able to notice its impact simply by an ocular inspection of the macroeconomic performance, even when other concurrent factors influencing GDP and inflation change. However, no such relationship can be detected from the numbers of table 7.1. Catching the wider macroeconomic impact of commodity market disruptions is apparently a complicated task.

There are also important non-economic aspects of commodity supply disruptions. For example, defense concerns underlie many of the efforts to assure strategic metal imports. When a military threat is serious, the needs of the armaments industry will be satisfied on a high-priority basis, irrespective of the costs that are involved.

### **7.3 Measures to alleviate the consequences of supply disruption**

Damaging disruptions of physical commodity supply in the international market are rare. Prices can vary a lot due to, e.g., shifts in desired inventory levels, expectations about future events, or outright speculation, but quantities are much more stable. Inspection of global agricultural production data reveals no sharp man-made disruptions. Relatively rare crop failures of up to 15% of global output from one

Table 7.1 Oil prices and the macroeconomy

Year	2003	2004	2005	2006*	2007*
Crude oil price, \$/bl	28.9	37.8	53.4	64.3	57.2
Change from previous year, \$/bl	3.9	8.9	15.6	10.9	-7.1
GDP growth, %					
OECD	1.9	3.3	2.5	3.1	2.5
China	10.0	10.1	10.4	10.7	10.0
India	7.2	7.8	9.2	9.2	8.4
Consumer prices, % change					
OECD	1.8	2.0	2.3	2.3	1.8
China	1.2	3.9	1.8	1.5	2.2
India	3.7	3.8	4.2	6.1	6.2

Note<sup>d</sup> \*Oil price in 2007 is for the first quarter. Macroeconomic numbers for 2006 and 2007 are estimates and projections, respectively.

Source: IMF (2007).

year to the next have occurred in coffee and cocoa, the production of which is geographically concentrated, while downward fluctuations have been much smaller for essential food products like cereals and sugar, or for cotton.

From the minerals world I know of only two man-made disruptions of significant magnitude over the past forty years. The *first* relates to cobalt, an “indispensable alloy of strategic importance.” In 1976, world production fell by almost 20%, in consequence of political upheavals in Zaire, where more than half of world output was produced. The producer price reacted with a lag, from \$5.40/lb at the time the crisis broke out to \$25 later in the decade, and remained elevated for a four-year period. The substitution process triggered by the price change was painful and costly, but its force and speed proved that the metal was indeed dispensable. Demand in the US fell by 53% between 1978 and 1982, and developments in other countries ran in parallel. By 1983, production had fully recovered, and the price had returned to its pre-crisis level (USGS, 2002). The *second* disruption occurred in the oil market in 1979–80, initially in consequence of the Iranian religious revolution, when the Shah was deposed, followed very soon after by the Iran–Iraq War. Global oil output fell from

64.6 million barrels per day in 1979 to 58.2 in 1981 (BP, annual), a 10% decline. The price more than doubled from December 1978 to May 1979, when it attained \$32 per barrel, and rose even further in the following two years (UNCTAD, 2000).

The fact that disruptions in the supply of essential commodities are rare does not necessarily alleviate fears of their occurrence, nor does it discourage action to overcome their undesirable consequences. But it is interesting to note that the intensity of such action tends to come in waves, with peaks after disturbing developments in commodity markets. One such peak occurred in the early 1970s and was related to the widespread belief in commodity power and the many cartel attempts launched at the time (see chapter 8). After a long period of calm in the commodity markets, new concerns about supply disturbance and the need of measures to assure supply have emerged in the 2000s decade, with a focus on oil and gas. The US has dominated the efforts in the 1970s, but in the 2000s the action had a more international character.

Two general remarks are in place before I discuss the security of supply arsenal in detail. *First*, when markets are truly global, a supply disruption is bound to be a global phenomenon too, warranting international action to come to grips with the problems. Actions by individual nations in isolation may be ineffectual and politically destabilizing, and the benefits, if any, may be appropriated by free riders (Griffin, 2008). *Second*, with the proliferation of commodity exchanges, supply disruptions have lost some of their sting, since commodity users can insure themselves against price increases by hedging in futures markets. Of course, the users' gain must be juxtaposed against the losses incurred by the speculators who issue the insurance.

Many different measures can be employed to reduce the risks for and consequences of disruptions in essential commodity imports. The menu can usefully be divided into (a) the measures intended to secure an uninterrupted import flow, and (b) those aimed at assuring a greater domestic availability that can be relied on in the event of an import breakdown. My discussion follows this order.

Most of the measures to assure stable commodity imports concern the choice of suppliers and the development of special relationships with them. There would be no need to be concerned about supplier choice if commodities were homogeneous and markets operated

under perfect competition, for then a supply disturbance would merely result in higher prices that rationed what was available among interested buyers. The realities of most commodity markets deviate significantly from this ideal. Problems could arise because some suppliers may be unable to offer the precise grades required. Furthermore, physical trade is typically conducted on the basis of standing relationships that take time to develop. Quite often, the price at which transactions are conducted reacts to shifts in supply with a lag. After a sudden reduction in supply, the buyers whose source had been knocked out would need time to establish new trading relations. In the meantime some of their demand would be unsatisfied, while the price remained below market-clearing equilibrium. In such circumstances it becomes important to avoid the disadvantage suffered by the commodity user who is left out in the cold. There is a benefit in stable relations with reliable suppliers, even though, in the end, the supply disruption will result in higher prices for all buyers.

### *Choice of suppliers*

An obvious and straightforward measure in this regard is to diversify the importing country's sources of supply on both geographical and political criteria. The consequence of a breakdown of one source will seldom be critical if none of the suppliers accounts for a dominant share of the total.

The choice of suppliers should also favor ones deemed to be stable and secure. Three instances from the early 1970s point to the criteria of unreliability that continue to be valid in the new century, though they do not in all cases apply to the same countries: the embargo of 1974, imposed by the members of the Organization of Arab Petroleum Exporting Countries on oil sales to the US and Netherlands, made the members of the group appear unreliable. The short-lived embargo on soybean exports instituted by the US government in 1973 aimed at assuring domestic availability at a low price, but it reduced confidence in the United States as a reliable supplier, and strengthened Brazil's position in the soybean market. Canada's refusal to honor its uranium supply commitments to some European countries in the 1970s, also motivated by the priority of domestic needs, encouraged the development and expansion of alternative supply. Admittedly, the cases involving the US and Canada are examples of government activism in

primary resources that has since long been replaced by policies favoring international collaboration and market solutions.

The efforts to assure stable imports through careful choice of suppliers do carry a cost. Diversification of import sources may reduce economies of scale. Geographical diversification can add to transport costs, especially for high-volume products like oil, iron ore, bauxite, and coal. A premium price can be commanded by suppliers with an established record of reliability. For this reason, the Netherlands and Norway can charge a higher price than Algeria and Russia for their sales of natural gas to Europe. Suppliers with an uncertainty element, in contrast, have to accept a discount. This was long true with coal and strategic metals from South Africa. Until apartheid was disbanded, there was a risk that importing governments might embargo South African exports.

### *Tighter relations with suppliers*

In the 1950s and 1960s, direct foreign ownership was commonly regarded by the multinational resource enterprises and their governments in the Anglo-Saxon world as the most effective means to assure steady raw materials import flows. The profit motive was obviously another reason for direct investments to exploit foreign natural resources. Nevertheless, backward integration was seen as an important tool to assure not only against disruption of physical availability, but also against destabilizing fluctuations of market prices. Irrespective of what happened to prices, the owner could always count on the output at the cost of production.

As events turned out, the backward integration proved to be of doubtful value to the multinationals. Many of their direct foreign investments were nationalized in the 1960s and 1970s by the newly independent administrations in developing countries, at a substantial cost to the investors, since compensation was meager, when it was paid at all (chapter 9). More important, however, the nationalizations disintegrated the very foundations on which the policies of supply security had been based. Even in cases where foreign ownership remained, its role for supply security was diluted by the government activism in the host countries that characterized the primary sector of these times.

In contrast to the Anglo-Saxon practices, Japanese and to some extent German supply security arrangements emphasized the establishment of long-term supply contracts with independent raw materials producers. Quite often, these contracts involved a provision of long-term finance with some concessional element, as an inducement to establish raw material production (Radetzki and Zorn, 1979), along with technical assistance in a variety of fields, e.g., exploration for minerals, but they seldom comprised managerial control.

The long-term contractual arrangements entered into in the 1960s could stretch over anything from a year to more than a decade. When long-term investment finance was provided, the supply obligations regularly lasted at least until the loans had been repaid. The standard contracts of the period specified both quantities and prices, the latter often with escalation clauses. Prices have come to play a reduced role in concurrent long-term contracts. Such contracts are basically agreements about quantities, while the prices are determined by commodity exchanges.

Long-term contracts do provide a shield against supply disruptions, so long as they last. The problem is that, when they involve corporate parties in different countries, their enforcement is not easy. Hence, if changing circumstances create dissatisfaction with one of the parties, a renegotiation will be necessary for the contract to survive. The supply assurance at predetermined conditions, therefore, becomes quite limited.

The irony is that supply was forthcoming and disruptions were rare irrespective of the mode chosen to assure supply. The Anglo-Saxon mode was less successful, however, given the cost to the investors as their assets were nationalized. The Japanese-German mode, too, involved an added cost of supply, but it was not exposed to the detriment of state takeover, since there was nothing to nationalize.

A further irony is that the lessons about the outcome of the alternative modes seem to have been solidly forgotten, or maybe never learnt, by the new actors, often state owned, from China, India, Brazil, Malaysia, and other developing countries. In the 2000s, these actors have gone on a somewhat indiscriminate buying spree to obtain foreign ownership positions, predominantly but not exclusively in energy production, in their efforts to assure their raw materials imports. The deals have involved very substantial investments in countries presenting quite high political risk (IEA, 2006).

Tighter relationships with commodity suppliers also include treaties with political and/or economic content between the governments of the countries that trade. The importing government can offer political and military support, a foreign aid package, a generous bilateral trade deal, or a long-term price guarantee, against a promise of first option on the raw material produced by the exporting country. The relationship between Saudi Arabia and the US in the 1990s and 2000s has contained many of the elements listed here.

### *Other measures to assure imported supplies*

Military power has long antecedents in its role as a guarantor of international commodity supplies. Both the Allied and the German and Japanese fleets provided protection to the commodity flows from overseas to Europe and Japan during the Second World War. Naval protection of petroleum shipping from the Persian Gulf has been used off and on during later decades, in times of political and military tension in the region.

Joint sharing arrangements among importers constitute yet another measure to alleviate the impact of supply shortfalls, especially when the buyers risk being unevenly hit. The petroleum emergency policies under the auspices of the International Energy Agency (IEA, 2001), involving saving and sharing, put in place in response to the oil crisis of 1973–4, are a case in point.

Barter trading arrangements have sometimes been used to help in cementing bonds with foreign raw material suppliers. The commodity-importing country can become a priority buyer by offering the exporter some especially valuable goods (food, specialized manufactures) in return. Mutual priority barter arrangements prevailed for decades between Finland and the USSR, the former supplying high-tech manufactures in return for oil. The arrangements broke down with the collapse of communism in 1990.

### *Promotion of domestic output*

With greater domestic output, the impact of an international supply disruption will be less severe. The measures to promote production within the country can be dealt with very briefly, since they were discussed in some detail in chapter 3. Agriculture was the focus of

that discussion, but the arguments and measures used have applicability to all commodity categories. As is apparent from that discussion promotion of domestic output often has other, even stronger, motivations, i.e., to maintain employment or to prevent capital destruction in the supported activities, irrespective of whether there is a threat to domestic supply.

Import restrictions commonly constitute a key element in the promotion of domestic output. These permit higher prices to be charged domestically than would be possible if there were a free import flow. Subsidies to domestic production is often an element of protection. Public procurement is another tool to encourage domestic production. This measure, too, would ordinarily involve the payment of prices above the world market level to the domestic producers.

A grotesque example of maintenance of domestic output using supply security as motivation is the production of hard coal in Germany and Spain with the help of huge subsidies. Stockpiling could accomplish the supply security objective at a fraction of the subsidy cost (Radetzki, 1995).

### *Stockpiling of strategic metals in the USA and other countries*

Maintenance of commodity stocks is a classical measure to come to grips with issues of supply security. Government efforts to establish and maintain stockpiles of strategically important imported commodities have been launched at different times in virtually all major industrialized countries that depended on imports (Vernon, 1983).

The efforts of the United States have been, without comparison, the largest and most persevering. Inventories of some eighty commodities (mainly but not exclusively metals) of importance for the country's defense efforts were built after the Second World War and expanded further in the early 1950s, in response to fears of shortage aroused by the Korean War. The US strategic stockpiles continued to grow until 1973, when their total value was assessed at some \$6.7 billion (around \$25 billion in 2005 money). The stocks of many commodities represented very sizable proportions of total annual consumption in the US. The situation was most extreme in tin, where the stock corresponded to a full year of *global* consumption (Cooper and Lawrence, 1975). By 1973/4, however, stockpiling had gone out of

fashion. New directives were issued on the strategic needs, according to which some 90% of the stockpile was declared surplus and available for disposal (Mikesell, 1986). In 1992, the US Congress made a further downward adjustment of the strategic needs.<sup>2</sup> Though the sales have been gradual, they have at times had a depressing effect on the international markets. The disposal program continues (USGS, annual, 2007). Fashions moved in parallel outside the US. The governments of other countries also reduced or discontinued their strategic metals stock programs.

The stockpiling programs of the United States reveal some of the problems surrounding this kind of policy. The US endeavors have had a strategic-military objective. The determination of stockholding size then required a delineation of possible war scenarios, of the ensuing import shortfalls and their durations, and of the shares of these shortfalls that it was strategically important to satisfy from the government inventories. This proved fiendishly complicated, as the policy shifts described above demonstrate. When inventories are sizable, procurements and disposals due to a change in the perception of needs will destabilize markets and prices. Releases have been envisaged only in the event of scarcities caused by wars involving the United States itself. Shortages and ensuing price increases caused by other circumstances normally did not warrant stockpile action, but sometimes nevertheless triggered a perverse political decision to *increase* inventory levels, so accentuating the upward price move. Complaints have been repeatedly voiced about the great inflexibility in the procedure for inventory releases. Much of the potential benefit would have been erased if these had prevailed upon a sudden and acute war-related need.

The stockpile policies have involved a significant net cost. Apart from the storage cost and the interest on the capital tied up, one must reckon with a deterioration in quality due both to the passage of time and to the technical change which may have altered the needed specifications, and made old stocks unsuitable for the most critical needs. Given that procurements would have tended to take place in tense situations when prices were high, and disposals to occur in relaxed market conditions with low prices, one would expect the

<sup>2</sup> Home page of the Defense National Stockpile Center, [www.globalsecurity.org/military/agency/dod/dnsc.htm](http://www.globalsecurity.org/military/agency/dod/dnsc.htm).

transactions to yield losses on average. No assessment of the net cost to society from the stockholding programs has been undertaken.

The functioning of the US strategic minerals and metals stockpile has fortunately never had to be put to a fully fledged test during war or war-like emergencies. It is possible that its benefits would have proven well worth the cost incurred during peace.

### *The IEA emergency stockpile of oil*

In the 2000s, there has been a strong revival of the supply security concerns, this time, however, with a heavy focus on oil. The revival has been triggered by a greater OPEC activism, which along with the demand shock of 2004, importantly driven by China, led to an oil price explosion. Superimposed on these events have been political supply problems in Venezuela, along with the actions by Russia to control oil and gas supply, purportedly for political ends.

The antecedents to an internationally managed emergency stock for oil stretch back to the first oil crisis of the early 1970s, when the International Energy Agency (IEA) was established. The current membership of this organization overlaps, in the main, that of the OECD. Supply security measures have been one of IEA's major mandates. According to current rules (IEA, 2005a), the members that are net importers of oil have a legal obligation to hold emergency oil reserves equivalent to at least ninety days of net oil imports of the preceding year. In the mid-2000s, the stocks controlled by governments for emergency purposes have amounted to some 1.4 billion barrels, the equivalent of about 190 million tons. The adequacy of this inventory can be gauged by comparing it with the largest supply disruption since 1973, that of the Iranian revolution, which cut global supply by 5.6 million barrels per day during six months, creating a shortfall of 1 billion barrels or 140 million tons.

Taking a clue from the criticism of the inflexibility of the US strategic stocks of metals, the IEA maintains an emergency response team to facilitate rapid and flexible action to emerging disruptions. Current rules stipulate a maximum stock drawdown of 12.9 million barrels per day (53 million tons) during the first month of crisis, i.e., substantially more than the output of Saudi Arabia during recent decades. To make the stock last longer, the maximum drawdowns are rapidly reduced during the following months of crisis, while at

the same time, other measures, e.g., surge production, redirection of imports and demand restraints, are introduced.

No action by the strategic inventory managed by the IEA has been reported in response to the Iranian revolution and the Iran–Iraq War of 1979–80. But the inventory played a role during the Gulf War in January 1991, when 2.1 million barrels per day were released, and then again in September 2005, involving roughly the same quantities, to reduce the impact of Hurricane Katrina. On both occasions, the stockpile interventions were far below the maximum potential, yet the added supply helped to calm the market in some measure.

#### **7.4 A summary of findings**

While supply security is an issue that has emerged in response to an increasing dependence on imports of critically important commodities, it is important to remember that crises in supply are not limited to imported supply. In fact, a diversified network of imports may provide a better shield against disruption than a concentrated domestic supply subject to the vagaries of weather or strikes.

The rich industrialized world has long since practiced deep agricultural protection, assuring high levels of self-sufficiency of indispensable food. For this reason, food is seldom in focus when measures to avert raw material supply crises are under consideration. Instead, the issue of supply security typically relates to metals, minerals, and fuels deemed to be essential and hard to replace.

A global supply crisis of significance is not only characterized by a substantial price increase, but must also involve a significant cut in supply. Such crises have been quite rare, and I have been able to identify only two (cobalt in 1978 and oil in 1980) since the Second World War.

The implications for the importing economy will be felt in many dimensions. At the micro-economic level, the industries using the commodity will suffer a cost increase, and rationing will have to be employed when price is regulated. Some firms will have to do without, and may face a survival threat in consequence. At the macroeconomic level, the current account will deteriorate, inflation will gather pace, and the growth rate may decline, but the commodity consumption and imports have to be very sizable for these effects to be perceptible.

Various measures have been tried to assure the stability of imports in the event of a supply crisis. Careful choice and diversification of supply sources, tighter relationships with suppliers, bilateral treaties, and direct ownership positions in foreign production have been tried with varied success. Encouragement of domestic output or of domestic availability through strategic stockholding has also been common in the arsenal used to overcome supply crises. All these measures carry a cost, and, to be worthwhile, these costs have to be lower than the detriment of crisis.

Supply disruptions occurring in truly global markets are best countered by internationally coordinated measures. The emergency stockpile of oil under the direction of the IEA provides an illustrative example. The proliferation of commodity exchanges and futures markets has provided a means of price insurance to commodity users, thus reducing their pain and diminishing the need for public action.

Looked at in retrospect, the concerns and the costs incurred to overcome the vagaries of supply security may appear as somewhat exaggerated. The incidents of crisis have been rare, and the ability of the advanced economies to substitute out of the supply crises suggest that the cost of the measures used to assure stable supply must be quite small to make the efforts worthwhile. But then, history offers no firm insights about future events. If a supply crisis of huge dimensions and deep severity were to occur in coming years, then even the more costly among the measures considered in the present chapter might emerge as highly worthwhile.

# 8 | *Producer cartels in international commodity markets*

Producer cartels are about monopolistic coordination aimed at raising the suppliers' revenues. Efforts to cartelize typically come in waves, and have occurred throughout the history of international commodity trade. This chapter focuses on the 1970s, when the most recent wave occurred. While it lasted, a number of academic efforts were launched to explain the functioning of commodity cartels in general and of OPEC in particular. Despite the theoretical developments and the many modeling exercises that were undertaken, many of the key issues concerning commodity cartelization remain to be fully understood. The remark from an influential survey of commodity cartelization from the mid-1980s (Gately, 1984), that "There are a large number of alternative theories, but a much smaller number of sensible applied models," retains its validity even twenty years after it was published.

The present chapter begins by studying the necessary minimum preconditions in terms of elasticities and market shares, for successful cartel action. I then identify the markets where these preconditions appear to be fulfilled. There follows a brief account of the attempts of commodity producers to wield the market power to their own benefit, trying to answer questions such as: What were the triggers to the cartel action? How did it go? How did the buyers react? What prompted cartel disintegration? There is a heavy emphasis on the oil cartel, and an effort to explain why OPEC has persevered while the other cartel efforts failed. The findings of this analysis are not only of interest for the sake of history. They should have a bearing on the future too.

## 8.1 The formal preconditions for successful cartel action

Successful cartelization measures involve either a restriction of supply or a rise in the price charged by the members of the collaborating group, leading to increased revenue for the group. With a given

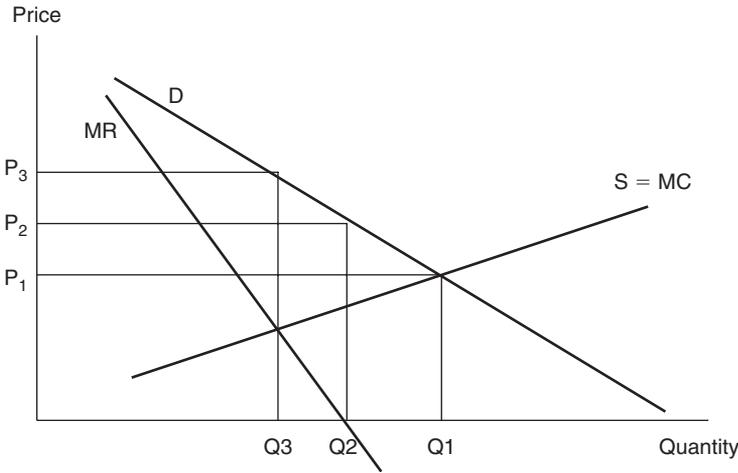


Figure 8.1 Maximization of profit and maximization of revenue

demand schedule, there is a unique relationship between the quantity supplied and the price at which the market is cleared, so the two measures would have equivalent consequences. Where the institutional market arrangements involve producer-set prices, cartel action would ordinarily take the form of an increase in the producer quotations. Where prices are set by exchanges, the colluding producers could achieve their aim by reducing supply until the desired price level is reached.

Under ideal conditions, producer collaboration should aim at maximizing the joint profits of its members. In terms of figure 8.1, this would be achieved by reducing supply from  $Q_1$ , the competitive equilibrium, to  $Q_3$ , given by the intersection between the collaborating group's marginal cost and marginal revenue. Any output above this level would be unprofitable, because the marginal cost of that output exceeds the marginal revenue. This is the standard profit maximization rule applied by a perfect monopoly. The criterion for successful producer collaboration employed here involves the cruder rule of revenue maximization, which disregards the costs saved by production cuts. Under this criterion, output would be reduced from  $Q_1$  to  $Q_2$ , the latter determined by the marginal revenue of the producer group being equal to zero. Revenue would then rise from  $P_1Q_1$  to  $P_2Q_2$ . I have adopted this cruder rule for the purpose of the

following discourse because I believe that this is about as much as a real world cartel could aim for. I know no cases of cartels that have defined their supply schedule with sufficient precision, and instituted income transfers between individual members, to make profit maximization a practicable policy.

The present analysis assumes that the participants in the cartel can reach full agreement on a marketing policy that aims at increasing their sales revenue, and that they will adhere strictly to the policy rules. Even these more modest assumptions about the behavioral discipline within the group are somewhat heroic. The possibility of increasing the group's revenue over that reaped in the absence of joint action can be shown to be greater, *first*, the higher its share in global supply; *second*, the lower the (absolute) value of the price elasticity of global demand; and *third*, the lower the value of the price elasticity of outsiders' supply.

In formal terms, successful market intervention by the cartel requires that the (absolute) value of the price elasticity of demand for its output  $E_{DC}$  should be less than 1. If  $E_{DC}$  is greater than 1, the cartel's revenue will decline when the members jointly raise prices or cut supply. The value of  $E_{DC}$  is determined by the formula (Radetzki, 1976):

$$E_{DC} = (1/M)E_{DW} - (1/M)(1 - M)E_{SR};$$

where  $M$  = the cartel's share of world supply;  
 $E_{DW}$  = the price elasticity of world demand; and  
 $E_{SR}$  = the price elasticity of supply outside the cartel.

An  $E_{DC}$  which is less than 1 implies that the marginal revenue from the cartel's aggregate supply is negative. Hence, the sales revenue will increase as supply is curtailed. A maximum will be reached when  $E_{DC}$  reaches a value of 1 and marginal revenue equals 0. This will happen when supply has been cut to  $Q_2$  in figure 8.1. The smaller the value of  $E_{DC}$ , the greater the potential for raising revenue through cartel action.

The success of the collaboration has an important time dimension. This is because the (absolute) price elasticities of world demand and of outsider supply ( $E_{DW}$  and  $E_{SR}$ ) will tend to increase over time, as the final users and independent producers adjust to the conditions caused by the cartel's intervention. The higher prices resulting from cartel

**Table 8.1** *The price elasticities of demand for output from a cartel ( $E_{DC}$ ) which controls 60% of world supply ( $M=0.6$ )*

$E_{DW} \backslash E_{SR}$	0.1	0.2	0.4	0.7	1.0
-0.1	-0.23	-0.30	-0.43	-0.63	-0.88
-0.2	-0.40	-0.47	-0.60	-0.80	-1.00
-0.4	-0.73	-0.80	-0.93	-1.13	-1.33
-0.7	-1.23	-1.30	-1.43	-1.63	-1.83
-1.0	-1.73	-1.80	-1.93	-2.13	-2.33

action can greatly increase the cartel members’ revenue in year 1, over what they reaped in the competitive market that prevailed in year 0. If the higher price is maintained, their revenue in year 5 may prove substantially lower than in year 0, as a result of the gradual shrinkage of global demand and of the cartel’s market share. Present-value calculations of the revenue gains and losses over time will be needed to determine the benefit of such a course of events. But a cartel is unlikely to be judged a success unless it manages to keep the members’ revenue above the competitive level for at least several years.

It may be something of a paradox that a cartel which commands no credibility in the outside world will have greater prospects of succeeding in its market actions than one that does. This is because, if no one believes that the price-raising collaboration will survive, there will be no adjustment to the higher prices resulting from its actions. With no adjustments, the short-run values of  $E_{DW}$  and  $E_{SR}$  will persevere.

The above formula can be used to determine the limiting combinations of the price elasticity of world demand,  $E_{DW}$ , and the price elasticity of supply outside the cartel,  $E_{SR}$ , that have to hold for the price elasticity of demand faced by the cartel,  $E_{DC}$ , to be less than 1, and hence for cartel action to increase the collaborating group’s revenue. Table 8.1 illustrates the limiting elasticity values for successful collaboration of a group whose share of world supply,  $M$ , equals 60%. It will be seen that the potential for revenue-raising action (numbers shown in italics) exists in all cases where the values of  $E_{DW}$  and  $E_{SR}$  are less than 0.4, but also for selected other elasticity value combinations.

The value of  $E_{DC}$  is also related to the range of commodities under the cartel's control, but multi-commodity cartels will gain additional market power (a lower  $E_{DC}$ ) from their wider coverage only if the commodities are each others' substitutes. No synergies will be obtained from launching a joint cartel by the coffee and copper producers. Since there is little relationship between these two markets, price-raising supply restrictions in one will have no effect on the other. In contrast, the copper producers' market intervention will be reinforced by a simultaneous restriction in aluminum supply. When copper producers intervene in isolation, the higher copper price will induce substitution in favor of aluminum, and the reduced copper demand will dilute the benefit from intervention. If the copper producers coordinate their action with the aluminum producers so that the prices of both products rise in parallel, no substitution from one to the other will be induced by the price change, and the producers of both metals can reap higher earnings than if each group had acted separately.

The increased market power follows from the fact that the price elasticity of world demand,  $E_{DW}$ , is lower for copper-cum-aluminum than for each metal in isolation. The greater the substitutability between the products, the higher will be the benefit of joint cartel action for both, and the lesser will be the possibility to establish a successful cartel for each product in isolation. Attempts to launch a cartel by primary copper producers would be much strengthened if it included a successful effort to get the suppliers of copper scrap on the bandwagon, given the substitutability between primary and secondary metal material.

However, market power is only one of several aspects that determine the prospects for launching successful cartels. Another is the ability to administer and coordinate the members' actions, so there is a trade-off between the augmented market power and the increased complexity in managing multi-commodity cartels.

## **8.2 Other preconditions for successful cartel action**

The preceding section clarified why the control of a large share of total supply and low price elasticities are necessary preconditions for successful cartel action. That discussion, however, is far from

adequate for identifying the commodity markets in which cartelization is feasible.

A first ambiguity arises from the definition of total supply. One could alternatively look at the share of global output under the cartel's control, or at the share of global exports accounted for by its members. The latter figure is usually higher, so it produces a more optimistic impression of the cartel's potential success, but it disregards the possible dilution of the collaborating producers' market power as independent supply switches between the domestic and export markets.

A second problem is due to the uncertainty and instability of the elasticity values. Price elasticity estimates can vary greatly depending on precisely what is measured, the method used, the time period to which the estimate applies, and the price level at the time of measurement. As noted, long-run price elasticities are usually substantially higher than short-run ones. In terms of figure 8.1, the demand and supply schedules will be flatter if a longer time period is considered. Price elasticities can also vary with the absolute price levels. For instance, when the demand curve is a straight line, as in figure 8.1, the price elasticity will rise as prices increase. Hence, measurements of elasticity made at a given time will not necessarily hold if a price change has subsequently occurred.

For these reasons, exercises like that contained in table 8.1 cannot bring out neat distinctions between commodities that are amenable to successful cartel action and those that are not. Clearly, considerable standard errors are attached to all elasticity estimates, and the best one could expect from such analyses is a first crude categorization of commodities according to the prospects for monopolistic manipulation.

A third problem concerns the practicalities of producer coordination intended to control commodity supply. Since cartel action is about cuts in supply, the initial issue that needs to be resolved is the overall size of the cut. Well-established producers and producers with above-average cost levels are likely to be interested in greater cuts than new and low-cost producers who are keen to expand their output. The need to assure the full collaboration from producers who jointly account for a large proportion of the total will tend to result in agreements scaled down to suit the convenience of the parties which desire the least proportional output reduction.

Coincidental with the determination of the overall output reduction are decisions about its distribution among participating members. Optimally, only the high-cost output ought to be cut, but, to be acceptable, such policy would require income transfers from lower-cost producers who are allowed to continue their operations to those who close down. This is rarely, if ever, practicable, so the sharing of cuts would typically be in proportion to output in the recent past, to actual capacity, or to the capacity-including expansions in the pipeline. These alternatives usually give rise to protracted quarrels as each cartel participant positions himself to maximize his own yield.

After the joint supply cut has been implemented, each individual member will have a strong temptation to covertly increase his supply, and so benefit from the higher price while letting the others carry the burden of restriction. A close inspection of the participating members' adherence to the agreement will therefore be needed to prevent it from breaking apart.

A few important inferences for the practicability of international commodity cartels can be drawn from the above. The smaller the group of participating producers needed to attain the required share of world supply, the simpler will it be to reach and maintain a supply-restricting action. Agreement will be much easier to reach and administer in a group of four or five than in a group of twelve or more. Similarity among the participants will also facilitate monopolistic coordination. If they are of equal size, have matching cost structures and levels, pursue similar goals and operate in comparable social and political environments, an agreement will be easier to reach than when there are great differences within the group. The ease with which output can be cut and supply can be monitored will also affect cartel operation. The cohesion and trust within the collaborating group will benefit from transparency of the burden-sharing.

Empirical studies of international cartel endeavors in commodity markets have often been simplified by regarding countries instead of producing corporations as participants. Individual producers are not always easy to identify, and the volume of their exports may be hard to quantify. Identification and quantification are much easier to handle at the national level. There are also some more fundamental arguments in favor of treating national governments instead of corporations as cartel members. *First*, in many countries, corporations are subject to anti-trust legislation which makes their overt

participation in cartel action difficult. Governments are not subject to such restrictions. *Second*, the governments have and often do exercise sovereign powers to regulate exports as they deem fit. A *third* motivation for viewing governments rather than corporations as the key cartel players is that the 1970s, the decade when there were strong and widespread beliefs in “producer power,” and numerous commodity cartels were launched, was just preceded by or coincidental with a great wave of nationalizations of resource industries, predominantly, but not exclusively, in developing countries (see chapter 9). Efforts to intervene in commodity markets were often initiated by governments, with the newly nationalized corporations used as instruments for policy implementation.

The question of whether governments or producing corporations are the more efficient executors of cartel policy in international commodity markets has been discussed for decades, but still remains unsettled. Summarizing experiences from the inter-war period, Rowe (1965) concludes that an effective international commodity control scheme could be secured only with the active participation of governments. While the empirical evidence from petroleum, bauxite, phosphates, and uranium in the 1970s (see below) supports Rowe’s conclusion, opposite views have been aired. For instance, Grilli and Yang (1988) assert that effective collusion is easier to achieve by a group of private profit-maximizing agents that can act in a covert manner than for governments with a variety of national goals, whose actions by necessity become a “semipublic international political affair.” The dynamic of cartel launch sometimes follows a path where leading private corporations initiate the process and then approach producing country governments to act as cartel fronts. This was the case in 1974 when Rio Tinto Zinc initiated discussions with the governments of i.a. Chile and Zambia about a production cut, with the subsequent action handled by CIPEC, the Intergovernmental Council of Copper Exporting Countries (Wikipedia on the internet). A similar course of events took place somewhat later in the uranium market, where the leading private producers coordinated their marketing efforts, using the Canadian government as their visible front (Radetzki, 1981).

The characteristics of commodity markets that are amenable to successful price-raising actions by producers can now be summarized, and the potential candidate commodities which meet the required

criteria picked out. The method used will be that of successive elimination.

Reasonable prospects for cartelization require a low (absolute) price elasticity of demand. The commodities must not be easily replaceable by close substitutes. This excludes the group of edible oils and their raw materials, which are easily interchangeable, and whose production is so dispersed that a joint product cartel would hardly be feasible. The same is true for fruits like bananas, apples, and oranges.

Another precondition for successful cartel action is that the price elasticity of outside supply should be low, at least in a perspective of three to five years. This would exclude quite a number of commodities, for example the cereals group and sugar, the production of which could be speedily expanded in many places in response to higher prices that looked like persevering for couple of years. The same is true for products like cotton, jute, and possibly wool.

After these eliminations, we are left with rubber, the tropical beverages, and most minerals, all characterized by limited substitutability and extended periods required to create new production capacity. One would now like to fine-tune the price elasticities of these commodities, to get a better grasp of the prospects for market control, but, given the sizable standard errors that surround existing measures of elasticity, I deem such an effort to be futile

The level of supply concentration might throw at least some additional light on the issue under scrutiny. With all else equal, a high level of concentration among producers (whether nations or corporations) should facilitate supply coordination. In 2001–3, the five major exporting nations accounted for 89% of global exports of rubber, and 88% of maize. The corresponding measures for cotton, iron ore, maize, rice, and wool work out at between 70% and 80%. The shares for cocoa and tea were around 70%, but for coffee only 44%. The five leading exporting countries' share of global exports of iron and steel, and aluminum, copper, lead, and zinc at the refined metal stage, as well as of crude oil settled between 40% and 50% (UNCTAD, 2005). On this count, cartelization of the markets for cocoa and tea should be easier to accomplish than that for coffee, and rubber appears to be a better cartel candidate than cotton or iron and steel, but, given the role played by many other factors, the argument should not be carried too far. Note that many of the commodities

listed have a lower level of concentration than the 60% employed in the construction of table 8.1. The Raw Materials Group (2004) has compiled data on the shares of the five largest corporate units in world production for a number of mining industries. Measured in this way, high concentrations were recorded for niobium (94%), platinum (89%), titanium ore (70%) and chromite (64%).

Further insights into the prospects for cartel action would require more profound analyses of the affinity of the producers, the structure of the export market, and the industrial organization of the buyers of each commodity. Successful cartel action would be less likely where the buyers are few, financially powerful and able to retaliate.

### **8.3 Actual experiences of commodity cartels in the 1970s**

The popularity of commodity cartels appears to occur in waves, usually triggered by one or several outside events, but the cartels that attempt to establish monopolistic prices are seldom long-lived, and tend to disintegrate in consequence of stagnant demand and rising independent supply, both prompted by aggressive price policy.

In the 1930s, a number of price-raising international commodity cartels were established by the producers in agricultural as well as in mineral commodity markets, somewhat counter-intuitively in response to the exceedingly low price levels that reined during the Great Depression (Rowe, 1965). The monopolistic actions were widely viewed with sympathy and were overtly supported by the governments of the consuming countries, including the US government. Higher prices were seen as essential for the maintenance and expansion of commodity production, sometimes even for the survival of producers, and, at a wider level, for the restoration of world prosperity (Herfindahl, 1959). These cartel efforts were overtaken by events following the outbreak of the Second World War, with ensuing scarcities and far-reaching government controls.

Another wave of commodity cartel action occurred during the 1970s, this time in response to the combination of widespread nationalizations of mineral resource industries, following Third World independence from colonial bonds, and a very strong boost in commodity demand in 1973–4, triggered by the global macro-economic boom in those years. A widespread perception of commodity power emerged among producers, especially in the developing

world, and efforts were launched to establish producer associations, predominantly in the minerals field, with price raising as the primary goal. The most important and persevering was the oil cartel. The successes of OPEC created a lot of enthusiasm among other commodity producers. Producer efforts to raise prices in non-oil markets were successful in some cases, though short-lived, and the failure was often due to shrinking demand for the cartel's output, as the longer-run price elasticity proved to be disappointingly high. In other cases, no visible price impact can be detected from the attempts at market intervention.

### *Bauxite*

In the late 1960s, Jamaica began to urge the governments of bauxite-producing countries to form an association for the exchange of information, reduction of rivalries, establishment of a joint front to the multinational aluminum companies, and coordinated increases of export taxes (Brown, 1980). Enthused by the successful collaboration within OPEC, but also by the booming demand for their product, the bauxite-producing countries founded the International Bauxite Association (IBA) early in 1974. By 1975, its members accounted for 85% of non-socialist world output. The production units were still largely owned by the vertically integrated aluminum companies, and there were not really any meaningful market quotations for the product. The cartel, therefore, largely operated through the increase of production and export taxes.

Jamaica's government was also the first to take action. At the time, the country was the world's second-largest producer, and, on account of transport distances, it enjoyed a considerable cost advantage in the US market. In 1974 and 1975 the government instituted a very sharp increase in its production levies and export taxes that went far beyond its locational monopoly. As a result, the import cost in constant money of Jamaican bauxite in the United States roughly doubled between 1973 and 1976 (Vedavalli, 1977), and continued to increase until 1980 (World Bank, 1994).

The Jamaican government apparently expected that the other members of IBA would follow suit, so eliminating the relative loss of Jamaica's competitiveness. To some extent, this also occurred. Surinam instituted fiscal levies similar to Jamaica's. Guinea, too,

**Table 8.2 Bauxite output among leading producers in the non-socialist world (NSW)**

	1974	1982	1990	1995
NSW total, m tons	71.3	66.7	99.9	102.9
Jamaica, %	22	12	11	11
Surinam, %	10	5	3	4
Guinea, %	11	18	16	18
Australia, %	28	35	41	42
Brazil, %	1	6	10	10

Source: Metallgesellschaft (annual, several issues).

raised its bauxite taxation, but by less than the two Caribbean countries. However, Australia, the world’s largest producer, and an IBA member, refused to join in these interventions.

Table 8.2 reveals an apparent depletion in the Caribbean producers’ competitiveness, resulting in a substantial loss of market share. The main gainers were Australia and Guinea, members of the IBA who were more concerned about their sales, and Brazil, which never joined the association.

The falling market shares of Jamaica and Surinam would have been easier to handle in an expanding market. In fact, the non-socialist world demand for bauxite fell by 6.5% between 1974 and 1982, importantly due to the extended recession in the wake of the 1973–4 oil crisis. This speeded up the erosion of the cartel.

The frequent alterations of the Jamaican taxes and levies in the 1970s and 1980s, along with other concurrent changes implemented in its bauxite/alumina industry (e.g., production controls, nationalizations), make it difficult to isolate the impact on the government’s revenue from the bauxite levies. Nevertheless, the price-raising interventions must be deemed a failure. The country’s share of the NSW market declined from 22% in 1974 to 12% in 1982, with no subsequent recovery. The Caribbean policies clearly favored Australia and Brazil, which declined participation in the market management. Jamaica, the original founder of IBA, formally withdrew its membership in 1994, and the association collapsed soon after (Crowson, 2006).

In terms of the formal analysis in section 8.1, the cartel’s lack of success was caused by  $E_{DC}$  being too high in the medium term. The

very low value of  $E_{DW}$  was overwhelmed by a low  $M$  (the initial market share of the Caribbean producers) and a high  $E_{SR}$ . The advantage of the Caribbean nations' resource endowment was not pronounced enough to give them a durable market power.

### *Phosphate rock*

Booming demand and the example of OPEC led to a decision by the state-owned Moroccan phosphate rock producer Office Chérifien des Phosphates to raise its producer price, from \$14 to \$42 per ton in January 1974, and then again to \$63 in July (UNCTAD, 2000). In the short run, this intervention was highly effective, because the state-owned phosphate enterprises of Algeria, Togo, and Tunisia, the mixed-owned producer in Senegal, along with the members of the US export cartel,<sup>1</sup> Phosrock, raised their list prices in close concert with the Moroccan action. The entire group accounted for more than 70% of global phosphate rock exports at the time, almost half of which from Morocco (UNCTAD, 1981).

The price-raising scheme proved short-lived. In 1974 itself, exports from all the participants in the scheme increased significantly, so the price gain was exacerbated by gains in volume. In 1975, however, a severe world recession reduced demand. The higher prices also resulted in deferred farmer demand and substitution in favor of other fertilizer raw materials.  $E_{DW}$  proved to be quite high, and the cartel was unable to withstand the strains that emerged, despite its high market share. The Moroccan phosphate rock price was reduced to \$49 in 1976, and \$38 in 1977 (UNCTAD, 2000). In constant dollar terms, the 1977 price was at par with levels in pre-cartel days.

### *Uranium*<sup>2</sup>

The international uranium-mining industry entered the 1970s in a state of profound depression. It had been built to satisfy huge military demand during the 1960s. With the military needs fully satisfied by the end of the decade, the existing uranium capacity was far in excess

<sup>1</sup> US legislation does permit export-oriented cartel measures, so long as there is no impact on the domestic market.

<sup>2</sup> This draws on Radetzki (1981).

of nuclear reactor needs for many years into the future. The low prices did not provide full cost coverage for a large segment of the industry, so many producers left the business.

The depressed market was the trigger that brought producers together in an effort to safeguard their survival. A series of meetings initiated by the government of Canada took place in 1971. The governments of France and South Africa were represented, and leading private producing companies from a number of countries took part. The meetings were intended to “put some order into the international uranium market ... to coordinate uranium production and marketing policies” (*Nucleonics Week*, 1971).

This embryo of the uranium cartel was quite frail while the market remained weak. The most it could do was to reduce rivalry among members, and to issue directives aimed at preventing further price falls. At the end of 1973, however, a number of unrelated but coincidental factors completely reversed the market situation. The most important of these was a decision by the US enrichment agency (at the time a state-owned virtual world monopoly) to change the rules under which it marketed its services. According to the new rules, enrichment had to be commissioned decades in advance, and there were high penalties for cancellation. Owners of existing and planned nuclear reactors signed up excessive enrichment contracts, and then went on a buying spree to secure their future uranium needs.

Having institutionalized their collaboration in the preceding years, the uranium producers responded by temporarily withdrawing from the market, and the prices exploded. The spot quotation went up from less than \$7/lb  $U_3O_8$  in late 1973 to more than \$40 by mid-1976, in spite of a non-socialist world output increase of 15% between the two years. Prices in long-run contracts signed in this period followed suit. The producers re-entered the market only after prices had reached the \$40 level. The cartel worked under very favorable conditions. The private producers were actively supported by the governments of the major exporting countries. The group accounted for a high proportion of the non-socialist world supply, but the precise level of  $M$  is hard to establish given the covert nature of much of the cartel's operations. It faced a price elasticity of demand ( $E_{DW}$ ) that was close to zero. New capacity to produce uranium would take long to establish, and in the meantime  $E_{SR}$  remained quite low. So, the prices stayed very high through most of the 1970s.

The subsequent decline was caused by an increasing realization among the nuclear utilities that they had greatly overcommitted themselves to uranium purchases, given the shrinking plans to expand nuclear capacity. Demand for newly mined uranium was sharply reduced, as the excessive inventories held by the nuclear power generators were scaled down. New production came on stream by the end of the decade, and discoveries of large and very rich uranium deposits in Canada and Australia altered earlier perceptions of impending scarcity. After five years of exceedingly high profitability, the prices in constant money were back to the levels that had prevailed before the cartel burst into life.

### *Copper and iron ore*

Two further attempts at establishing commodity cartels in metal mineral markets need to be mentioned, but they can be treated quite briefly, since they both failed to institute effective price-raising measures (Crowson, 2006).

CIPEC, the Intergovernmental Council of Copper Exporting Countries, was formed in 1967 by the governments of Chile, Peru, Zaire, and Zambia for the purpose of raising prices through collective interventions in the copper market. Yugoslavia and Indonesia joined later, while Australia and Papua New Guinea became associates. Enthused by OPEC's success, CIPEC tried in 1974–6 to raise prices with the help of production cuts, but the efforts failed due to mistrust among members, and because the eight members controlled too small a share (37% in 1975) of global mine supply (M). CIPEC subsequently dwindled in importance with the collapse of production in Zaire and Zambia, and the withdrawal of several members. It was formally dissolved in 1988, and its then remaining functions were taken over by an International Copper Study Group, formed in 1993.

The Association of Iron Ore Exporting Countries (APEF) attempted in 1975 to set export prices. The effort was unsuccessful, first, because two important members, Australia and Sweden, were unwilling to go along, and second, because Brazil and Canada, both sizable export suppliers, refused even to join. APEF reduced its role to collecting statistics on market trend, until its demise in 1989.

## OPEC

The Organization of Petroleum Exporting Countries was brought into existence in 1960. Its major purpose was to form a united front in an attempt to arrest the fall in its revenue per barrel (Griffin and Steele, 1986). The posted prices were used at the time to determine the income tax imposed on the multinational corporations that exploited oil in the OPEC countries. With the entry of new producers, particularly Libya, Nigeria, and Abu Dhabi, and the ensuing excess supply of oil, the posted price of Saudi Marker Crude fell from \$1.9 per barrel in 1960 to \$1.8 in 1970 (World Bank, 1985), but increasing tax rates assured OPEC of stable revenues per barrel. Furthermore, the period was extremely important for the producers in that it established a sense of cohesion and common purpose within the group.

By the early 1970s, the market situation had changed in view of the very fast growth of world oil consumption (8.3% compound annual growth between 1960 and 1972).<sup>3</sup> The world's increased reliance on OPEC supplies helped the organization to raise the posted price to \$2.5 in 1972. The sellers' market became even more accentuated during the global macroeconomic boom of 1973, when the prices of virtually all commodities rose sharply. Late in the year, the OPEC governments agreed to roughly triple posted prices, whereby they hugely increased their fiscal revenue, while the oil companies passed the increase on to the final consumers. With the very low short-run price elasticity of demand for oil, and of supply outside OPEC, there was little need for downward supply adjustments by the cartel, in response to the higher price.

Later in the 1970s the OPEC countries instituted additional increases in the posted price, but these mainly compensated for the ongoing inflation. Also, a large part of OPEC production capacity was nationalized during the decade, strengthening the governments' ability to intervene in the market, and reducing the relevance of posted prices. The market price developments in deflated dollars are depicted in figure 4.4. Ever since 1974, these prices have contained a significant monopoly element, importantly, though not exclusively, imposed by OPEC's interventions. I assert that under competitive

<sup>3</sup> All production, consumption, and proved reserve figures from BP (annual).

conditions, oil prices would have been lower throughout this long period.

In 1979–80, there was another strong upward move in prices resulting from reduced Iranian supply after the country's religious revolution, and later from the outbreak of the Iran–Iraq War. While this second price rise was not caused by OPEC's own actions, the cartel helped to maintain the very high price through adjustments in supply.

In the 1980s, OPEC experienced increasing difficulties in its efforts to control oil prices. The longer-run price elasticities turned out much higher than the short-run ones. World demand for oil stagnated in response to the elevated price levels. The compound rate of global demand growth between 1973 and 1986 was no more than 0.4%. Demand in the OECD fell by 14% in the period, despite a 40% expansion in the area's GDP. Supply outside OPEC, which had been stagnant at 18–19 million barrels per day until 1977, rose to 27.7 million by 1985. From a full-capacity utilization output at 30.8 million barrels per day in 1979, OPEC had to reduce production to 16.2 million in 1985, to maintain the high price. The Saudis' preparedness to cut output from 10.2 million barrels per day in 1979 to only 3.4 million in 1985 was crucial for the price defense.

At this juncture, the cartel realized that the exceedingly high price was not in its own interest, since it resulted in falling sales as demand stagnated and market share contracted. Following internal controversy, output was increased by 2.6 million barrels per day, prices declined by almost half in early 1986, and the cartel's revenue was sharply cut. There followed a fourteen-year period of relatively stable (real) prices that appear to be somewhat modest in comparison with the 1974–85 period, but which nevertheless were significantly above the competitive equilibrium defined as the total cost of the marginal potential project in the industry, so OPEC must be deemed to have thrived even through this period.

In the mid-2000s, oil prices exploded once more, initially in consequence of a rising assertiveness by the cartel group, combined with disciplined production cuts, soon amplified by political supply problems in the Middle East (the 2003 war in Iraq) and a demand shock caused by a strong macroeconomic boom of global dimensions, along with China's entry on the scene as a large importer of oil.

A number of factors come into play in my analysis of OPEC's persevering market power. The low short- to medium-term price

**Table 8.3 World oil production, mbd, share, and percentage change**

	1979	2005	Change, %
ME OPEC	21.3	20.8	-2.3
Other OPEC	9.5	9.0	-5.3
Total OPEC	30.8	29.8	-3.2
OECD	15.7	20.3	29.3
FSU	11.7	11.6	0
ROW	6.5	22.4	244.6
Total World	64.7	84.1	30.0
OPEC share, %	47.6	35.4	-25.6

Source: BP (annual).

elasticities of demand ( $E_{DW}$ ) and of outsiders' supply ( $E_{SR}$ ) have obviously been helpful, and have overcome the cartel's unimpressive market share (see table 8.3). Saudi Arabia's dominance of the group (its production has most of the time hovered between one-quarter and one-third of the total) and its willingness to keep production capacity in reserve has strengthened OPEC's discipline. The cartel's unique natural resource position has added strength to its interventions. Its members account for upwards of 75% of global proved reserves, none of which come near the top of the global cost curve. Even more important is the Middle East "geological anomaly." Middle East OPEC members control over 60% of global proved reserves, and all of these are exploitable at exceedingly low cost. Assessments by the IEA (2001) put the total average cost of supply for the Middle East Majors at \$4 per barrel, so even at a price of \$10 (only occasionally touched since 1974), production in the Middle East remained hugely profitable. The public ownership of most of the production assets has also facilitated coherence of market interventions. The cartel's operations can be instructively divided into short- and long-run measures. I assert that the long-run measures have been instrumental for OPEC's perseverance.

The tool employed to assure OPEC's short-run price objectives has been to vary capacity utilization by cutting supply when prices were deemed to be too low, and by increasing output when they strengthened to above the desired level. Throughout the period since 1974,

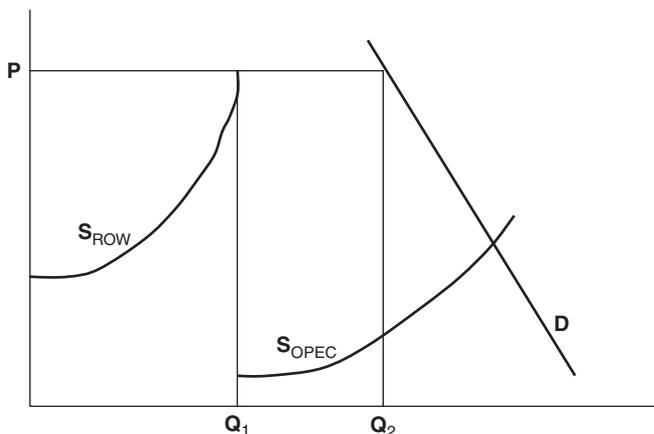


Figure 8.2 OPEC and oil price formation

the oil price has been maintained at levels above the marginal cost in existing capacity outside OPEC, making continued full utilization of that capacity economical. The short-run supply conditions are depicted in figure 8.2. This presentation differs from the conventional supply – demand diagrams in that the higher-cost non-OPEC supply capability to the left in the figure has a priority of use over that in OPEC's lower-cost installations. With a world demand curve like  $D$ , the cartel has to limit its output to  $Q_2 - Q_1$ , to attain its price objective,  $P$ , thus assuring non-OPEC output equal to non-OPEC capacity,  $Q_1$ .

OPEC's short-term efforts have been less than entirely successful in terms of price maintenance within the desired band. Admittedly, some of the price shifts were due to changing objectives. This was clearly true of the dramatic price adjustment of 1986. But other price moves away from the desired band were due to unanticipated shifts in demand (demand increase for inventory buildup during the 1990 war in Iraq and Kuwait; demand decline in 1997–8 prompted by the East Asian economic crisis), or weak quota discipline among the cartel members. I assert that OPEC's ability to command monopolistic prices would have disintegrated, much as happened with the other cartels described above, if it had relied solely on short-term output adjustments.

The long-run tool that has held the cartel alive is a remarkable constraint on capacity expansion, whether by conscious policy or by

default. Table 8.3 provides a stark demonstration. It shows oil output by region in 1979 and 2005, two years of high prices when demand was booming and the global capacity was, for all practical purposes, in full use. The production numbers can therefore also be seen as indicators of existing capacity. It appears that the OECD region, deemed in the late 1970s as not very rewarding for expanding oil production, nevertheless increased its output over the twenty-six-year period by 30%, in line with the global total. The Former Soviet Union (FSU) has not increased its output at all between the two years. This is the result of a deep crisis in its oil industry after the fall of communism, from which it is still recovering. The rest of the world outside OPEC, however, accomplished a truly remarkable 245% increase. The OECD and ROW achievements contrast with those of OPEC, which records a small capacity decline. Even more remarkable is the decline in the Middle East, given its extraordinary resource wealth.

The capacity stagnation in OPEC and the Middle East has obviously been related to the short-run measures to restrict supply. There was little purpose in expanding capacity if it could not be used because of production quotas. But I conjecture that a measure of complacency also played a role. Life with the cartel was so good that capacity expansion was not felt to be urgent even in periods when quotas were not in force. The dominance of state ownership in OPEC's oil industry is another factor explaining capacity stagnation. A majority of the state-owned firms exhibit an extended record of inefficiency and in particular an inability to undertake investments in capacity expansion. Furthermore, the government owners have often depleted these firms financially for the benefit of the public budget, leaving insufficient resources for investments in expansion (see chapter 9).

I note in chapter 9 that the widespread nationalizations of resource industries in the 1960s and 1970s were followed by equally widespread privatizations in the 1980s of the metal mineral industries, while oil and gas, inside and outside OPEC, remained in public hands. This, too, has had implications for the survival of the oil cartel. The state-owned oil firms in several non-OPEC countries, though not tied by production quotas, faced inabilities similar to those within the cartel in executing energetic investments in capacity expansion, constraining the global production potential.

As oil prices rose to levels far above even the wildest OPEC ambitions in consequence of the Iraq War and of the demand shock of

2004–5, a related factor in support of the cartel was increasingly felt. It emerged that a very large proportion of the global undeveloped, yet easy-to-exploit, oil resources were controlled by governments that were either unwilling or unable to expand production capacity in response to the high prices (*Economist*, 2006b). And the private oil industry that wanted and was able to invest had no access to these resources, so had to rely on highly marginal deposits from which oil could be produced only at high cost.

The circumstances discussed in the preceding paragraphs provide, I believe, the main explanations for the perseverance of OPEC's market power. But the fact that the cartel has been able to charge monopolistic prices for over thirty years does not mean that its market power is permanent. Several circumstances are worth considering. First, the share of mineral oil in world energy consumption is shrinking. It fell from 40.5% in 1979 to 36.4% in 2005. The decline tends to occur in spurts after periods of high prices. The revival of nuclear energy in the mid-2000s decade, along with the energetic efforts to develop bio-fuels, is in great part a response to the high oil prices since 2004. Second, the share of OPEC in world oil has declined from 47.6% to 35.4% over the same period. Finally, there is an accentuated underutilization of the low-cost resources in the Middle East. Abstracting from the differences in quality, the region's proved reserves accounted for 55% of the global total in 1979, rising to 62% in 2005, but its share of global output fell from 33% to 25%. These trends may not lead to OPEC's demise in the near future, but they must cause increasing tension, suggesting that the cartel is mortal after all.

## 8.4 Conclusions

Not many commodity markets are amenable to successful monopolistic collusion. The necessary but not always sufficient formal conditions are low price elasticities of demand and of outside supply, along with a high market share for the colluding group. Even when these conditions are fulfilled, concentration among suppliers and a considerable degree of cohesion is essential for success.

The urge to launch cartels comes in waves, and different circumstance can trigger their establishment. During the 1930s, depressed prices prompted cartel action by bringing together producers that

faced a survival threat. Third World independence in the 1960s and the subsequent nationalization of resource industries established a firm belief in “producer power” that resulted in concerted monopolistic interventions in many commodity markets in the 1970s. Experiences from these periods reveal that price-raising cartels normally have a short life. Government participation appears essential for launching and maintaining price-raising intervention. Even then, cartels tend to disintegrate after some years, as the critical elasticity values increase over time.

The OPEC cartel is exceptional in that it has survived and thrived for over thirty years. A number of fortuitous circumstances explain its success, but most important has been its ability to arrest its members’ capacity growth. Governments and/or state-owned firms control the access to a very large proportion of undeveloped, yet easy-to-exploit, oil resources worldwide, including the exceptional resource wealth in the Middle East. These resources have been kept out of the private actors’ reach, forcing the oil multinationals to rely on marginal high-cost deposits. This, too, has helped the cartel’s market management.

# 9 | *Public ownership in primary commodity production*

## 9.1 Introduction

Why is it important to devote special attention to the issue of public ownership in a book that deals with international commodity markets? The answer is straightforward. As will be shown, state-owned enterprises have for several decades accounted for sizable shares of global supply in many commodities. There is a common belief that these enterprises behave differently from privately owned supply agents. This claim must be investigated, for, if it is true, then the analyses of how international commodity markets function, based solely on the private enterprise paradigm, could plausibly go seriously astray.

There is another reason, very important, though not equally central to the themes of the present book, for studying state enterprises in commodity production and trade. Such enterprises are particularly dominant in the developing world. A majority of them were established through nationalizations in the 1960s and 1970s, because it was believed that public ownership would speed up the economic development process. It is essential to verify whether the purported benign effects of nationalization have in fact occurred, especially since the belief has recently gained renewed popularity.

There are two important limitations to the treatment of this subject in the present chapter. *First*, it deals only marginally with the former socialist countries, where prior to 1990 virtually all production was in public hands as a matter of course. Until that time, therefore, there was hardly any private entrepreneurship to provide a scale of comparison with state-owned enterprise.

*Second*, the subject is limited, by and large, to the mineral and energy industries. Many countries, especially developing ones, have a large proportion of their mineral and energy sector activities owned and operated by state corporations. In agricultural production, in contrast, public enterprises are regularly of minor importance. In

both the Third World and the rich industrialized countries, limited government presence as agricultural producer mainly reflects the dominance of small-scale operations, which have always remained in the hands of the local private farmer. A World Bank study from the mid-1980s relating to LDCs notes that state ownership in agriculture seldom exceeded 5% of the sector's output, while in mining 75% or more was common (World Bank, 1983).

Despite the virtual absence of state-owned production in agriculture, governments have exerted a major influence over the agricultural sector. This has been done in many countries through ownership of agro-based industries such as sugar refining, or by the maintenance of fiscal monopolies for beverages and tobacco. Sometimes, public involvement has taken the form of development corporations that provide finance and other services to agriculture. In many cases, public marketing boards have held a monopoly as suppliers of agricultural inputs, and a monopsony as buyers of agricultural produce. These boards have ensured stable prices to farmers, but often at a level yielding ample profits to the government owner when the goods were sold in international markets (Floyd *et al.*, 1984). As discussed at length in chapter 2, international trade policies, too, have had a very profound influence on agriculture, in both industrialized and developing countries. But state-owned enterprises for the production of agricultural commodities have not been common.

This contrasts starkly with the conditions in the minerals and energy sectors, where state ownership is pervasive. But it is important to note that the entry of the state on a large scale in these sectors is a relatively recent phenomenon. Observing the case of copper, Sir Ronald Prain (1975) concluded that production in which the government held any sort of interest in the early 1960s was a mere 2.5% of the non-socialist world total. By 1970 the share had risen to more than 40%. Broadly the same picture emerges for the metal mineral industries in general. In the mid-1950s state involvement in the world outside the socialist countries was insignificant. At that time the metal mineral industries of Africa, Asia, and Latin America were completely dominated by privately owned multinationals from the leading industrialized market economies. In the early 1980s, when state ownership of metals and minerals stood at its peak, it accounted for something like one-third of overall capacity in the world outside the socialist countries. The emergent state enterprise phenomenon was

heavily concentrated in the developing countries, where it accounted for about one-half of total capacity. In the industrialized market economies the share was limited to about 10% (Radetzki, 1985).

In petroleum, the emergence of important state ownership positions is even more recent. As late as 1966, the share of state-owned production in the world outside the socialist countries was negligible, and consisted in the main of the Mexican, Iranian, and Iraqi production facilities, nationalized in 1938, 1951, and 1963, respectively (Marcel, 2006). Many more nationalizations occurred during the 1970s (Algeria, Libya, Kuwait, and Saudi Arabia, among others), importantly inspired by OPEC's successful market interventions of the early to mid-1970s, so that, by 1979, the state-owned share had risen to 55% (Vernon, 1983).

This chapter continues by clarifying a few methodological issues. How precisely is state enterprise defined? And what do the percentage shares quoted above represent (section 9.2)? I subsequently explore the motivations for establishing public ownership in the mineral and energy sectors, in industrialized as well as developing countries (section 9.3). Then, after pointing to the features that characterize state-owned mineral firms (section 9.4), I analyze the likely impact of state ownership in minerals and energy on the domestic economy (section 9.5), providing in the process the rationales for the wave of privatizations and the shrinkage of state-owned enterprise after 1980. The chapter ends (section 9.6) by briefly discussing the impact on the international market for a commodity that follows from the important presence of state-owned enterprises as suppliers.

## **9.2 How to define and quantify the state enterprise sector**

I noted above that the concerns about publicly owned firms are based on the belief that these enterprises behave differently in some way from private corporations. If differential behavior is the focus of interest, then the state enterprise sector should be defined not by equity ownership, but by the extent of government control, since control, rather than equity holdings, will determine behavior. In practice, the state-owned sector is almost always measured by the state equity holding, because this is most easy to observe. The underlying presumption is that publicly held equity and control go hand in hand.

This is by no means invariably true. The practice of using equity ownership as a differentiating rod between the private and state sectors is also due to the impracticability of establishing and measuring the degree of government control in a uniform way.

Even when equity ownership is employed, some ambiguities remain to be resolved. Many analysts include within the state-owned universe all enterprises in which the public equity holding is 5% or more, on the presumption that the government is a particularly influential owner, and that even a significant minority holding constitutes a kind of “golden share,” providing this holder with substantial ability to exert his influence. Others include in the state-owned group only the firms that are majority owned by government. The two measures will obviously yield very different quantitative results. Yet a third approach is to assume state-owned capacity to be proportional to the government’s equity holding in each firm. Though this approach avoids the arbitrary borderlines of the first and second methods identified above, a distinct disadvantage is that the measure does not permit a clear-cut identification of individual enterprises as either state or private.

The proportional rod was applied in deriving the state-owned shares in metal mineral industries listed in the introduction. The sources for the petroleum industry figures quoted above do not state the method used for quantifying the public enterprise share. Vernon’s assessments appear to be based on individual country submissions, so in all likelihood, a variety of methods was used.

The Raw Materials Group, a Swedish consultancy, has developed a more sophisticated definition of state control, i.e., *either* majority share ownership *or* a minority ownership with no other dominant owners. Table 9.1, extracted from the Raw Materials Group’s data files, assesses the size of state ownership using this definition for a group of major metal minerals. The figures relate to the “Western world” only, primarily on account of measurement problems. Prior to 1990, all production in the socialist bloc was state owned. After the collapse of Soviet communism, what is state or privately owned and controlled in the former Soviet Union and China has become very hard to gauge.

The time series in the table shows a clear peak for state ownership in the mid-1980s (except for the aluminum industry, where the peak occurred somewhat later), followed by a sharp shrinkage due to the wave of privatizations that were concentrated in the 1990s.

Table 9.1 State-controlled share of Western world production, %

	1975	1984	1989	2000	2005
Bauxite	25.5	39.9	43.3	21.8	18.0
Alumina refining	17.1	27.2	30.2	10.6	13.1
Aluminum smelting	1.7	39.8	49.7	24.6	34.5
Copper mining	52.1	85.2	64.4	20.1	20.1
Copper refining	27.5	48.7	41.9	20.4	21.6
Gold mining	3.0	4.8	3.0	1.8	1.6
Iron ore	41.9	70.8	64.1	27.6	13.9
Lead mining	14.0	23.0	13.9	4.5	2.0
Nickel mining	3.9	26.0	22.2	9.4	8.0
Nickel refining	1.3	14.7	17.3	4.1	3.4
Zinc mining	17.1	23.3	19.8	8.8	4.0
Zinc refining	16.4	23.1	16.9	6.3	1.6

Notes: (a) Western world is defined as the world except FSU, former communist countries of Eastern Europe, China, Vietnam, North Korea, and Cuba. (b) Controlled share is defined as capacity with majority state ownership, or capacity with dominant state ownership position with no other dominant owners.

Source: Raw Materials Group (2006).

### 9.3 Motivations for public ownership in mineral industries

The metal minerals and fossil fuels industries throughout the world have been a favorite area for government intervention in a variety of forms, including the taking up of direct equity positions. The authorities' desire to be involved and to control has had a variety of explanations. *First*, the widespread perception of mineral wealth as a national patrimony has often been used as a motive to sanction public participation, for instance to prevent the appropriation of this patrimony by private, and especially foreign, interests. A *second* and related argument for intervention has seen the extraction and processing of minerals as strategically important, either because such activities have assured critical supplies of key inputs into domestic manufacturing, including the defense industries, or due to the very large size of many mineral ventures. *Third*, the immobility of mineral deposits has facilitated far-reaching public intervention without any risk that the activity escape beyond the government's reach. And

*fourth*, the recurrent generation of high rents in mineral and fossil fuels endeavors, coupled with the difficulty of appropriating such rents through fiscal measures, has aroused strong temptations for public ownership. Motivations such as the ones enumerated here explain many of the public ownership positions in mineral industries in the industrialized market economies. It helped that the period between 1945 and 1975, when most were established, was one of marked socialist leanings and strong worldwide beliefs in collective action.

The more prominent examples of state ownership in minerals in rich industrialized economies comprised all stages of aluminum production in France, aluminum smelting in Germany, Italy, Norway, and Spain, copper mining through refining in Finland, iron ore production in France and Sweden, coal mining in Germany and the United Kingdom, parts of the petroleum industry in Norway and the United Kingdom, all stages of the natural gas industry in France, steel production in several West European countries, and uranium mining and uranium enrichment in France and other countries, the latter notably in the USA. The modes for establishing these ownership positions have varied. In a few cases, they resulted from confiscation of enemy property at the end of the Second World War (aluminum smelting in Norway). In some instances, the state acquired its ownership stake by bailing out bankrupt private enterprise. In others, the government purchased the equity at a price agreed through negotiations (Swedish iron ore), or determined unilaterally through government decree (French aluminum). In yet other cases, the operations arose out of government initiatives from scratch (petroleum in Norway).

However, as noted, a major proportion of the state-owned mineral and oil enterprises outside the socialist economies were established in the developing countries. Although the arguments and motivations enumerated here are certainly valid in explaining the existence of state ownership in the developing country group too, an additional perspective is required for a fuller understanding of the emergence and growth as well as the performance of the publicly owned mineral and energy sectors in the Third World.

As was argued briefly in chapter 1, the 1960s and 1970s involved a historically unique economic emancipation process for a majority of the developing countries, following the severance of formal or informal colonial bonds. With gradually improving administrative, technical, and managerial capabilities in the post-colonial period, the

ambitions and abilities of the authorities to promote development through control and direction of the national economy were expanded. The implications were general and far-reaching, and the take-over of foreign production assets was an important part of the process. Williams (1975) estimated that, between 1956 and 1974, around one-quarter of overall foreign direct investments in the developing countries was nationalized, some 60% of it without compensation. Metal minerals and oil constitute a large proportion of the foreign-owned property taken over by governments.

The great national importance of the mineral and oil sectors in many cases, their predominantly foreign ownership and secluded enclave character *vis-à-vis* the rest of the economy made them major targets for public policy initiatives. The wish to implement radical change was enhanced by a feeling that the mining multinationals in charge of operations were arrogant, unwilling to give local talent a chance to participate and to develop managerial skills, and generally insensitive of national needs.

The initiatives to control and direct the mineral sector took a variety of forms. The ultimate and most far-reaching measure in the developing countries heavily dependent on mineral exports was to nationalize the industry, in part or completely. The motivation to nationalize was usually based on the view that other intervention measures, like taxation or specific regulation pertaining to, for example, investment, employment, or exports, were inadequate, and that only direct ownership could provide the means for extracting a major proportion of the mineral rent, and for establishing effective control over this key industry. The practice of compensation payments to previous owners varied, from none at all to sums that might appear adequate to impartial observers. However, the former owners invariably complained about the compensation received.

#### **9.4 The distinguishing characteristics of state-owned mineral firms and of the environments in which they operate**

In principle, ownership *per se* should have no impact on behavior. All corporations, both private and state owned, are supposed to be subject to the same existing legal and institutional regime. The difference in behavior arises for two reasons. *First*, when the government is both

owner and regulator of industrial firms, it is likely to bend the rules in favor of the companies it owns. Regulation in the field of, e.g., environment or labor conditions will tend to be applied in a more relaxed manner on the state-owned firms, with obvious consequences for corporate behavior. A *second* difference arises because in state enterprises the owners exert influences, distribute favors, and erect operational constraints, all with the purpose of affecting corporate behavior for *political ends*. The goal of profit maximization is typically subordinated to the pursuit of a broader set of social goals, or of specific agendas that politicians in a position of influence choose to pursue.

Ideally, one would have liked to establish a clear-cut distinction between the private profit-seeking mineral firms, on the one hand, and the state-owned mineral enterprises, characterized by their broader social pursuits, on the other. In the real world, the distinction between the two types of enterprise is hazy. Private firms usually approximate, but seldom conform fully to, the pure microeconomic paradigm. In recent decades, the privately owned mineral enterprises in many countries have been increasingly conditioned, by law or convention, to assume many functions other than profit maximization. “Social responsibility” has since the 1990s become a vaguely defined mantra that the private profit maximizers have been forced to adopt to avoid being attacked by a plethora of NGOs with distinct and incompletely overlapping agendas. The state-owned mineral enterprises come in many different shapes. They range between those indistinguishable from private corporations at one extreme and ones where a variety of social and political considerations predominate over concerns with return on capital at the other. But, although the line is blurred, there does appear to be a significant difference in goals, characteristics, and behavioral patterns between the average private and state-owned mineral firm.

The emphasis in the following characterization is on the state-owned mineral firms in developing countries. After all, this group has experienced the fastest growth, and it currently accounts for a dominant share of the total state-owned universe in the mineral and energy industries worldwide. I begin by considering the state-owned firms’ distinctive behavior in current operations, discuss briefly their financial environment, and continue by scrutinizing how investment behavior may differ between the public and private entities.

### *Operations*

In a performance review of state-owned firms in the minerals industries in developing countries, a crucial distinction needs to be made between newly established, inexperienced, and hence inefficient corporations on the one hand and mature ones which have been there for some time and have acquired the necessary expertise to run their operations with reasonable proficiency on the other. The relevance of this distinction is predicated on the fact that a large part of the existing state-owned universe was set up through successive waves of nationalizations of foreign-owned positions, mainly in the 1960s and 1970s. Since gaining experience and improving performance efficiency is a time-consuming process (see below), it follows that a review covering the past several decades will encounter a significant proportion of cases characterized by low efficiency due to inadequate experience, and not to state ownership per se.

Nationalizations frequently involved extended and heavy setting-up costs. The state-owned firms established to manage the operations that were taken over from the foreigners usually had a difficult start. The old owners, dissatisfied with the compensation offered, were often unwilling to provide assistance. The new managers regularly lacked the appropriate experience, but were compelled to take on wide-ranging responsibilities long before they had a chance to acquire the necessary skills. For this reason, the result was almost invariably chaos and confusion that disrupted operations. The disruptions regularly reached a maximum soon after take-over, and then gradually subsided over a long period of time. Initially, the inexperienced management was often unable to maintain production at full capacity levels, and the cost of output tended to rise.

Available evidence suggests a wide variation in the time needed for overcoming the disruptions and inefficiencies due to managerial inexperience after nationalization. The speed of improvement in this respect appears to be related to the level of economic development of the country, the extent of earlier exposure of the national managers to the problems of the industry, and the ability to strike constructive arrangements with outside specialists for managerial support and training. Overcoming the loss of efficiency due to inexperience at the time of nationalization took no more than five years in the case of Venezuela's iron ore operations. In Indonesia's tin, more than twenty

years were needed to develop a national management cadre of international quality standards, after the industry was taken over from the Dutch in the 1950s. In Zambia, where the government took a majority holding of the copper industry in 1970, the process was never completed (Radetzki, 1985), and the never-ending inefficiencies provided a strong rationale for the decision to privatize the industry in the 1990s. The speed of improvement has also been related to the mode for selecting top management. It was fastest where appointments were made on the basis of managerial skills, and most unimpressive where selection was guided by a desire to disseminate political favors.

The inefficiency due to inexperience that has characterized a substantial part of the state-owned enterprise group through the past decades is, with few exceptions, a transient feature. After the waves of nationalization came to a virtual end by the late 1970s, the state-owned universe has become increasingly proficient and mature.

But while the deficiencies due to a difficult start have by and large been overcome with time, it is evident that state-owned mineral firms, in both developing and industrialized countries, also suffer from systemic and permanent weaknesses. These enterprises are often forced by their owners to pursue a more complex and diversified goal structure than privately owned firms. In addition to the generation of a return on the capital put at their disposal, the state-owned units are regularly required to attend to a profound “social responsibility” agenda, comprising employment, skill creation and technological progress at the national level, regional development, and foreign exchange generation, even when the pursuit of these goals compromises their profitability and long-term financial health. In Auty’s (2003) terse terms, the executives are “sidetracked into performing political favors” as their enterprises “become providers of political patronage.”

Even where the non-profit objectives provide bona fide contributions to social development, their addition to the goals of the state-owned firm are bound to involve a cost, and so result in higher costs of mineral production. The requirement that the activity should yield not only mineral output but also the output of one or other social good is akin to the requirement that byproducts be extracted from the ore, along with the main product. There is a cost in obtaining the byproducts, whether mineral or social. But while the mineral byproducts typically enhance profitability to the firm by the revenue they generate, the social byproducts do not, with the result that profits

are suppressed. If society attributes sufficient value to the social byproducts, the outcome may nevertheless be desirable, and need not involve any inefficiency from society's point of view.

There is another reason, however, why the subordination of the profit motive to a set of social goals will often result in unequivocal inefficiency, and will tend to increase the firm's production costs even further. Multiple goals make it harder to measure managerial performance, and so are likely to lessen the pressure to minimize costs. Where several goals are pursued at the same time, high cost levels will be easier to justify by the pursuit of some or other social objective than it would be in a firm where profit maximization is the sole yardstick for measuring the quality of management.

The three arguments just spelt out, namely (a) a transient inefficiency due to inexperience; (b) the costs involved in pursuing social goals; and (c) a permanent inefficiency due to less pressure to minimize costs, should lead, on average, to higher costs of mineral production in state-owned mineral enterprises than in private firms exploiting mineral deposits of a corresponding quality.

### *Financial environment and investment behavior*

The financial environments under which state-owned mineral firms operate differ a lot depending on country, government, and industry. Gillis (1980) asserts that state-owned firms lived under particularly lax financial conditions in the 1970s. The owner governments often endowed them with an implicit guarantee for financial survival. They were hardly ever allowed to go bankrupt. Undercapitalization resulting from unprofitable operations was remedied through new financial infusions. Through their owners, such firms had better access to subsidized capital, from the government budget or from the international development agencies, than did private mineral corporations.

Where they occurred, the impact of such financial guarantees and implicit subsidies for the state-owned firms' relative competitiveness should not be overemphasized. The benefits could be regarded as compensation for the costly social obligations that these firms were forced to assume. Clearly, the governments of countries heavily dependent on the mineral industry could not possibly find the means to provide subsidies to that industry over the long run. Furthermore, there should be no need for subsidies after the initial period of

inefficiency due to inexperience. A majority of the large state mineral firms exploit superior resource deposits, so, except during periods of severe price depression, or when recklessly robbed by their owners (see below), they should reap significant Ricardian rents to assure reasonable corporate financial comfort even after their social obligations have been paid for.

Moreover, while Gillis' (1980) observations were shared by many analysts at the time, they are clearly less than general. They may reflect a fortunate sub-group of firms or, more importantly, the positive government attitudes of the 1970s, when many of the state-owned positions had been recently established, and hopes about their long-run contributions to national development were high. Finally, one cannot preclude the possibility that the perception of lax financial conditions applying to state-owned firms was a myth actively fostered at the time by private producers.

Two decades later, the financial circumstances of the state-owned mineral firms were definitely not superior to those in the private sector. The firms' access to capital from international development agencies had become strictly controlled by the finance ministries that worried about budget deficits. The flow of funds was clearly from corporate profits to government budget, often to the extent that reinvestment and capacity expansion were impaired. The survival guarantee remained, but non-performing managements saw privatization as a clear threat. The somewhat romantic view of state ownership as a tool for automatic national progress, which needed to be nurtured, had been replaced by a more realistic and much tougher attitude.

Pinpointing systematic differences in the investment behavior between state-owned firms and private multinational corporations in the mineral and oil industries may be as difficult as the identification of dissimilarities of the respective financial environments in which they operate. The difficulty arises mainly from the diversity of investment objectives imposed by the owners of the state mineral enterprises. Several such objectives can be stated: the simplest rule could be to encourage investments that look profitable, whenever adequate funding is available. This is no different from the guiding rod employed by private enterprise. If the country is richly endowed with natural resources, the policy may be to afford preferential treatment to the state-owned enterprises in the development of this wealth, and so to ensure a predominantly national character for the

mineral industry. Yet a third rule may be for the government to induce or require state enterprise investments in uncommercial ventures, for example, to promote regional development or to satisfy national strategic needs of the output. The last rule will reduce profitability. It is akin to the requirement that the firm pursue some social goals in its operations. In some cases, the state mineral enterprise may also be employed by its owner as an instrument to assure the supply of some critical commodity, e.g., oil, by direct investments abroad.

Two important constraints on the investment activities of the state-owned mineral enterprises should be noted. One is the government's need to appropriate the operational surpluses to balance its budget. This has sometimes left the state firm with inadequate funding for its investment plans. The other has to do with the transitional inefficiencies discussed above. Investment in new capacity is probably the most complex activity in the mineral sector, and one that takes much longer to master than the operational problems. Such inefficiencies would add to costs and deter the investment.

Empirical observations confirm the vast differences in investment behavior within the state-owned group. At one extreme, some state enterprises were simply robbed by their government owners, who extracted available cash flow to the extent that the firms were decapitalized. There were no means for investment and little for reinvestment. In some cases, resources were not available even for proper maintenance, and the companies were forced to cannibalize equipment and spares to maintain any operations. One of the worst examples is Gecamines, the state-owned copper producer in the Democratic Republic of Congo (Bomsel, 1994), whose mine output went down from 500Kton in 1975 to only 35Kton twenty years later. ZCCM in Zambia represents another sad copper story: its output fell by half in the corresponding twenty-year period, but the industry has recorded an impressive recovery after it was privatized around the turn of century. Other examples of non-investment and shrinkage due to government greed include Comibol (Bolivia) and Centromin and Petroperu, the latter both in Peru. Petroperu had been reduced by 1989 to little more than a conduit for channelling oil revenues to the government, even at the expense of maintaining exploration and field development (Auty, 2003).

The nationalized oil producers in OPEC countries represent another case of very weak investment in capacity expansion. The members of

the cartel control 75% of the world's proved oil reserves, including the huge deposits in the Middle East, which are extremely cheap to exploit. Yet, between 1979 and 2005, two years when global production capacity was employed to its full technical ability, production (and capacity) in the OPEC group had declined by 3%, while the rest of the world, with much inferior resource prospects, produced 60% more (BP, annual). The absence of a more aggressive investment in capacity expansion can be seen as an element of cartel policy: expansion was held back to permit the extraction of monopolistic oil prices. But other interpretations cannot be precluded, e.g., that the government owners quickly expanded expenditure for welfare programs and other purposes after the 1970s oil price increases, and that the need to finance these programs left their oil firms with little surplus for capacity expansion. Deficient competence for executing the investments may also have held back production growth in the decades after nationalization. These two reasons are said to explain why Indonesia, an OPEC member, has become an oil importer in the 2000s after many years of substantial production declines. Pertamina, its state-owned company, which dominates the industry, has failed to undertake the necessary investments in the country's many deposits to maintain and/or expand output (*Economist*, 2006b). State enterprise dominance is also seen as the main cause of the oil output stagnation in non-OPEC countries like Mexico and Peru (IEA, 2006).

The above experiences contrast sharply with those recorded by other state-owned enterprises which built managerial competences speedily and the owners of which encouraged expansion and left the firms with sufficient resources to implement the necessary investments. CVRD of Brazil is one example. It impressively expanded its iron ore production and sales and at the same time it ventured into other minerals, notably bauxite. At the time of its privatization in the 1990s, it was the world's largest iron ore producer, and held important positions in several other metal minerals. The record of Codelco of Chile, which continues to be fully state owned, varied over time. Mined copper output rose by no more than 8% in the ten-year period 1985–95, but subsequently increased by almost 50% in the following decade. However, the output of other Chilean copper mines, with owners other than Codelco predominantly in the private sector, expanded by 370% and 180%, respectively, in the corresponding periods (COCHILCO, 2005).

The nationalizations of the 1960s and 1970s frequently involved ruptures of the international vertical integration chains maintained by the private multinationals. The downstream processing facilities located in the mineral-importing countries were out of reach of the nationalization efforts. The ruptures remained in the metal mineral industries in the decades that followed, since the state-owned mineral firms were particularly unwilling to launch investments outside their home territory. The investments of Chilean Codelco and Zambian ZCCM in European downstream processing of copper were clear exceptions from the common practice (Radetzki, 1990a).

The metal mineral experience of forward integration contrasts with that in petroleum and natural gas. After a period of hesitation, some of the state-owned oil enterprises, notably from Norway, Kuwait, and Venezuela, undertook energetic efforts in the 1980s and 1990s to integrate forward by buying up refineries, distribution chains and other downstream facilities in the industrialized importing nations. The intention, presumably, was to secure outlets for the crude oil they produced.

The foreign investment appetite has grown tremendously among another selected group of state-owned oil firms in the 2000s, but the character of these investments has been dramatically different from the post-nationalization forward integration efforts. A perception of oil depletion and forthcoming scarcities has sent many state enterprises in China, India, Brazil, and other developing countries with fast oil consumption growth on a worldwide hunt to acquire reserves or developed production facilities, to assure domestic needs for oil and gas. The government owners of these companies have been strongly supportive of this new trend. Even Petronas, the state-owned corporation of oil-exporting Malaysia, has joined the bandwagon. Intriguingly, these companies have been prepared to assume political risks in their engagements in, e.g., Chad, Sudan, or Venezuela that were considered unacceptably high by many private multinationals (IEA, 2006).

## **9.5 The impact of state ownership on the national economy**

This section briefly reviews how the establishment and operations of state-owned mineral enterprises have impacted on the national economies of their home countries. In turn, I will assess whether the public take-overs have really contributed to improved government

control, to greater national revenue, and to other goal fulfillments. After illuminating the disappointments about public ownership that emerged widely during the 1980s, the section discusses the subsequent worldwide wave of privatizations. It ends by recording some revival of resource nationalism by the middle of the 2000s.

### *Control*

As noted, many of the publicly owned units in the mineral industry were taken over from foreign owners, and an important motivation for the state action was that the foreign control over these important industries compromised national sovereignty. State ownership, it was felt, would provide the government with a crucial tool for directing national development. This end was not satisfactorily achieved. At least two problems were involved. Both have to do with the unclear relationship between the managements and their owners, typical of state enterprises (Aharoni, 1982).

The *first* problem, involving too much and poorly coordinated owner intervention, tends to make successful control and direction hard to attain (Dobozi, 1987; Wälde, 1984). In many cases, the owners cannot be clearly identified and certainly do not speak with one voice. The state commonly exerts its ownership rights through a variety of individuals and institutions. There is bound to be a tendency for the political owner representatives who happen to have the greatest influence at a particular time to extract short-term economic or political benefit to themselves or to their constituency without considering the longer term, when they will no longer be in charge, or the nationwide implications.

The *second* problem is that the blurred nature of the principal-agent relationship has sometimes allowed state mineral enterprises to grow into powerful political and economic empires, unrestrained by government control and public accountability. Influential politicians were often put in charge as CEOs of the large state-owned corporate structures. Their political clout permitted the bosses to act with a much greater independence from, say, the ministry of finance, than would have been possible for a foreign owner, who could always be threatened by nationalization. The specialized ministry often became the spokesman of the state firm, rather than the instrument for government control.

Pertamina, the Indonesian state petroleum company, provides perhaps the most striking case of lost government control. Its management implemented unwieldy diversification into transport and tourism with borrowed money, all on its own initiative. The government regained control only after it had to rescue this corporation from an impending bankruptcy in the early 1980s. In Latin America, a large proportion of the foreign borrowing during the 1970s that eventually resulted in a widespread debt crisis was incurred by the state-owned enterprises, without proper monitoring by the government. Quite contrary to the original intentions, the nationalizations in many cases led to a reduction, rather than an increase, in effective government control.

### *Mineral rent*

Another very important motivation for nationalization has been the governments' desire to reap the entire mineral rent. Under foreign ownership, a substantial part of that rent was dissipated abroad. The share of rent accruing to the nation did indeed increase strongly when firms were taken over from foreigners. Some dissipation continued, because the newly established units often had to rely on costly foreign management contracts and consulting services. More important, however, was the fact that mismanagement reduced the total amount of rent in many cases, shrinking the public revenue in absolute terms.

World price developments for metals and minerals provided an additional cause of disappointment, but this was obviously not a result of nationalizations. The 1975–90 UNCTAD metal and mineral price index in constant money turned 22% below its value in 1960–74. This decline reduced the mineral rents even more. In petroleum, of course, the OPEC cartel assured prices in 1975–90 that were more than 200% higher than in the preceding fifteen years (Radetzki, 2006).

Zambia provides a drastic example of reduced public revenue due to a combination of persevering inefficiency and declining price after the nationalization of its copper industry. In 1965–70, a period of private ownership, the average copper price was \$1.92/lb, and the annual government revenue from the copper industry amounted to \$758 million on average (all money is expressed in constant 1980 dollars). In 1971–4, after the government had taken over as the majority owner, the copper price settled at \$1.49/lb, but the public revenue declined to

\$438 million per year. Between 1975 and 1980 copper prices averaged \$0.90/lb, while the annual government income fell to \$30 million (*Zambia Mining Yearbook*, various issues; World Bank, 1986a; IMF, 1982). Underinvestment and persevering inefficiencies resulted in falling production in the 1980s. This further accentuated the suppression of government income. While prices fell by 53% between 1965 and 1970, the government revenue declined by 96%, despite a higher share of the mineral rent accruing to the government in the latter period.

### *Other national goals*

How have the nationalizations contributed to the non-commercial goals that the public enterprises were asked to pursue? The evidence as well as the measure of comparison is quite opaque on this count. Nationalization of most of the managerial functions after takeover must have speeded up skill creation among the indigenes by giving them a broader exposure to managerial responsibilities. This benefit has to be set against the cost of temporary inefficiency due to inexperience, but also, more importantly, due to the many managerial appointments based on political favoritism, and not on merit.

The state-owned mineral enterprises have clearly also pursued a variety of social goals more energetically than could be expected from private multinationals. Given the cost incurred by the firms in the pursuit of the non-commercial objectives, the net benefit to society of these endeavors is somewhat uncertain. Employment creation and regional development are certainly worthy social pursuits, but the capital-intensive, commercially oriented state mineral enterprises appear to be highly unsuitable tools for the purpose. The social welfare effects would no doubt improve if the firms were simply required to maximize profits, and if the government established more appropriate institutions for the work towards social goals.

Before ending this somewhat disillusioned assessment of the impact of state-owned mineral enterprises on the national economy, it is worth repeating that these firms come in many different shapes, and that some have been highly successful. For instance, Codelco, the Chilean state-owned copper corporation, has been given a clear-cut mandate by the government to maximize profits and to leave the pursuit of social goals to others. It has maintained a high international

reputation for cost suppression, for rising productivity, and for expansion through efficient execution of investments. That is fine. But even in this case, an outside observer may be perplexed by the company's inability to close the Salvador mine despite its perennial losses, and wonder about the purpose of arrangements, in force many years after democracy was restored, whereby a sizable royalty is paid by this state-owned corporation directly to Chile's military establishment, or the regular habit of incoming national presidents to appoint a new CEO, irrespective of the performance record of the preceding one.

### *Disillusion and privatization*

In the 1980s and 1990s, a worldwide wave of privatizations led to a sizable abdication by the governments from their positions as owners and managers of industry. The shift in metal minerals is starkly apparent from the figures of table 9.1, and yet these figures underestimate state withdrawal by not recording the privatizations in the former socialist bloc. Several factors explain why this happened. The ideological revolution prompted by Margaret Thatcher and Ronald Reagan played an important role in bringing about the turnaround. It strengthened the belief in the ability of unregulated markets as instruments to solve social and economic problems, while casting serious doubts on the entrepreneurial abilities of government. It pointed to *political failure* as a much more serious and more frequent problem than *market failure*. In the metal mineral industries, the post-colonial push for economic emancipation had become a spent force, while the glaring deficiencies of state ownership described above became increasingly apparent. Borchering *et al.* (1982) and Megginson and Netter (2001) present inter-industry surveys of the low efficiency levels of state-owned enterprises, though they do not appear to have taken the temporary nature of part of the inefficiencies into account. One study of Brazilian iron ore (Schmitz, 2004) even contends that privatization improved productivity in private industry too. Historically low prices in the 1980s reduced the mineral rents, shrinking the hypothetical gains of national ownership. In numerous cases, the mining multinationals were being welcomed back, in recognition of the value and uniqueness of the inputs that they could provide when they took over state-owned property. Constructive collaboration replaced political demagoguery between the parties, and amicable

arrangements for the development of new projects, with management responsibilities entrusted to the private partner, become common.

The wave of privatizations in metal minerals appears to have come to an end. This is apparent from the number of privatization deals and the amounts involved in the transactions. In 1997, twenty deals were recorded for a total of \$5 billion. By 2000, the numbers were down to four deals and \$0.3 billion (private communication with Magnus Ericsson, Raw Materials Group). Ironically, the buildup of the state-owned universe occurred in a period of high prices and elevated mineral rents, while its dismantling took place in years of depressed mineral markets. This must obviously reflect negatively on the state-owned enterprises' performance when comparisons are made with the privately owned industry.

Privatizations played a much lesser role in the oil industry. Those that occurred took place predominantly in Western Europe, with British Petroleum being the most notable example. In the developing countries, state ownership remained virtually intact, and not only in OPEC's member nations. The major oil companies in Brazil, Malaysia, and Mexico, for example, have remained in state hands. The absence of privatizations in OPEC could be motivated by the argument that cartel policy is easier to implement if control remains in state hands, for that reduces the number of decision units and, possibly, assures a greater uniformity of values among them. A more convincing argument is that the high oil prices maintained by OPEC's market control have resulted in a more forgiving attitude towards state ownership by helping to disguise their inherent inefficiencies. High prices have also discouraged privatization because of fears that they might dissipate part of the high rents away from the governments.

Mineral and oil prices have been experiencing an exceptional and persevering boom since 2003, and this has probably been the main reason for a selective revival of resource nationalism. Many exporting countries have raised taxation in efforts to increase the government's share of the rent, and some increase in the government-controlled share in alumina refining and smelting between 2000 and 2005 is apparent in table 9.1. However, more dramatic efforts to take over control from foreign investors have until mid-2006 been limited to hydrocarbons and to three countries. Venezuela's government is extracting more tax but it is also pushing out foreign investors by its demand for a greater say in the oil industry's production and

investment decisions. A mixture of political and economic motives has prompted the government of Bolivia to take over the country's natural gas operations from the foreign owners, though the final outcome of the Bolivian actions remains unclear as this is being written (mid-2007). A similar mixture of rationales appears to be behind the Russian government's confiscation of Yukos, the largest oil company in the country, and its active interventions against the foreign owners of its oil and gas in the early years of the century. Through their actions, the three countries appear to follow the tradition of the many developing nations which nationalized their hydrocarbon industries and have kept them under state ownership ever since. It is far from clear how far these efforts to expand government control and ownership will spread to the non-fuel minerals industries.

## **9.6 Implications for the international mineral markets**

The explosive growth of the state enterprise universe in the mineral industries, and the trauma with which many of the state-owned firms came into being, gave rise to widespread concerns, and a variety of claims and exhortations about their likely impact on the international mineral markets.

One important worry has been that the widespread nationalizations in developing countries will result in inadequate mineral supply, with harmful consequences for user industries in importing countries. The underlying argument was that state-owned firms are so inefficient and so heavily taxed that the cash flow remaining at their disposal was insufficient for adequate capacity expansion, or even for capacity maintenance (Mikesell, 1979; Giraud, 1983). This worry clearly had little foundation, given the lax supply conditions and the low prices for most minerals (including oil after 1985) during the 1980s and 1990s. Interestingly, Mikesell's and Giraud's argument that state ownership causes serious supply constraints even outside the realms of the oil cartel has resurfaced recently as a part explanation for the high oil prices (IEA, 2006).

An opposite concern has been that excessive investments due to a lax financial regime, and inflexible response to price changes due to the suppression of profit maximization in favor of social goals characteristic of state mineral enterprises, will result in lower average prices and greater price fluctuations, with severely detrimental consequences

for the privately owned mineral industries (*Mining Journal*, 1983; Metallgesellschaft, 1984).

No convincing empirical support has been provided to back up the claims that the dissemination of state ownership compromised supply or that it suppressed prices. And a detailed econometric analysis of the copper industry failed to confirm a lesser price sensitivity of supply in state-owned than in privately owned firms, though it indicated that such sensitivity was lower in poor countries and especially in countries heavily dependent on copper exports (Markowski and Radetzki, 1987).

There are in fact not many convincing claims that can be made about the impact of the establishment and operations of the state-owned enterprise universe on the mineral markets.

The temporary as well as the permanent, systemic inefficiencies of state-owned enterprises resulted in higher production costs, but seldom in higher prices, because these firms regularly exploited attractive intra-marginal deposits.

Nationalizations often involved ruptures of vertical integration built by the mining multinationals. While this does not appear to have reduced the reliability of supply, it did introduce a greater openness and more competition in the markets for raw materials like bauxite and iron ore. The more competitive conditions under which the raw materials have since been traded might conceivably have lowered their prices.

The absence of striking conclusions follows from two findings. State-owned enterprises show a great diversity, so a uniform impact of their establishment and operations is hard to identify. And the picture emerging from the investigations carried out above suggests that the average state-owned mineral firm is a somewhat pedestrian and unremarkable organization, unlikely to leave behind it a strong and easily verifiable impact on the international market.

# 10

## *The monoeconomies: issues raised by heavy dependence on commodity production and exports*

This chapter is devoted to the special problems encountered by nations that are heavily dependent on a small group of commodities, or, in the extreme case, reliant on a single commodity (monoeconomies). I begin by discussing the measures of commodity dependence and define the monoeconomies in the process. I then turn to exploring the problems of export instability, of fiscal extraction, and of exchange rate policies that often arise in commodity-dependent countries. I finally deal with the *Dutch Disease* and the *resource curse*, two ailments of particular significance to monoeconomies.

### 10.1 Measurement of commodity dependence

The degree of national dependence on primary commodities can be measured in a variety of ways. One can alternatively try to establish the share of the commodity sector in GDP, or in investments, employment, government income, or exports. The nature of the production and consumption of a specific commodity composition will influence the level of the alternative measures. Among commodities accounting for an equal share of GDP, one that is capital intensive (petroleum extraction) will normally account for a higher share of investments and a lower share of employment than another that is labor intensive (coffee). All else alike, the share of government revenue will vary with the generation of rent in the production of a specific commodity. Even when dependence measured by the share of GDP or of employment is high, the export dependence could be limited if most of the commodity is consumed at home (rice in Bangladesh).

The difficulties in defining commodities in a uniform way, discussed in chapter 2, tend to blur the assessments of commodity dependence. Such dependence is sometimes measured by considering the raw material extraction exclusively. This is the practice when the share of agriculture or minerals in GDP is measured (UN, annual b). In other

cases the processing activity is also comprised. The export share measurements usually consider processed commodities like metals or butter and flour, along with their raw materials (GATT, annual). The inclusion of processed products will obviously increase the dependence figures. These ambiguities notwithstanding, it is usually not difficult to point out the countries that are heavily dependent on commodities.

Through most of the twentieth century, the division of work in the world economy was such that the industrialized market economies dominated manufactures production and raw materials imports, so the heavy commodity dependence typically occurred in developing nations. The latter then provided the industrialized world's import needs. This is no longer so. Taking non-fuel commodities as the measuring rod, recent statistics (UNCTAD, 2005; the figures are 2000–3 averages) reveal that this commodity group accounts for 11.7% of the industrialized countries' total exports, fractionally more than the corresponding figure for developing countries in aggregate. The picture changes if fuels are included, for then the commodity share of industrialized countries' exports rises to 16.3%, but that of developing countries increases almost threefold to nearly 30%. Non-fuel commodities currently account for only 7% of China's exports, manufactures for 90%, a significantly higher share than recorded by the industrialized nations (80%). These Chinese figures are non-typical for developing countries. They are the result of China's extraordinarily fast growth and industrialization in the last two to three decades.

Reliable and systematic inter-country comparisons of the dependence on an individual commodity are hard to come by, except in the case of export shares, and even these figures can be misleading where re-exports (sometimes after slight processing) are significant. Export shares are the measuring rod applied in table 10.1. The table lists all the countries where the leading non-fuel commodity exceeded 40% of total exports in the early 2000s. This is the definition I employ for monoeconomies. Several reflections come to mind when the contents of the table are reviewed. *First*, all the fifteen countries are poor and very small economies. This is not surprising. Figure 1.1 demonstrated clearly that poor countries tend to be heavily dependent on the primary sector. More developed, or larger, or geographically more extended economies are usually more diversified, so a single commodity will seldom dominate any important aspect of the national economy. *Second*, the dominance in exports is accounted for by only nine

**Table 10.1** *The monoeconomies: leading non-fuel commodity accounted for 40% or more of total exports in 2002–3*

Country	Commodity	Share of total exports 2002–3, %
Armenia	Precious stones	43
Burkina Faso	Cotton	61
Central African Rep.	Precious stones	42
Guinea	Bauxite/alumina	49
Ivory Coast	Cocoa	42
Jamaica	Bauxite/alumina	64
Kyrgyzstan	Gold	41
Malawi	Tobacco	55
Mali	Cotton	73
Mauritania	Iron ore	43
Mozambique	Aluminum	55
Niger	Uranium	50
Surinam	Bauxite/alumina	62
Tajikistan	Aluminum	54
Zambia	Copper	52

Source: UNCTAD (2005).

materials. Commodities of significance in international trade, like coffee, sugar, or wheat, do not dominate the exports of individual countries. *Third*, the non-fuel monoeconomy phenomenon appears to have become less common and less accentuated over time. A table similar to 10.1, but related to exports in 1982–3, contained 19 nations, of which 14 exhibited over 60% dependence (Radetzki, 1990), compared to only four of the countries listed in Table 10.1.

Oil is exceptional among commodities. In 2003–5, the average annual value of crude oil and oil products exports was \$700 billion (Table 2.2 ). No other commodity comes anywhere near this level. One would have to aggregate the value of the sixteen following commodities ranked by export value to attain a corresponding total export value. Commodities like copper (global export proceeds of \$35 billion), wheat (18), iron ore (19), coffee (9) and cotton (9) appear as dwarfs in comparison to oil.

Given the exceptional size of the oil market, a number of the exporters of this commodity are monoeconomies par excellence. The maximum weight of the leading non-fuel commodity in table 10.1 is

**Table 10.2** *The oil monoeconomies: oil and oil products accounted for more than 73% of total exports in 2002–3*

Country	Oil and oil products share of total exports 2002–3, %
Azerbaijan	86
Congo Brazzaville	80
Equatorial Guinea	90
Gabon	86
Iran	84
Kuwait	88
Libya	93
Nigeria	93
Saudi Arabia	88
Sudan	75
Venezuela	79
Yemen	91

*Source:* UNCTAD (2005).

73% of total exports. Table 10.2 lists the twelve countries whose oil exports *exceeded* this high level of export dominance. The countries whose exports are dominated by oil are more diverse than the non-fuel monoeconomies. There are some which are of considerable size, e.g., Iran and Venezuela, and there are several (Kuwait and Saudi Arabia) which have been made quite prosperous by their oil resource wealth. In addition to the countries listed in table 10.2, there are eleven more nations where oil and oil products account for at least 40% of overall exports, the guiding rod in constructing table 10.1. Norway, one of the world's richest economies, is included in that group.

The leading commodity will not only dominate exports, but will also play other important roles in monoeconomies. Thus, its share of GDP or employment will often exceed 10%, and it will easily account for 25% or more of government revenue.

A heavy dependence on commodities creates special complications – sometimes also opportunities – for national development. The resolution of these complications will require special policy actions that assist in avoiding the traps that a one-sided commodity reliance could involve, but that also help to realize the opportunities inherent in rewarding commodity production and trade.

## 10.2 Export instability

I noted in the discussion on price formation in chapter 4 that primary commodity prices tend to fluctuate much more than the prices of manufactures or services. Unless there are compensating variations in the quantities traded, one must expect a greater variation in the export revenues of countries with a heavy commodity component in their exports, and for monoeconomies in particular.

This deduction is indeed corroborated by empirical evidence, at least at a high level of aggregation. Analyzing exports for the 1950s, 1960s, and 1970s for different country groups, MacBean and Nguyen (1987) conclude that instability, measured as the mean absolute deviation from the trend value of export revenue, was much lower in the nineteen industrialized countries than in the eighty-nine developing countries included in their sample, both for the period as a whole and for each decade separately. They also notice a persistently higher instability among poorer countries with a heavy commodity dependence, when the LDC sample is divided into two sub-groups. More to the point, Ghosh and Ostry (1994) note a steady increase in the volatility of commodity prices from the early 1970s to the early 1990s, with an ensuing destabilization of the export earnings and the macroeconomy in commodity-dependent nations. However, commodity price instability appears to have been somewhat reduced in the fifteen years to 2005, importantly on account of greater geographic diversification of agricultural production (IMF, 2006b).

To get a feel for the national significance of the instability in export revenue that can occur in monoeconomies, consider a case where the leading commodity accounts for 60% of exports and where total exports correspond to 25% of GDP. Then, if the price of the leading export doubles from one year to another, a not exceptional development in commodity markets, the increase in export revenue will correspond to 15% of GDP. If the price then falls again to the old level, the decline in the export revenue will correspond to 13% of GDP, on the assumption that the entire initial increase in export revenue was added to GDP, and more, if the assumption does not hold. The impact will be even greater if export supply responds to the price changes.

Even for countries that are not monoeconomies by the definition adopted above, the export revenue changes due to commodity dependence can be quite important in relation to the national economy.

These changes, caused predominantly by international price variations, are unpredictable and, in the main, outside the control of the exporting countries. A study by UNCTAD (1987), quite relevant despite its age, assessed the difference between actual non-fuel commodity export revenue in 1980–4, and projections of that revenue, based on an extension of the actual 1970–80 trend. The average annual shortfalls in the five-year period of depressed commodity prices corresponded to 2.6% of GDP in Chile, 5.8% in Costa Rica, 7.3% in Ghana, 8.4% in Guyana, 7.0% in Honduras, 8.9% in Ivory Coast, 4.2% in Jamaica, 10.1% in Liberia, 10.6% in Niger, 9.9% in Papua New Guinea, and 2.7% in Thailand. The shortfalls in individual years were, of course, substantially higher.

Are these numbers big or small? An impression of their significance is obtained by comparing them with the rise of the OECD countries' aggregate import bill in consequence of the oil price increases in 1973 and 1979. On each occasion, this rise corresponded to between 2% and 3% of the area's GDP, and was followed by drawn-out macroeconomic pains for the region, though of course the numbers were higher for individual OECD nations. In this perspective, the export instability experienced by many commodity-dependent countries is extremely high.

A priori, there are a number of strong grounds for the belief that instability retards growth. Most of these were spelt out succinctly in a famous memorandum written in 1942 by J.M. Keynes (1974). When producer incomes vary in an irregular and unpredictable way, they will hamper a rational investment pattern in the commodity-producing industry. What may seem a very good investment opportunity while prices are high can turn out to be a loss-making venture when the price level drops. Such experiences will tend to discourage total investments. Export instability can also be expected to have a negative impact on the macroeconomy, through such variables as imports, savings, employment, and government revenue. The inability of existing studies to confirm such a negative relationship (MacBean, 1966; Behrman, 1987; Sachs and Warner, 1999) could be because the research approaches have not been perceptive enough to reveal the relationship, or, as Behrman suggests, that the problems in empirical estimates have obscured the negative effects. But it could also be due to the existence of a positive relationship between export instability and the macroeconomy. Such a counter-intuitive result could follow from the observed asymmetry, with short commodity booms followed by

extended periods of subdued prices. The price spike would then be merely a windfall, too brief to influence the longer-run policy stance, which would instead be determined by the subdued market conditions. In this way, instability could plausibly yield temporary benefits without destabilizing the macroeconomy (private communication with Graham Davis).

Despite the inconclusive analytical results, export instability was a very important policy issue to the international community during several decades after the Second World War. The merits of inter-governmental policy intervention through International Commodity Agreements and Compensatory Finance Schemes in fact dominated the international commodity debate in the 1970s and 1980s. These policy measures can be regarded as elements of the government activism characterizing the period between the 1930s and 1980s (see chapter 1). Both efforts had serious inherent contradictions, which explains why they were, for all practical purposes, dismantled long before the turn of the century.

Stabilization of prices over the business or harvest cycle has been the proclaimed objective of commodity agreements. Buffer stocks, along with export restrictions, have been the main tools employed. Where prices fluctuate due to regular changes in demand, as is the case for metals, stabilization of price will even out exporters' income, but often at a cost of lower average revenue over the cycle. This is apparent from the simplified diagrammatic representation in figure 10.1. A stabilized price,  $P_2$ , will yield an average revenue equal to  $P_2Q_2$ , which is clearly less than the average of  $P_1Q_1$  and  $P_3Q_3$ , which would be earned with fluctuating prices. If changes in supply due to varying agricultural harvest conditions cause the prices to fluctuate, stabilization of price may well destabilize export revenues. Figure 10.2 shows that, with a meager harvest, a higher-price  $P_3$  will compensate for the limited quantity supplied  $Q_2$ , so that revenue will not be much different from  $P_1Q_3$ , earned with a lower price in a good harvest year. Stabilization of price at  $P_2$  destabilizes income to  $P_2Q_1$  and  $P_2Q_4$  between good and bad harvest years. These perverse effects of price stabilization obviously reduced the developing exporting countries' incentives for launching and operating commodity agreements.

An even more important fallacy of the commodity agreements has been the inability to correctly determine the equilibrium around which prices would be stabilized over the cycle. In practice, operations often came to aim at defending a price level above equilibrium, requiring

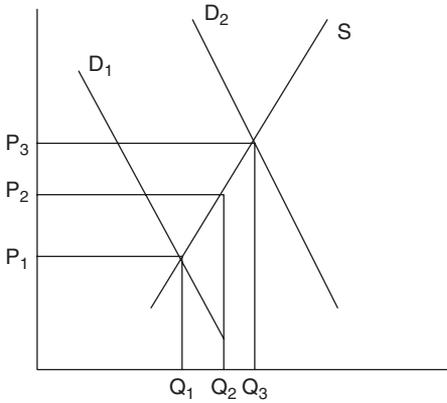


Figure 10.1 Price stabilization with variable demand

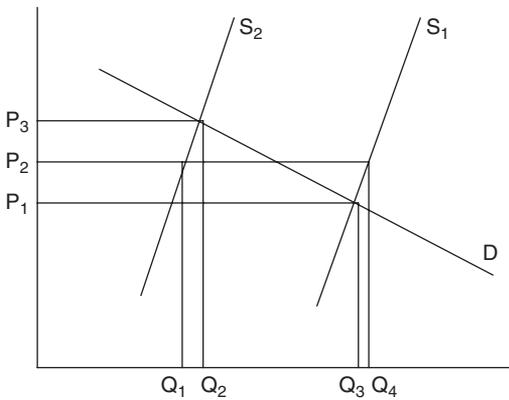


Figure 10.2 Price stabilization with variable supply

ever greater funding, and collapse often followed, given the importers' unwillingness to support and fund this more ambitious goal. The international tin agreement broke down in the mid-1980s for precisely this reason. The failure of the economic provisions of the coffee and cocoa agreements in 1988 and 1989 shook fundamentally the belief of governments and development economists in commodity agreements. Over the following years, the agreements have been transformed, and their ambitions and goals have dramatically shrunk. In the early 2000s, none of the seven existing commodity agreements

(cocoa, coffee, cotton, grains, olive oil, sugar, and tropical timber) contains any economic provisions that attempt to regulate markets by supply or price managements. They have all developed into administrative fora for producer-consumer consultations, market transparency, and sources of statistics.

In contrast to commodity agreements, the international compensatory finance schemes established in the 1960s and 1970s were to respond much more pointedly to the problem of export revenue instability. Their aim was precisely to compensate for shortfalls in the export revenues of individual countries, with contributions from the schemes during export shortfall periods, and repayment when export revenues had recovered. But they had one serious shortcoming in common with commodity agreements. Stabilization requires that an equilibrium level (of export income in this case) be determined. This problem was never resolved, so that, contrary to the schemes' aims, the contributions and repayments often resulted in destabilization of the foreign exchange flows.

The Compensatory Financing Facility of the International Monetary Fund was established in 1963, but its activities became quantitatively important only after 1975. In 1980–6, the heyday period, sixty-nine countries borrowed a total of about \$10 billion under this facility. Of these countries, fifty-two had a non-fuel commodities share in total exports of 50% or more (UNCTAD, 1987). By the new century, the facility must have gone into hibernation. Not a single hit was attained on the IMF's home page (September 2006), despite several attempts with alternative search words and thousands of IMF documents reviewed.

The second scheme for stabilization of export earnings, STABEX, was established in the mid-1970s by the European Economic Community. It was much smaller than the IMF scheme, and its geographical reach was limited to sixty developing countries associated with the EEC under the Lomé conventions, nearly all former colonies of some EEC countries. The amounts set aside for STABEX payments in the 1980–4 period amounted to less than \$1 billion, and actual payments exhausted all the available resources (UNCTAD, 1987). STABEX continued through the 1990s in reduced form, and was ultimately abandoned in 2003 as it was considered too unwieldy to operate successfully (private communication with Gino Debo at the European Commission, September 2006).

Disappointments with the inter-governmental commodity stabilization arrangements have prompted a number of commodity-dependent economies to establish financial buffer institutions of various kinds. State marketing boards were set up long ago in many developing countries with the objective of protecting domestic producers of agricultural commodities from excessive price fluctuations in the international markets. Many of these agencies became statutory monopsonies and developed into fiscal instruments to extract public revenue from the agricultural sector (see section 10.3), with stabilization evolving into an unimportant side objective. Since the 1980s, however, there has been a marked policy shift in many of the boards back to the original goal of stabilizing the prices paid to farmers.

Other domestic measures adopted by a growing number of countries have the purpose of stabilizing the government revenue from commodity production. These measures have usually involved the investment of strongly fluctuating fiscal revenues from the commodity sector into a stabilization fund, with annual withdrawals into the government budget at levels that were considered sustainable in the long run. Canada, Chile, Ghana, Norway, Papua New Guinea, Venezuela, and Zambia, among others, have at times tried to improve the stability of their government budgets in this way (Davis and Tilton, 2005). At the sub-national level, Alberta and Alaska in Canada and the US have done likewise. From the 1990s, some of these efforts have contained elements of private, market-oriented efforts. The stabilization schemes have met with reasonable success, at least in richer economies.

The marketing boards and stabilization funds are of course confronted with the same difficulties that the international measures had to face: The measures require the establishment of an equilibrium level of price or revenue, around which stabilization can be centered. If that level is wrongly set, the measures will not be sustainable and may cause serious dislocation when they break down. It could be that national decision makers, being closer to the issue, have a better feel for the equilibrium than international bureaucrats. Also, one may presume that national policies in this field exhibit a greater flexibility, and a faster reaction patterns than international measures.

A simple and straightforward price stabilization measure that has come to much wider use since the 1990s is hedging with the help of futures on the commodity exchanges. Two developments have promoted the use of this stabilization tool. The first and most important

is the proliferation of commodity exchanges and the extension, rising liquidity, and falling cost of futures trading. When considering this stabilization tool, one should nevertheless recognize that there is a cost involved, since futures prices always include a reward to the market maker for offsetting risk. The second development that has promoted hedging is the wide-ranging privatization that occurred in many resource industries in the 1980s and 1990s (chapter 9). Private profit maximizing firms have exhibited a greater readiness than government bureaucrats to use the exchanges for securing future prices.

Finally, there is evidence that developing countries have significantly increased their savings in response to export instability. Between 1974 and 1994, the external current account balances rose by 3.5% of average imports in non-fuel primary commodity-exporting countries, and by even more among fuel exporters (Ghosh and Ostry, 1994). These are quite significant amounts. Current account surpluses and growing exchange reserves have become even more fashionable in developing countries, including the monoeconomies, in the decade since 1995. The developing world in aggregate improved its current account position from  $-2.2\%$  of GDP in 1995 to  $1.4\%$  in 2000 and  $4.1\%$  in 2005. Shifts from sizable deficits to large surpluses occurred in all major developing regions (IMF, World Economic Outlook Database on the internet, September 2006). The growing foreign exchange reserves afford substantial protection against export instability, even though one may claim that in the absence of instability the resources could have been immediately employed for valuable development purposes.

The key problems of instability caused by high commodity dependence are as old as Joseph's advice to the Pharaohs, and simple to summarize: when harvests fluctuate, set aside from fat years for consumption in meager years. High reliance on commodities with unstable supply, demand and price can seriously destabilize the national economy. Efforts to even out prices and revenues may therefore often be appropriate and worthwhile. Stabilization involves a significant cost, and if the actions are to gain credibility, considerable resources have to be put aside for the purpose. Furthermore, the averages and trends of the series to be stabilized are extremely hard to determine. Actions which *ex ante* may appear as purposeful for the attainment of stabilization, can easily turn out to have effects quite opposite to their intentions. The costs and the disappointing results explain the limited

enthusiasm in recent times for grandiose international measures to stabilize commodity markets and commodity revenues. Down-to-earth national efforts on a more modest scale may have a greater prospect of achieving the desired ends.

### 10.3 Extraction of fiscal revenue

An economy which is heavily dependent on the production and trade of a particular commodity will ordinarily have to rely on that commodity for a large part of its fiscal revenue. That heavy reliance calls for fiscal caution, to avoid damage to the sector where the commodity is produced. The two issues that have to be resolved are (a) how much revenue can be obtained, and (b) what should be the form of fiscal extraction, in order not to kill or weaken the milking cow. When considering these issues, it may be instructive to keep two general rules applying to all fiscal systems in mind. The first is that the tougher the fiscal regime, the more likely it is to damage the activity to which it is applied, especially where the tax income is employed to lure capital to other sectors via tax holidays or subsidies (Davis, 1994). A fiscal system that leaves little surplus to the owner will certainly discourage investments in expansion, and in the extreme case, even in capacity maintenance. The second rule is that stable fiscal conditions with predictable outcomes are of great importance to those considering involvement. With a given level of fiscal toughness, investors will be discouraged from involvements by fiscal instability.

The public sector share of GDP in most developing countries, including the major commodity producers, was quite low in the early 1960s. It experienced a very substantial expansion during the following decades, as the increasingly emancipated government administrations of these countries enhanced their ambitions to establish physical and social infrastructure facilities, promote national entrepreneurship, and contribute to development in other ways. The public expenditure expansion had to be financed by increased revenues. Where the commodity sector dominated the economy, it was seen as an obvious source for a large part of the growing revenue needs. For lack of experience or due to insufficient foresight, or simply because of short-run greed, the overall fiscal impositions became so onerous in many countries that they led to a stagnation or decline of commodity

production and trade, in absolute or relative terms. The extractable fiscal revenue ceased to grow or contracted in consequence.

The maximum fiscal extraction policy compatible with unchanged output is one where all revenue above the variable cost of production is creamed away, leaving no return at all to the invested capital. So long as the variable costs are covered, it will be economical to maintain production in existing facilities. This policy is feasible only in the short run, however. Its consequence would be a complete cessation of capacity expansion and capacity maintenance, and so output would soon start to contract.

In the long run, the resource rent is an important determinant for how much revenue the taxman can take from the commodity sector without harming his tax base. The resource rent is that part of profit which is attributable to the superior quality of the land, climate, or mineral deposit, over the marginal quality of these resources used in the global production of a commodity. Superior resource bases, consisting of conveniently located fertile soils which enjoy a favorable climate or rich mineral deposits, have provided a strong comparative advantage to a number of countries in the production of commodities. The resource rents generated by these activities have made them by far the most important sources for tax in many nations.

In principle, the entire resource rent can be taxed away without impairing the long-run viability of commodity production. When the relatively high-cost North Sea oil deposits represented the marginal oil production, then any cost advantage due to the superior deposits in, say, Saudi Arabia or Indonesia could be taxed away, leaving the investors in these countries with no more than the normal return on capital investments, i.e., about the same as that obtained by the North Sea investors. A moral argument in favor of fiscal appropriation of the entire resource rent has often been forwarded. This is that the resource rent represents the superior natural endowment of the nation, a kind of patrimony. The state, as the representative of the nation, should therefore have a first right to this rent.

In practice, the determination and extraction of resource rents raises many difficulties. For instance, a reduction in global demand, which results in price declines, will normally lead to closure of the highest cost units, and so diminish the size of rent throughout the industry. The existence of resource rents provides a strong attraction to private investors, and a policy of complete government appropriation will

reduce their interest, with long-run consequences for the sector's growth. Furthermore, low costs and high profitability could be due not to a superior resource base, but to the monopolistic supply of superior management or technology which may cease to be available unless it is allowed to keep its returns. Partial extraction of the rent is therefore the most that can be accomplished, if one wants to avoid causing long-run harm to the industry.

The fiscal regimes applicable to commodities in *monoeconomies* and other commodity-dependent countries tend to give an impression of complex and confusing structures that are difficult to disentangle and hard to compare. On closer scrutiny, however, most of the fiscal provisions can be categorized as variations of three alternative measures used by governments to obtain revenue from the commodity sectors (Kumar and Radetzki, 1987).

A first measure, the *royalty*, extracts the fiscal dues on the basis of the volume of production, or the value of sales or exports. Royalties come in many different forms. They can be shaped as a levy per ton produced, or per dollar sold. Especially for agricultural products, they have often been imposed by state marketing boards to which the farmers were compelled to sell at prices below those quoted in international markets. In the case of minerals, royalties often have the more straightforward form of export taxes.

Royalties are very widely used and regularly regarded as the prime tool for extracting the resource rent. Appropriation of resource rents with the help of royalties requires a differentiation of royalty rates between products and production units, depending on the quality of the resources that are being exploited. A "just" differentiation to reflect the superiority of the natural endowment in each case is complex and time consuming. Royalties are therefore often applied at fixed rates, e.g., 5% on all copper sold, and 10% on gold and cocoa. Such generalities create injustice to those who exploit inferior endowments.

Royalties have the important advantage of easy assessment and application. They also afford the government a relatively stable revenue, since production and sales ordinarily vary much less than profits. This advantage must be weighed against the harmful consequences of this fiscal tool. To producers, royalties basically constitute additions to cost, which have to be paid irrespective of profit levels. A high royalty can easily wipe out the entire profit, or even impose losses, when pre-tax profits are low. Producers will therefore avoid ventures

with less than exceptional profits prospects, or with cyclical price and profit patterns, since the viability of such projects will be continuously or recurrently impaired by high royalties. The less outstanding resource endowments which could support commodity production with only normal profitability will not be developed at all when royalties are high.

Although we deal here with the imposition of royalties by individual countries on their own, it is important to note that royalties have been used on several occasions to implement international monopolistic coordination, most notably in the case of OPEC. Prior to the nationalization of the oil-producing installations, sales taxes were predominantly used by the OPEC countries to raise export prices. The same was true of the monopolistic effort by the Caribbean countries to raise bauxite prices in the mid-1970s.

The second measure for fiscal extraction, the *profits tax*, extracts the fiscal dues on the basis of profits, i.e., on the income that remains after deducting all costs of production. Withholding taxes (e.g., on dividends, or on professional fees paid abroad) are usually regarded as part of the profits tax system. A major variation among profits taxes concerns the specification of allowable costs. Another variation is between proportional and progressive profits taxes. One approach in designing a progressive profits tax is through an "additional profits tax." By creaming off a substantial proportion of profits that are considered "above normal," the additional profits tax can be employed as a substitute to royalties for extracting resource rents. A variety of additional profits taxes have come into use, in the UK and Russia, among others, to appropriate part of the very high profits earned by oil companies after the sharp oil price increases during the 2000s (IEA, monthly).

While avoiding some of the problems with royalties, notably that no tax is imposed when there is no profit, profits taxes are much more difficult to assess and impose, especially when producers are many and small, as is frequently the case in agriculture. The necessary estimation of profits requires accepted accounting standards, which often do not exist in poor countries. Since profits fluctuate much more than volume of output or sales, it follows that profits taxes yield a far greater variation in public revenue than royalties, a clear disadvantage to the public authorities. This variation will be particularly strong when an additional profits tax forms part of the fiscal structure.

The third measure for fiscal extraction is through provisions affording *public ownership* positions in the production activity, for free or on concessional terms. Public ownership for fiscal extraction is often employed when it is felt that neither royalties nor profits taxes provide adequate tools for capturing the resource rent.

The extent of fiscal extraction through public ownership depends entirely on the degree of concessionality through which that ownership is acquired. Confiscation of private property carries no direct cost to the public authorities, even though the indirect costs of ensuing mistrust felt by the former owners may be considerable. If the government pays for what it acquires, the extent of fiscal extraction will be inversely related to the price. No extraction will occur if a full market price is paid for the acquisition. A common government practice has been to demand a minority equity share for free at the time of the original investment decision, as compensation for the resource rent inherent in the assets to be exploited. This practice has similarities with a royalty. In other respects, ownership participation resembles the profits tax in that it assures the government of a share of the profit, so long as a profit is earned. Ownership, however, is not always easy to transform into a fiscal income flow. A detriment is that it may expose the government to the costs involved in reinvestments and expansions.

Although public ownership may be desired on other grounds, it is an opaque tool for fiscal extraction, both due to uncertainties about the right commercial price for the acquisition and because of the painful legal or moral obligations that may arise with an ownership role. Furthermore, as noted in the preceding chapter, because of the inefficiencies characteristic of many state enterprises, the involvement of government as owner often leads to a reduction in the size of the overall resource rent.

Private investors have had varying attitudes to public ownership acquisitions on concessional terms. In the 1950s and 1960s, when the mining multinationals still reigned supreme, they regularly regarded such government involvement as undesirable in principle, because of the perceived dilution of managerial control. After the many painful nationalizations of the 1960s and 1970s, many investors became more favorably inclined to a degree of government participation, because they saw such partnership as an assurance of fair treatment to themselves.

Parenthetically it may be noted that the production-sharing agreements practised by Indonesia, some of the republics of the

former Soviet Union, and many other host countries in their relations with multinational corporations in the extractive sectors are akin to concessionally acquired ownership positions. Under these, the government remains the sole owner, while the foreigners finance the investment and run the operations in return for a share of the output.

Where the commodity production is dependent on massive imported inputs, as is often the case in minerals, import duties may offer an additional and straightforward tool for fiscal extraction.

The producers face a tradeoff between the size and form of the fiscal burden. While they prefer one fiscal tool to another, a fiscal package using unpopular tools may nevertheless appear preferable if it involves a lesser overall tax burden.

Royalties, frequently imposed in the shape of price controls at which state marketing boards purchase crops, or overvalued exchange rates, have dominated the taxation of agricultural commodities. The primary reason is the administrative difficulties in imposing profits taxes on large groups of small-scale agricultural producers. The small-scale and predominantly national ownership also explains why public ownership in agricultural production has been quite limited.

In many cases, the government impositions on agricultural commodity production have been excessive and have resulted in a shrinkage in the relative or even absolute levels of output. Many African governments overtaxed their agricultural producers in the 1960s and 1970s, and this led to a shrinking market share as production relocated, mainly to Southeast Asia and Brazil, but some African countries also did quite well in the ongoing change. The trends have not been equally clear between 1985 and 2000 (UNCTAD, 2005).

From the early 1960s to the early 1980s, Ghana's share of the world cocoa market shrank from 40% to 14%, that of Nigeria from 18% to 11%, as a result of heavy export taxes. At the same time, Ivory Coast, with much more favorable fiscal treatment of its cocoa producers, expanded its share from 9% to 26%. Admittedly, part of this increase was accomplished through the exports of cocoa that had been smuggled out of Ghana, but this too was an effect of excessive taxation. In the 1990s, Africa as a whole lost further cocoa market shares to Asia, but Ivory Coast continued to consolidate its market position. Mainly for fiscal reasons, the share of Nigeria and Zaire in the world palm oil market shrank from 48% to virtually zero in the twenty years to the early 1980s, while that of Malaysia expanded from

18% to 71%. In the following two decades the Asian share of the market continued to expand, as did that of South America, while Africa virtually disappeared as an exporter of this product. Overtaxing lost Egypt half its international market share in cotton in the two decades to 1985. Sri Lanka's tea exports dwindled from one-third to one-fifth of global exports, and never recovered, while Kenya, which treated its tea producers more fairly, saw its share triple to 9% during the twenty years to 1985, with a further expansion to attain 16% by 2003 (World Bank, 1986b; UNCTAD, 2005). The declines in fiscal bases came as surprising disappointments to the governments of the high-tax countries.

In the case of minerals, the fiscal menu has been much more varied, but, for historical or other reasons, the emphasis on the respective tools has varied considerably among countries (Faber, 1982). Royalties have been applied in some measure by most mineral exporting countries. Public ownership positions acquired on concessional terms have been quite common, though the reasons for these acquisitions usually went beyond fiscal concerns (see chapter 9). In contrast to the farmers, mineral enterprises possessed a degree of administrative sophistication which made the application of profits taxes practical.

Excessive fiscal ambitions slowed or arrested the expansion of the mineral industries in some countries. This was true, for instance, of Zambia and Peru, though, as discussed in chapter 9, intriguingly, the over-taxation often also applied to fully state-owned entities. Very high royalty impositions by some Canadian provinces in the early 1970s virtually arrested all mineral exploration efforts, but there was no visible impact on mineral output because the royalties were soon withdrawn. The internationally coordinated efforts of some bauxite producers to increase prices through export taxes substantially reduced the demand for their output, with a lag (chapter 8). In the weak mineral markets of the 1980s, there was a reversal of earlier fiscal trends in selected cases. Some leading mineral-exporting countries have attempted to attract foreign investments by offering internationally more competitive fiscal arrangements. Chile has been extremely successful in this respect, and has seen its share of (Western) world copper mining rise from 14.5% in 1975 to 44.3% in 2003 (Metallgesellschaft, annual). So has Brazil, notably in iron ore, where its share of global exports rose from 19% to 33% between 1980 and 2000 (UNCTAD, 2005).

These experiences reveal that monoeconomies have to tread a difficult balance in designing their fiscal systems. On the one hand the governments need fiscal revenue to cover public expenditures, and the commodity sector is their major revenue source. Lax taxation of oil in the Middle East and bauxite in the Caribbean in the 1960s resulted in very meager national benefit to the countries producing these commodities. On the other hand, they have to be cautious in the determination of the overall fiscal burden, and in the selection of fiscal instruments. The instances of agricultural shrinkage, listed above, point to the potential dangers. Wrong decisions have proved counterproductive in many cases.

Most of the instances of overtaxed and shrinking commodity production quoted above were the result of misconceived expectations about the primary sector's ability to generate public revenue. However, there may be cases where excessive fiscal burdens are imposed precisely for the purpose of diminishing what is considered an excessive commodity dependence of the national economy. The market instability of the dominant commodity may be felt to be overly onerous. The country's competitive advantage in the commodity may have contracted, or the commodity market may be in a structural depression, so that there is little likelihood of large and sustainable private or public revenue generation. In such circumstances, the fiscal policy could have the explicit purpose of speeding up a contraction of the sector through fiscal squeeze, and of encouraging diversification by an expenditure policy that promotes, say, manufacturing, or other commodities with more dynamic market prospects.

Intriguingly, fiscal squeeze aimed at reducing commodity dominance and at promoting diversification is sometimes urged for precisely the opposite reason, i.e., when the commodity sector has an outstanding ability to generate resource rent and fiscal revenue. This is the subject of the next section.

#### **10.4 The Dutch disease and the resource curse**

Two evils that are said to afflict economies heavily dependent on commodities will be dealt with here. The first, the Dutch disease, arises from an export-oriented resource bonanza that can give rise to far-reaching macroeconomic reorientation, with ensuing sectoral adjustment. The second, the resource curse, is the purported tendency

of nations heavily dependent on minerals and fuels to record slower economic growth than other countries at a corresponding stage of development.

### *The Dutch disease*

The term Dutch disease was coined in the late 1970s to describe the economic change to which the Netherlands was subjected, in particular the stagnation and shrinkage of manufacturing, in consequence of the country's highly profitable exploitation of natural gas through the 1970s. For several reasons, the concept is a misnomer. *First*, the syndrome is not particularly Dutch. Other countries have experienced much more accentuated impacts of resource bonanzas, some of them long before the Dutch natural gas discovery. More than a hundred years ago, the booms in gold mining in Australia, in guano exploitation in Chile and Peru, and in sugar exports from Cuba led to far-reaching and sometimes quite painful structural change in these economies. More recent instances are the cases of Zambia (copper 1965–74), Niger (uranium 1975–81), Colombia (coffee 1976–86) and Nigeria, Saudi Arabia, and Norway (oil 1974–85). *Second*, there is reason to question the term “disease.” The additional export income from the bonanza provides a potential for increased national welfare. It can also be used for overcoming the pain of dislocation caused by the commodity boom. It would be hard to justify a policy recommendation that the country forgo the extra income so as to avoid the need for adjustment and change.

To explore the macroeconomics of the Dutch disease, it is instructive to subdivide the national economy into three sectors, namely (a) the booming commodity sector, (b) the sector where other tradables are produced, whether for export markets or as substitutes for imports, and (c) the sector for non-tradables, goods, and services that do not enter international trade (Corden, 1984).

The earnings from the commodity boom invariably result in a substantial increase in the demand for tradable as well as non-tradable goods and services. The price of tradables is determined outside the country, and so is not affected by the commodity boom. Increases in demand will be satisfied by expanded imports which are perfectly price elastic (the booming country is assumed to account for a small share of world imports). By contrast, the supply of non-tradables is limited

by the domestic production capacity, so their price will tend to rise as domestic demand expands. The shift in relative prices between tradables and non-tradables makes domestic production of tradables less attractive. Hence, their output stagnates, and a greater proportion of domestic demand is satisfied through imports.

The difficulties of the tradable sector are accentuated as the booming commodity activity attracts labor and other inputs by bidding up their price. The high profits in the booming commodity production make it easy to absorb the higher costs. The tradable sector, in contrast, has no excess profits, so its international competitiveness is weakened as the input costs increase. In the absence of the booming commodity, increasing costs throughout the economy would weaken the current account and force through a devaluation. This would restore the international competitiveness of the tradable sector. With the commodity bonanza, exports and the current account develop strongly, with no need to devalue.

The ultimate effects of the resource bonanza are quite similar to those that follow from lavish receipts of foreign aid. An accentuated overvaluation of the domestic currency perseveres. A withering of domestic tradable activities ensues, along with an increasing dependence on imports and on the booming commodity. If it was not one before, the nation subject to the Dutch disease becomes a true mono-economy. The problems with that will be quite bearable if the bonanza continues. In practice it regularly does not, and often ends with a bang.

Nigeria provides an interesting and painful case study. Before the oil price increases of the 1970s, the country was self-sufficient in food and a sizable exporter of agricultural commodities. The high oil prices and export incomes in the late 1970s and early 1980s led to an inflationary boom that resulted in an increasing overvaluation of the country's currency. The agricultural sector could not compete internationally, so agricultural exports dwindled, while food imports substituted for a shrinking domestic food production. There was no pressure to restore competitiveness of the declining sectors through devaluation, because the booming petroleum revenue assured a positive current account. Neither was there any urgency to arrest the Dutch disease. Oil prices were believed to follow a permanent upward path, and the petroleum industry was seen as a lasting generator of high and rising income for Nigerian society. There was little anticipation of the oil price collapse

in the mid-1980s, and the ensuing painful adjustments that were forced on the country.

The bonanza can end for a variety of reasons. In Nigeria's case it was a sharp weakening of the oil cartel's market power in the mid-1980s. But it could also result from depletion of the booming resource, as happened with Australian gold in the 1860s (Davis, 1995), or because technical innovation in the German chemical industry made guano redundant, or due to an emerging commodity surplus as the high price attracts new coffee producers to the market. Precautions are then clearly needed to avoid the problems faced by Nigeria in the 1980s. Even if the bonanza continues, policy may be desirable to prevent an accentuation of dualist development, with a poor hinterland existing besides the booming and rich commodity sector.

In an initial step, the policy remedies all involve the removal of a substantial part of the profits from the booming sector. This reduces its expansion. Taxation is the obvious instrument. Constraints on investment in new capacity may be an additional policy measure to prevent the emergence of monoeconomy extremes. Removal of profits will reduce the inflationary pressures, an inherent part of the disease, by limiting the conspicuous consumption and waste that is often connected with new riches.

A follow-up policy step involves the use of the funds extracted from the booming sector. There are basically two options. First, they can be employed for subsidizing the tradable sector, so as to assure its survival. And second, they may be placed in reserves to carry the nation through after the bonanza has ended. Both of these have inherent problems. Subsidization requires a complex selection of activities to be supported, and there is a risk that uneconomic choices will be made. Most would agree that subsidization of wheat production in the desert of Saudi Arabia to an extent that yields export surpluses (UN, annual, a) is going a bit too far. That is easy. In other cases, the borderline between appropriate and faulty selection in this area may be harder to agree upon. Sterilizing the bonanza proceeds through the establishment of funds to be used in lean days may be appropriate for short-run cyclical stabilization, as noted above. For the longer-run purposes considered here, funding risks becoming politically explosive. There will be strong temptations to spend immediately. A considerable degree of political maturity is needed for this instrument to be used as intended.

Economic purists may well assert that the Dutch disease simply involves an optimal reallocation of resources towards the most rewarding activities, and that activist government policies to prevent such reallocation are always undesirable. That seems to me to be an exaggeration and to abstract from the inflexibilities and frictions that always characterize real economies, and especially underdeveloped ones.

Yes, the Dutch disease can cause serious economic problems. And yes, it can be avoided by cutting any tendencies for a resource bonanza in the bud. But it is hard to imagine the government that would make such a choice. The temptations and potential benefits of a resource boom are simply too valuable to be missed. The policy adviser's role is clearly limited to issuing early warnings against the risks, and pointing to the measures whereby the problems are reduced.

### *Resource curse*

The resource curse is related to, yet distinct from, the Dutch disease. According to its proponents (Auty, 2001; Gylfason, 2002; Sachs and Warner, 2001), the curse condition afflicts economies heavily dependent on the minerals and fossil fuels sectors. Such dependency, it is claimed, slows economic growth and social progress compared to that of other countries at corresponding levels of economic development. The dislocations caused by the Dutch disease are seen as one important reason for the deficient performance of the mineral-dependent country group.

Why should the mineral-rich countries exhibit inferior development performance? One reason is the detriment of extreme dualism following from a resource bonanza and its ensuing social tensions. Another is the painful need for macroeconomic reallocation and the instability caused by volatile mineral markets. The mineral rent is not an undivided blessing. Where this rent is large, it is often wasted on conspicuous consumption or publicly financed "white elephants" with no economic prospects under competitive conditions. Furthermore, large rents (e.g., in diamonds) often trigger unproductive corruption and give rise to destructive internal strife resembling that encountered in the production and trade of narcotics. In all these instances, the negative relationship is an indirect one. The presence of mineral dependence gives rise to social tensions, deficient governance, instability, conspicuous consumption, etc., more frequently than when such dependence is

absent. There is nothing wrong with the mineral sector as such. But when these effects occur, they tend to result in slower growth.

While there is reasonably general agreement that the growth-retarding problems listed here do occur in mineral-dependent economies (Davis and Tilton, 2005), a number of other studies have rejected the generality of the resource curse case. Some of these have been unable to replicate the negative development conclusions for the mineral country group in aggregate. Davis (1995) compares twenty-two mineral and fossil fuel economies with fifty-seven non-mineral ones in the Third World between 1970 and 1991, to conclude that the former performed much better in terms both of per capita growth and of the human development index. This conclusion holds even when the fossil fuel country group is separated out. Maddison's (1994) monumental study covering 1913–50 concludes that resource-rich countries like Canada, Finland, Sweden, the US, and Latin America as a whole had much faster growth than resource-poor ones, e.g., Japan, Korea, and Asia more generally. Maxwell (2004) adds Chile after 1980 to the successful high-growth mineral economies. A World Bank (2002) study does find a negative worldwide correlation between mineral dependence (fossil fuels not included) and economic growth in developing and transitional economies in the 1990s, but this difference disappears when comparison is made on a regional basis. A majority of the mineral-dependent countries in Africa and Latin America, did grow faster than the non-mineral group in each continent.

Alternative definitions, data sources, and methodologies may be the causes of the contradictory finding of the studies on the resource curse, and the thesis that one exists has not been definitively proven. The subject matter of economic development is complex, and a fifty-year-old quote by Charles Kindleberger (1958) still holds good: "Anyone who claims to understand economic development in toto or to have found the key to the secret of growth, is almost certainly wrong." It could be that the resource curse is no more than a chimera. Wright and Czelusta (2004) may have hit the nail on the head in the title of their study on the subject: "The Myth of the Resource Curse."

## 10.5 Exchange rate policies in monoeconomies

The main purpose of a standard exchange rate policy is to keep the domestic currency (peso) at an equilibrium level, defined as the dollar

price for a peso that assures a balanced current account. An overvalued currency (more dollars per peso) regularly results in a current account deficit. Overvaluation often follows from peso inflation that is higher than dollar inflation. The current account deficit can be remedied through a devaluation, which stimulates export demand by reducing the dollar export prices, and discourages imports by making them more expensive in peso terms. Conversely, an undervalued currency (fewer dollars per peso) typically yields a current account surplus, which can be symmetrically overcome through an appreciation of the peso.

The conditions in the market for the leading commodity, and not relative rates of inflation, are the main drivers of current account imbalance in monoeconomies. Years of high commodity prices will ordinarily yield a sizable current account surplus, indicating an undervalued peso, and vice versa for years of low prices. Is an exchange rate policy aiming at a balanced current account appropriate for economies whose dominant exports experience strong price fluctuations over the business cycle? The policy rule would require currency appreciation during the boom and devaluation during recession: not a very convenient policy stance, since it would destabilize conditions for other economic sectors.

The monoeconomies are special, and not only because of their high dependence on a single commodity export. They are invariably also small nations. Size regularly involves economic diversification, so large monoeconomies are uncommon.

The small size has a bearing on the exchange rate policies. Monoeconomies face numerous intricate problems in their efforts to stabilize the current account and their choice of exchange rate policies. There are no straightforward solutions to these problems. The countries' small size has a bearing on these issues. One effect of devaluation is that all import prices, including the prices of imported inputs in commodity production, will rise. The change in competitiveness after devaluation is dependent on reduced payments in terms of dollars to the domestic factors of production. But the domestic share in total production costs will be quite limited, given the smallness of the economy. Devaluation must then be quite sizable to have a perceptible impact on competitiveness. Furthermore, any gain in competitiveness is hard to maintain over time, since small trade-dependent economies will find it hard to resist inflationary pressures after devaluation. Domestic factors will demand compensation for the increased cost of

imports, especially where trade has a heavy weight in total consumption. If compensation is granted, the initial competitive improvement will be depleted. The need for new devaluation rounds will then arise, until the government succeeds in the difficult task of containing the upward price pressure by domestic labor and capital, which may not be easy.

A standard exchange rate policy would also have an adverse effect on the international stability for the dominant commodity, and on its non-devaluing exporters. Devaluation during recession will lower the monoeconomies' supply curve, so the market price will weaken even more than it did due to recession in cases where the devaluing countries represent a significant share of total supply. Lesser volumes will therefore be sold at even lower prices by diversified producers as a result of the monoeconomies' exchange rate policy. The obverse will occur in consequence of the monoeconomies' currency appreciation during a boom. In this way, the exchange rate policy will accentuate price movements and destabilize export earning for other suppliers. For this reason, too, the standard exchange rate policy advice may not be appropriate in the case of monoeconomies.

If the commodity business cycle is short and regular, a more appropriate prudent policy might be to establish foreign exchange reserves of sufficient size to carry the country through the commodity cycle. Reserves buildup would then conveniently occur during the boom, with a subsequent drawdown during recession. A related though somewhat less prudent alternative would be to rely on borrowing from, e.g., the IMF or from private international financial markets.

I claim that borrowing from the IMF or the international market is less prudent because experience has shown that the commodity cycle is not as short and regular as suggested above. Most commodity prices experienced substantial declines in real terms throughout the 1980s, and they then remained depressed until the boom of the 2000s. A monoeconomy that borrowed in the 1980s to overcome the commodity price declines in the expectation of a price recovery in the near future would have lost all its credit facilities due to an extreme indebtedness long before the prices improved. The extended commodity price depression was certainly a contributory factor to the international debt crises of the 1980s and 1990s. By encouraging capacity expansion in the commodity sector, international borrowing

along with the expectation of an impending price recovery probably prolonged the period of low commodity prices. Eventually, devaluations became unavoidable, as the indebted commodity-dependent nations tried to come to grips with their persevering current account deficits. Ironically, this too suppressed commodity prices through the mechanisms explored above.

### **10.6 Conclusion: a general case for economic diversification?**

This chapter has surveyed the problems that confront monoeconomies and other countries that are heavily dependent on commodity production and exports. The discussion of commodity instability, generation of public revenue, the Dutch disease, the resource curse and the exchange rate policies in this country group clearly suggests that the problems they experience have a particular character and require special solutions. But while the one-sidedness of the commodity-dependent economies clearly involves risks, the coverage of which warrants signing an insurance, and paying the premium, the above analyses have clearly not established a general and unambiguous case for diversification.

After all, commodity dependence is often the result of competitive advantage that normally yields above-normal returns to the commodity sector. These yields may well be more than adequate to cover the cost of instability and other monoeconomy problems. Obversely, part of the resource rents contained in the above-normal returns will be forgone when the country diversifies out of its reliance on commodities.

It is true that the global demand for many commodities has trend growth rates that are slower than for the aggregate of manufactures. Slow demand growth per se need not involve disadvantage. The market for the output of a monoeconomy can expand briskly if the supply from other sources stagnates. Besides, high profits can be earned even when demand is stagnant.

Chapter 4 revealed that the aggregate price index for commodities has tended to lag behind that for manufactures. This, too, does not by itself constitute a case against commodity specialization for countries that benefit from a strong comparative advantage. Besides, the profitability from commodity production can be maintained in the face of falling prices if technical advancement reduces the cost of production in equal or greater measure.

Commodity dependence does not constitute a general entrapment in technical or other forms of backwardness. Contrary to frequent perceptions, commodity production often requires as much advanced technology and human skills as manufacturing. Modern agriculture and mining make heavy use of microbiology, electronics, and the highly qualified labor that goes with these techniques.

Large and profitable primary commodity production, both agricultural and mineral, holds a prominent place in the economies of prosperous nations like Australia, Canada, Norway, Sweden, and the United States. This production would be even greater if the resource base permitted. The markets or governments would force a contraction of the raw materials industries if they were unprofitable or otherwise socially undesirable.

On these grounds, I conclude that a heavy concentration on commodity production in a national economy is not detrimental *per se*. Diversification out of a commodity sector that has lost its competitive advantage and superior profitability is certainly warranted. But it is much harder to find tenable arguments for a recommendation to, say, Ivory Coast or Venezuela, both heavily dependent on the exports of a few raw materials, that they should reduce their commodity reliance by a greater emphasis on manufacturing.

## References

- Adelman, M. (2002), "World Oil Production and Prices," *Quarterly Review of Economics and Finance*, vol. 42.
- Adelman, M., and C. Watkins. (2005), "US Oil and Natural Gas Reserve Prices, 1982–2003," *Energy Economics*, vol. 27.
- Aguilera, R. (2006), "Assessing the Long-Run Availability of Global Fossil Energy Resources," Doctoral Dissertation at the Division of Economics and Business, Colorado School of Mines, Golden, CO.
- Aharoni, Y. (1982), "The State Owned Enterprise: An Agent Without a Principal," in L. Jones *et al.*, *Public Enterprises in Developing Countries*, Cambridge University Press, Cambridge.
- Albanese, T. (2006), "Copper: Running Out of Resources or Harder to Mine?" Rio Tinto paper presented at Commodity Research Unit's 5th World Copper Conference, Santiago, 6 April.
- Anderson, K. (2004), "Subsidies and Trade Barriers," in B. Lomborg (ed.), *Global Crises, Global Solutions*, Cambridge University Press, Cambridge.
- (2006), "Outline of the Research Project on Distortions to Agricultural Incentives," 30 June, Project Proposal to the World Bank.
- Anderson, K., W. Martin and D. van der Mensbrugge (2006), "Distortions to World Trade: Impacts on Agricultural Markets and Farm Incomes," *Review of Agricultural Economics*, vol. 28, no. 2.
- Anderson K., W. Martin and E. Valenzuela (2006), "The Relative Importance of Global Agricultural Subsidies and Market Access," CEPR Discussion Paper no. 5569, March.
- Auty, R. M. (2003), "The Geopolitics of Mineral Resources," UNCTAD, Geneva.
- (ed.) (2001), *Resource Abundance and Economic Development*, Oxford University Press, Oxford.
- Bairoch, P. (1965), "La Baisse des coûts des transports et le développement économique," *Révue de l'Institut de Sociologie*, no. 2, Université libre de Bruxelles, Brussels.
- Barnett, H. J. and C. Morse (1963), *Scarcity and Growth: The Economics of Natural Resource Availability*, Resources for the Future, Washington, DC.

- Behrman, J. R. (1987), "Commodity Price Instability and Economic Goal Attainment in Developing Countries," *World Development*, May.
- Bentley, R. W. (2006), "Global Oil and Gas Depletion," *IAEE Newsletter*, second quarter.
- Bohi, D. R. (1999), "Technological Improvement in Petroleum Exploration and Development," in R. D. Simpson (ed.), *Productivity in Natural Resource Industries: Improvement Through Innovation*, Resources for the Future, Washington, DC.
- Bomsel, O. (1994), "The Future of Mining Countries: New Strategies or the Restructuring of the State?" UNCTAD, Geneva.
- Borenstein, I. (1954), "Capital and Output Trends in the Mining Industries 1870–1948," *Occasional Paper 45*, NBER.
- BP (annual), *Statistical Review of World Energy*, London.
- Brown, C. P. (1980), *The Political and Social Economy of Commodity Control*, Macmillan, London.
- Campbell, C. J. (1997), *The Coming Oil Crisis*, Multiscience Publishing, Brentwood.
- Cashing, P., and C. J. McDermott (2002), "The Long-Run Behavior of Commodity Prices: Small Trends and Big Variability," *IMF Staff Papers*, vol. 49, no. 2.
- Center for International Securities and Derivatives Markets (2006), *The Benefits of Commodity Investments, 2006 Update*, Isenberg School of Management, University of Massachusetts, Amherst.
- COCHILCO (2005), *Copper Statistics 1985–2004*, Chilean Copper Commission, Santiago de Chile.
- Commodity Yearbook* (1964), Commodity Research Bureau, New York.
- Cooper, R. N., and R. Z. Lawrence (1975), "The 1972–75 Commodity Boom," *Brookings Papers on Economic Activity*, vol. 1975, no. 3.
- Corden, M. (1984), "Booming Sector and Dutch Disease Economics: Survey and Consolidation," *Oxford Economic Papers*, vol. 36, no. 3.
- Crowson, P. (1987), "The Global Distribution and Availability of Mineral Resources," paper presented to a Symposium on Mining and Petroleum at the Delft University of Technology, 3–4 November.
- (1998), *Minerals Handbook 1998–99*, Mining Journal Books, London.
- (2006), "Mineral Markets, Prices and the Recent Performance of the Minerals and Energy Sector," in P. Maxell (ed.), *Australian Mineral Economics, A Survey of Important Issues*, Monograph 24, Australasian Institute of Mining and Metallurgy, Carlton, Victoria.
- Cyert, R., and J. March (1992), *Behavioral Theory of the Firm*, Blackwell, London.
- Darmstadter, J., et al. (1971), *Energy in the World Economy*, Resources for the Future, Washington, DC.

- Davis, G. (1994), *South African Managed Trade Policy – The Wasting of a Mineral Endowment*, Praeger, New York.
- (1995), “Learning to Love the Dutch Disease: Evidence from the Mineral Economics,” *World Development*, vol. 23, no. 10.
- Davis, G., and J. Tilton (2005), “The Resource Curse,” *Natural Resources Forum*, vol. 29.
- Dillard, D. (1967), *Economic Development of the North Atlantic Community*, Prentice Hall, Englewood Cliffs, NJ.
- Dobozi, I. (1987), “Emergence, Performance and World Market Impact of the State Mining Companies in Developing Countries,” *Studies on Developing Economies No. 123*, Institute for World Economics, Budapest.
- Economist* (2004), 16 December.
- Economist* (2006a), 1 July.
- Economist* (2006b), “Oil’s dark secret,” 10 August.
- EIA (2006), *International Energy Outlook 2006*, Energy Information Administration, Washington, DC.
- Exxon (1980), *World Energy Outlook*, New York, December.
- Faber, M. (1982), “Some Old and New Devices in Mineral Royalties and Taxation,” in *Legal and Institutional Arrangements in Mineral Development*, Mining Journal Books, London.
- FAO (2004), *Commodity Market Review 2003–2004*, Rome.
- Financial Times* (2006), 22 December.
- Financial Times* (2007), 2 March.
- Fliessing, H. and S. Van Wijnbergen (1985), “Primary Commodity Prices, the Business Cycle, and the Real Exchange Rate of the Dollar,” World Bank Background Paper, WDR–1985, Washington, DC.
- Floyd, R. H., C. S. Gray and R. P. Short (1984), “Public Enterprise in Mixed Economies, Some Macroeconomic Aspects,” IMF Discussion Paper, Washington, DC.
- Fouquet, R. and P. Pearson (2006), “Seven Centuries of Energy Services: The Price and Use of Light in the United Kingdom (1300–2000),” *The Energy Journal*, vol. 27, no. 1.
- Friedman, M. (1969), “In Defence of Destabilizing Speculation,” in *The Optimum Quantity of Money and Other Essays*, Macmillan, London, 1969.
- Gately, D. (1984), “A Ten-year Retrospective: OPEC and the World Oil Market,” *Journal of Economic Literature*, September.
- GATT (annual), *International Trade*, Geneva.
- Geman, H. (2005), *Commodities and Commodity Derivatives. Modelling and Pricing for Agriculturals, Metals and Energy*, Wiley & Sons, Chichester.

- Ghosh, A. and J. Ostry (1994), "Export Instability and the External Balance in Developing Countries," IMF Working Papers 94/8-EA.
- Ghosh, S., C.L. Gilbert and A.J. Hughes Hallet (1987), *Stabilizing Speculative Commodity Markets*, Clarendon Press, Oxford.
- Gilbert, C. (1996), "Manipulation of Metals Futures, Lessons from Sumitomo," unpublished manuscript.
- Gillis, M. (1980), "The Role of State Enterprises in Economic Development," *Social Research*, vol. 47, Summer.
- Giraud, P.N. (1983), *Géopolitique des ressources minières*, Economica, Paris.
- Goeller, H. E. and A. M. Weinberger (1976), "The Age of Substitutability," *Science*, February.
- Goldman Sachs (2005a), *Commodity Sales: The Case for Commodities*, New York, June.
- (2005b), "Global Energy, 100 Projects to Change the World," London, January.
- (2006), "Global Energy, 125 Projects to Change the World, Key Issues from our Annual Review," London, February.
- Gorton, G. and G. Rouwenhorst (2006), "Facts and Fantasies about Commodity Futures," *Financial Analysts Journal*, March.
- Griffin, J. (2008), *Balancing Cheap, Clean, and Secure Energy: An Economist's Prescription for a Failed Energy Policy*, American Enterprise Institute (forthcoming).
- Griffin, J. and H. Steele (1986), *Energy Economics and Policy*, Academic Press, Orlando.
- Grilli, E.R. and M.C. Yang (1988), "Primary Commodity Prices, Manufactured Goods Prices and the Terms of Trade of Developing Countries: What the Long Run Shows," *World Bank Economic Review*, January.
- Guajardo, J. C. (2006), Copper presentation, 13 July, Cochilco, Santiago de Chile.
- Gylfason, T. (2002), "Mother Earth: Ally or Adversary?" *World Economics*, January–March.
- Haigh, M. S., J. Hranoiva and J. A .Overdahl (2005), "Price Dynamics, Price Discovery and Large Futures Trader Interaction in the Energy Complex," US CFTC Working Paper, Washington, DC, April.
- Hartzman, M.L. (1987), "Returns to Individual Traders of Futures. Aggregate Results," *Journal of Political Economy*, 95, December.
- (1991), "Luck Versus Forecast Ability: Determinants of Trader Performance in Futures Markets," *The Journal of Business*, 64:1.
- Herfindahl, O. (1959), *Copper Costs and Prices 1870–1957*, Resources for the Future, Washington, DC.

- Hotelling, H. (1931), "The Economics of Exhaustible Resources," *Journal of Political Economy*, April.
- Houthakker, H. S. (1975), "Comments and Discussion," *Brookings Papers on Economic Activity*, vol. 1975, no. 3.
- IEA (2001), *Oil Supply Security – The Emergency Response Potential of IEA Countries in 2000*, International Energy Agency, Paris.
- (2001), *World Energy Outlook 2001*, International Energy Agency, Paris.
- (2004), *Analysis of the Impact of High Oil Prices on the Global Economy*, International Energy Agency, Paris.
- (2005a), "Fact Sheet on IEA Oil Stocks and Emergency Response Potential," International Energy Agency, Paris.
- (2005b), *Resources to Reserves*, International Energy Agency, Paris.
- (2006), *Medium-Term Oil Market Report*, International Energy Agency, Paris.
- (monthly), *Oil Market Report*, International Energy Agency, Paris.
- IMF (1982), *Financial Statistics Yearbook*, International Monetary Fund, Washington, DC.
- (2006a), *World Economic Outlook*, International Monetary Fund, Washington, DC April.
- (2006b), *World Economic Outlook*, International Monetary Fund, Washington, DC, September.
- (2007), *World Economic Outlook*, International Monetary Fund, Washington DC, April.
- International Tin Council (1964), *Statistical Yearbook*.
- (monthly), *Monthly Statistical Bulletin*.
- Iwarson, T. (2006), *Investering i råvaror*, Handelsbanken Capital Markets, Stockholm.
- Kat, H. M. (2006), "Is the Case for Investing in Commodities Really That Obvious?" Alternative Investment Research Center, Cass Business School, City University, London, September.
- Keynes, J. M. (1933), "National Self-Sufficiency," *Yale Review*, Summer.
- Keynes, J. M. (1936), *The General Theory of Employment, Interest and Money*, Harcourt, New York.
- Keynes, J. M. (1974), The International Control of Raw Materials (A UK Treasury Memorandum dated 1942), *Journal of International Economics*, no. 4.
- Kindleberger, C. (1958), *Economic Development*, McGraw Hill, New York.
- Kleinman, G. (2004), *Trading Commodities and Financial Futures: A Step to Step Guide to Mastering the Markets*, Financial Times Press, London.
- Kumar, R. and M. Radetzki (1987), "Alternative Fiscal Regimes for Mining in Developing Countries," *World Development*, May.

- Kuznets, S. (1966), *Modern Economic Growth, Rate, Structure and Spread*, Yale University Press, London.
- Labys, W. C., et al., (1999), "Metal Prices and the Business Cycle," *Resources Policy*, vol. 25.
- Landes, D. S. (1980), "The Great Drain and Industrialization: Commodity Flows from Periphery to Center in Historical Perspective," in R. C. O. Matthews (ed.), *Economic Growth and Resources*, vol. II, *Trends and Factors*, Macmillan, London.
- Layard, P. R. G., and A. A. Walters (1987), *Microeconomic Theory*, McGraw Hill, New York.
- Lomborg, B. (2001), *The Skeptical Environmentalist*, Cambridge University Press, Cambridge.
- Lowell, J. D. (1970), "Copper Resources in the 1970s," *Mining Engineering*, April.
- Lundgren, N. -G. (1996), "Bulk Trade and Maritime Transport Costs: The Evolution of Global Markets," *Resources Policy*, vol. 22, nos. 1–2.
- MacBean, A. I. (1966), *Export Instability and Economic Development*, Oxford University Press, Oxford.
- MacBean, A. I., and D. T. Nguyen, (1987) *Commodity Policies: Problems and Prospects*, Croom Helm, London.
- Macquarie (2006), *Macquarie Research Commodities*, Sydney, October 30.
- Maddison, A. (1994), "Explaining the Economic Performance of Nations," in W. Baumol, R. Nelson and E. Wolff (eds), *Convergence of Productivity*, Oxford University Press, Oxford.
- Malthus, T. R. (1798), *An Essay on the Principle of Population*, reprinted by Penguin Books (1970), Harmondsworth.
- Marcel, V. (2006), *Oil Titans, National Oil Companies in the Middle East*, Brookings, Washington, DC.
- Markowski, A., and M. Radetzki (1987), "State Ownership and the Price Sensitivity of Supply: The Case of the Copper Mining Industry," *Resources Policy*, March.
- Maurice, C., and C. W. Smithson (1984), *The Doomsday Myth, 10,000 Years of Economic Crises*, Hoover Institution Press, Stanford, CA.
- Maxwell, P. (2004), "Chile's Recent Copper Driven Prosperity," *Minerals and Energy*, vol. 19, no. 1.
- Meadows, D. H., et al. (1972), *The Limits to Growth*, Universe Books, New York.
- Meggison, W., and J. Netter (2001), "From State to Market: A Survey of Empirical Studies on Privatization," *Journal of Economic Literature*, June.
- Metallgesellschaft (1984), "Pressmeldungen ueber die Metallmärkte," Frankfurt am Main, January.

- (annual), *Metal Statistics*, Frankfurt am Main.
- Mikesell, R. (1979), *New Patterns of World Mineral Development*, British–North American Committee, London.
- Mikesell, R. F. (1986), *Stockpiling Strategic Materials*, American Enterprise Institute for Public Policy Research, Washington, DC.
- Mill, J. S. (1848), *Principles of Political Economy*, vol. I, John W. Parker, London.
- Mining Journal* (1983), 9 December.
- Nordhaus, W. D. (1997), “Do Real-Output and Real-Wage Measures Capture Reality? The History of Lighting Suggests Not,” in T. F. Breshnan and R. J. Gordon (eds), *The Economics of New Goods*, University of Chicago Press, Chicago.
- Nucleonics Week* (1971), “Canada, Australia Move Forward Uranium Price, Processing Collaboration,” 13 May.
- OECD (2004a), *Agricultural Support: How Is It Measured and What Does It Mean?* OECD Policy Brief, Paris, June.
- OECD (2004b), *OECD Employment Outlook 2004*, Paris.
- OECD (2005), *PCE/CSE Database*, updated annually, available on <http://www.oecd.org>.
- OECD (biennial), *Historical Statistics*, Paris.
- OECD (monthly), *Main Economic Indicators*, Paris.
- Paley, W. S. (1952), *Resources for Freedom, The President’s Materials Policy Commission*, Summary of vol. I, Washington, DC.
- Penrose, E. F. (1968), *The Large International Firm in Developing Countries*, Allen & Unwin, London.
- Pindyck, R., and J. Rotemberg (1990), “The Excess Co-Movement of Commodity Prices”, *The Economic Journal*, vol. 100, no. 403.
- Platt’s Metals Week* (2006), February 27.
- Prain, R. (1975), *Copper, the Anatomy of an Industry*, Mining Journal Books, London.
- Prebish, R. (1962), “The Economic Development of Latin America and Its Principal Problems,” *Economic Bulletin for Latin America*, no. 1.
- Radetzki, M. (1970), *International Commodity Market Arrangement. A Study of the Effects of Post-War Commodity Agreements and Compensatory Finance Schemes*, Hurst, London.
- (1974), “Commodity Prices During Two Booms,” *Skandinaviska Enskilda Banken Quarterly Review*, no. 4.
- (1975), “Metal Mineral Resource Exhaustion: The Case of Copper,” *World Development*, vol. 3, February.
- (1976), “The Potential for Monopolistic Commodity Pricing,” in G. K. Helleiner (ed.), *A World Divided: The Less Developed Countries in the International Economy*, Cambridge University Press, Cambridge.

- (1981), *Uranium, A Strategic Source of Energy*, Croom Helm, London.
- (1985), *State Mineral Enterprises. An Investigation into Their Impact on the International Mineral Markets*, Resources for the Future, Washington, DC.
- (1990a), *A Guide to Primary Commodities in the World Economy*, Blackwell, Oxford.
- (1990b), "Long Run Factors in Oil Price Formation," in L. A. Winters, and D. Sapsfords (eds), *Primary Commodity Prices: Economic Models and Policy*, Cambridge University Press, Cambridge.
- (1995), "A Scrutiny of the Motives for Hard Coal Subsidies in Western Europe," *Resource Policy*, no. 2
- (2001), *The Green Myth – Economic Growth and the Quality of the Environment*, Multiscience Publishing, Brentwood.
- (2002), "Is Resource Depletion a Threat to Human Progress? Oil and Other Critical Exhaustible Materials," *Energy Sustainable Development – A Challenge for the New Century (Energex2002)*, Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Krakow.
- (2006), "The Anatomy of Three Commodity Booms," *Resources Policy*, vol. 31.
- Radetzki, M., and S. Zorn (1979), *Financing Mining Projects in Developing Countries*, Mining Journal Books, London.
- Raw Materials Group (2004), Database, Stockholm.
- (2006), Database, Stockholm.
- Resources for Freedom* (1987), 35th Anniversary Edition, Resources for the Future, Washington, DC.
- Rowe, J.W.F. (1965), *Primary Commodities in International Trade*, Cambridge University Press, Cambridge.
- Sachs, J., and A. Warner (1999), "The Big Push: Natural Resource Booms and Growth," *Journal of Development Economics*, vol. 59.
- (2001), "Natural Resources and Economic Development: The Curse of Natural Resources," *European Economic Review*, vol. 45.
- Schmitz, J. A. (2004), "Privatization's Impact on Private Productivity: The Case of Brazilian Iron Ore," *Research Department Staff Report 337*, Federal Reserve Bank of Minneapolis.
- Simon, J. (1996), *The Ultimate Resource*, Princeton University Press, Princeton, NJ.
- Simpson, R.D. (ed.) (1999), *Productivity in Natural Resource Industries: Improvement Through Innovation*, Resources for the Future, Washington, DC.
- Singer, H. (1950), "The Distribution of Gains Between Investing and Borrowing Countries," *American Economic Review*, 1950.

- Skidelsky, R. (1996), *The Road from Serfdom. Economic and Political Consequences of the End of Communism*, Allen Lane, London.
- Société Générale (2006), *Bubble About to Burst*, Paris, June.
- Stein, J. L. (1981), "Destabilizing Speculation Activity Can Be Profitable," *Review of Economics and Statistics*, vol. 43.
- Stewart, B. (1949), "An Analysis of Speculative Trading in Grains Futures," *US Department of Agriculture Technical Bulletin 1001*.
- Svedberg, P., and J. Tilton (2006), "The Real, Real Price of Non-renewable Resources: Copper 1870–2000," *World Development*, vol. 34, no. 3.
- Telser, L. G. (1981), "Why There Are Organized Futures Markets," *Journal of Law and Economics*, April.
- Tilton, J. (2003), *On Borrowed Time? Assessing the Threat of Mineral Depletion*, Resources for the Future, Washington, DC.
- (2006), "Outlook for Copper Prices – Up or Down?" *Mining Engineering*, August.
- Tilton, J., and H. Landsberg (1999), "Innovation, Productivity, Growth and the Survival of the US Copper Industry," in R. D. Simpson (ed.), *Productivity in Natural Resource Industries*, Resources for the Future, Washington DC.
- Tilton, J., and B. Skinner (1987), "The Meaning of Resources," in D. McLaren and B. Skinner (eds), *Resources and World Development*, John Wiley, New York.
- UN (annual, a), *International Trade Statistics Yearbook*, United Nations, New York.
- (annual, b), *Statistical Yearbook*, United Nations, New York.
- (annual, c), *Yearbook of International Accounts Statistics*, United Nations, New York.
- (monthly), *Monthly Statistical Bulletin of the United Nations*, United Nations, New York, several issues.
- UNCTAD (1976), *Handbook of International Trade and Development Statistics*, United Nations, New York.
- (1981), "Processing and Marketing of Phosphates: Areas for International Cooperation," TD/B/C. IIPSC/22, Geneva.
- (1987), "Commodity Export Earnings shortfalls," TD/B/AC.43/5, July, Geneva.
- (1999), "The World Commodity Economy: Recent Evolution, Financial Crises, and Changing Market Structures," TD/B/COM.1/27, Geneva.
- (2000), *Monthly Commodity Price Bulletin, 1960–1999 Supplement*, United Nations, New York.
- (2003), "Back to Basics: Market access issues in the Doha Agenda," UNCTAD/DITC/TAB/Misc9, Geneva.
- (2005), *Handbook of Statistics 2005*, United Nations, Geneva.

- US Bureau of Mines (1986), *South Africa and Critical Materials*, Washington, DC, July.
- USGS (2002), "Cobalt, Statistical Compendium," United States Geological Survey, Washington, DC.
- (annual), *Mineral Commodity Summaries*, United States Geological Survey, Washington, DC.
- Vedavalli (1977), "Market Structure of Bauxite/Alumina/Aluminum, and Prospects for Developing Countries," *World Bank Commodity Paper*, no. 24.
- Vernon, R. (1983), *Two Hungry Giants, The United States and Japan in the Quest for Oil and Ores*, Harvard University Press, Cambridge, MA.
- Wälde, T. (1984), "Third World Mineral Development: Current Issues," *Columbia Journal of World Business*, Spring.
- Williams, M. L. (1975), "The Extent and Significance of the Nationalization of Foreign-owned Assets in the developing Countries," *Oxford Economic Papers*, vol. 27.
- World Bank (1981), *World Development Report 1981*, Washington, DC.
- (1983), *World Development Report 1983*, Washington, DC.
- (1985), *Commodity Trade and Price Trends*, Washington, DC.
- (1986a), *Commodity Trade and Price Trends*, Washington, DC.
- (1986b), *World Development Report, 1986*, Washington, DC.
- (1994), *Market Outlook for Major Primary Commodities*, Report no. 814/94, Washington, DC.
- (2002), *Treasure or Trouble? Mining in Developing Countries*, Washington, DC.
- Wright, G., and J. Czelusta (2004) "The Myth of the Resource Curse," *Challenge*, vol. 47(2).
- Zambia Mining Yearbook* (annual), Kitwe.

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