The Southern Engine of Growth and Hard Commodity Prices : Does China Lead to Disruptive Development

Thesis

THE SOUTHERN ENGINE OF GROWTH AND HARD COMMODITY PRICES: DOES CHINA LEAD TO DISRUPTIVE DEVELOPMENT?

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Abstract

The 2003 to 2008 commodity boom was the longest period of rising commodity prices seen since the Second World War. The main drivers of base metal prices were increasing Demand from China, Inflexible Supply from within the Global Mining Industry and the increased participation of Financial Actors in commodity markets.

This research examines the role of the main drivers in the 2003 to 2008 commodity boom, and their impact on the future behaviour of hard-commodity prices. The persistence of these drivers, despite the interruption due to the financial crisis towards the end of 2008, leads us to conclude that the Boom is the start of an expansionary phase of a commodity Super Cycle.

China's increase in base-metals consumption has directly led to demand disruptions in the global commodity markets. Indirectly, it has affected the global mining sector and influenced a change in perception of financial actors. China's growth has been a disruptive element in traditional commodity price behaviour.

Given the commodity pessimism since the 1950s, the current rise in commodity prices has implications for development policy. The orthodoxy of deteriorating terms of trade of commodities relative to manufactures, price volatility, the low income elasticity of demand and the nature of the global mining industry, are all challenged by the rising trend in commodity prices.

Hard-commodity-exporting countries have an opportunity to benefit from the current and expected growth of commodity prices in the medium term. For base-metal ore abundant countries, commodity optimism may well define the next fifty years of global economic development.

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List of Acronyms

BME	Bloomsbury Mineral Economics
CISDM	centre for International Securities and Derivatives Markets
CPI	Consumer Price Index
DCF	Discounted Cash Flows
EMH	Efficient Market Hypothesis
ESDS	Economic and Social Data Service
ETF	Exchange Traded Funds
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GSCI	Goldman Sachs Commodity Index
ICSG	International Copper Study Group
IFSL	International Financial Services London
IMF	International Monetary Fund
IP	Industrial Production
ISI	Industry Specialisation Index
LME	London Metals Exchange
M&A	Merger and Acquisition
MEG	Metals Economic Group
MUV	Manufactures Unit Value
NBER	National Bureau of Economic Research
NPV	Net Present Value
OECD	Organisation for Economic Cooperation and Development
OPEC	Organisation of Petroleum Exporting Countries
OTC	Over the Counter
RCA	Revealed Comparative Advantage
RMG	Raw Materials Group
UNCTAD	United Nations Conference on Trade and Development
USGS	United States Geological Survey
WEO	World Economic Outlook
WIR	World Investment Report

AN INTRODUCTION TO COMMODITIES IN ECONOMIC DEVELOPMENT

When you start on your journey to Ithaca,

then pray that the road is long,

full of adventure, full of knowledge...

... Always keep Ithaca fixed in your mind.

To arrive there is your ultimate goal.

But do not hurry the voyage at all[1].

In the old Westerns, in the days of black and white movies, men would head off to hostile regions to stake their mining claim and face adversity, on the road to making something of their lives. With the introduction of the local greedy villain, justice would eventually prevail, after the necessary shooting of the bad man in a dusty small town street. The mine would strike it rich, and our hero would live a prosperous life. Mining, usually gold, had worked well as a theme for 'happily ever after' in Hollywood. In the 18th and 19th centuries mining, as a theme, also worked well for countries and brought wealth and prosperity to many including the United States, Britain and Germany.

Today, from the villains in James Bond (Casino Royal), to the conflict ridden world of the 'Blood Diamond' (with Leonardo DiCaprio), commodities are no longer in favour with Hollywood, as with the rest of the world. They are now seen as a source of conflict, injustice and suppression of human rights, having led to war and debt for many African and Latin American countries.

Commodity led growth, over the past century have been first seen as constructive and then harmful, for many developing countries. As a source of wealth, they can offer a great domestic resource, and yet their ability to deliver on growth is under question. From the 1950s onwards, commodities suffered from volatile prices, short lived price booms and terms of trade deterioration relative to manufactures. By the end of 2003 things began to change. Commodity prices were rising and

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[1] Source: Ithaca by Constantine Cavafy

continued to rise for the next five years. In the middle of 2008, a financial crisis interrupted this trend, but as 2009 progresses, commodity prices are recovering.

Global economic growth has been led by western economies, with developing countries often relying on the advanced countries for aid, trade and investment. The main international financial institutions, such as the World Bank and the IMF, based mainly in the North, are the leading organisations offering advice on domestic and trade issues. The Washington Consensus, focused on markets and liberalisation, has been the basis for many of the development policies recommended for the South.

Economic development and advances in the South were made mainly by the 'Tiger Economies' in the late 1980s and 1990s. South Korea, Taiwan, and Malaysia experienced rapid economic growth during this period. The economic rise in East Asia was impressive and although they were upheld as models for others to follow, their impact on other developing countries remained largely inconsequential. Latin America and Africa saw little corresponding growth in response to changes in the emerging economies of East Asia.

Towards the end of the 20th century, China began to emerge as a large export orientated economy. A combination of state-led and market-orientated export growth, increased China's exposure to the global economy. It began to emerge as the top exporter in one market segment after another. Starting from low technology products, such as toys and shoes, its expansion continued into higher technology products, such as laptops and mobile phones. With its accession to the WTO in 2001, its growth in shares of major export markets increased further.

The beginning of the 21st century witnessed a new dimension in China's engagement with the world. Its imports of raw materials began to increase, as its growth led to higher demand for inputs. With the rise of China perhaps, soon to be followed by India, the potential of these Asian Drivers to push growth via trade in other developing economies has become important.

China's rapid economic growth has influenced growth patterns in a number of areas in the manufacturing, commodities and services sectors. From using production value chains to lower

prices for manufactured products, to investing heavily in African resource-rich countries for raw material, China has emerged as a new economic power. There are now references to the 'Beijing Consensus' as an alternative model of development to the Washington Consensus.

The start of this research proposal, in 2006, was the observation of an increase in commodity prices over a three year period, mainly in metals, with little signs of abating. Other economic events of interest were the rise of China, showing exceptional growth in both its domestic and international markets. Connecting the two events our first query was a simple one: was the rise in commodity prices a result of China's growth?

Progressing further into our research, we came across other factors fuelling the rise in commodity prices. As important as China's demand was, the nature of the global mining industry was also pushing prices up. Supply issues and how the global mining industry responded to increasing demand were flagged as important contributors to the price rise. The financial markets and their interest in commodities were also growing, both in terms of actors and funds tracking commodity prices. In 2006, concerns with how investors traded commodities and with 'speculative activity' were rising.

As our research focus sharpened, we began to concentrate on the role that all three factors played in the rise of commodity prices post 2003. The consequences of a rise in commodity prices for developing countries, and how these factors would affect the role of commodities in development became our central theoretical issue.

1.1 Commodities in Development

The developed world is a major producer and consumer of primary commodities, accounting for 63% of world exports (excluding fuel) in 2003-2005. In the same period, an average of 11.7% for the developed and 11.0% for the developing countries' total export earnings came from primary commodities (excluding fuel)[2].

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[2] Source: UNCTAD Handbook of Statistics accessed June 2008

Although the developed world has a larger share in global primary commodity-exports, the importance of the sector is much greater for developing countries. Maizles (1992) argues that the impact of changes in commodity markets is asymmetrical for the developing world. Adverse price effects in commodity markets are likely to have a deeper impact on developing countries, even when their share in world exports is smaller.

In the late 19th century, countries with coal and iron ore deposits such as Britain, Germany and the United States, were able to develop successful domestic steel industries that contributed to their rapid industrialisation (Sachs and Warner, 1995). Natural resource endowments were considered a major advantage for achieving rapid economic growth (Higgins, 1968). The availability of natural resources could aid in industrialisation through various linkages, such as generating investable capital, providing a domestic market for the industrial sector, and linkages to other sectors of the economy (Rostow, 1961; Drake 1972; Kruegar, 1980; Wright and Czelsuta, 2004). Revenue generated from the mining sector could help fund growth in the manufacturing sector, as well as being spent by the State on education, health and developing human capital within the economy.

With the Prebisch-Singer Hypothesis in the 1950s this view was challenged; developing countries exporting primary commodities were importing less and less manufactures in return. The declining terms of trade for commodities with respect to manufactures raised doubts about their ability to deliver on growth. Experiences of commodity dependent countries, with regards to the Dutch disease and volatility of commodity prices, meant that the sector was no longer seen as the panacea for economic growth. Additionally, the Resource Curse inspired little faith in commodities as the lead sector.

Since the late 1970s commodity prices have remained low and developing countries have been urged to diversify exports into manufactures, and to follow strong industrial policies to meet economic growth targets. With a rather pessimistic view of commodities, the steady rise in international commodity prices since 2003 has re-awakened an interest in this sector. Can commodities play a major role as the lead sector in economic development, or will the resource curse limit their contribution to growth?

1.2 Why Commodity Prices are Important

Commodity prices are important for developing countries especially in terms of their exchange value relative to manufactures. Commodities as inputs usually have a very small share in the overall cost of production of manufactured products. They are homogenous products, requiring a relatively low degree of processing, and can be shipped in bulk. The product and production nature of most commodities make it a very competitive market, competition in general making producers price takers rather than price makers. The low income and price elasticity of demand and supply for commodities, also limits the extent to which producers can a play a role in increasing production and revenues. The price of commodities, in relation to that of manufactures, determines the terms of trade for a developing country. In the face of deteriorating terms of trade, growth can suffer in these countries.

The low and often volatile commodity prices over a short term can have negative consequences for export revenues. Sustained price changes, over a medium or long term, have relevance for a country's terms of trade and therefore the industrial and trade policies. The priority that is given to the commodities sector is affected by the prices of these goods. Commodity prices can effect developing countries through direct linkages such as export revenues, or indirect linkages such as prices of manufactured products through terms of trade. Through either transmission, commodity prices are important for developing countries and their economic growth.

1.3 Commodity Price Behaviour

An examination of commodity prices and the factors that drive them has much to offer in understanding how singular events can have large global consequences. Periods of rapidly increasing prices, such as those experienced in commodity booms bring into sharp focus the drivers of price. The first post World War II commodity price boom was seen in 1951 to 1953', followed by the 1973-1975 boom, and the latest in 2003-2008. The 2003-2008 commodity boom accompanied a major expansion in the global economy. Advanced economies were expanding at 2.5% p.a. on average in 2000-07 while emerging and developing economies showed higher growth

rates, averaging around 6.4% p.a.[3]. Figure 1.1 shows the UNCTAD all commodity price index from 1960 to early 2009 (2000=100)[4].

Figure 1.1: UNCTAD All Commodity Monthly Price Index (1960-2009) (2000=100)
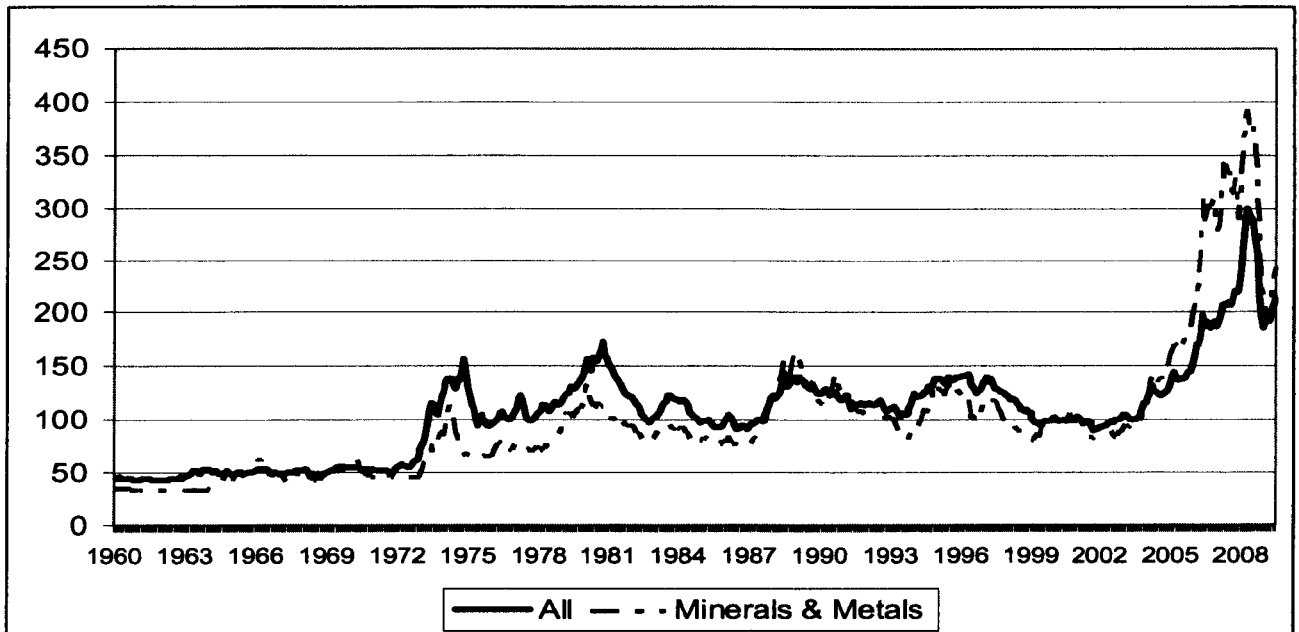
Source: Calculated from UNCTAD Statistics online accessed June 2009

The 1960s experienced low prices remaining around the 50 index point, before rising substantially in the early 1970s. The commodity boom in the 1970s and the oil price shock contributed to sharply rising prices and retaining the price increase in this decade, where prices averaged around the 100 index point. Commodity price behaviour remains unremarkable for most of the 1980s and 1990s, limited to fluctuations between 100 and 150 index points. After 2000 we find a sustained increase in commodity prices continuing until the later half of 2008. Between 2000 and 2003 the index rose from 100 to 105, and by 2007 it had doubled to 207. In mid 2008 it was at its highest point touching the 300 mark.

In the autumn of 2008 the financial centres in the developed economies began to unravel, as banks and investment institutions collapsed from poor risk management of their portfolios. Government bailouts and crashing stock markets took their toll and a majority of the OECD economies were officially in recession by the start of 2009. Commodity prices by June 2009 had lost nearly half their

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[3] Source: World Economic Outlook data via ESDS accessed on 15th February 2009
[4] Data pre 1960 are not available for the UNCTAD index

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value relative to their peaks in early 2008. The financial crisis in the western economies brought about the start of a global recession and a slow down in growth rates in other emerging economies.

For the moment if we ignore the drop in prices towards the end of 2008, Figure 1.1 indicates a major disruption in price behaviour after 2000. Prices have risen higher over a sustained period in comparison to the previous four decades. Even as prices dropped, they maintain levels higher than those seen before 2000. This observation leads us to two questions. First, what factors led to the recent increase in commodity prices? Second, is this price drop a transient phenomena or will price trends upwards again? To answer these questions we need to examine the determinants of commodity prices.

1.4 Determinants of Commodity Prices

The fundamental drivers of commodity prices are demand and supply, with the financial markets playing an active role in determining an international price level. Commodities in general refer to agricultural raw materials and food, mineral and metal ores and energy products such as oil and gas. Agricultural goods are often classified as soft commodities, while the latter are referred to as hard commodities.

Demand: As a general principle, commodity demand has low income and price elasticity of demand. An increase in income or prices will result in a less than proportional change in demand. On a larger macroeconomic level, the demand for natural resources is closely linked to the various stages of economic development. The income levels of an economy and the structure of its GDP guides the relationship between growth and the demand for commodities.

Supply: Commodities have a low income and price elasticity of supply, and will see a less than proportional response in output levels to price or income changes. At a more general level, supply of commodities has two components; the output of a given year and inventories. Soft or agricultural commodities have relatively smaller production cycles than hard or mineral commodities. Soft commodities also tend to have limited storage life, and inventories can be maintained for limited periods only. Contrastingly hard-commodities have relatively longer production cycles, but can also

be stored for extended periods of time. Short term supply needs may be met by increasing capacity utilisation, whereas long term output increases take time. Therefore, supply in the short term can be met by changes in inventory levels, while in the long term it is dependent on the production cycle of the commodity in question.

Financial Markets: Commodities can be classified as homogenous products, as they are easy to harmonise in terms of quality and standards. A ton of Grade A copper is the same all across the world. This trait allows for an 'international' price for commodities to be easily established, usually at international commodity exchanges. Investors' evaluations of international demand and supply positions are reflected in their current and future pricing of commodities.

1.5 Research Parameters

This dissertation, using the three major determinants of price, examines how they account for the change in price levels seen post 2003 (Figure 1.1). In order to offer a detailed analysis we limit ourselves to certain parameters.

First, commodities in general are a large product group and sectors within the group have exhibited different price behaviours. Commodities cover agricultural raw materials, minerals and metals. The recent commodity price increase has been most dominant and lasting in the metals sector (Figure 1.1), and we believe an in-depth study of this sector will be beneficial. Therefore our research will look at base metals when considering demand, supply and financial market issues. The example of copper is extensively used to illustrate metal price behaviour since it is one of the largest internationally traded metals.

Secondly, commodity prices react to both international demand and supply, a price 'event' is likely to result when there is a discrepancy between the two. There have been three such commodity price events, or booms since the Second World War: the first in 1951-1953, the second in 1973-1975 and the latest in 2003-2008. Examination of each period of a sustained price increase, rather than tracking the entire trend from 1950-2009, offers a distinct focus on the factors that disrupt price. This dissertation therefore offers an analysis of the major determinants of price during the boom

periods, with our focus remaining on the latest commodity boom in 2003-2008. References are made to the other two post World War II commodity price booms for comparative purposes only.

Thirdly, we emphasise the period of the commodity boom 2003-2008 and are less focused on the aftermath of the financial crisis. The impact of the crisis is still emerging and a clear trend has not been established, making a comprehensive analysis difficult. Although the financial crisis has dominated the news in the last eight months, the expansion of the global commodity markets lasted for over five years. It would be unfair to relegate this expansion to the background, and concentrate on the last few months alone.

Finally, the fastest growing emerging economies in the South are mainly China and India. These Southern Engines of Growth are large developing economies, and their engagement through international trade is aiding economic growth in other developing countries. Of the two Asian Drivers, our focus is on China. It has exhibited the fastest GDP growth rates economy as well it is a growing consumer of metals and minerals. With limited domestic natural resources, China's increasing integration within the global commodity systems makes it an ideal candidate to study demand. India, will become an actor in this evolving picture over time, but its role will not be directly considered in this dissertation. References to other economies such as Brazil, Russia and South Africa have also been highlighted in recent literature as emerging global players. These are large commodity-exporting countries but since our main focus is on the demand-driven consumption of commodities, we do not address their role in commodities and development.

The research focuses is on hard-commodities in particular and on base-metals specifically and therefore our review of evidence, analysis and discussions will focus on minerals and metals. Given the difference between minerals and agricultural commodities, in their linkages with the larger economy and the factors that drive their demand and supply, our findings and policy implications are relevant for the hard-commodities sector only.

Research Questions: With our concentration on the three major determinants of hard-commodity prices and having defined our research parameters we frame our research questions as follows:

1. What has been the contribution of China's economic growth in creating a demand pull effect on metal prices?
2. What has been the contribution of supply in the determination of metal prices?
3. What role has the financialisation of commodity markets played in the determination of metal prices?
4. With the financial crisis in late 2008, how persistence is the influence of these drivers on long term prices?

1.6 Research Context and Relevance to Development Theory

Our research questions arose from three major events in the global economy in recent years. The first was the emergence of a large developing economy (China), the second was the increase in commodity prices and the third was increased investor participation in commodity markets. These events have implications for the current and future trend of commodity prices and the development of resource-rich developing countries.

With expectations of China's future growth and India to follow in its footsteps, commodity demand is likely to be substantial in the foreseeable future. This will affect the trend for commodity prices and in turn have an impact on their terms of trade with manufactures. A structural shift in commodity prices in relation to manufactures is a probable result. Changes in the dynamics of the terms of trade would require a re-think of policies based on its earlier conclusions, as a terms of trade reversal or a structural shift impacts core development policy. Increasing hard-commodity demand also opens up space for foreign direct investment (FDI) into resource-rich developing countries and the direction of their industrial policy needs to be re-examined.

The economic expansion of a large country such as China creates pressures in international commodity markets. Short term supply reactions, such as lowering inventories may be unable to

fulfil demand, forcing greater pressure on supply to increase. An industry such as the mining sector with a low price elasticity of supply and its response to increasing prices needs to be examined.

The other major development during the 2003 to 2008 commodity boom has been the emergence of a strong investor interest in commodity markets. The role of speculative money in exaggerating price volatility has been raised in developed countries as well as by international financial institutions. The impact of investors on commodity markets needs to be examined. If their role is important, then any discussion around the future pricing of commodities must consider the financial markets in commodity price behaviour.

The foremost theoretical issue this dissertation addresses is the impact of the Southern Engines of Growth on commodity prices and disruptions to the traditional commodity price mechanism. What implications does this have for commodities in development?

Contribution to Knowledge: Academic literature addresses the issues of commodity prices, demand, supply and financial markets, but always in separate strands. This dissertation examines the fundamental and financial side of commodities in the same sphere.

Development economics has looked at the role of commodities in growth as well as the sector's impact on poverty, environment and social areas. Supply side economics has looked at mining from a firm and industry level perspective, while natural resource economics takes a more mining specific outlook. Financial and business economics takes a very different view, often examining commodity price issues outside the physical market context. Our research brings all three strands to the same arena, to present a collective understanding of how the 2003-2008 commodity boom unfolded.

More importantly, understanding the commodity boom in its entirety allows us to appreciate what the future of commodity prices may hold. The implications are considered together to form a coherent view of commodity price behaviour and policy impact. Our contribution to knowledge is then the examination of a 'big picture' view of commodity markets and the policy implications thereof.

1.7 Research Methods

The first three of our research questions focus on different levels of the global economy. China's role in commodity demand requires an examination of its macroeconomic country level data. The state of the mining industry requires a more globalist view of developments in the sector. Our third research question deals with global financial markets, and focuses on the developed world.

Given the wide range of issues we wish to cover, a field based research would be highly problematic. Since we are attempting a global analysis of commodity markets, with major actors spread across the world, time and resource constraints would not allow us to engage face-to-face with these actors. Alternatively, secondary sources have offered a high degree of access to information required for our analysis. This dissertation is informed mainly by desk-based research; yet where possible we did gather primary information. Overall three research methods were employed.

Literature Review: Two sources of literature were used in this research. The first source deals with academic research, while the second studies business outputs. We examined the standard academic literature review of past theories and empirical evidence in mainstream development economics as well as areas specific to the natural resource.

In order to understand the current operations of the mining industry, we reviewed publications from major mining companies, commodities exchanges and business consultants who advise them. For information around financial markets, The Financial Times (United Kingdom), as well as company presentations by leading mining consultants, were extensively used to tap into business opinions and industry level information. This resources were obtained from company websites and through personal communications with informants within consulting firms.

Secondary Data Analysis: Our second approach was the use and analysis of empirical data from various sources. Where possible, international financial institutions, such as the IMF, World Bank and UNCTAD data sets were used. The United States Geographical Survey (USGS) was extensively used for commodity production data. However, most of these databases can take up to

a year or more to update information therefore for 2008 and 2009 data we relied heavily on the business sector publications. Data for global demand and supply of physical commodities was easily accessible, but information on the nature of financial investments was very limited. In order to gauge events in the financial markets, we used opportunities at conferences to gather information.

Interviews and Presentations: Conferences hosted by the mining industry provided ideal venues for tapping the current thinking of major actors and key industry informants, as well as gaining access to information otherwise not available in the public domain. Information regarding price trends and the future trajectory of demand and supply are important for a number of financial consultants who are not always willing to share this information within the public domain. Major conferences where leading consulting firms present their business models and predictions were an ideal platform allowing us access to these views. Key industry informants were willing to share their understanding and estimations with this researchers as long as their business models were not directly quoted within this dissertation.

During 2006-2008 this researcher was present at major mining related conferences in London, as well as in Sweden. The Annual London Metals Week conference (2007 and 2008), The Mining Investor Series 20:20 in London (2006 to 2008), and The Globalization of Primary Commodity Markets in Stockholm (2008), were some of the major conferences attended. These venues allowed for open ended interviews with key informants including mining producers and investors. Participation at these events allowed interaction with a wide variety of actors and conversations related to demand and supply trends and issues allowed us to describe and justify the empirical evidence given in this research. Semi-structured interviews were also conducted at UNCTAD offices in Geneva in 2006-2007. These were used to contextualise the information being learnt from secondary data sources.

The start of the research was in November 2006 and we continued data gathering until June 2009. Therefore, work was carried out parallel to the rise and eventual fall of commodity prices. Describing and analyzing events as they happen is challenging. In September 2009, when this dissertation was submitted a number of global financial and economic indicators were still in flux.

Being so close to changing events, the conclusions of this research are based on the 'best information' at the time.

1.8 Summary of Chapters

In order to answer the research questions raised we start with establishing the context of our research. The First Chapter has therefore been used to set out the outline of this dissertation.

The Second Chapter examines how commodities have been perceived in development literature since the 1950s. We examine the theoretical discussions around the reasons commodities have failed to deliver growth.

Chapter Three outlines the main elements of the commodity booms in 1951-1953, 1973-1975 ,and 2003-2008. We look at the similarities and differences between the previous two and the recent commodity boom.

China then takes centre stage in Chapter Four, where we examine the demand disruptions to global markets caused by the rise of the Chinese economy. We look at the current and future driver of China's resource-intensive growth.

Chapter Five turns to our second price determinant: supply. We look at the response of the global mining industry to the commodity boom as well as the financial and non-financial constraints facing the sector.

The Sixth Chapter turns to our final determinant of price behaviour, i.e. the Financialisation of commodity markets. We examine the consequence for prices after the recent influx of investors and liquidity in commodity exchanges and related investment vehicles.

Chapter Seven brings our three disruptive factors demand, supply and financialisation together. We explore how the three interact and what implications this has for the future behaviour of commodity prices. We end with a discussion on policy implications as a result of our findings and highlight areas for further research.

1.9 Conclusion

Previously, commodity booms were experienced in 1951-1953 and 1973-1975. In early 2003, commodity prices began to rise and continued to do so until mid 2008. This was classified as the third commodity boom experienced since the Second World War. The latest period saw a sustained increase in commodity prices at a time when China was also demonstrating accelerated GDP growth rates.

This research, starting with the role of China's demand for metals, expanding to include supply and financial market issues, is focused on how and why the 2003-2008 commodity boom came about. In jointly understanding the three determinants of price, we wish to comprehend how persistent these changes in hard-commodity prices are likely to be, given the interruption to price increase caused by the 2008 financial crisis.

The possible role that China has played in disrupting commodity price behaviour and the implications of a Southern Engine of Growth for other developing countries is an expanding area of research in development policy and practice. A change in the behaviour of current and future commodity prices, relative to the low and volatile prices seen since the 1960s, has important implications for resource-exporting developing countries. Commodities and their role in development will need to be re-examined. This research therefore addresses an important development policy agenda; the ability of hard-commodities to deliver growth for developing countries when growth is driven by a Southern Engine.

THINKING ABOUT DEVELOPMENT AND COMMODITIES

'Why should agriculture [commodities] be viewed only as a sector from which resources were to be drained? Why should agricultural [commodities] investment and improvement not be a starting point of economic growth?[5]

Historically, hard-commodities were essential in the development process with the stages of civilization categorised by man's use of metals, such as in the Iron Age and the Bronze Age. The Classical economists viewed commodities as a capital resource that could be an asset in the growth process. Trade theory advocated that resource abundant countries should capitalise on their comparative advantage in commodities to gain the largest benefits. With commodities experiencing diminishing returns, while the manufactures sector would experience economies of scale, commodity prices would rise relative to manufactures. However by the 1950s doubts began to emerge over their capability as the lead sector to deliver economic growth.

Three events emerging in the 1950s through to the 1970s, are important in understanding the shift of development orthodoxy away from commodities and towards industrialisation. The first was the discovery of the deteriorating terms of trade for commodities (Prebisch, 1950; Singer, 1950). Prebisch, arguing within the Dependency school, viewed the continued expansion of a primary exporting sector to be harmful to the economy. Strong government intervention and an opposition to free trade led him to focus on Import Substitution Industrialisation as the appropriate policy prescription for the periphery to escape from the centre. Prebisch, through the Economic Commission for Latin American Countries had great influence in Latin America, where mineral exports were the dominant sector in a number of countries (Davis, 1995). The push towards industrialisation consequently meant a move away from mining and commodities.

The second event in the 1950s was the increasing number of countries gaining independence from colonial rulers. With mining firms generally being Multinational Companies (MNCs) headquartered

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[5] Toye (2003)

in the North, their continued operations were seen as a form of neo-colonialism (Davis, 1995). Mining was considered a root cause of 'backwardness' due to the way labour was treated by the firms (Myint, 1954). Mining's enclave nature, with limited linkages to the rest of the economy, was considered detrimental to growth and contributory to poverty (Hirschman, 1958). Waves of nationalisation in the mining sector in a number of African and Latin American countries followed, with the subsequent inability to successfully manage these mines (World Investment Report, 2007). The preference for investment in mining was on the decline.

The third event was the emergence of the resource curse thesis in the 1960s which linked commodity dependent economies with low growth rates. The Dutch disease, with its associated deindustrialisation, was part of the resource curse. Volatile commodity prices left commodity dependent countries less able to deal with windfall gains and long price slumps as compared to more balanced economies. Borrowing against expected higher future commodity prices, which then failed to materialise, led to high debt problems. The developed world seemed to benefit from low commodity prices and accumulated wealth through manufacturing, while incomes deteriorated in the South. The first oil price shock in the 1970s and foreign exchange problems for some of the energy exporting countries lent further credence to the Resource Curse (Davis, 1995).

By the end of the 1970s, commodities had failed to deliver on growth for a number of developing countries, and a growing body of literature evidenced this failure (Nankani, 1979; Auty, 1990, 1993; Sachs and Warner, 1995, 1997, 1999). Only a few countries, such as Botswana or Malaysia had been able to benefit from their natural resource wealth. Commodity-exporting countries often tend to be poor developing countries, and successful cases of resource led growth were few and far between (Auty, 1990; Gelb, 1988; Berge et. al, 1994).

In the later half of the 20th century development focus shifted to industrialisation for growth on the one hand, and commodity pessimism on the other. In this chapter we examine the major reasons why commodities failed to deliver on growth and justify our decision to examine hard-commodity prices within development theory. Section 1 looks at the six major tenets of the Resource Curse that account for commodity pessimism. Section 2 then examines the role of commodities within

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economic growth. In Section 3 we set out our justification for the examination of hard-commodity prices and how this will address our theoretical issues.

SECTION 1 WHY COMMODITIES HAVE FAILED TO DELIVER ON GROWTH

The failure of commodities to deliver on growth for developing countries was first documented by Prebisch (1950) and Singer (1950) showing commodity-exporting developing countries suffer from adverse terms of trade relative to manufactures exporting developed countries. Price volatility in terms of short booms and long price slumps also has adverse effects on the export revenue for developing countries (Cashin and McDermott, 2006). Other concerns of the negative impact of commodity-exports on growth reflect the Dutch disease which leads to commodity sector crowding out manufacturing, as well as having an adverse impact on exchange rates (Ellman, 1981; Corden and Neary, 1982). Political economists have raised the issue of rent seeking behaviour on part of the State (Moore, 2001; Auty 2001). Violent conflicts in resource-rich developing countries have had a further detrimental impact on their growth (Collier and Hoeffler, 2004). The nature of the mining industry itself, which is capital intensive and has long gestation periods, calls for large investments over long periods of time. The profitability of the sector is also affected by volatile prices (Tilton, 2005).

The issues behind commodity pessimism can be divided between those that are a result of global economic relations and those that arise at the country level. The major frameworks developed to explain the resource curse focus on terms of trade and the associated low income elasticity of demand for commodities. Price volatility looks at the cyclical behaviour of prices over time, and the impact of price on the nature of the global mining industry. These issues are fundamentally economic in nature and relate to the prices of commodities. The Dutch disease and the implications of rent seeking behaviour are non-price topics and areas of governance and politics. Given the negative political and economic influences of commodity led growth, the push for industrialisation as a means to development was proposed by a number of governments and international financial institutions. We examine each framework of the resource curse and its contribution to commodity pessimism, and outline the general argument to favour industrialisation over commodity led growth.

2.1 The Terms of Trade

The terms of trade refer to the ratio between an exported commodity bundle and the imported manufactures bundle. It is a relative term, and therefore changes in either variable will have an impact on the ratio. Terms of trade can be calculated for price indices, incomes and factorial contributions. We use the barter terms of trade which is the relative price of exported goods to imported goods.

The Classical economists, such as Smith (1776) and Mill (1844) believed that the price ratio between primary commodities and manufactures exporters would favour the former. This assumption rested on two fundamentals: the diminishing returns in agriculture commodities and increasing returns in manufactures due to economies of scale. Expansion of land for agriculture use would increase less productive land brought under cultivation, and the diminishing marginal productivity of increased labour would result in diminishing returns to scale for agriculture. As scale economies and productivity increases were brought into effect in manufactures, the increasing returns would push prices downwards. Apart from scale, the increase in productivity and technological progress in the manufactures sector would also lead to lower prices. Therefore, the price ratio between primary commodities and manufactures exporters, in the long run, would favour the former.

Prebisch (1950) and Singer (1950) in examining the pattern of trade for the United Kingdom, as a proxy for the centre and the periphery, came to the exact opposite conclusion: the terms of trade were deteriorating over a period of time for primary commodities in relation to manufactures. They concluded that developing countries, which primary product exporters, were worse off because of the continued deteriorating terms of trade against the manufactures exporting industrialised countries.

Prebisch (1950) focused on the differences between labour markets in the centre and the periphery. The centre was a capital abundant country while the periphery was labour abundant. Given the labour abundant nature of the periphery, he argued, any gains made from productivity increases would not be passed on as wages, since labour abundance would result in the subsistence wage to

be maintained. Productivity increases in the agricultural sector would be passed on to the centre, via trade, as lower prices. The centre on the other hand, with labour scarcity, would see productivity increases being retained as higher wages and not as lower prices of manufactures. Gains in productivity would be retained by the centre and not the periphery. For each downturn in a business cycle, prices would be pushed down in the periphery's' exports but not in the centres' exports. With each completion of a business cycle, the gap between the wage in the centre and the periphery would increase. Uneven spread of technical progress would also led to differences in productivity ratios between North and South, i.e. the North having faster increases in productivity and technology in both agriculture and manufactures, would ensure that terms of trade would continue to deteriorate for the South (Prebisch, 1959).

Singer (1950) focused on the enclave nature of the export sector in less developed countries. He saw a structural tendency for developing countries to loose from trade given the price ratio of their export and import bundles. Singer assigned four major reasons to the deterioration of terms trade for developing countries. First, the price elasticity of demand for primary commodities relative to manufactures was low. Secondly, as with Prebisch, the income elasticity of demand favoured manufactures over commodities. Thirdly, the industrialised countries were able to generate Schumpeterian innovation rents while the developing countries were not. Fourthly, the structure of labour and commodity markets in the two regions would lead to technical change being absorbed by the industrialised countries but not by the developing countries. Regardless of the South exporting primary commodities or manufactures, they would face deteriorating terms of trade in relation to the North.

Lewis (1954), Findlay (1980,1981) and Evans (1987) looked towards supply side factors for an explanation and focused on the role of technology advances to explain the deteriorating terms of trade faced by developing countries. They argued that due to the structural nature of the labour-abundant economies of the South, any technological advances would tend to be capital saving and may result in lower prices in its export sector. Conversely, technological advances in the North would tend to be labour saving, mostly in its non-trade able sectors. As a result, export sector of the

North would not see a decrease in prices. Technological advances in the South would result in terms of trade deteriorating for the South.

The Empirical Evidence: The Prebisch-Singer hypothesis was based on the empirical work of Schlote who examined the terms of trade for the United Kingdom over the 1870-1938 period[6]. His study showed a 40% improvement for the United Kingdom and therefore a decline for developing countries. A number of studies have been conducted on terms of trade trends with some showing negative trends, while other researchers show no trends. Still, others have argued for Structural Breaks within the time line. There has been no evidence of an upward trend. The evidence for a downward trend also remains contested. Spraos (1980), Thrilwall and Bergevin (1985), and Grilli and Yang (1988) showed negative trends for the prices of primary commodities, Cuddington and Urzua (1989), and Powell (1991) show no trends. Some of these results are summarised in Table 2.1.

Table 2.1: Empirical Findings for Deteriorating Terms of Trade

Studies		Results
Spraos	(1980)	
Thrilwall and Bergevin	(1985)	
Sapsford	(1985)	
Grilli and Yang	(1988)	Negative Trends
Ardeni and Wright	(1992)	
Bleaney and Greenaway	(1993)	
Cashin and McDermott	(2002)	
Cuddington and Urzua	(1989)	No Trends
Powell	(1991)	
Sapsford	(1985)	Structural Break - 1950
Cuddington and Urzua	(1987,1989)	Structural Break - 1920
Powell	(1991)	Structural Break - 1921, 1938 and 1975

Source: Author's compilation from various sources

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[6] Diakosavvas and Scandizzo (1991)

Sproas (1980) comparing pre and post World War II prices for commodities (1900-1970) found that although there was a negative trend before the war, it was not to be found in data post World War II. Sapsford (1985) using 1900-1980 data, excluding petroleum prices, showed a decrease of 1.3% per year in terms of trade for primary commodities. The exception he noted was an upward structural break for the 1950s, but thereafter the downward trend continued.

Bleaney and Greenaway (1993) covering 1900-1991 prices, show a downward trend of 0.5% per year for non-fuel primary commodities. Breaking the time line further, they show the trend was negligible for the 1925 to 1980 period, but post 1980 the average price for commodities was relatively low as compared to the previous period.

Grilli and Yang (1988) covered the period 1900 to 1986 and found a 0.5% fall per year for all commodities, and a decrease of 0.6% per year for non-fuel commodities relative to manufactures. They document no structural breaks.

However Cuddington and Urzua (1987, 1989) using different statistical techniques found no deterioration in the barter terms of trade for the period 1900-1983, apart from one drop after 1920. Ardeni and Wright (1992), covering 1900-1988 found a downward linear trend in commodity prices, and dismiss the structural shift in the 1920s found by Cuddington and Urzua (1989). Powell (1991) argues for three major structural breaks, all downwards, in 1921, 1938 and 1975; while the overall trend remains downwards.

Cashin and McDermott (2002) using prices from 1862-1999 showed a downward trend in commodity prices of about one percent per year, over the 140 year time period. They found little support to suggest a break in the declining long run trend but increasing incidences of volatility in commodity prices in more recent years. The long run trends in real commodity prices are small in comparison to the annual variability in prices, making short term movements highly unpredictable. Deaton (1999:27) agrees: 'What commodity prices lack in trend, they make up for in variance'.

The major statistical studies surveyed lead to no firm conclusions, and as Sapsford and Singer (1998:1654) comment: '[...] it has often proved difficult to disentangle the question of the existence,

or otherwise, of a declining trend from that of the performance and adequacy of the particular statistical technique employed'.

Depending on the time series and statistical methods used, the magnitude of a downward trend remains inconclusive. Moreover the timings of structural breaks are dependent on the time series used and for some periods structural breaks coincide with major global events such as war and global recession. Increased variability in recent terms points to much stronger fluctuations that temper the overall trend. Cyclical fluctuations in commodity prices are as important as the long term trend and are discussed in detail in Chapter 3. We raise the possibility of a rising trend in terms of trade linked to the 2003-2008 commodity boom in Chapter 7.

Irrespective of whether the commodities–manufactures terms of trade have declined, there are two important implications of this debate. First, the explicit inference that growth in the South is dependent on the growth in the North. Secondly, the implicit assumption that supply of commodities is unlimited. The terms of trade hypothesis states that the North, being the labour scarce economy relative to the South, tends to retain most of the benefits from improved technology, productivity increases, and innovation rents in relation to the South. The technical change in the North will generate higher rents/wages while those in the South will generate lower prices.

Given the income and price elasticity of commodities and manufactures, growth in incomes will generate increased demand for manufactures as compared to commodities. Therefore, growth in incomes in either region will be beneficial for exports of the North and not the South. Even when the South exports manufactures, it will still suffer from adverse terms of trade as compared to the North (Sarkar and Singer, 1989, 1991). Edgeworth (1894) further argues that productivity increases in an export commodity, where demand is less than unity, will lead to welfare losses for the exporting country. This would be true for commodities and commodity-exporting developing countries which are mainly in the South.

If only the barter terms of trade are declining, an increase in the income terms of trade may outweigh the loss in welfare due to the former. Income terms of trade refer to the ratio between the values of exports and the price of imports. An increase in the volume of exports may generate

higher revenues while import prices remain the same, thereby improving the terms of trade for the commodity-exporting developing country. If the income generated from increased commodity-exports is rapid enough, then it can compensate for the falling barter terms of trade. However, this effect is dampened by the low income elasticity of demand for commodities.

Due to the nature of demand for the products of the North (mostly manufactures) as compared to the South, growth will be determined by tastes in the North. Given the low income elasticity of demand for commodities relative to the high income elasticity of demand for manufactures, the overall welfare effect for the developing country is likely to be negligible. Demand for commodities will not rise to compensate for rising demand for manufactures as income levels increase in either region. The income elasticity of demand dictates that the North's consumption decisions have a much higher impact on the trade between North and South than do the latter's' consumption decisions (Evans, 1987).

Given the deteriorating terms of trade for the South relative to the North, the role of trade as a driver of growth for the South becomes an important one. Growth in the North will be transmitted to the South through trade, as an increase in demand for its exportable product. But whether these exportables are commodities or low technology manufactures, their low income elasticity ensures that the increase in demand is not proportional to the increase in incomes. As a result of the different income and price elasticity's of demand for the exportable products of the South, Lewis (1980) suggests that the North controls the rate of growth of the South through trade. If the growth in the North falls off, so will growth in the South. Only when a large number of Southern countries 'reach self-sustaining growth [...] instead of trade determining the rate of growth of LDC [*Less Developed Countries*] production, it will be the growth of the LDC production that determines LDC trade' (1980:562).

The second issue in the terms of trade discussion is the assumption of unlimited supply of commodities. Wright and Czelusta (2004) point out that a comparative advantage in commodities does not equal 'resource abundance'. The discussion around the production of primary commodities tends to focus on the labour abundant nature of the economies that produce them.

Even in the case of mineral commodities, they are considered to be in plentiful supply. When an advanced economy is assumed to produce commodities, the implications of the capital intensity method of their production on wages and prices is discussed. Whereas barriers to manufacturing output growth are understood, no such production limitations are considered in the case of commodities.

There is a need to caution against the assumption of abundant commodity supplies. A hard-commodity underground does not constitute a product of value until it is exploited and extracted. Its production has costs which may be prohibitive enough to discourage extraction in the first place. Labour-abundant countries may not be able to extract commodities at low price levels, if factors other than low wage rates or non-appropriation of innovative rents are the determinants of price. These determinants are discussed in Section 3 of this chapter. The assumption of unlimited commodity supply is therefore not always a valid one. This point is discussed in more detail when exploring the nature of the mining sector in Section 2.4.

2.2 Income Elasticity of Demand for Commodities

One of the explanations for deteriorating commodity terms of trade was the lower elasticity of demand for commodities relative to manufactures. With economic development, as per capita incomes grow, the demand for manufactures will increase relatively more than commodities. Clark (1957) argued that much like Engel's law states that rising incomes will see a smaller proportion being spent on food, increasing incomes will first see a higher share spent on manufactures and then on services.

Commodities are a smaller share of the input into manufactures, and hence will not experience a proportionate rise in demand when manufactures demand increases. Improvement in technology and productivity, including substitution of natural resource inputs with man-made resources, will also result in less commodities being demanded for per unit increase in manufactures output. The lower income elasticity of commodities would result in slower growth rates for countries that relied on them through exports (Johnson, 1954).

The higher income elasticity of demand of manufactures over commodities also explains why the increase in demand for commodities tends to lag overall economic growth rates. The significance of commodities in gross national output is reduced as the economy grows (Kuznets, 1966). Rising productivity in the industrial sectors means that fewer and fewer resources are required as factor inputs. Even though the industrial sector relies on the primary sector, with increasing productivity of non-commodity factors economic growth will tend to carry forward a smaller material weight over time. Thus, demand for raw material tends to have a slower growth rate than the overall economy (Radetzki, 2008). The rate of demand for commodities will tend to lag economic development, and as income growth accelerates in emerging or advanced economies commodity demand will not see a similar increase.

Matsuyama (1992) argued that resource-abundant countries could achieve higher growth rates if they had no resources. Krugman (1987) identified a loss in competitiveness and lower income levels as a result of temporary commodity price booms. The Staple Theory, based on forward and backward linkages argued that the primary sector can be a source of growth, through the export sector. However if the primary sector exhibits 'enclave industry' properties, its impact on overall growth can be severely limited. Mineral and metals extraction are more likely to have an enclave nature than agricultural production.

Natural resource-rich countries tend to focus on their comparative advantage in the resource sector and away from manufacturing, thus delaying their industrialisation. Therefore they export more commodities than manufactures relative to other countries at their income levels. Chenery and Taylor (1968) find that given similar income levels, small primary-exporting countries tend to lose out on scale when compared to small manufactures exporting countries. Since scale is one of the factors that contributes positively towards higher income levels, this leaves the primary exporters at a disadvantage relative to manufactures exporters.

Industrialised nations will tend to grow more rapidly than commodity based ones. The former's growth pattern allows productivity and innovation rents to be retained in the North and as a result income levels tend to rise in the North relative to the South. With the low income elasticity of

demand for commodities, the increase in income in the industrial economies does not translate into a proportionate increase in the demand for the exported products of commodity based economies. Even with some increase in demand, the value of the exported bundle continues to fall due to the deteriorating terms of trade.

2.3 Price Volatility

One of the defining characteristics of commodity prices is their volatility, both in the short and long run. Price fluctuations affect the revenues of an exporting economy, and make it difficult to plan for slumps and booms within State budgets (Gylfason *et. al* 1999; Herbertsson et. al, 2000). Numerous attempts, such as international price stabilising schemes and the construction of buffer stocks to smooth out volatility, have been tried and have failed (Gilbert, 1996).

One of the major works conducted in commodity price volatility has been that of IMF researchers Cashin and McDermott (2002, 2006). Analysing real commodity prices from 1862 to 1999, they conclude that prices have been experiencing a downward trend. However the increase in fluctuations in price and the frequency of these fluctuations were large enough to drown out the trend itself: 'Although there is a downward trend in real commodity prices, this is of little practical policy relevance, since it is small and completely dominated by the variability of prices' (2002:175).

They reach three conclusions from their analysis of long term trends and commodity cycles. First, given the highly volatile trend in real commodity prices, it is difficult to know either the growth trend rate or to use the historical trend rate for policy purposes. Secondly, they report an increase in volatility, i.e. price movements have become more variable over time. The increase in price volatility is first seen in early 1900s, and then again from the early 1970s. Thirdly, when comparing long run trends to annual variability in price, the latter are far greater than the former, allowing for little scope of forecasting short term price movements of commodities. In terms of policy implications, they conclude that more attention should be paid to the commodity price fluctuations rather than the long run trend.

In another paper Cashin, *et al.* (2000) using monthly averages for commodity prices (1957-1998), look at price cycles and shocks. Their findings conclude that not only are shocks to commodity prices typically long lasting, but more importantly to our research, the persistence of these price shocks is wide. Persistence signifies the time that it takes for the affects of the shock to dissipate. Persistence is likely to occur in commodities where weather has a limited role in production. 'For persistent shocks it is likely that the entry of new producers could have long-run effects on the evolution of prices (metals, fuels, and fertilizers), and that those commodities where shocks have a greater possibility of originating from the demand side of the market could result in long periods of excess supply or demand' (2000:197).

Within commodities, price slump and boom periods are also differentiated between hard and soft commodities due to varying supply inelasticity. Agricultural commodities have short production cycles, usually of a year when related to farming such as grains and cereals, and longer when focusing on products such as coffee, rubber or timber. Hard commodities, minerals and metals, have longer production cycles relative to agricultural commodities. From identifying an ore body, to extraction, processing and shipment, the production period can vary between 5 to 10 years and in some cases even more. Decisions over increasing or decreasing output can take long periods to enact. The factors behind such long production cycles are discussed in detail in Chapter 5. A single cyclical movement for hard-commodities tends to be longer than that experienced by agricultural commodities.

Price slumps in commodity prices tend to be noted for their longer durations relative to periods of booms. Cashin, *et al.* (1999) examined 36 commodity prices for the period 1957-1999 and suggest that on average price slumps tend to occur for a longer time period (39 months) than do price booms (29 months). The magnitude of price slumps (46%) also tends to be higher than the magnitude of price booms (42%). They find little evidence of a consistent shape in commodity price cycles, and 'for all commodities the probability of a slump in prices ending is independent of the time already spent in the slump. This finding of no duration dependence in slumps also holds for most commodities in boom periods' (1999:11).

Deaton (1999) argues the opposite of Cashin and McDermott and suggests that unlike consumption or income cycles, commodity cycles are not persistent and shocks do not have long run effects. Commodity prices tend to return to a trend, and the long term average price tends to remain fairly consistent. However, Deaton does concede that conclusions drawn from 'numbers' are very much dependent on the commodity chosen and the years under consideration. Trends tend to be small relative to the variance of prices. Deaton also refers to the Lewis model (1954), arguing that the reason prices for tropical commodities (mainly agriculture) tend to remain low, is the presence of a large number of unemployed labour. This keeps the wage rate low and the prices of commodities low. 'Prices always eventually revert to base because, while short run events can increase prices, sometimes for many years, long-run marginal costs is set by the poverty of the tropics and supply will eventually be forthcoming' (Deaton, 1999:30).

The studies covered above, point us in two specific directions for further analysis. First, that volatility tends to be much more prominent than trends, so historical data has little strength in forecasting future prices. Secondly, this volatility has increased since the 1970s with a higher frequency of cycles. This coincides with a change in the price setting mechanism, which has gradually moved towards greater market activity than producer price setting. It is also important to recognise the difference between price volatility caused by an increase in the frequency of cycles, and one that results from an increase in amplitude of price movements. These issues are explored in further detail in Chapters 3 and 6.

2.4 Nature Of The Mining Industry

The nature of the mining industry can be examined within a single economy or in a wider context of the global mining sector. At the country level, development economics considered the enclave nature of the industry to be detrimental to growth (Hirschman, 1958; Seers, 1964; Baldwin, 1966). Most of the inputs for the industry are imported, and the ores are often exported with little value added in the country of origin. The benefit from natural resources tends to incur to the MNCs that operate the mines in developing regions rather than the country itself (Girvan, 1987). Given the point nature of hard commodities, i.e. they occur at fixed geographical locations, local communities

tend to bear the brunt of environmental and social costs that are associated with mining, while it is the State at the centre which receives the royalties and benefits (Davis and Tilton, 2005). This is especially relevant in developing countries where regulations and enforcement of environment and labour laws may be lax relative to advanced economies.

A country's minerals and metals resources are finite and non-renewable leaving the economy to face the possibility of resource extinction. The Club of Rome Report (1972) raised this possibility and projected that by the 21st century, world population, industrialisation, pollution and food production would lead to resource depletion. In 2004, a revision titled 'Limits to Growth; The 30 year Update' (Meadows et al. 2004) was published, suggesting that the use of the world resources was indeed heading towards an environmental catastrophe and resource depletion. Such considerations led some organisations like Oxfam (2002) to actively discourage mining projects in developing countries.

Despite the issues raised around resource extinction, those within the mining industry believe that natural resource depletion or extinction is unlikely to occur. For example, the known reserves for copper will last for 34 years, while known resources for copper can last for 264 years[7]. 'Running out' of commodities is not as much a matter of physical depletion as the inability to extract it at an affordable price. Tilton (2007) argues that resource availability depends on a race between the cost-increasing effects of depletion and cost-reducing effects of new technology. Additionally, factors other than depletion, such as cartel activity, economic booms can influence prices, especially in the short run.

There have been very few cases of a single country depleting its resources, for e.g. Dubai and Tunisia, facing oil reserve depletion. However they managed to successfully diversify their economies to maintain growth levels. The Netherlands, after the discovery of large natural gas fields in 1959, faced an appreciating exchange rate and a decline in its non-resource sectors that disrupted growth. But it too has successfully managed to diversify away from its dependence on its natural gas sector.

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[7] Reserves are concentrations of ore body that are accessible for extraction, while resources indicate ore bodies that are, or may become reserves. (Tilton, 2007)

In more generalised, non country specific terms, the nature of the mining industry tends to set it apart from the manufacturing sector. As minerals and metals are point commodities, the extractive industry is also fixed in terms of location. Apart from a few select metal ores such as gold and platinum, base metal ores are scattered across various geographical regions. The cost of extraction may be higher or lower given the accessibility to location. The grade and nature of the ore deposit will determine the cost of production at each location, which may not always be profitable given the expected future price. Production barriers in the industry can arise from the prohibitive cost of mining rather than limited access to the ore body itself.

The mining industry tends to be capital intensive, as well as its forward and backward linkages. For example, services and mining equipment require high expenditure, while processing and smelting operations for the mined ore incur high capital costs. Economies of scale are important and one processing plant may service a number of different mines to achieve cost efficiency of operation. Given the high capital cost of running a mining project, firms in the short run can continue operating even when marginal cost is higher than marginal revenue. The costs of shutting operations and then re-starting can be high, resulting in firms choosing to operate even during periods of price slumps as long as part of the fixed costs are being met. This behaviour partially accounts for the price inelasticity of supply for the commodities sector (Crowson, 1998).

A country's mining sector is also limited by the size of its domestic market. Given that mining tends to be a large scale activity with high costs, its output tends to be large as well to meet part of the fixed costs of production. However, rarely is a developing country able to absorb all its output domestically. A high level of manufacturing and infrastructure expenditure would be required to do this. Therefore a major share of the output is exported to the more industrialised nations.

For the global mining sector as a whole, growth in demand is therefore dependent on the absorption capacity of the industrial economies. An individual country increasing mining exports may not generate larger export revenues due to the fallacy of composition, especially if it's a major producer with a large share of global production. Their collective efforts will lead to over-supply and hence lower prices. With the debt crisis in the 1980s, the World Bank and IMF advocating

increasing commodity-exports for developing countries, the 'adding up' problem led to such an over-supply and consequently low prices for these commodities. Sapsford and Singer (1998) argue that commodity markets must be considered from a general equilibrium analysis in terms of global supply and demand, and not a partial equilibrium analysis from the viewpoint of a single country.

Demand from advanced countries will determine the rate of growth for the global mining industry. Increasing supply without a collaborating increase in demand will result in surplus markets and lower prices. With the global mining sector intensely competitive, with no cartels or monopolies in base metals, output will tend to reflect demand and supply fundamentals[8]. Thus, the global level of demand, generated largely from the advanced countries, will determine pace of growth of the industry.

Environmental and social costs in mining are as yet poorly factored into price, and increasingly pressure is being exerted to make the mining industry more responsible in terms of pollution and labour rights. The Extractive Industries Transparency Initiative, introduced in 2002 and subsequently supported by the UN, is just one example of such efforts. Factoring these issues into price is one method to make the industry take the social and political consequences of their operations more seriously. Some of the leading mining firms are responding to these pressures positively.

2.5 The Dutch Disease

The Dutch Disease is named after the experience of the Netherland's economy after the discovery and exploitation of its natural gas fields in 1959. The subsequent decline of its manufacturing sector and growth are termed as the Dutch Disease. The disease occurs when resource abundant countries fail to grow as their commodity-export sector leads to an underdeveloped manufacturing sector (Saaraf and Jiwanji, 2001).

Corden and Neary (1982) attribute this to two impacts of a commodity price boom on an economy, namely a 'resource movement effect' and a 'spending effect'. The first causes resources such as

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[8] The exception to this rule is Iron Ore, where prices are reached through annual negotiations between producers and consumers.

labour and capital to move into the commodity-exporting sector and away from the manufacturing sector. Public and private investment is crowded out of the manufacturing sector and into the commodity sector. Productivity gains, and learning by doing are no longer a priority in the domestic manufacturing sector, leading to its inability to compete in the international markets (Wijnbergen, 1984; Krugman, 1987; Sachs and Warner, 1995; Gylfason *et al.*, 1999). This leads to the manufacturing sector facing higher wages and capital costs in order to attract factors away from the resource sector.

The spending effect is a result of windfall gains from the commodity boom, which increases the demand for the traded and non-traded sectors outputs. Traded products can be imported and their prices are set by international markets. The non-tradable sector on the other hand, in the face of rising demand, competes for factors of production with the commodity sector, and hence bids up wages and capital costs. Thus prices rise in the non-tradable sector, unless the commodity sector does not draw on local factors of production (McMahon, 1997).

The appreciation of a country's exchange rate due to its resource-exports makes it more difficult for its manufacturing export sector to compete in the international markets (Fardmanesh, 1991). Inflation within the domestic markets, coupled with an appreciating exchange rate put further pressures on the domestic manufacturing sector.

The impact of a strong commodity-export sector is linked to direct-deindustrialisation through the resource movement impact, and to indirect-deindustrialisation through the spending effect (Stevens, 2003). With appreciating exchange rates, the traded non-mining sector has to face higher competition in international markets for its exports. Manufacturing also faces greater competition within the domestic markets against imports that are cheaper due to the high exchange rate. Economic activity therefore gets pushed into the non-traded sector. The non-traded sector, both in manufacturing and agriculture comes under further pressure from competing in the domestic economy for capital and labour with the traded mining sector. From the point of view of a resource-rich developing country, its economy tends to become dependent on the commodity-exporting sector, while the domestic sectors face more difficulty in gaining a strong hold in both the domestic

and international markets. The mining sector itself tends to have less forward and backward linkages, and thus its contribution to growth is limited relative to the agriculture or manufacturing sectors.

2.6 Rent Seeking Behaviour

The point commodity nature of metal ores tends to make them prone to rent seeking behaviour on part of the State or other monopolies. Dependence on primary commodities over a long time period can encourage predatory behaviour on the part of the government (Auty, 2001). When a government receives royalties for its natural resources, without a strong system of accountability and responsibility to the people in place, the temptation for the State to ransack the country for its own gains can be large (Mkandawire, 2005).

Rent seeking behaviour on part of the State ensures that the mineral wealth of the country is not shared equally or used to benefit the population at large. This is likely to increase income disparities within a country and benefit a few at the cost of the many. Lack of accountability towards the people may cause further damage such as a decline in institutional quality (Ross, 2001; Sala-i-Martin and Subramanian, 2003). Since the royalties are paid to the State, while mining operations are conducted in remote regions; control of the centre becomes important. This often results in conflict and civil war. Such armed struggles over ownership of natural resources have led to a detrimental impact on growth and is evidenced for a number of developing countries (Karl, 1997; Knight et al., 1996; Collier and Hoeffler, 2004; Ross, 2001).

2.7 Push for Industrialisation

Although commodities are essential as inputs for the expansion of an economy, commodities themselves have rarely played a lead role in growth. GDP growth relies on the expansion on the industrial and eventually services sector and not on the primary sector. Auty (2008:388): 'Economists have long tended to regard natural resources as generally far less important to economic growth than capital and labour'. Such observation led development orthodoxy to promote industrialisation in developing countries. The 1950s gave rise to a time of commodity pessimism

and modern growth theory argued against dependence on commodity-exports (Rosenstein-Rodan, 1943; Scitovsky, 1959). Capital accumulation within the economy was the essence of most growth models, and an industrial sector was considered essential to increase productivity and growth of GDP. With increasing evidence of the resource curse on the one hand and growth in manufacturing-orientated exporters on the other (mainly in the 1960s and 1970s), growth theory found a firm footing in advocating industrialisation over commodity led growth.

Larger countries benefit from economies of scale and tend to reach middle and late industrialisation quicker than smaller countries (Chenery, 1960).

The historical observation that all the development 'successes' have been strongly associated with manufacturing growth led to similar strands in development policy. 'The development of a strong manufacturing sector has been at the core of all successful catch-up experiences over the past 250 years, which suggests that achieving a lasting productivity-based increase in manufacturing is indispensable for a sustained rise in income levels and ultimately the eradication of poverty' UNCTAD (2006:150).

There are a number of economic, political and social issues that have resulted in commodities being unable to deliver growth in the past decades. The failure of commodities has further strengthened the role of industrialisation in development. But how does the industrial and the commodity sector compare in the growth pattern? In the next section we outline structural change and the growth process, highlighting the changing roles of the industrial and primary sectors as growth progresses and consequent demand for commodities.

SECTION 2 STRUCTURAL CHANGE AND ECONOMIC GROWTH

Economic growth is 'a sustained increase in per capita or per worker product, most often accompanied by an increase in population and usually sweeping structural change' (Kuznets, 1966:1). Syrquin (2008) describes structural change as a conflictive process, with individual and societies required to adapt to the transformation, and the movement of rural populations to urban centres in the early stages of growth. Growth within an economy may be generated through

different sectors, but cross-country comparison over time indicates a generalised pattern of economic growth.

2.8 Normal Patterns Of Growth

The diversity amongst countries in terms of natural and human resources, country size and population, access to technology, transport and finance networks are so varied that it is difficult to model a pattern of growth that will apply to all. However, some generalisations are helpful in understanding the growth path most economies are likely to take.

Low income economies tend to be agrarian based and the highest contribution to GDP comes from the primary sector. As incomes rise and manufacturing expands, the industrial sector takes over as the major driver of GDP growth. Continued income growth leads to higher demand for services, and at higher income levels it is the dominant GDP contributor. The structural shift within an economy as income levels rise is a well established pattern, observed in a large number of countries over time. Whereas the Neoclassical school did not pay much attention to the changing structure of the economy as incomes increased, others such as Kuznets(1971), Rostow (1961), Chenery and Syrquin (1975) and Baumol et. al (1989) focused on the link between structural changes and economic growth.

Differences in sectoral composition between economies explains 22% of the variation in their income growth rates (Echevarria, 1997). Certain regularities have been observed in transformation of sectoral composition and economic growth. First, poor countries have the lowest rates of growth, followed by the richest countries and then the middle income countries which have the highest growth rates (Lucas, 1988). Secondly, within poor countries, the highest proportion of value added to GDP comes from the agricultural sector, while in the richest countries it comes from the services sector (World Bank, 1987). Middle income countries tend to have strong industrial sectors. Thirdly, the share of employment in agriculture decreases as economies grow, while for the high income countries services is the dominant employer. This is accompanied by increased rural-urban migration.

Sectoral change can be seen as a transformation in the contribution of each sector to the value added in GDP, change in the employment structures, as well as increasing urban populations relative to rural areas. We identify two major factors these sectoral shifts in normal growth paths[9]. The first is the effect of income elasticity on aggregate demand while the second is changes in productivity levels. We briefly outline the impact of these drivers on observed structural change within an economy.

Income Elasticity of Demand: The income elasticity of demand for final products indicate that as incomes rise the demand for agricultural products will decrease, while that of manufactures will increase. At high income levels the demand for services will exhibit high income elasticity.

Engels law dictates that as incomes rise, a smaller proportion of the income will be spent on food items. Manufactured products have higher income elasticity of demand and therefore an expansion in income will lead to higher demand for the output of that sector. Bonatti and Felice (2008) report the income elasticity of demand for services to be greater than unity for services as an aggregate, while that for manufacturing is below unity. The differences in elasticity will gradually increase the share of the industrial sector and demand induced changes in consumption induces a shift in the sectoral value added as a share of GDP (Pender, 2003; Pender et. al, 2003). Sectoral elasticity also account for the differences in growth rates due to differing sectoral composition (Echevarria, 1997).

The transformation of aggregate demand and its impact on sectoral composition results from the change in hierarchy of needs. The consumption bundle within a country differs between the rich and poor households, and income inequality can effect growth rates and structural changes (Foellmi and Zweimuller, 2006). As households become richer the hierarchy of needs change, what were first considered luxuries now become necessities. In advanced economies the satisfaction of more complex needs can largely be fulfilled by the services sector and therefore the demand for its output increases (Foellmi and Zweimuller, 2008). This is reflected at the highest income in the services sector having the highest share of value added to GDP.

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[9] The number of factors linked to economic growth are quite large, and we focus on the two relevant drivers here.

Bonatti and Felice (2008) in accounting for the sectoral changes observed for the industrialised countries conclude: '[...] tastes and attitudes of households may have relevant consequences for the long term-term growth performances of an economy by affecting the composition of consumer's demand. More in general, one may conclude that every factor affecting the composition of final demand can influence long-run growth' (2008:123).

The employment structure tends to follow the shift in sectoral composition accompanying growth. At low per capita income levels the agricultural sector will have the largest share of employment and as income's rise and the manufacturing sector, employment will shift to the industrial sector. At the higher income levels, the services sector will be dominant employer. Studies by Kravis et al. (1983) Summers (1985), Appelbaum and Schettkat (1999), Mattey (2001) and the OECD (1994) confirm such shifts in employment structures for the industrialised countries.

Changes in Productivity: Echevarria (1997) argues that since productivity grows at different rates within each sector, the sectoral composition of the economy will determine its overall rate of growth. For example, since productivity rates are the highest in the manufacturing sector, relative to agriculture or services, an economy where the industrial sector is the largest will also show faster economic growth rates compared to an agricultural or services based economy. This accounts for the differing growth rates across income levels observed by Lucas (1988). Maddison (1982) confirms similar results for industrialised countries over the 1820-1973 period.

Pender (2003) examines for two other productivity factors that can account for sectoral shifts. First, the assumption that that industries with higher labour productivity will be the recipient of greater labour allocation while those with lower productivity levels will gradually fall away and secondly, Baumol's (1967) 'cost disease' argument. Baumol's argument essentially states that while progressive industries can attract higher skilled workers by offering higher wages, industries in which labour productivity increases are limited, in order to compete with the progressive sectors, will have to increase wage rates and therefore production costs rise without an accompanying rise in productivity. Therefore employment and wages rises in 'stagnant' sector and act as a structural burden for the economy overall. Pender (2003) concludes that structural shifts do have positive and

negative contributions to aggregate productivity growth, but the overall impact of sectoral change on productivity growth is weak since the net impact of these contributions are weak.

The employment structure also tends to follow the shift in productivity levels across sectors. The shift from agriculture to industry is easy to understand, given the higher productivity levels between the two sectors. Between manufacturing and services, the latter tends to have lower productivity levels (Kravis et al., 1983; Summers, 1985, Maddison, 1991; Rowthorn and Ramaswami, 1999; Inman in OECD 2000, Mohnen and ten Raa, 2001). In general this leads to services being more labour intensive than manufacturing (Glyn, 1997; Bonatti and Felice, 2008) as a larger labour force is required to maintain output[10].

At higher income levels the services sector dominates the share of value added to GDP as well as being the major source of employment. In this dissertation our focus is on China, which is a developing country and is decades away from mature economy status. Since the services sector is dominant at higher income levels only, we do not consider further the various aspects of service led growth.

The pattern of structural change driven by the income elasticity of demand is an important argument for understanding China's resource demands. In general the elasticity for commodities is low but relatively higher in certain growth phases compared to others. In a resource-intensive stage, where the industrial sector is expanding, the income elasticity of demand will be high as commodity consumption increases within manufacturing and urban sector expansion. A sectoral shift from primary to the industrial sector is referred to as a resource-intensive stage of growth. Relative to the transition from an industrial to a service base, commodities are used more intensively in this stage. We return to this point in detail in Chapter 4.

The issues surrounding the role of commodities in development are far reaching, from global economic issues (terms of trade), to those applicable at a country level (rent seeking behaviour) and others that are more sectoral in nature (the enclave nature of the industry). Each of these

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[10] This also accounts for the relative increase in price for services compared to manufactures at higher income levels documented by studies. However our focus is on the expansion of the industrial sector and therefore this point is not discussed further.

issues spans a vast area of literature, evidence and policy implications, which cannot be dealt with adequately in the space of this dissertation. We therefore focus on the determinants of change in recent commodity price behaviour, and the issues these changes address.

SECTION 3 DETERMINANTS OF COMMODITY PRICE

In understanding hard-commodity price behaviour we examine both the fundamental and financial side of commodity markets. Demand and supply in the real economy, coupled with investor activity at the commodity exchange set the international price of commodities. We focus on four main issues in the commodities and development research area; income elasticity of demand, the global nature of the mining industry, price volatility, and terms of trade debate:

- To establish behaviour of commodity prices we examine periods of commodity price booms.
- The income elasticity of demand is examined in the larger dynamics of structural change in a growing economy.
- The supply dynamics are explored in association with the nature of the global mining industry.
- Price volatility issues are discussed within the parameters of the financialisation of commodity markets.
- If there are changes in patterns of commodity price behaviour, a re-examination of the terms of trade debate is required.

Each of these steps is explained in further detail below.

Commodity Price Booms: Commodity prices can be studied through a trend analysis as well as observing their cyclical behaviour. Our review of the literature indicates a growing importance of commodity cycles, since their length often obscures trend movements. In examining commodity price behaviour, we focus on major 'price events' within cycles, where the interaction of drivers of commodity prices is clearer to articulate. Major commodity price booms offer such an opportunity, and are examined in detail. Since the Second World War, three commodity booms have been experienced in 1951-1953, 1973-1975 and in 2003-2008.

Commodity price booms occur when commodity prices in different sectors rise together, but not necessarily by the same extent. Sub-sectors, such as agricultural raw materials, food, energy and metals can all experience an increase in price due to global economic or political events. Individual commodities may experience individual price booms such as coffee prices increasing due to a frost in coffee growing regions. Such movements represent changes in particular sectors, often at an industrial level only, and do not reflect changes in the global economy. Patterns of price behaviour and the drivers of change during the three booms are addressed in Chapter 3.

Demand Drivers: Hard-commodity demand in the real economy is derived from their usage as inputs or intermediate products. The intensity of usage per capita is dependent on the structural nature of the economy. Metals and minerals are intensively used in a number of sectors like infrastructure, construction (urbanisation) and manufactures. The income elasticity of demand for commodities will change as an economy moves from an agrarian base to an industrial one. This move will also be accompanied by populations migrating from rural to urban centres, where the latter's rate of expansion will generate higher rates of commodity demand. The increased intensity of consumption during a resource-intensive stage can lead to demand disruptions in price.

Demand disruption refers to a state when a high income elasticity of demand and unanticipated increases in volume of demand emerge at a global level. This can occur when a large developing country reaches a resource-intensive stage of growth relative to other developing or advanced countries. We examine this argument in detail in Chapter 4.

Supply Drivers: Hard-commodity supply refers to the collective output of the global mining industry. The economic issues within the sector include the capital requirements of the industry, the time horizon of investment returns, and project gestation periods. Given that some mines are found in some of the most politically fragile regions in the world, the risk premiums associated with mining operations are large. Price volatility is also an important supply driver. Given the characteristics of the mining industry, supply disruptions are possible.

A supply disruption refers to the inability of the global industry to generate the output that is required by global markets. This does not necessarily refer to temporary bottlenecks or lowering of

output in a given year due to natural disasters or political events. A supply disruption is likely to occur, when the inflexible nature of the global supply industry leaves it unable to meet market demand. These disruptions are discussed in detail in Chapter 5.

Financial Drivers: The homogenous nature of products and their varied international use makes commodities easy to trade at international platforms or exchanges. Price at the London Metals Exchange, the premium metals exchange in the world, are used as the bench mark in bilateral contracts elsewhere. Traditionally, the transactions at the exchange involved consumers and producers, with investors acting as middlemen to ensure the smooth functioning of the exchange. In recent years, commodities have increasingly attracted investors and financial flows.

Financial disruptions are likely to occur in commodity markets, when factors other than the fundamentals of demand and supply have an impact on price. This can have consequences for price movements and volatility. The impact of increasing investor activity on commodity prices is addressed in Chapter 6.

Terms of Trade: As stated earlier, terms of trade is a ratio between the price index of commodities and that of manufactures. Our focus is on the numerator, i.e. commodity prices. A rise in the price of commodities and a fall in that of manufactures can result in the terms of trade improving for commodities, or in a reversal of terms of trade. We concentrate on the nominal prices of commodities and examine the changes in direction that have occurred over the recent commodity boom. The manufactures prices are considered towards the end of the research, in relation to overall changes in the terms of trade.

It is important to distinguish the context in which the terms of trade are discussed. This ratio can be between commodities and manufactures, or between the export of developing and advanced economies. In the Prebisch-Singer commentaries, since developing countries were primary product exporters, and advanced economies were manufactures exporters, the distinction was not essential. However, since the 1970s a number of developing countries' export contain a substantial share of manufactures, even if these are low technology products. The Prebisch-Singer Hypothesis needs to be distinguished on either commodity/manufactures levels or developing/advanced economy

products level (Diakosavvas and Scandizzo, 1991; Kaplinsky; 2006). We concentrate on terms of trade implications for resource-exporting developing countries.

For commodity-exporting developing countries to benefit from their natural resources, an improvement in their terms of trade cannot be a short term event. An increase in commodity prices needs to be sustained over a period of time rather than a sustained increase in prices over a short period of time. This does not suggest that prices should plateau at their peak, but when they retreat, the fall should not be near or similar to the previous trough. The persistence of the three drivers of price is important for the resource-exporting developing countries and is addressed in Chapter 7.

2.9 Conclusion

This chapter started with an inquiry into why natural resources have failed to deliver on growth for many developing countries. Resource dependent countries faced the double challenge of having declining terms of trade, compounded by commodity price volatility, resulting in uneven export revenues. Point commodities tend to be accompanied by a high incidence of civil wars. Conflict associated with rent seeking behaviour on part of the State leads to much of the population not sharing the mineral wealth of their country.

We outlined factors such as the deteriorating terms of trade, price volatility and the intrinsic nature of the mining industry that are economic and global in nature. Other issues such as rent seeking behaviour and the Dutch disease lie in the realm of governance debates and their policy implications are focused at the country level rather than the global level. For this reason rent seeking behaviour and the Dutch disease are not discussed further in this dissertation.

An analytical review of the literature helped to outline the debate that surrounds the role of commodities in development. The reasons for the inability of commodities to contribute to growth were established on two levels, characteristics intrinsic to commodities and those that apply at a country level.

Having established the general role of commodities in different economic structures, and how these structures change as economies grow, we have established the context for our examination of demand fundamentals in Chapter 4. The discussion around the mining industry sets the context for Chapter 5, while that of price volatility sets up our argument in Chapter 6. In Chapter 7, we then return to the terms of trade debate and a re-think about commodities in development. We now turn our attention to the post World War II commodity booms. Starting with an overview of periods of high commodity prices in the next chapter, we then turn to a detailed examination of commodity demand, supply and financialisation.

WHAT IS IN A COMMODITY PRICE MOVEMENT?

'While much has been learnt about the properties of world commodity prices, there still remain big

gaps in economist's understanding of why commodity prices move as they do' [11].

Commodity prices during the 20th century have been plagued by long slumps, punctuated by short periods of price spikes. The failure of commodity prices to increase relative to manufacture prices and their continued volatility were some of the reasons behind commodity pessimism. There were some periods of high commodity prices, as those experienced in commodity price booms since World War II in 1951-1953, 1973-1975 and 2003-2008. The first two were short in duration and their impact resulted in windfall gains and rather than sustainable benefits for commodity-exporting developing countries. The latest boom was five years long and was interrupted by a financial crisis and the preceding global recession.

If commodities are to deliver on growth, the increase in prices must be sustained over a period of time, and must be strong enough to influence the terms of trade for commodity-exporting developing countries. Before we move to a discussion around how the global economic system will change with such an undertaking, we need to examine what the drivers of commodity price increases have been. What is the nature of the variables affecting this rise? How persistent are these drivers in the medium and long term?

We focus on the drivers of change in the past commodity booms and draw some generalisations from these events. Using an analytical literature review we outline the three main price drivers in price movements; demand, supply and financial markets. In Section 1 we examine some of the concepts that are used to study commodity price behaviour. In Section 2 we look at the 1951-1953, 1972-75 and 2003-2008 commodity booms in terms of physical demand and supply and the role of financial markets. In Section 3 we conclude with a comparison of price behaviour in the three periods.

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[11] Cashin, McDermott and Scott (1999)

SECTION 1   WHAT IS IN A PRICE MOVEMENT?

The term commodity prices has been used extensively in the literature for studying the terms of trade between commodities and manufactures, and in policy discussions around the deteriorating trends of these prices. However, the term itself can represent different values, depending on how it has been calculated and what time frame it has been contextualised in. We highlight some of the measurement issues surrounding the research on commodity prices.

A commodity price can be measured as the nominal price set at an international commodity exchange or the unit value price of commodity-exports. To reach real commodity prices, nominal prices can be deflated by the US GDP deflator, the Consumer Price Index (CPI), or the US $ Index. When the Manufacturing Unit Value Index (MUV) is used to deflate commodity prices, they implicitly reflect terms of trade, since the ratio offsets commodity prices against manufacturing prices. Radetzki (2008) warns of the advantages and disadvantages of using each of these deflators, as they can cause real price developments to be substantially different from each other, depending on the deflator used.

When examining prices over a long time horizon, where some researchers have gone back to data sets from the 1870s and the early 1900s, it is essential that nominal prices are normalised. The choice of deflator will influence the interpretation of commodity price trends. Researchers following commodity terms of trade trends, tend to use the Manufacturing Unit Value (MUV) index as a deflator. The original data set for the Prebisch and Singer studies looked at the unit value of British commodity imports and manufactured exports. Spraos (1980) extended the original data set used by Singer and Prebisch to evidence the terms of trade deterioration. Sapsford (1985) uses the unit value of world wide exports of commodities and manufactures as classified by the SITC trade structure. The other major commodity data set constructed and used by a number of authors is the Grilli and Yang (1988) commodity price index. The authors used 24 internationally traded commodities, using the 1977-79 value of exports of each commodity as its weight in the index. To calculate relative prices, the commodity index was deflated using a modified version of the UN-MUV index. All authors found deteriorating terms of trade for commodities. The major objections

raised against these studies was the inability of the MUV indices to reflect changes in the quality and technology of manufactures exports, and therefore not being incorporated into the terms of trade analysis.

The question of whether a deteriorating trend does exist, and to what extent structural breaks are relevant is an important one. A secular decline in the trend suggests that even if price variability is present in terms of cyclical movement, prices will revert to the mean and the secular decline will continue. If commodity prices are not trend stationary, but exhibit random walks or are stochastic in nature, the structural breaks will be an important explanation for lack of trend in prices. A non-stationary price trend implies that there is no long term commodity price trend, and that temporary or permanent shocks to prices push trends upwards or downwards. When shocks cause structural breaks to push prices downwards, shocks may also occur to push prices upwards.

Disentangling trend from cyclical behaviour is also important in terms of policy responses, for different prescriptions would be required to deal with trend behaviour as compared to cyclical behaviour (Borensztein *et al.*, 1994). Trend behaviour suggests commodity prices are mean reverting, and therefore policy prescriptions will focus on smoothening revenue over the fluctuations. Cyclical behaviour, which is not mean reverting, calls for policy to limit the impact of amplitude variations rather than frequency variations.

In more recent literature, the argument has shifted from long term trends to price volatility and cyclical behaviour. Cashin *et al.* (2000) argue that the impact of temporary or permanent shocks to prices can take a long time to dissipate, and therefore obscure the trend itself. This volatility makes the impact of cyclical behaviour on terms of trade more important than that of a long term trend analysis. Commodity prices experiencing long lasting shocks, where the half-life of a shock is disseminated on average over a five year period, increases the importance of variability as an issue rather than an elusive trend. The amplitude of price movements has also increased, since the early 1900s and price cycles have become more frequent since the 1970s adding to the volatility of commodity prices (Borensztein *et. al* 1994, Cashin *et al.* 2000; Cashin and McDermott, 2006).

Unravelling the empirical evidence and the econometric techniques for observing trends in commodity prices is challenging, especially in a debate where a decisive conclusion has not been reached. The non econometric issues with observing commodity price trends over a fifty to hundred year period must also be considered. Changes within the global economic sphere that affect nominal commodity prices have been large in the past century. Calculations based on indices that have been re-weighted a number of times raise issues of continuity. Commodity price indices constructed on export unit values weighted by the share of commodities in developing or the developed world exports, also have similar issues of continuity as composition of world trade has changed over the decades. Matters of continuation are also relevant where commodity prices suffer from temporary shocks, such as periods of war. These periods were characterised by ceilings and floors and which may cause discrepancies to appear in trend analyses, for e.g. when price determination is removed from a relatively free market mechanism to a State or producer controlled one.

The cost of shipping, which has fallen over the century, affects FOB and CIF prices of exported goods and hence their unit values. Radetzki (2008) argues that the fall in the cost of shipping has had a larger impact on the price of commodities, which are often traded in bulk, as compared to manufactures. Studies which use unit value of exports and imports are implicitly factoring in the change in transport costs, and what might be seen as a change in the price of commodities may actually reflect a change in transport costs.

All these parameters have also added to problems in calculating long term trends. Such issues make it difficult to reach a firm conclusion as to the long term trends in commodity prices. In principle, however, we accept that commodities suffer from adverse terms of trade against manufactures. Since our focus is on commodity price behaviour in the present and near future, we step away from these issues of measurement of long term price movements. Rather than on long term trends, we instead focus on the cyclical price behaviour, which in recent commodity price related literature has been highlighted as a major cause of concern for commodity-exporting developing countries. Trend, unless stated specifically, is used to refer to short to medium term average prices rather than a long term movement.

Since nominal prices have been used by other authors to observe cyclical behaviour (Cuddington and Jerrett, 2008; Labys *et al.*, 2000; Cashin and McDermott, 2002) we adopt a similar approach and make no attempt to deflate prices. The UNCTAD Commodity Price Index has been used extensively in this dissertation. The index compromises 86 commodities, which are base-weighted, with weights representing the relative values of exports from developing countries for the period 1999-2001[12]. Figure 3.1, using the UNCTAD Commodities Price Index illustrates the movement in commodity prices, and the occurrence of price cycles, price booms and possible super cycles in commodity prices.

Figure 3.1: UNCTAD All Commodity Monthly Price Index (1960-2008) (2000=100)
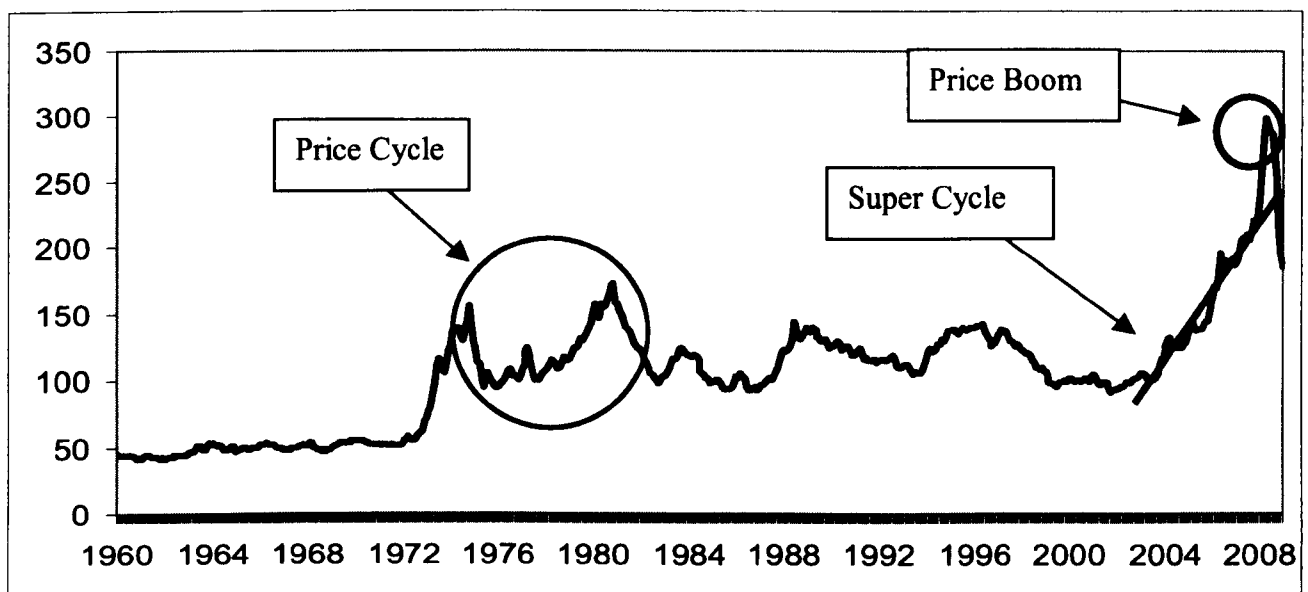
Source: UNCTAD Handbook of Statistics.

Figure 3.1 uses nominal prices and has not been deflated as our focus is largely on the direction of price changes being seen in commodities. In calculations of real prices, where either the Consumer Price Index or the US $ Index is used to normalise prices, changes in the value of these deflators will also impact commodity price trends. Periods of restrictive monetary policy in advanced economies, affecting interest and inflation rates, have an implicit impact on the value of commodity prices when studied over decades. For example, the collapse of the Bretton Woods system affected financial indicators that may be used as deflators over a long time series. Using real prices, especially when deflated by the MUV, intrinsically reflects a terms of trade ratio. Within this

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[12] Source: UNCTAD Commodity Prices accessed June 2007

dissertation we are focusing on one part of terms of trade, the prices of commodities, and are not concerned with the overall movement of real prices[13]. All commodity prices therefore refer to nominal prices in the remainder of this work.

A Price Cycle is defined by the National Bureau of Economic Research (NBER) as a trough to trough measurement. Thus a cycle consists of an expansion from trough to peak and a contraction from peak to trough. In a trough to trough measurement every change in direction does not necessarily represent a cycle in itself, and a turning point cannot be established until a fixed number of observations after the event. Following Watson (1994) and Cashin *et al.* (1999) we define a cycle without a trend component, i.e. the cycle does not move around a trend line, but is considered independent. Thus, a price boom is experienced as periods of absolutely increasing prices and not as a period spent above trend. A price slump is then a period of absolute decrease in prices and not a below trend period.

The duration of a cycle is the time measurement between one trough and the next. Each commodity differs on the duration of its cycle as well the number of cycles experienced. For example, between 1960 and 1993 coffee experienced 16 price cycles with 134 month maximum and 6 month minimum duration. Copper experienced 24 cycles, with a maximum duration of 46 months and a minimum duration of 6 months (Labys *et al.*, 2000).

There are fluctuations within a cycle and not every turn in price movement qualifies as a cycle. Fluctuations within a price cycle are based on the frequency and amplitude of price changes over weeks or months. An increase in either frequency, amplitude, or both, will lead to higher volatility in commodity prices. Slade (1991) has argued that price volatility in commodities has increased over the years as pricing mechanism moved from being set by producers pricing regimes to terminal markets such as the London Metals Exchange. Cashin and McDermott (2002) show the duration of price cycles is becoming shorter in recent years. In examining data from 1862-1999, they observe that commodity price variability over time has increased, with volatility first rising around 1899 and then again in the early 1970s. They conclude (2002:196): '[…] although the rise in volatility in the

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[13] The implications of real price movements for the terms of trade ratio and policy implications are briefly addressed in Chapter Seven.

early 1900s was due to greater *amplitude* of price movement, the further rise in volatility in the early 1970s was due to the increased frequency of large price moments'. This would indicate a larger number of price cycles of shorter durations.

A Commodity Price Boom occurs within a price cycle, and is identified as its expansionary phase. Since World War II, three periods of commodity price expansion are recognised as booms: 1951-1953, 1973-1975 and 2003-2008. A commodity boom is a sharp increase or 'explosion' in international commodity prices in all sub-categories, i.e. of agricultural, minerals and metals, and energy commodities (Radetzki, 2008). Since there is no formal definition of a commodity boom, for our purposes we define a commodity boom as one in which a price peak is achieved that is higher than previous localised peaks and study the three identified price booms.

Increases in prices are usually triggered by a shock in market fundamentals, which may be caused by unanticipated changes in either demand, supply or both. Although shocks can drive changes in cyclical movement, some shocks are temporary while others are permanent. Depending on their nature, the degree of persistence of the shock will differ as well (Cuddington, 1992; Reinhart and Wickham, 1994). The three booms are discussed in detail in the next section.

A Super-Cycle is a medium to long term phenomena, and is defined as '[…] a prolonged (decade or more) trend rise in real commodity prices' (Heap, 2005). There have been two to three metal price super cycles in the past 150 years. Heap (2005), on a cursory examination of price trends suggests that there were two, the first experienced in the late 1800s that ran until the early 1900s, corresponding with the economic growth in the United States. The second was between 1945 and 1975, driven mainly by the post World War II reconstruction in Europe and Japan's industrial expansion. Cuddington and Jerrett (2008) offer a closer examination of data and argue for three periods where Super Cycles were in their expansionary phases; from 1890 to 1911, from 1930-1951, 1962 to 1977, and finally the latest starting in from 1999 which is still to complete its expansionary phase. Super cycles are discussed in detail in Chapter 7.

The drivers of prices can lead to temporary or permanent changes in prices, which may persist over a short or long term. Due to the differing nature of production cycles for different commodities the

terms short, medium and long may define very different periods for each commodity. Agricultural commodities tend to have short production cycles (sowing to harvest) usually completed within a year. Yet, they cannot be stored for long periods and therefore have a short shelf life in their raw form. In comparison, metals and mined products have longer production cycles (from mining to processing) taking at times up to five to ten years. Their storage life is much longer and so they have higher inventory lives. When we refer to a 'short' period in agricultural commodity we may be referring to months, while for metals the term 'short' may indicate years. Since this dissertation is focused on the base metals sector, all references to 'time period' are for the mining and minerals sector unless stated otherwise.

SECTION 2 THE THREE COMMODITY BOOMS

The three drivers of demand, supply and financial markets act together to reach an international price that reflects the general state of the commodity market. A commodity boom, as an event, indicates the introduction of a shock to the determinants of price that results in a sharp rise in price.

We focus on the main drivers of price, looking at their behaviour during major price events. Commodity price booms have been chosen for this purpose because the documentation of the three drivers is easy and the results of their actions are clearer relative to times of market balances. Thus the three post World War II commodity booms offer a unique moment in price movement to examine the determinants of commodity price behaviour.

The study of the booms is meant to offer an analysis of trigger and response only, and not as a model of what may happen to prices in the future. The aim here is not to predict future behaviour, but to gain an understanding of major price events. It is not always prudent to use past events to forecast future price movements in commodities. Commodity prices do not lend themselves easily to forecasting due to the sheer number of variables involved in their determination; both in the short and medium term. Even when identified some of these variables cannot be directly measured, such as natural disasters, labour strikes, geo-political events, etc. In interviews with key informants at

UNCTAD[14], the unpredictability of future commodity prices, and the challenge of effectively modelling such changes was stressed.

In order for a commodity boom to materialise, the market fundamentals have to experience a mismatch between demand and supply. Since prices react to both, a positive movement in demand accompanied by a similar movement in supply will not generate a price boom. Only when markets are constrained in terms of supply being unable to meet demand, will a price hike result. Mismatched demand and supply may result in a market surplus or market deficit, often referred to as tight markets.

Periods of strong economic growth will not necessarily be accompanied by price increases, unless supply limitations are also present. As Radetzki (2006:63) comments: 'Not all periods 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'. Thus market constraints are essential to generate a commodity price boom. We now take a closer look at the shocks and drivers of change for the three commodity booms.

3.1 First Post War Price Boom: 1951-1953

The first post World War II period to experience sharply increasing prices was between 1951 and 1953. The overall commodity price index started to rise in early 1950 and peaked in the 1st quarter of 1951, when the index was 45% over its 1949 values. The boom lost momentum quickly, with prices falling for the rest of 1951, and were just 16% over their 1949 values in the 2nd quarter of 1952 (Figure 3.2). By the end of 1952 and early 1953, prices had receded close to their pre-boom levels.

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[14] Conducted in June 2007 at Geneva UNCTAD offices

Figure 3.2: Quarterly Index of Commodity Prices; Nominal US$ (1949-52) (1949=100)
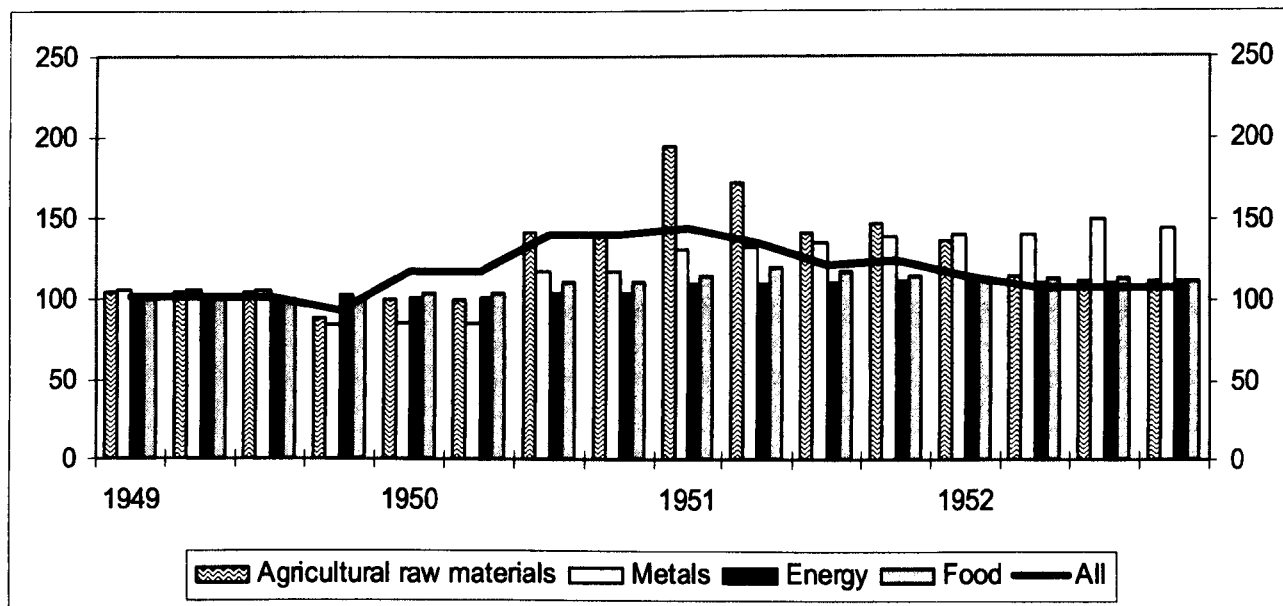
Source: Radetzki (2006)

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The rise in prices was not spread equally across all commodities. Agricultural raw material and food prices peaked in early 1951 while energy prices were at their highest in early 1952. Metals were the last sector to peak in the third quarter of 1952. In terms of price rise, agricultural raw materials saw the highest gains compared to their 1949 levels, followed by metals. Food and energy prices saw the lowest gains relative to pre-boom levels. By the end of 1952, the All Commodity Price Index has returned to its 1949 levels.

Demand: The 1930s and 1940s were dominated by economic depression and the Second World War. The world economy began to recover from these events and Industrial Production (IP) began to increase again in the advanced economies. The index for the United States and the United Kingdom grew at an average of 9% and 4% p.a. between 1949 and 1953, with the overall IP index for industrial countries rising from 16 to 21 over the period 1949-1953[15]. The global economy started to recover, and demand for commodities was growing. As industrial production began to pick up pace, demand for industrial raw materials increased.

The year 1949 saw the end of the economic recession that had gripped much of the world. The main driver of demand was the unleashing of consumer demand for products that had been pent up

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[15] IMF IP index, (2000=100)

in the previous decades of economic depression and rationing during the Second World War, leading to a surge in demand for manufactured products. Rising wage rates after 1949 also generated demand for consumer goods, which in turn generated demand for commodities. Lewis (1980) notes that nominal wages in the United Kingdom rose by 2.1% and in the United States by 3.7%, while the GDP deflator increased by 0.6% and 0.5% per annum in 1949 and 1950 respectively. Growth in real wages led to increasing demand for manufactures and consumer goods.

After the devastation of the Second World War, Europe was beginning to rebuild its infrastructure and manufacturing sector. The Marshal Plan, announced in 1947, was initiated in 1948 and continued for the next four years. Industrialisation and economic growth accelerated in this period and for the next two decades in most OECD economies, partly due to the plan (Eichengreen and Uzan, 1992).

The second major impetus underlying commodity demand in the early 1950s was the Korean War. Its indirect effect was the increase in demand for industrial raw material brought on by war demands (Radetzki, 2006). As the United States went on to a war footing, increased industrial production raised the demand for commodities. Lewis (1955) reports that the United States national security spending doubled between 1951 and 1953. As an indirect result of the war effort, non-defence spending also increased by $6 bn[16]. Within the private sector fixed capital expenditure rose by 10% from 1951 to 1953[17]. This level of economic expansion increased the demand for commodities as inputs into the manufacturing sector was linked to the increased spending within the United States.

Supply: The process of economic recovery led to increasing demand for commodities, but supply concerns began to emerge, due to the Korean War. The Asian region at this time was a major source of industrial raw material and the war threatened the security of supply lines. Fears of war escalating further into the region added to this threat. In response to a possible slowing or shutting down of supply lines, producers using industrial raw materials began to stockpile commodities. The

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[16] $ 87.6 bn in 2005 $ value: calculated by using US GDP deflator
[17] All data from Lewis (1955)

push for increased inventories was responsible for short term supply constraints, rather than fundamental constrictions in the supply side.

Industrial consumers increased their personal inventories too. For example, in 1951 in the United States manufacturing and trade inventories were $15 bn[18] above their June 1950 levels. As it became clear that the Korean War was not going to spread to other regions, and industrial production was not being affected, inventories were brought down. In the United States, between the last two quarters of 1951 and the first two quarters of 1952 investment in inventories dropped by $16.4 bn[19] (Lewes, 1955). The government also released commodities from its strategic stockpiles increasing supply to markets (Rowe, 1965).

The energy and food sectors, where a supply threat was not perceived and stockpiling was not an issue, did not experience the same level of price increases as industrial raw materials (see Figure 3.2). The major consumers of agricultural products and energy were in general self-sufficient at this period of time, and so a major import demand did not originate in the global economy. The United States was an oil exporter at this stage and there had been no significant harvest failure to cause security scares in the food sector (Radetzki, 2008). Security issues did not arise in the energy and food sectors, and no efforts were made to stockpile in these commodities.

The Financial Markets: The Stock Markets were robust during this period and equity returns were high. Inflation in 1950-1960 was at an average of 1.8% per year in comparison to the 6% per year in the previous decade[20]. Inflation was well under expected parameters and the major financial markets showed healthy growth. A robust mainstream financial market indicates less reason to find safety from fluctuations and uncertainty, and hence hedge with alternative assets such as commodity markets. Although data on investor interest in commodity markets is not available for this era, it is reasonable to assume that their interest in commodity exchanges remained minimal in relation to other asset markets.

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[18] $219 bn in 2005 $ value: calculated by using US GDP deflator
[19] $239 bn in 2005 $ value: calculated by using US GDP deflator
[20] http://www.theskilledinvestor.com/wp/how-unstable-have-stock-market-returns-been-over-time-231.htm (accessed January 2009)

Another reason for lack of investor participation would be the dearth of financial instruments with which to invest in commodity markets. Derivatives and commodity related indices were not present at this time. With limited access, other than to buy commodity contracts outright, the investor/speculative activity within the commodity markets would have been limited. The financial markets played a minor role in compounding the price effects triggered by the fundamentals in the physical market.

Overall the 1951-1953 commodity boom was more about perceived supply security issues rather than actual bottlenecks in the supply side. As the world economy recovered from a recession in 1949, the Korean War broke out in 1950. To ensure security of supply, there was a large scale movement to build up stocks and inventories of commodities. This triggered excessive demand in the market, and inventory build-ups resulted in tightening markets leading to price increases. As it became clear that the Korean War was not going to spread to other regions, short term security issues receded. With supply risks not materialising, inventories were brought down and the resultant supply increases from destocking led to the dissipation of price pressures. The boom was not significant in strength and was over by 1953.

3.2 Second Post War Price Boom: 1973-1975

The late 1960s were a period of strong economic growth, with the industrial economies expanding in the West as well as Japan. Supply was well able to keep up with demand, and it was only in 1972 that supply disruptions were first felt in agricultural commodities, then in metals and oil, that resulted in the price boom of 1973-1975.

The Overall price index started to rise in the last quarter of 1972, finally peaking in the last quarter of 1974 (Figure 3.3). Prices dropped quickly by the middle of 1975, though the index remained higher than the pre-boom level, largely due to the sustained increase in oil prices. As with the previous boom, different sectors experienced increases at different times.

Figure 3.3: UNCTAD All Commodity Monthly Price Index (1970-75) (2000=100)
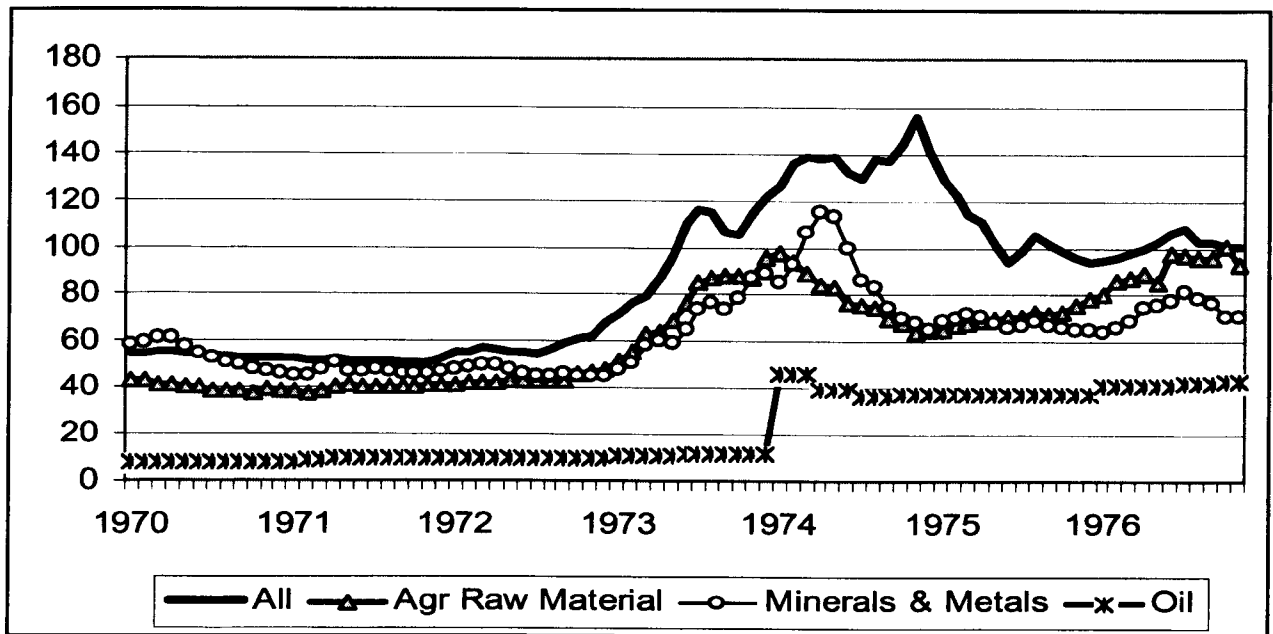
Source: UNCTAD Handbook of Statistics.

Food prices were the first to rise in late 1972, followed quickly by agricultural raw material and metals, rising in early 1973. The agricultural raw material prices were the first to peak in early 1974, followed by ores and metals in mid 1974. Food prices did not peak until end of 1974 and remained above their pre-boom price level by the end of 1976. Oil prices rose at the end of 1973 and remained at higher levels mainly due to the cartel pricing of OPEC.

Demand: The demand surge for commodities came from the simultaneous economic expansion of three major industrial regions: the United States, Western Europe and Japan. The global economy was in a strong macro economic position in the early 1970s, with the IP index for OECD Europe rising from 53 to 62 over the 1970 to 1974 period[21].

In metals, Japan was the major hard-commodity importing country at this time, accounting for nearly 20% of global imports of major metals and mineral ores. It was very heavily dependent on imports to feed its refineries and industries. Such was the demand for commodities, led by need and by perceived supply security threats, that in 1973 imports of non ferrous metals increased by 40%, while industrial production increase by 17% only. Some of these imports can be considered as 'hoarding' as late 1974 saw Japan becoming a major seller of metal. The United States actually

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[21] Source: www.OECD.Stat accessed June 2008

decreased its net imports of metals, mainly by drawing down from their own strategic stockpiles (Cooper and Lawrence, 1975).

Supply: In 1970 the concern for commodities was more about over-supply issues rather than deficits. Fried (1976:644) reports: 'In the past two decades, demand for most primary commodities has grown comparatively slowly and exports have lagged substantially behind the growth in world trade. That is why most of the attention devoted to commodity issues was concentrated on proposals to reduce burdensome surplus and to support price'.

The over supply in most commodity markets led to growing concerns of resource depletion. The world with its growing population and expanding manufactures production saw an increasing pressure on the resource base. The Club of Rome Report (1972) raised fears of an eminent resource exhaustion, and predictions about the inevitable collapse of economic systems.

In contrast to concerns of over supply, it was the shock of a supply disruption that materialised in 1972, with the Soviet Union, South Asia and North America experiencing bad harvests (Sanderson, 1975). The Soviet Union chose to import the deficit from international markets, rather than to allow domestic prices to increase and curtail consumption. At the same time, the United States Department of Agriculture had drawn down its own inventories and stocks. The United States also suffered from a bad harvest in 1972, which resulted in an overall shortfall of supply to meet demand. Rising incomes had led to higher demand for sugar, coffee and cocoa, while supplies of these products were unable to keep up. In 1974 stocks of these products had fallen to a 10 year low. With crop failure in major producing countries, and the supply of cereal, sugar, coffee and cocoa in international markets fairly constrained, food prices were the first to rise in the boom (Fried, 1976).

Agricultural raw material prices were affected when the traditional producers of these commodities turned land towards growing food crops, rather than cash crops. The supply deficits from the food sector were passed on to the cash crops sector. 1973 saw a dearth in inventories of both food and agricultural raw materials, and consequently the first two sectors to see price increases.

Hard-commodities were hit by strikes and political unrests in major metal ore producing countries like Chile which is the major exporter of copper. Metal and mineral supply was affected by labour disputes in the mining areas, as well as political unrests in the metal producing economies. Transportation bottlenecks in Africa and the Jamaican tax on Bauxite, later followed by other bauxite producers, led to further supply constraints of industrial raw materials (Fried, 1976). Copper and Lawrence (1975) estimate that smelter production for lead, zinc and copper lagged demand in that period.

The first oil shock in this period was related to cartel pricing by the OPEC economies, and was not a reflection of fundamental supply issues. If anything else, it was a political move motivated by allegiances in the recent Arab-Israel war. Increase in energy prices led to a permanent increase in the commodity price index, and also contributed to the global recession that brought an end to the commodity boom by 1975. In a period of rising raw material costs, further cost increases due to the oil price rise, led to a global economic slowdown. Security of supply again became an issue, with businesses and consumers of commodities building up stocks and inventories, while governments released their stocks to ease tightening markets.

The Financial Markets: The Bretton Woods era came to an end in mid 1971, with the United States opting out of maintaining the gold standard for currencies. The world moved to a system of floating exchanges, with the United States dollar the major currency vehicle for trade. The financial markets were plagued with uncertainty and increasing volatility was seen in major stock and currency markets. Looking for safety, investors increased participation in commodity related investments as a safeguard against fluctuations in currency exchange rates and inflation hedging.

Financial commodity markets played a larger role in this boom as compared to the previous one. High inflationary pressures in the United States, around 8% per year in 1970-1980 and periods of negative equity[22] in stock markets, made investment safe havens more popular. Hedging against inflation and currency fluctuations, investors turned to commodity contracts and began using commodity futures for both hedging and speculative purposes. Copper and Lawrence (1975) report

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[22] Negative equity occurs when the value of an asset used to secure a loan is less than the outstanding balance on the loan

an intense increase in price and volume of commodity future contracts[23] over 1970-75. From early 1970 to the first half of 1974 future contract transactions rose by over 50% in lead and tin, doubling in copper and zinc, and nearly tripling in rubber. In the financial markets, the demand for future commodity contracts grew substantially. The increase in non-ferrous metals prices in 1974, accompanied by decline in industrial demand for these products at the same time, was indicative of the investor interest in commodity markets for hedging and risk aversion purposes (Copper and Lawrence, 1975).

As the recession hit, the investment sector liquidated its inventories, which increased the physical supply of commodities in international markets and therefore contributed to the decrease in prices. With demand for commodities increasing from the investors, supply shortages were further exacerbated by these non producer/consumer actors. Fried (1976:642) comments:

> Inflationary expectations, exchange rate fluctuations, and sometimes an exaggerated
> concern about the adequacy of raw material supplies made matters much worse.
> They were reflected at times in a preference for holding commodities over currencies,
> in speculative purchases and in a general build-up of inventories_ all of which
> exacerbated shortages.

The three main elements to the rise in commodity prices in 1973-1975 were first the strong macro economic performance of the OECD economies. Secondly, widespread crop failure in 1971 and 1972 resulted in the substitution of land for food crops over cash crops. The last contribution to higher prices came from the increase in oil prices in 1973 led by OPEC. The constrained supply in a period of increasing demand of raw materials pushed the all commodity price index higher than its 1971 level and created a commodity boom. Although we have no clear data on the level of financial speculation verses hedging, increasing turnover of commodity contracts confirms the involvement of investors in this sector. As much as the boom began in a period of economic expansion, its end marked the start of the global recession of the late 1970s. The 1973-1975 boom

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[23] In London and New York exchanges

was due to constrained commodity markets, brought about by a supply shock in a period of rising demand.

3.3 Third Post War Price Boom: 2003-2008

The 2003-2008 commodity boom accompanied a major expansion in the global economy. Growth post 2000 was robust in the developed markets and particularly strong in the emerging economies. Advanced Economies on average were expanding at 2.5% p.a. between 2000-07. Higher growth rates of an average 6.4% p.a. were seen in emerging and developing economies[24]. Between 2000 and 2003 the UNCTAD All Commodities Price Index rose from 100 to 105, and by 2007 it had doubled to 207. Different commodities experienced different price increases, and as Figure 3.4 shows, oil and metals and minerals experienced much higher prices than agricultural or soft commodities. The peak of the price boom was seen in mid 2008, after which prices crashed for all sectors. However, even at the end of 2008 the indices were above their 2000 values.

Figure 3.4: UNCTAD All Commodity Monthly Price Index (Jan. 1999- Sep. 2009) (2000=100)
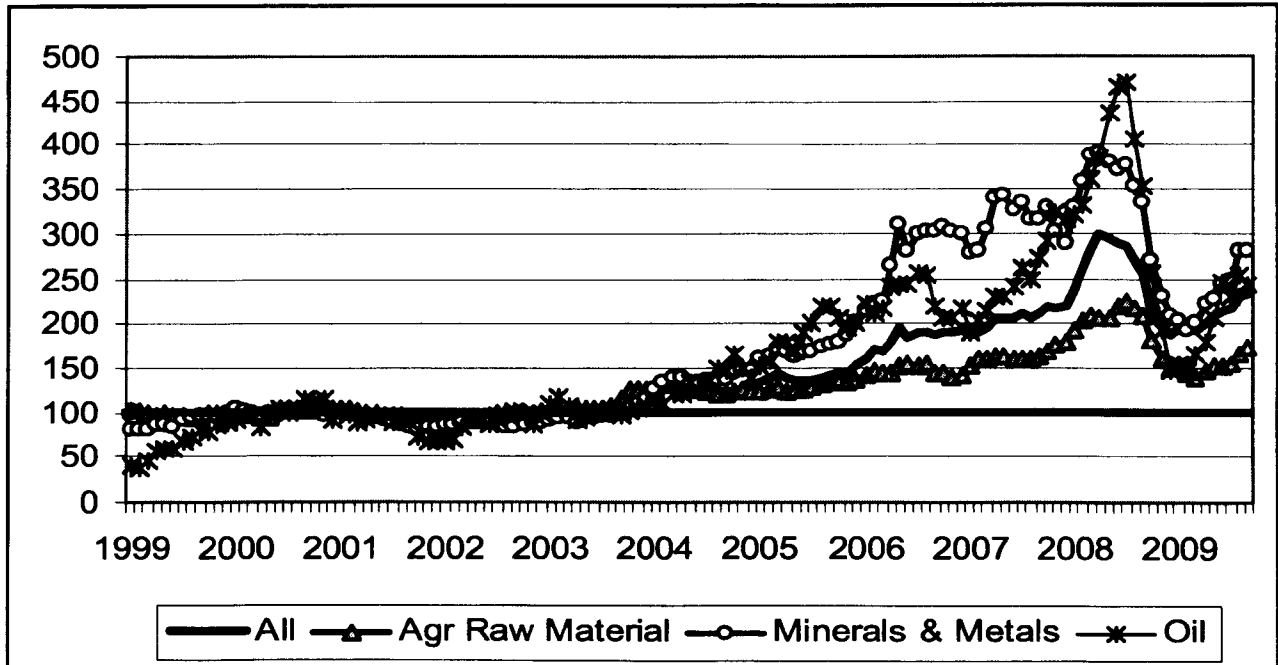
Source: UNCTAD Handbook of Statistics.

International commodity prices began to rise for most sectors post 2003, and continued on an upward trend until autumn 2008. With the collapse of the financial system and recession in western

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[24] Source: World Economic Outlook data via ESDS accessed on 15th February 2009

economies towards the end of 2008, commodity prices also dropped. Early 2009 saw a modest price recovery for most commodities. As with other commodity booms, the price rise across sectors varied in strength and duration. Metals and fuel saw an earlier and sustained price increase since 2003, with metals peaking in the 2nd quarter of 2008, while oil continued to rise in the second quarter of 2008. As Figure 3.4 shows, this rise in the metals index till mid 2008 has been gradual (no sharp jumps), even though the index value had tripled from 2002. Agricultural raw material prices also increased, but not at the same pace as metals and oil. Prices did not start to rise until late 2004, and they reached their peak levels in 2008. The extent of their rise, in comparison to 2002 values, is much smaller than that experienced by the metals and fuel sector.

The rise and fall in commodity prices has been substantial in the 2003-2008 period, and much greater than in the two previous booms. Table 3.1 shows the rise in price indices for different commodities from the start to the height of the boom over a five year period. From their base in 2003 to their peak in mid 2008, the largest increase was seen in oil prices (422%), followed by the ores and metals sector (392%), and food (269%). The all commodities price index tripled in value between early 2003 and mid 2008, and the fall in prices has also been strong. Between mid 2008 and December 2008, oil prices fell by 69%, ores and metals by 47%, and food by 32%. Even though the all price index remained above its 2003 levels, it experienced a fall of 38% in six months.

Table 3.1: Percentage Change in UNCTAD All Commodity Price Index (2003-2008)

	UNCTAD Price Index			% Change	
	Early 2003	Mid 2008	End 2008	Early 2003 to Mid 2008	Mid 2008 to Dec 2008
Food	100	269	184	169	-32
Ores and Metals	89	392	207	340	-47
Oil	90	470	147	422	-69
Agri. Raw Material	102	229	146	124	-36
All	100	300	185	200	-38

Source: Authors' calculations from UNCTAD Handbook of Statistics.

Demand: Fast economic expansion in the OECD economies coupled with the growth of China and India, triggered increasing demand for commodities. China is a large developing country with demand for infrastructure, construction and consumer goods. A detailed discussion of China's demand for commodities is carried out in Chapter 4.

Supply: Metals, which experienced the highest price increase in the sectors, were facing supply bottlenecks and constraints leading to tight markets for most of the period. The inflexibility of supply and the reasons behind the slow response from the global mining industry are discussed in detail in Chapter 5.

The Financial Markets: The stock markets after 2000 were performing well, and liquidity within the financial markets was large until autumn 2008. In 2005 global stock of core financial assets had reached $140,000 bn. From 1980 to 2005 the ratio of global financial assets to annual world output had risen from 109% to 316% (The Financial Times, 18th June 2007). The impact of increased investor activity in the commodity exchange and its affect on price is discussed in detail in Chapter 6.

SECTION 3 THE THREE BOOMS: COMMONALITIES AND DIFFERENCES

The previous section highlighted the behaviour of commodity prices and the events that influenced them in a time of major price hikes. In outlining the price movements in the three commodity booms we can draw some generalisations of these drivers.

The 1950-53 commodity boom was the shortest of the three price events. The increase in the index price of all commodities never doubled beyond the pre-boom prices in 1949. As the boom receded, prices returned to their pre-boom levels. Price gains were seen in the metals and agricultural raw material sectors, with little movement in the food or energy sectors. The threat to supply security was the largest motivation behind the price rise.

In the 1972-75 commodity boom, prices did rise well above their pre-boom levels, and maintained some of the rise even after the boom was over. However, the increase in price was not gradual

over the period and a the large jump occurred in 1973-74 (majorly influenced by the OPEC price rise). All sectors experienced rising prices, although energy made the largest gains. As in the previous boom supply security was an issue, but unlike the previous boom, supply was actually affected (bad harvests and OPEC oil pricing) rather than the 'perceived' threat to supply that did not materialise in the 1951-1953 boom.

The 2003-2008 commodity boom is the longest compared to the other two, lasting over five years. Price increase in the overall commodity index has been substantial, similarly to the 1972-75 boom. The rise has been much more gradual over the boom period in comparison to the latter, where a sharp peak in a single year led to the price increase. Although all sectors have experienced rising prices, those in food and fuel were only realised in the latter years, whereas the metals price index started its rise in the beginning of 2003. There have been no 'disruptions' to supply, such as natural disasters or major political upheavals in producing countries. The boom abated due to a fall in demand from the financial crisis.

The Duration: The difference in the three booms is seen in the time it took for prices to increase. Table 3.2 shows the percentage increase and decrease in price, as well as the duration of the three booms.

Table 3.2: Percentage Change in Prices and Duration of the Three Commodity Booms

Indicator	1951-1953	1973-1975	2003-2008
Percentage Price Rise	122%	217%	286%
Percentage Fall from Peak	75%	63%	62%
Duration from beginning of boom to peak.	12 months	23 months	64 months

Source: Authors' calculations from UNCTAD Handbook of Statistics and Radetzki (2006)

Even though both the 1973-1975 and the 2003-2008 booms achieved relatively similar price increases in percentage forms, the duration that the latter took to get to this height indicates a more sustained price rise over time, as compared to the sharp increase in the former. In the 1951-1953 boom it took a year to reach the peak, while the 1973-1975 boom took almost 23 months to achieve the highest peak. The 2003-2008 boom on the other hand took 64 months to reach its highest peak.

This opens up the possibility that the drivers behind the price increase were different, either in nature or in strength between the two periods.

The Price Rise: In terms of price rise, the 2003-2008 boom saw the largest price rise (286%) at its peak compared to the one in 1973-1975 (217%) and in 1951-1953 (122%). Price increase is calculated as the percentage rise in the All Commodity Price Index from the first month of the price boom year to its highest level achieved during the boom. Both the 1973-1975 and 2003-2008 booms saw similar levels of a fall in prices once the boom was over (62% and 63% respectively). In comparison to these two, the rise and fall of prices in the 1951-1953 boom was mild, rising by 122% and falling by 75%.

Prices in the first two booms returned closer to their pre-boom levels, while in the 2003-2008 boom prices have tended to remain substantially higher than pre-boom levels. In the first quarter of 1950, the price level was 118, while in the last quarter of 1953 it was 108[25]. In January 1973, the price index was 72, while in December 1975 it was 94. In January 2003 the price index was 105, while in December 2008 it was 185[26]. Some of the index price increase in 2003-2008 seems of a permanent nature. This is discussed in greater detail in Chapter 7.

Demand Disruption: Metal and mineral production and consumption is projected over the medium and long term, supply or demand increases are usually anticipated. When demand rises faster than projected, or events occur to disrupt supply, two possibilities arise. If the disruption is on the demand side of the market, sufficient inventory levels may exist to fulfil the shortcomings in the short term. But, if insufficient inventories are present, the impact of rising demand will have a demand push impact on prices, resulting in a price hike.

In the 1951-1953 and 1972-73 periods demand increases were a response to events occurring in the supply side of the equation, rather than unanticipated demand itself. Demand for hard-commodities is generated by industrial production and GDP growth. The 1951-1953 boom occurred at a time when the world was recovering from a serious economic recession and World War II. The

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[25] Radetzki (2006)
[26] UNCTAD All Commodity Price Index

recovery started as early as the end of 1949, and in 1950 and demand for commodities was expected to continue to rise. It was the possibility of supply disruptions due to the Korean War, which increased inventory demand as a response to supply insecurities.

In the 1973-1975 boom, economic expansion had been prevalent in the past few years and industrial demand for commodities had been fulfilled. Western Europe and Japan's industrial expansion was gradually building up in the late 1960s and was not unanticipated. As in the previous boom, it was supply side insecurities that triggered responses in demand to build up inventories. As global recession started to set in by 1975, the demand for commodities also decreased.

The 2003-2008 commodity boom came at a time where the global economy was recovering from the East Asian Currency Crisis in 1997 and the bursting of the Dot Com bubble on Wall Street. To a large extent, removed from these financial events was the strong GDP growth in China, which was sustaining an average eight percent growth rate per year for over a decade. Demand played a more important role in the 2003-2008 boom than it did in the previous two periods.

Supply Disruption: As stated earlier, supply and demand imbalances together are likely to trigger a commodity price hike. Supply tends to be price inelastic in the short run due to the nature of production of commodities cannot respond in the short term. Inventories and stockpiles can be used to address short term supply gaps, but increasing output, especially in metals and minerals, is a medium term undertaking.

The event that set off the 1952-53 commodity boom was the Korean War. Anticipated disruptions in supply of materials from this region were seen as a reason to increase producer and consumer inventories, spurning higher than anticipated demand, contributed to a price rise. As it became clear that the anticipated supply disruptions were not going to materialise, demand pressure eased as well. With the release of commodities from government strategic stockpiles, supply levels within the markets increased pushing prices back towards their pre-boom levels.

Similarly in 1973-1975, supply shocks in agricultural goods, followed by those in other industrial raw materials led markets to believe supply shortages were imminent. These shortages did materialise, pushing the world economy into recession. Supply constraints, perceived or actualised were real factors in the 1951-1953 and 1973-1975 commodity booms, and inventories played an important role in bring markets back to balance. In the medium term, a fall in demand due to the recession resulted in balancing the markets.

The 2003-2008 period witnessed market deficits in metals for the most period. It was only towards the end of 2008 that most metals markets moved from near deficit to surplus positions because of a slow down in demand. The first two booms were driven by disruptions in supply and were over when supply came back in balance with demand. The third boom, contrastingly, was very much about demand, and subsided after the demand element receded and not due to a major response from the supply side.

Financialisation: The financial markets, working through commodity exchanges and other commodity denominated investment tools, play a crucial role in pricing of international commodities. The role of the financial markets in commodity price behaviour has evolved over the three commodity booms.

In the 1951-1953 boom, the tools available for commodity investments were limited. Although we have little information on the level of their participation in commodity exchanges, we do know that a healthy stock market existed at this time. With inflation under control and stability in currency and stock markets, the motivation for a large number of investors to enter commodity markets was limited. Coupled with the non-availability of a wide variety of commodity trading investment tools, the attention that commodity markets received from financial markets was low.

During the second boom (1972-75), stock markets performed weakly and investors were actively seeking alternative investments. With fluctuating currency values and inflation, attention was being paid to 'safer' investment alternatives. The tools to invest in commodities had also been better developed and therefore the interest of financial investors in commodity contracts was higher than before. We do not have the numbers to offer a coherent analysis of this participation.

In the 2003-2008 commodity boom, commodity investment had become more main-stream. Interest from short and long term investors had increased considerably compared to the previous two booms. The role of financial markets has grown successively over each commodity boom.

3.4 Conclusion

The 1950-53 commodity boom was the shortest of the three price events, with prices just taking a year to reach their peaks. In the 1972-75 commodity boom, prices did rise well above their pre-boom levels, taking 23 months to do so. The 2003-2008 commodity boom is the longest compared to the other two, lasting over five years. As 2009 progresses, these prices have begun to recover, and financial markets expect them to continue to show an upward trend for the rest of 2009 and beyond. This opens up the possibility that the drivers behind the price increase in the latest boom were different either in nature or in strength relative to the 1951-1953 and 1973-1975 periods.

DISRUPTIVE DEMAND: THE RISE OF CHINA

'Bear in mind, China accounts for more than 20 per cent of global population, and it is inevitable that, as incomes improve and the minerals intensity of consumption grows as it has in other countries, this will continue to lead to rising demand for imported materials[27].

Base metals are used as inputs in a wide variety of sectors: from cars to bridges, from electric wiring to dams. The drivers of metal consumption tend to come from their derived demand nature. Improvement in technology and productivity can lead to fewer resources demanded as inputs. Substitution of natural resources with artificial ones can also displace demand. They are a small share in the total cost of production of most consumer goods although higher prices can lead to demand destruction in the commodity sectors.

The demand for commodities is linked to the growth of an economy and the nature of its structural change. When sectoral change leads to the expansion of the industrial sector, there will be a greater demand for commodities. At the same time, the low income elasticity of demand ensures that the rate of GDP growth will not produce a similar level of increase in demand for commodities. In understanding the consumption of metals within an economy one needs to study how different sectors account for commodity consumption. The industrial sector, which comprises of infrastructure and manufacturing, has higher hard-commodity consumption than agriculture and services. Economies where the industrial sector has a large share in GDP will also tend to consume more commodities relative to countries that are agrarian or services based.

This chapter addresses our first research question: *What has been the contribution of China's economic growth in creating a demand pull effect on metal prices?* In order to understand China's impact on prices we examine the general link between economic growth and commodity consumption in Section 1. Section 2 then looks at the drivers of commodity demand within China's

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[27] Kaplinsky (2005)

structural change. The impact of China's demand on global base metals demand is examined in Section 3. Finally in Section 4, we look at the persistence of Chinese demand given the recent financial crisis.

SECTION 1 ECONOMIC DEVELOPMENT AND COMMODITY DEMAND

Economic growth follows a pattern of structural change, where the economy moves from low to high value added sectors. This generally involves an agrarian based economy expanding into manufacturing, and eventually services. Although there might be exceptions to this rule, generally the pattern of growth observed for most cross sectional and time series data supports this pattern (Kuznets, 1959, 1960, 1964; Chenery and Syrquin, 1975).

An increase in demand for hard-commodities is likely to occur when the structural transformation of an economy calls for large inputs of metals and minerals. Metals and minerals are intensively used in a number of sectors; infrastructure, construction (urbanization) and manufactures. Any economy where the major share of the GDP comes from manufacturing and infrastructure expenditure, will be using more commodities relative to other economies with similar GDP levels, but where the primary or the services sector is driving growth. Crowson (1998) estimates that for the United States the automotive industry accounts for nearly 15% of total demand for steel, while the transport sector accounts for 13% of copper and 26% of aluminium demand. The building and construction sectors further account for 42% of copper and 17% of aluminium consumption. On a global basis Crowson estimates that almost half of zinc consumption is associated with the building and construction industry, and one tenth is consumed by public infrastructure. The changing nature of technology and advances in productivity can affect these estimates over time, as well as between countries.

Economic growth will be accompanied by expansion in infrastructure, manufacturing and expansion in urban centres which will account for an increase in mineral and metals consumption. As the industrial sector expands it demands more labour located in or close to urban centres. Efforts to house this labour force makes increasing demand for investments in construction and urbanisation.

Industrial expansion requires an enhancement of infrastructure, ranging from larger roads and transport networks, the expansion of seaports, higher electricity generation, distribution facilities and telecommunications. The Industrialisation process involves a change in composition of demand for intermediate and final goods on the one hand and in net trade on the other (Syrquin and Chenery, 1989). Substitution of imported commodities by domestic production and growth in the final use of products will increase the levels of industrialisation, and hence the demand for commodities. Syrquin (2008) indicates an increase in the density of the input-output matrix as income levels grow. This movement in the industrial production mix, towards capital and technology intensive manufactured goods such as transport equipment and machinery, expand the consumption of inputs, i.e. metals and commodities. As income levels increase with a strong industrial phase, it will be accompanied by a higher income elasticity of demand for commodities, relative to lower income levels and non-industrial expansion.

The development of physical infrastructure was seen as a key ingredient for economic development in the mid twentieth century (Ingram and Fay, 2008). Aschauer (1989) showed a positive impact of infrastructure investment in explaining the total factor productivity growth in the US. While Banerjee (2004) reports evidence that of infrastructure spending being higher in rich countries relative to low income economies, Canning (1999) and Auty (2008) argue that returns to infrastructure fall as economies mature, and they are at their highest at the early stages of economic growth. Hulten (1996) in comparing East Asia and African economic growth finds that the efficient use of infrastructure stocks accounts for 40 percent of the difference between low and high growth rates.

Global populations are increasingly living in urban centres and for the first time in history urban populations may be higher than rural populations. Larger urban populations are not only a result of migration but an increasing difference between rural-urban fertility rates (Becker, 2008). Increasing urbanisation is strongly correlated to higher levels of economic growth (NRC, 2003) even though cities may house large segments of low income earners in slums. Urbanisation results from both the positive effect of seeking higher wages and employment and from the negative impact of adverse conditions in the rural areas. Becker (2008:527) further argues: '[...] future urban growth seems likely to be dominated by service sectors, especially in large cities. Total manufacturing and

extractive industry employment is likely to continue to rise, but the greatest gains will be in services, both sophisticated and unskilled labour-intensive'.

In general, economic growth accompanied by increasing industrial expansion, rising urban populations and increased infrastructure investments will increase the demand for hard commodities. Structural change and commodity demand can be considered across similar income levels or along a time series. Countries with similar income levels and sectoral distribution of GDP will have similar commodity usage. Likewise, countries with different income levels or different sectoral distribution, will exhibit differences in their consumption. The resource intensity of an economy will change along a time series as its sectoral distribution changes.

At low per capita income levels only basic needs can be met, and as such metal consumption remains low. As income levels rise, demand for consumer products, housing and infrastructure are likely to grow, generating higher demand for minerals and metals. As advanced economy status is reached, and domestic growth in infrastructure and construction slows down, consumption of metals fall as well. Low income countries with a low share of industrial sector, will have low commodity consumption. Advanced economies, having a larger services sector than an industrial sector, will have low commodity consumption as well. Generally, emerging economies will experience more commodity-intensive growth per percentage point increase in GDP in relation to advanced economies (Radetzki, 2006).

4.1 Commodities Demand and Income Levels

An economy can be classified as primary, industrial or services orientated based on the share of the largest sector in GDP. The overall GDP levels can be classified as advanced, middle and low-income countries. In general, low-income countries will tend to be primary based, middle-income countries industrial, and advanced economies will be service orientated. The per capita consumption of commodities is strongly influenced by the economic structure of an economy (Crowson, 1998). Per capita income reflects the development level of an economy, can be used to look at differences in income levels, and the intensity of metal consumption (Guzman *et al.*, 2005).

This allows us to draw a direct link between income levels and commodity usage across different income groups.

Figure 4.1 provides a cross country comparison of GDP per capita as well as the share of mineral and metals costs in industrial production for selected emerging and advanced economies. GDP per capita is used to indicate development levels, while the share of mineral costs is used as a proxy for metals consumption within an economy. A simple quadratic equation is fitted to the data points to indicate a trend line.

Figure 4.1: Percentage Share of Costs of Minerals/Extractive Sector in Industrial Production and Per Capita Income (PPP) 2004
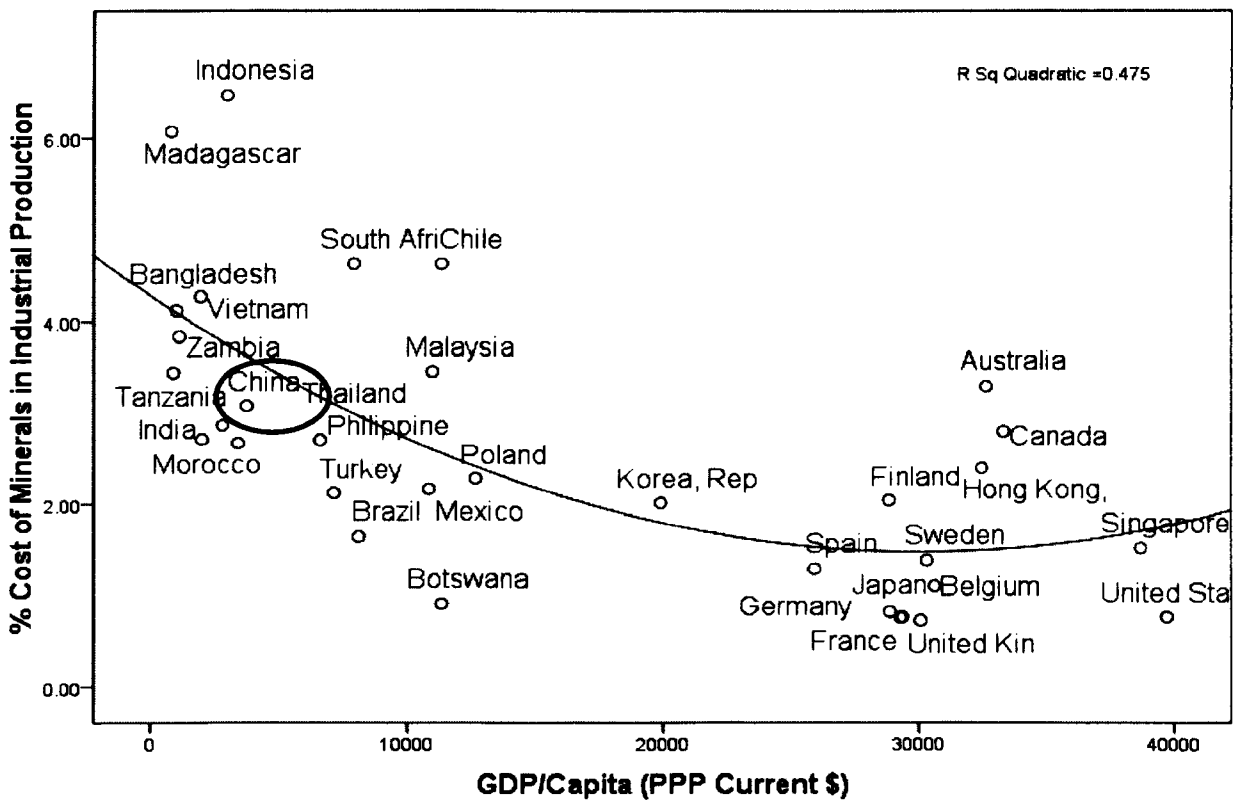
Source: Author's calculations from GTAP and World Development Indicators

Starting from the left hand side of the figure, low per capita income is associated with the highest relative consumption ratios of minerals and metals within an industrial economy. As we move along the curve, middle income countries correlate with lower consumption; while towards the right hand side, the clustering of advanced economies are associated with the lowest consumption of metals and minerals in the industrial sector.

From Figure 4.1, we note that China is in the region of low income countries, and lies just below the curve. This would indicate that its expenditure on minerals and metals conforms to patterns seen in other developing countries and is in no way exceptional. China's current consumption patterns of metals are in line with the normal patterns of growth. As its income levels rise, we expect it to move down and along the curve.

The resource-intensive stage for China is likely to continue for the medium to long term; although it is one of the largest economies in the world, it is still a developing country. In comparison to high-income OECD economies, where the per capita income (PPP in constant 2005 $) was around $35,000 in 2007, China's per capita income was just $ 5,083[28]. As China moves towards higher income levels, its consumption patterns should be similar to that of a middle-income country, such as Korea, and eventually of an advanced economy such as the United States With rising income levels, its demand for commodities will eventually taper off.

Only the resource abundant countries such as South Africa, Chile, Canada and Australia show deviations from the trend. Radetzki (1990), Tilton (1990) and Dobozi (1990) argue that the intensity of metal use can vary among countries with similar per capita incomes. These are usually due to differences in resource abundance of economies, because domestic availability of raw materials makes their use in industrial production more likely than those who rely on imports.

4.2 Commodities Demand and Income Growth

As commodity demand differs across countries at various income levels, it also differs within a country over time. The overall economic conditions, such as the population growth, rate of urbanisation, and the nature of the manufacturing sector (capital intensive as compared to labour intensive) effect commodity consumption within an economy. Countries at earlier stages of development will experience low consumption of metals, rising as incomes rise, and eventually tapering off with further growth.

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[28] Source: World Development Indicators via ESDS accessed December 2008

Currently China is in the beginning phase of a resource-intensive stage of growth, as its structural changes are focused on infrastructure development and manufacturing (Radetzki, 2006). Although the OECD economies account for 52% of global GDP in 2005, and developing Asia for just 27%, the latter is experiencing a more resource-intensive stage of development as compared to the former. Every dollar generated in developing Asia will absorb twice as much commodities relative to the de-materialising OECD economies. This results from the nature of GDP growth, with developing countries focused on expanding infrastructure and their manufacturing sectors, while the developed economies focus on maintaining infrastructure and expanding the services sector. With developing Asia growing at nearly twice the rate of the OECD, its commodity demand growth rates would have been much higher relative to the advanced economies (Radetzki, 2008).

Figure 4.2 shows the per capita consumption of copper[29] for different countries over time, starting at the period of their industrialisation. The copper consumption of the United States is traced from 1960 to 2005, while Japan and South Korea are traced from 1970 and 1980 respectively. Since China was the last country to industrialise, its consumption per capita is shown from 1990 onwards.

Figure 4.2: Per Capita Copper Consumption and Economic Growth (1960-2005)
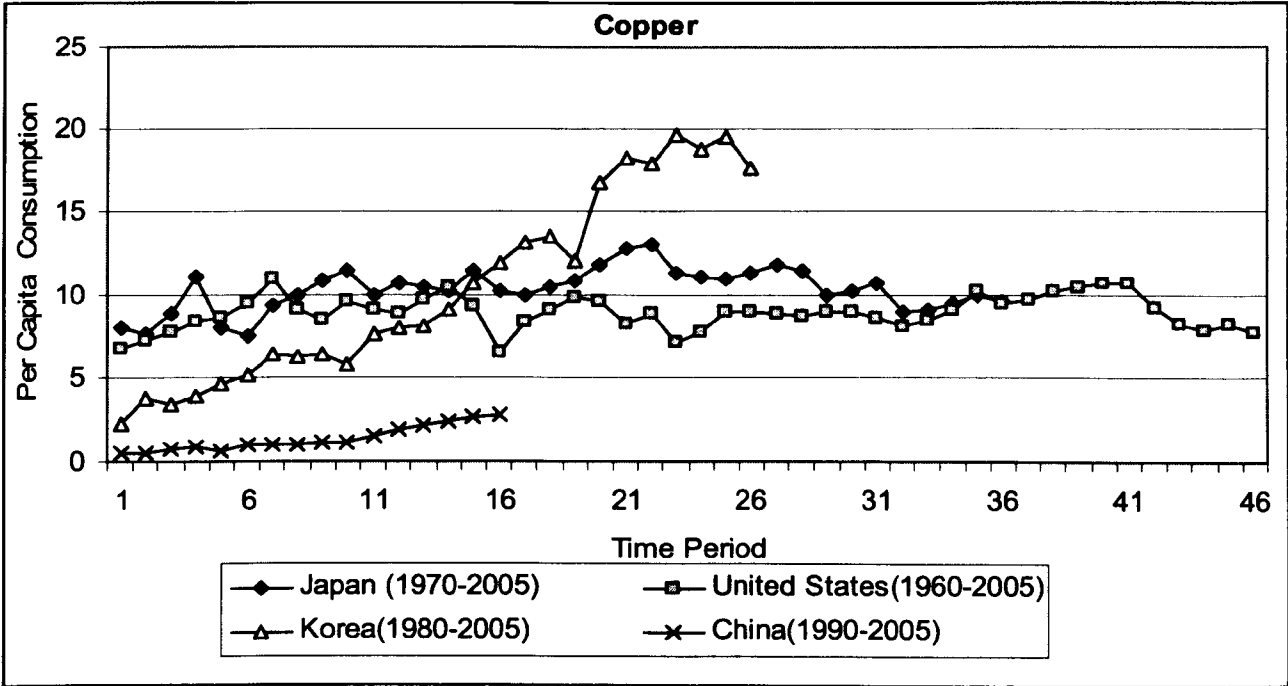
Source: Author's calculations from World Economic Outlook 2006.

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[29] Copper is widely used across sectors and is reflective of mineral demand and growth in general

The United States, which industrialised relatively earlier than the others, shows more fluctuations in consumption in the initial stages of its economic growth, which stabilises in later years. Due to data limitations, we are unable to trace this movement before 1960, and therefore cannot see the commodity consumption in its most resource-intensive stage of growth. In the case of Japan starting from 1970 we see a similar fluctuation and rise in commodity consumption in the initial stages of economic growth. This eventually smoothens out towards the later half of income growth, similar to the experience of the United States. The data for Korean starting in the 1980s reflects its period of rapid income growth, and shows an accelerating consumption of copper in the initial years, which is just beginning to decline. As Korea's GDP levels continue to increase, we expect it to follow similar patterns to the United States and Japan.

The values for China indicate that it is still at a very early stage of GDP growth, and its consumption levels are still very low. Although it has begun to increase consumption in recent years, these levels are still far below that of Korea and the advanced economies. As the Chinese income levels rise, they can be expected to emulate consumption patterns seen in the more industrially advanced economies. We now take a detailed look at the domestic and trade sectors that are generating current and expected future demand for metals in China.

SECTION 2 CHINA'S STRUCTURAL GROWTH AND METALS DEMAND

The period of 2000-07 saw world GDP grow at an average of 3% per annum, with most of the growth being led by the East Asian economies. Within this group, China has been the fastest and the largest emergent country, achieving double digit growth rates for most of the 2000s. China is now a firmly established and influential player in the global economy, both in terms of domestic growth and international trade.

In the late 1970s, China was emerging from a rigid authoritarian system. Policies such as the 'Great Leap Forward' (1958) and the Cultural Revolution (1966) contributed towards stagnation within the economy. After the death of Chairman Mao in 1976, internal political struggles ensued for a number of years. But by the early 1980s the State began to actively engage in economic and social reforms. The 1980s focused on inward looking growth, while the 1990 to 2000 period saw wide-ranging

industrialisation and the beginning of integration into the world trade economy. The years 2000 to 2008 saw expansive export and import regimes and accelerated economic, growth reaching double digits levels.

China's GDP growth averaged around 10% p.a. from 1990 to 2007. In 2006 and 2007 this rate climbed to 12% per year. GDP per capita (PPP constant 2005 $) increased from $2,644 in 2000 to $5,083 in 2007[30]. Figure 4.3 shows China's GDP and annual growth rates for the past two decades. Since 2003, China's annual growth rates have been in double digits, with the size of the economy doubling between 2000 and 2007.

Figure 4.3: China's GDP ($ Billion) and Percentage Growth Rates (1990-2007)
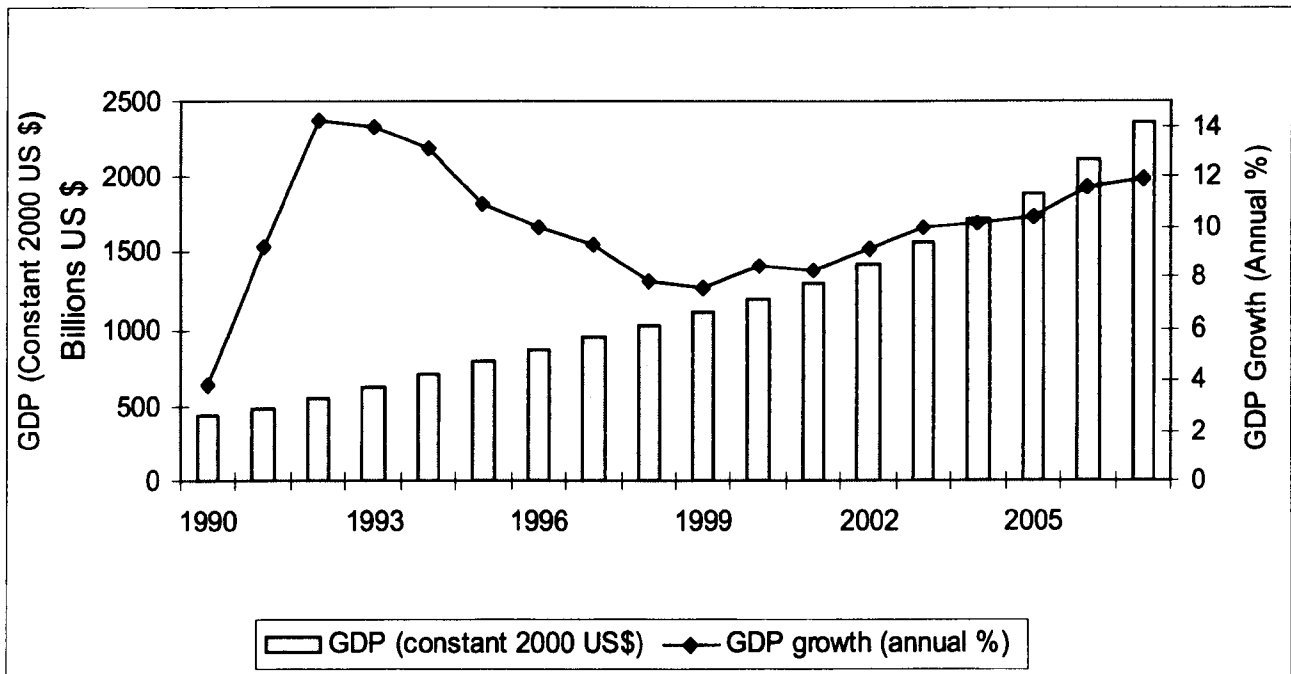
China as a Large Economy: Large sized economies, geographically and by population, will generate larger physical outputs in terms of demand and supply, than similar growth rates when experienced by smaller countries. The relationship between country size and economic development has been recognised for years (Smith, 1776; Kuznets, 1959, 1960, 1964; Chenery and Syrquin, 1975). Larger countries tend to follow a more balanced growth strategy, and tend to share similar economic structures with other large countries. Perkins and Syrquin (1989), in

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[30] Source: World Development Indicators via ESDS accessed December 2008

examining the influence of size on economic development, show that there are no major differences in the share of agriculture, manufacturing and services in GDP between small and large countries at similar income levels. China's structural growth can be expected to grow along similar lines as that of the United States. The share of the manufacturing sector will continue to expand until higher GDP per capita levels are achieved, and the services sector begins to take over as the largest contributor to the economy.

China as a Developing Economy: We have indicated in Section 1 that a developing country has a different intensity of commodity demand than more advanced countries, and this remains true even when size is held constant. For example, the United States and China are very similar in size in terms of land mass[31], but their raw material needs are very different given the variation in income levels. In 2007, metal ore and concentrate accounted for 7% of total imports for China, and only 0.4% of the United States. In real terms ($ value), China's ore and concentrate imports were nearly nine times the value of those imported by the United States even though its total imports were nearly half of that of the United States[32]. The volume of resources and raw materials that China demands at its current stage of economic development are different from those of advanced economies such as the United States. Secondly, due to its size, the volume of these imports is large.

China as Southern Engine of Growth: A demand disruption is likely to occur in today's global economy when growth is un-expectedly driven by a large emerging economy. China and India, known as the Asian Drivers are two such economies (Kaplinsky and Messner, 2008). Together they account for one third of the global population and cover a large land mass. China is expected to be the second largest economy in the world by 2016, and India the third largest by 2035. China, more than India, has sustained high GDP growth rates over the past two decades, but has much progress to make before it can achieve an advanced economy status. India, following in the footsteps of China, can be expected to reach the current Chinese growth levels in a decade's time.

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[31] Source: CIA World Fact book; both cover nearly 9,000,000 sq. km.
[32] All values from UN Statistics Division COMTRADE accessed 6th June 2009

With their size, economic structure and trading patterns, China and India have a large impact both on the developed world as well as the developing world. The rise of a large emerging economy has caused disruptions in the global economic system. Kaplinsky (2008) highlights five major reasons for China's disruptive impact on the global economic systems. The first is the size of the Chinese economy, where although China is following similar growth paths to South Korea or Japan, its large size makes a much larger impact on the global economy. Secondly, China's current account surplus can cause global financial imbalances. Thirdly, China's economic development has been a unique combination of a strong state with capitalistic markets compared to other industrialised countries. Fourthly, China has combined low wages and income with a high innovation potential, resulting in cheaper manufactured products. Finally, China is focused on securing supplies of raw materials for the future, and its business strategy in some countries tends to follow a resource driven agenda (Kaplinsky and Farooki, 2008).

These disruptive characteristics have both direct and indirect impacts on the global economy. For example, even though a strong manufacturing sector and innovation capabilities may be related to the domestic sector they can have strong indirect effects through trade. The exports of cheap manufactures and import demand for raw material can have both a positive or negative disruptive influence on the markets of other developing countries. The large size of China's economy forces us to ignore the small country effect in international trade, and consider disturbances caused by the volume of trade that China generates. These have significant impacts for the growth of other developing countries. We return to this issue in Section 3.

4.3 Structure of the Chinese Economy

As the Chinese economy grows, it is following a normal pattern of growth as discussed in Chapter 2. Over the preceding decade, the contribution of the agricultural sector to GDP has steadily declined, while that of industrial and services sector has increased. State support has led to a strong industrial and manufacturing sector as well as greater urbanisation. Table 4.1 shows the share of the three sectors to value addition in GDP. From 1990, the share of agriculture value added as a

percentage of GDP dropped from 27% to just 12% in 2006. The share of industry increased from 42% to 48%, while that of services rose from 31% to 40%.

Table 4.1: China's Value Added as a Percentage of GDP (1990-2006)

Year	Agriculture	Industry	Services
1990	27	42	31
1995	20	47	33
2000	15	46	39
2005	13	48	40
2006	12	48	40

Source: World Development Indicators, accessed via ESDS on 30th March 2009

Trade has played a large part in the growth of the Chinese economy, with trade as a ratio to GDP rising from 35% to 72% between 1990 and 2006. China's exports of manufactured products are progressively moving from low technology and assembly products, to medium and higher technology products (Kaplinsky and Morris, 2008). On the import side, commodity and energy items are becoming increasingly important. In 2006, the exports to GDP ratio was 40%, while that of imports was 32%. The metals intensity of the trade profile is discussed in detail towards the end of this section.

Although China's global engagement through trade often takes centre stage in discussions around commodity demand, it is important to note that in the case of metals, domestic demand is responsible for a large portion of overall demand. This demand is based around urbanisation, infrastructure and increasing local demand for durable goods as per capita incomes rise. Heap (2005) comments: 'In China, intensity of use [of metals] is now three times that of the United States, with demand driven by urbanisation, industrialisation and fixed capital formation. Importantly, the domestic market drives China's metals demand, not exports'. According to his estimates, as much as 70% of copper consumption is for domestic needs. We take a closer look at the sources of domestic demand before examining the trade sector.

GDP Growth vs. Resource-intensive GDP Growth: China's GDP growth has averaged at around nine percent per year since the 1980s, but its increase in demand for metals has only been seen in

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recent years. GDP growth is linked to changes in the structure of the economy. We have already shown how China's GDP is increasingly generated by the manufacturing sector, and the decreasing share of the agricultural sector (Table 4.1). Table 4.2 shows the average per capita consumption of aluminium and copper for China, and its GDP per capita growth rates for the past four decades. In the earlier periods of 1962 through to 1994, China's GDP per capita growth rates averaged around five to nine percent per year, while consumption of metals per capita steadily increased. After 1995, the consumption of metals more than doubled for both aluminium and copper, while GDP per capita has on average grown less than in the 1984-1994 period.

Table 4.2: China's Per Capita Metal Consumption and GDP Growth Rates (1962-2005)

Time Period	Consumption per capita		GDP per Capita Growth (in Percentage)
	Aluminium	Copper	
1962-1972	0.2	0.2	6.3
1973-1983	0.5	0.4	5.4
1984-1994	0.8	0.6	9.3
1995-2005	2.9	1.7	8.4

Source: Authors' calculations from World Economic Outlook (2006) and World Development Indicators

The increase in per capita consumption in recent years indicates that even though China's GDP has been growing steadily for over thirty years now, it has in the recent two decades entered a resource-intensive stage of GDP growth. The consequence of China's growth for global demand for commodities is therefore a more recent event, relative to its preceding decades of GDP growth.

Sources of Commodity Intensive Demand: The increasing share in value added by the industrial sector is a major driver for China's domestic growth. In 2006, the share of the industrial sector accounted for nearly half (48%) of its national output, compared to that of the more advanced economies such as the United States (22%) and Japan (29%), or even to transition and emerging economies such as South Korea (40%) and Russia (40%). Expenditure on Gross Fixed Capital Formation, a proxy for infrastructure investments, in China was 43% of GDP in 2006, which is much higher than the 18% for Germany and 29% for South Korea[33]. The industrial sector is more resource-intensive than the services sector, but it is difficult to measure the ratio of metals and

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[33] Source: World Development Indicators accessed December 2008

minerals used in various sectors with any precision. This inability arises as the properties of most metals overlap to certain degrees. Projects such as residential construction will require more steel, whereas as car production requires a variety of metals. The intensive sectors of metals consumption are in the manufacturing and construction sectors. Of total global consumption of aluminium, 26% is used in transport and 22% in packaging (22%). Copper is mainly used in wiring (22%) and in construction (28%), while zinc is used in galvanizing pipes (47%)[34].

We acknowledge that we cannot provide precise ratios of metal usage in various sectors in China, but are confident that an examination of its consumption relative to other countries supports the required analysis. Domestic growth generates demand for urbanisation, infrastructure and manufactured durable goods, and thereby acts as a large driver of commodity demand. The industrial sector can be further disaggregated into manufacturing, infrastructure and construction.

4.4 Commodity Intensity of the Manufacturing Sector

The manufacturing sector uses commodities as inputs for finished products, as well as for machinery and tools to build those products. Due to the differing nature of technology and efficiency, it is difficult to be precise about the cost of metal inputs in each sub-category of manufacturing. First, the input of metals in manufactured products may be lower than five percent of the total cost of the unit, making it difficult to differentiate the actual input cost. Secondly, different machinery can be used to produce similar manufactures. A more technologically advanced production line will make more efficient use of inputs, than less advanced equipment producing similar products. It is difficult to differentiate the level of technology and efficiency, and therefore input costs for similar products. Manufacturing sector outputs, when they are labour intensive products such as toys or shoes, will have different metals inputs costs, relative to those that produce cars and machinery. Given these issues, we examine the overall consumption of hard-commodities in manufacturing, rather than attempting a breakdown of metals consumption in different sub-sectors.

Figure 4.4 shows a cross section of countries, with different shares of manufacturing value added to GDP on the horizontal axis. The cost of minerals in the manufacturing sector is shown on the

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[34] Source: Adock (2009)

vertical axis. A simple cubic equation is fitted to show a trend line. Manufacturing sectors with a lower contribution to GDP than primary or services sectors can exist in both low income countries and high income countries. The low income countries have not made the structural transformation from agricultural to industrial, while the high income countries have made the change from industrial to services based economies. At the left hand side of the figure, we find both low and high income countries.

Figure 4.4: Percentage Share of Costs of Mining/Extractive Sector in Manufactured Products and Manufactures Value Added (% of GDP) 2004
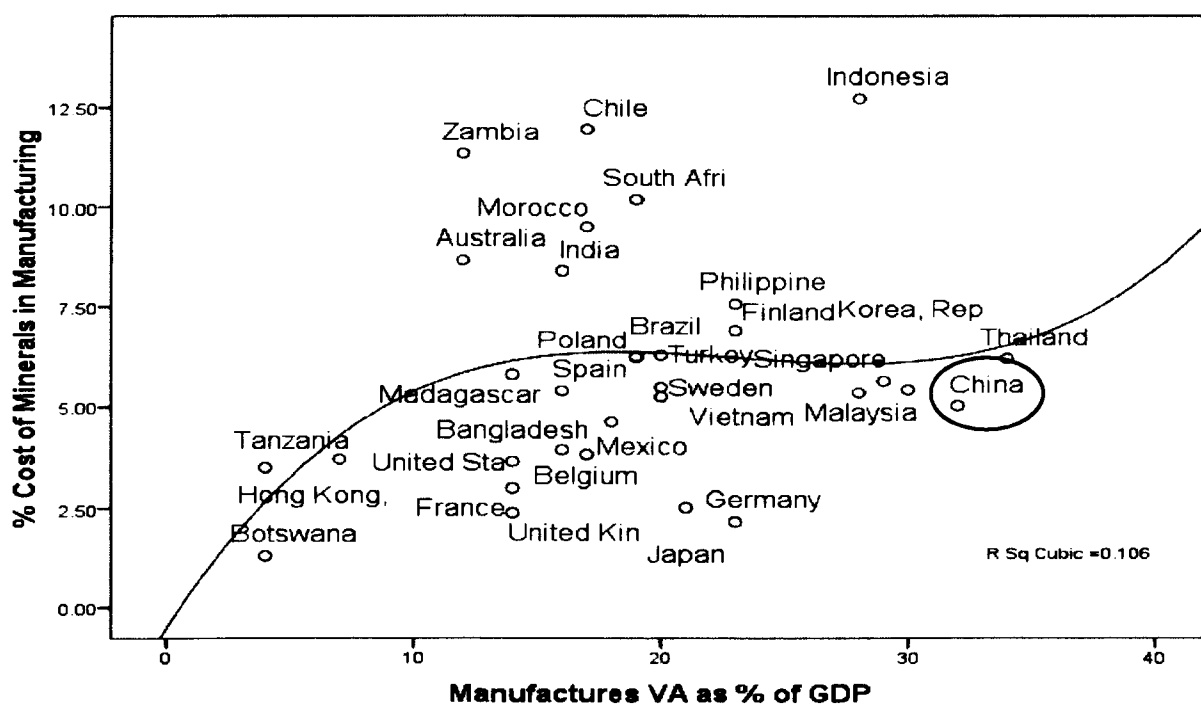
Source: Author's calculations from GTAP and World Development Indicators

As we move along the curve, the share of the manufacturing sector in GDP increases. Most of the emerging and middle income countries can be found as we move away from the origin. The outliers in this figure, similar to that of Figure 4.1, are resource-abundant countries. We have already explained why their behaviour is different from other countries.

China has a large share of manufactures in GDP; in this figure it is positioned just below the trend line. Its consumption of minerals and metals in manufacturing is similar to that of other emerging economies. China shows little deviation from the trend in terms of the share of commodities it consumes within its manufacturing sector.

As China grows, it will potentially move back along the curve to positions similar to that held by the more advanced economies. With changes in the sectoral distribution that accompanies income growth, we can expect the share of manufactures in China's GDP to eventually fall. Although, we are certain of the direction in which China moves, we cannot ascertain a time line for this change.

Demand for Manufactures: With the increase in annual per capita income, households in China have growing purchasing power, and hence there is a rising demand for consumer goods. Between 2001 and 2007, the retail sales in China were growing year on year at a rate of 10 to 15%. Between 2007 and mid 2008, this growth rate was between 15 to 20%. After the financial crisis, in the middle of 2009, these rates were beginning to recover to levels above 10%[35].

Given the high income elasticity of demand for manufactures, China's growing income levels have lead to increased domestic demand. As Table 4.3 indicates, between 2000 and 2006 urban households have increased consumption of most items such as automobiles (764%), air conditioners (185%) and motorcycles (35%).

Table 4.3: China's Ownership Of Major Consumer Goods (Units/ 100 Urban HH) (2000/2006)

Item	2000	2006	% Increase
Automobile	1	4	764%
Microwave Oven	18	51	188%
Air Conditioner	31	88	185%
Motorcycle	19	25	35%
Colour Television Set	117	137	18%
Refrigerator	80	92	15%

Source: Chinese Statistical Year Book (2007)

Currently 5% of the Chinese population owns a car, compared to 74% in the United States. Holmes et. al (2009) estimate that car ownership increases when per capita incomes increase over $3,000. The majority of China's population is still in the low income groups and the number of these households is relatively large compared to other developing countries (Figure 4.5).

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[35] Source: Holmes *et al.* (2009)

Figure 4.5: Households According to Disposable Income Bracket in BRIC Countries ('000 HH) (2002/2007)
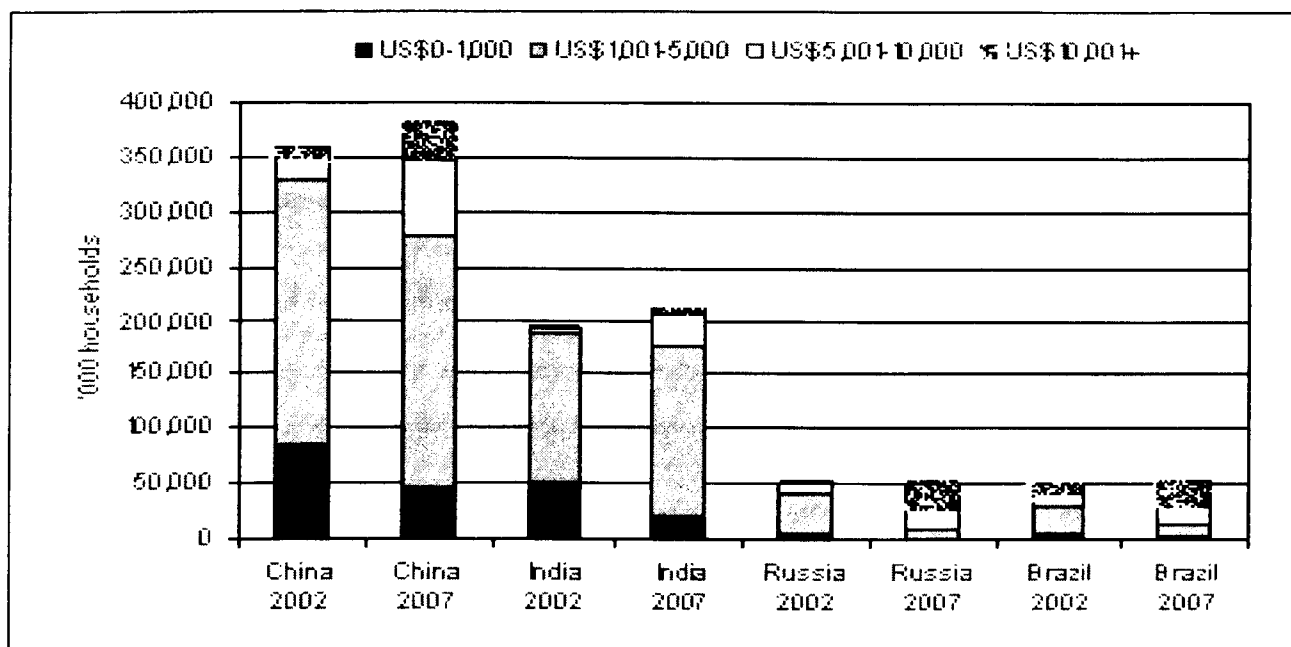
Source: Media Eghbal (2008)

Between 2000 and 2007, a number of households moved from below $1000 income levels to the $1000- 5000 bracket. Others from this level graduated on to higher income groups. Although a majority of the population remains in the low income group, the number of households relative to other emerging economies is large. This has two implications for the growth in income and volume of demand for manufactures.

First, as per capita incomes in China increase the domestic demand for manufactures will increase, too, due to the high income elasticity of demand for manufactures. Secondly, given the number of domestic households experiencing rising income, the increase in volume of demand will also be significant. Both factors will lead to a rise in manufactures demand, thus derived demand for commodity inputs will also rise. Given that the majority of the Chinese population is still located in the lower income group, there is a large domestic consumer market that is just beginning to emerge.

4.5 Commodity Intensity of Urbanisation

China is the fourth largest country in the world by geographical size covering 9,596,960 sq km; the United Kingdom is just 2.5% the size of China in terms of land area. In 2007, it had 287 officially classified cities, with 13 having populations above 4mn people, and 26 cities with populations

between two and four million. Despite the large number and size of Chinese cities only 45% of the population (594mn) live in urban centres. The population of Beijing is the same size as London, whereas Shanghai is twice that size. The UN population division estimates that by 2015 the urban population will rise to 684mn. By 2030 this will amount to 890mn people, a population larger than that of the United States and Europe combined[36].

The movement of the rural population to urban centres is relatively more planned in China, where some level of State control is exhibited over rural-urban migration. With the expansion of the manufacturing sector, the growth in urban centres, where these industrial units are based, has led to increasing rural to urban migration. Industrial units are now moving further in-country to expand industrial zones away from those based traditionally in the costal regions.

This movement will bring renewed pressure to create urban centres as labour moves from the rural farmland to work in industrial units. The chaotic scenes reported at train stations at the start of the 2009 Chinese New Year, as millions of urban labour migrants returned to their rural homes, is a small indication of the population that China will eventually settle in its urban centres permanently. The construction of residential buildings as well as the urban infrastructure required to support larger cities, will be metal intensive.

Figure 4.6 shows a cross section of countries with various income levels and the infrastructure costs. Gross Fixed Capital is used as a proxy for expenditure on infrastructure and urbanisation. A simple linear equation is fitted as a trend line. Low income and high income countries will both exhibit smaller shares of Gross Fixed Capital as a percentage of GDP, since infrastructure expansion has not progressed far in the case of the first, and has been largely completed in the case of the second.

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[36] Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat accessed February 2009

Figure 4.6: Percentage Share of Costs of Mining/Extractive Sector in Infrastructure and Construction and Gross Fixed Capital (% of GDP) 2004
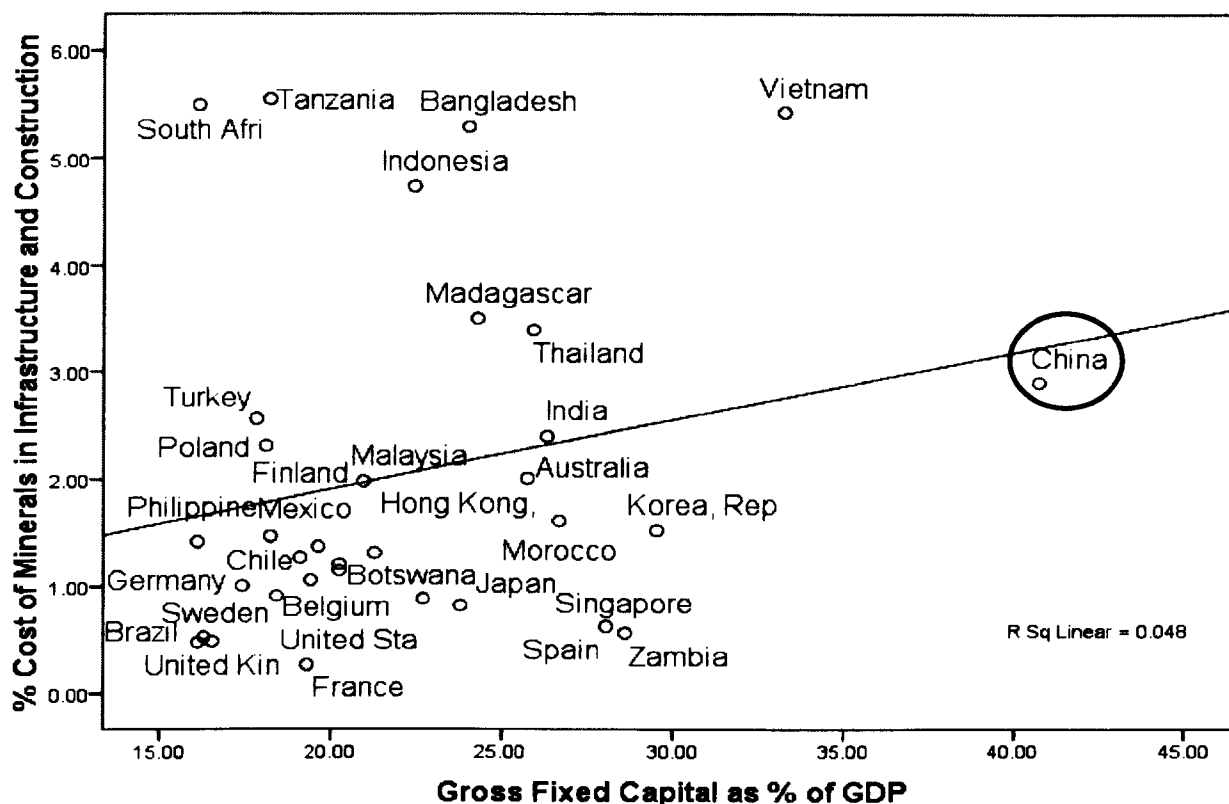
Source: Author's calculations from GTAP and World Development Indicators

China appears at the right hand side of the figure, with the highest expenditure on fixed assets in relation to GDP by a large margin. This can be attributed to the higher expenditures required to provide infrastructure and urbanisation facilities in a large land mass. The number of cities and the cost of expanding transport links, electricity and telecommunication networks, add to China's expenditure on infrastructure relative to other similar income levels but smaller sized countries.

In terms of the cost of commodities within infrastructure, China's consumption is similar to that of other developing countries. Even with a high rate of infrastructure spending, it does not have an exaggerated consumption of metals as a percentage share of costs. It is the overall expenditure itself that is higher. As is evident from Figure 4.6, China lies just below the trend line, indicating that its consumption patterns are not exceptional to those shown by other countries.

Income levels and expenditure on infrastructure are likely to have weak correlations, since other variables such as country size and geographical location tend to have a strong impact on the

infrastructure needs of an economy. Generally, advanced economies with higher per capita GDP tend to have a lower elasticity of commodity demand with respect to infrastructure expenditure. Infrastructure development and the urbanisation processes have been achieved and focus remains on expansion and upkeep rather than on new projects. Developing economies are more focused on the construction of new infrastructure projects, which require higher commodity usage. Given China's status as an emerging economy, a large share of infrastructure investments are for 'new' projects and less for upkeep and repair (Table 4.4).

Table 4.4: China's Investment in Fixed Assets in Urban Areas (1995-2007)

Year	Total Investment (100 ml Yuan)	% Share in Total Investment		
		New Construction	Expansion	Reconstruction
1995	16,000	30%	29%	12%
2000	26,000	32%	24%	15%
2007	118,000	44%	17%	12%

Source: Chinese Statistical Yearbook (2008)

The share of new projects has been increasing since 1995 and accounts for nearly half of the share in 2007, while expansion and reconstruction remain fairly stable. New projects tend to be much more commodity intensive as compared to expansion and reconstruction investments. Since fixed asset investments require large inputs of commodities, an emerging economy with larger infrastructure investments will reflect a tendency to incur a higher proportion of mineral and metals in their infrastructure costs.

As urban centres continue to grow, new cities and expansion of older cities generate demand for new housing and infrastructure. Chinese cities have seen the population density in city districts increase from 442 pers./sq. km in 2000 to 2,104 pers./sq. km. in 2007. More residential buildings also increase infrastructure demand: pipes for water and gas, cables for electricity and phone lines, etc. Of China's total expenditure on fixed assets in 2007, 61% was spent on construction and

installations. Within urban centres, the number of large projects (investment value of more than one bn Yuan) account for nearly 30% of all urban fixed assets investment[37].

As the Chinese economy matures, we can expect its investment to decrease in fixed assets to the levels of other advanced economies. With lower investments, its percentage share of costs of commodities in infrastructure is also likely decrease. China's move from its current investment levels to those exhibited by the developed world, is still on a long term horizon. Chinese urban population is expected to reach 1.12 billion residents by 2050 and it must cater to the needs of this growing urban population. It must also address the needs of the rural communities. For the short to medium term, we can expect Chinese fixed capital investments to retain their high levels, ensuring that commodity demand for infrastructure is going to remain strong in the medium term.

4.6 Commodity Intensity of the Trade Economy

In 1978, China's engagement with the international economy was limited; trade was 10% of GDP with a trade deficit of $11,400mn. In the 1980s, the trade sector's contribution to GDP increased to 22%, when most of the rise showing in the later half of the 1980s. The economy moved from a deficit to a trade surplus in 1985, and has maintained that surplus ever since (apart from 1993). The ratio of exports to GDP increased from 10% in the 1980s to 18% in the 1990s, rising to an average of 27% in 2000-06[38].

China's expansion in exports was initially based on low-technology manufactured products such as apparel, shoes and toys. As manufacturing capacity was built, China's export structure has increasingly been dominated by medium and high technology products. The Lall Taxonomy of technological intensity (2000) allows us to examine trade based on the level of technology embodied in a product at SITC (Rev 2) 3 digit level. A decomposition of Chinese exports and imports at the primary, resource-based, low, medium and high technology level indicates the changing structure of both imports and exports over the past ten years (Table 4.5).

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[37] Source: All data from Chinese Statistics Yearbook (2008)
[38] Source: World Development Indicators via ESDS accessed December 2008

Table 4.5: Chinese Trade Structure Based on the Lall Taxonomy (1995/2006)

Lall Taxonomy	Exports		Imports	
	1995	2006	1995	2006
Primary	10%	4%	11%	16%
Resource Based	11%	8%	14%	15%
Low Technology	46%	31%	15%	7%
Medium Technology	19%	22%	42%	26%
High Technology	13%	34%	18%	37%

Source: Author's calculations from COMTRADE data accessed via WITS November 2008

In 1995 China's exports were mainly in low technology products (46%), with this share falling to 31% by 2006. Primary and resource-based products saw a decline as well. Medium-technology exports increased from 19 to 22%, while high-technology products increased from 13 to 34% between 1995 to 2006.

With imports, low-technology products fell from 15% to 7% while medium-technology products fell from 42% to 26% as share of total imports. High-technology products on the other hand increased from 18% to 37%. Resource-based products maintained their share at 14-15% while primary products increased from 11 to 16% over the period 1995 to 2006.

Accompanying the changing nature of China's trade structure, the nature of import and export materials has also changed. Table 4.6 shows China's decreasing exports of food, fuel and ores and metals as they are diverted towards domestic consumption over the 1990-2006 period. Whereas food imports have fallen from 9% to 3%, the share of fuels has increased from two to 11%, and that of ores and metals from three to nine percent of overall imports from 1995 to 2006.

China's increasing imports of fuel, ores and metals indicates its increasing demand for raw materials. On the other hand, China is also increasing manufactured products exports, which are increasingly higher technology products. Disaggregated data on manufactures production for China is unavailable in the English language, however using manufactured exports as a proxy for domestic production, we can examine the metal-intensive product manufacturing in China.

Table 4.6: Percentage Share of Food, Fuels and Ores & Metals in China's Trade (1990-2006)

% Share in China's Exports			
	1990	**2000**	**2006**
Food	13%	5%	3%
Fuels	8%	3%	2%
Ores & Metals	2%	2%	2%
% Share in China's Imports			
	1990	**2000**	**2006**
Food	9%	4%	3%
Fuels	2%	9%	11%
Ores & Metals	3%	6%	9%

Source: Author's compilation from COMTRADE via WITS accessed November 2008

As already stated, the share of metals and minerals in particular manufactured exports is often difficult to establish, since they are usually a small but essential input in the manufacturing process. We use those products where base metals and mineral ores are the major input in the production process. These products are selected by using the SITC code, where a good is first classified as a manufactured product and secondly by material[39]. Figure 4.7 shows the share of metal and mineral ore intensive manufactured products in total manufactured exports.

Figure 4.7: China's Metal and Minerals Intensive Exports in Total Manufactures Exports (1990-2006)
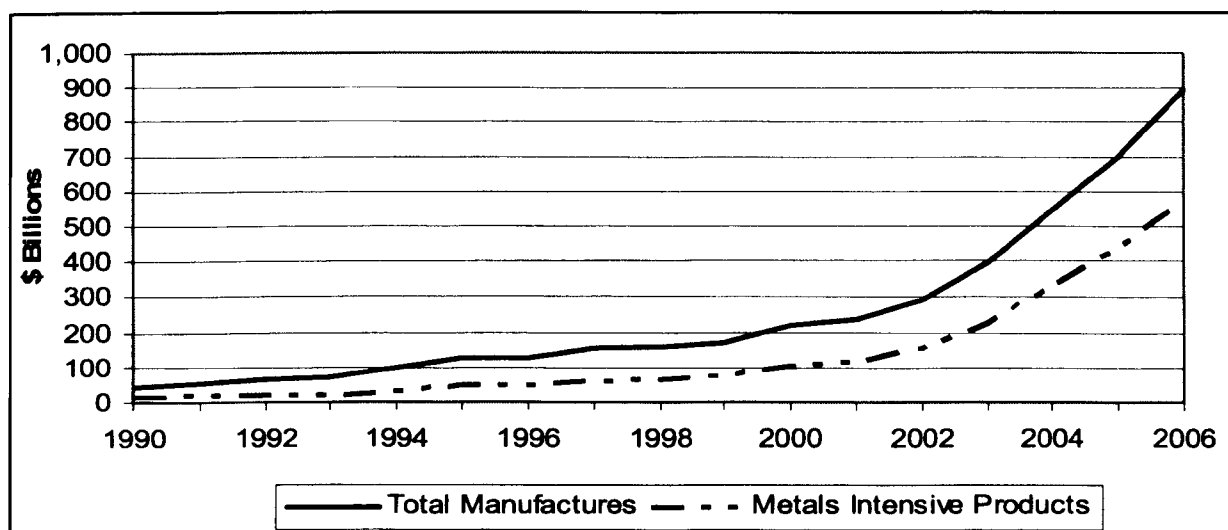
Source: Author's calculations from COMTRADE data via WITS accessed November 2008.

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[39] For a full list of products see Annex 1

In 1995 metal-intensive products accounted for 38% of the value of manufactured exports, rising to 48% in 2000, and 64% in 2006. As manufactures have increased over time, the share of metal-intensive products has also increased. But to what extent does the increase in metal-intensive manufactured exports account for its increased demand for base metals?

Given China's manufactures growth, a large number of firms have shifted production operations to China (Martin and Manole, 2004). The increasing metal-intensive nature of Chinese manufactured exports may be a reflection of companies taking advantage of its cheap labour costs and using it for assembly only. So the increase in Chinese manufactured exports may be substituting production in other countries. If that is the case, then increased demand for metals from China is not a reflection of its own manufacturing needs. This would imply that global demand as a whole has not changed, but simply shifted from one region to the other. To examine this possibility, we look at the nature of manufacturing in China's exports and the degree to which China is producing, as compared to assembling products. In Section 3 we analyse and international commodity demand to address the issue of displaced demand.

Revealed Comparative Advantage and Industry Specialisation Index: Initially, manufactured exports from China were largely based on imported inputs from East Asia, assembled in China and then exported abroad (Lall and Albaladejo, 2004). Until 2003, East Asia was the main supplier of inputs, and the only region with which China maintained a trade deficit. By 2006, China had moved into a trade surplus with its East Asian partners as well. In order to gauge the nature of China's manufactures trade, we calculate its Revealed Comparative Advantage (RCA) and the Industry Specialisation Index (RCA). The RCA allows us to establish the extent to which China's comparative advantage in manufactures has improved over the years, while the ISI tests the extent to which this manufacturing capability is domestically established.

Revealed Comparative Advantage (RCA): RCA is 'measured by a good's share in a country's total exports relative to that good's share in world trade. If the share of the good in the country's exports is larger than its share in world trade, the country has a revealed comparative advantage in

that good. If the share of the good in the country's exports is smaller than its share in world trade, the country has a revealed comparative disadvantage in that good' (Balassa, 1965).

Table 4.7 shows the RCA for manufactures exports from China and other selected countries. A value greater than 100 indicates a comparative advantage. China's increasing values over the last decade show its increasing advantage. By 2006 China had a higher comparative advantage in manufactured exports compared to Japan and Korea indicating its increasing competence in manufacturing products.

Table 4.7: China's Revealed Comparative Advantage In Manufactures (1995-2006)

	1995	2000	2006
China	110	117	131
Japan	124	124	128
Korea	119	119	126
India	96	101	92

Source: Author's calculations from COMTRADE data via WITS accessed November 2008

Industry Specialisation Index (ISI): The RCA does not address one concern, i.e. the possibility of a high degree of imported inputs in exported products. In order to look at the impact imported inputs may have on export output we use the Industry Specialisation Index (ISI). Kwan (1994) uses an ISI, to show the share of processing trade verses manufacturing trade for a country. The values range from -1 to +1, with a higher value implying stronger specialisation within the country.

Table 4.8 shows the ISI for China and other selected countries. China has become increasingly specialised in manufactures, with the ISI index rising from 0.09 in 1995 to 0.21 in 2006, which almost equals Koreas' levels by this time. The index shows China's increasing specialisation in manufactures, and more importantly, that these exports are relying less and less on imported inputs. Although China remains less competitive than Japan, it is catching up with Korea and its manufactures trade is gaining strength compared to its processing trade.

Table 4.8: China's Industry Specialisation Index in Manufactures (1995-2006)

	1995	2000	2006
China	0.09	0.13	0.21
Japan	0.41	0.36	0.33
Korea	0.12	0.22	0.24
India	0.09	0.22	-0.02

Source: Author's calculations from COMTRADE data via WITS accessed November 2008

Given the results of the RCA and ISI for China, even though it began its manufactures exports based on processing trade, it has progressively enhanced its capabilities to manufacture from domestic resources and increase its specialisation in manufactures. Therefore, the commodity inputs in the manufacturing sector are for domestic production rather than processing trade. As China becomes more self sufficient, and shifts towards manufacturing more capital-intensive products, such as machinery and transport equipment, it is likely to see a corresponding increase in demand for hard-commodities as inputs.

SECTION 3 INTERNATIONAL COMMODITY DEMAND

Our discussion around the nature of Chinese commodity demand concluded that there is nothing different about the nature of this demand relative to general trends. In terms of derived demand from manufacturing and infrastructure sectors, China's current commodity consumption follows patterns to those exhibited by countries at similar income levels, and its future demand will follow patterns similar to other advanced countries. As China's GDP growth rate accelerated in the past decade, so did its demand for minerals.

Over the 2000 and 2006 period, the annual average growth rates in its volume of demand for aluminium (18%), copper (14%), nickel (23%), and zinc (18%) have been substantial[40]. Given that China is a large geographical area, its own capacity to mine minerals and metals is considerable, yet it is increasingly sourcing raw materials through international trade.

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[40] Source: Humphreys (2007)

4.7 China's Domestic Natural Resources

In terms of volume China is one of the largest producers in the world for some metals, accounting for 32% of global production of aluminium, 37% of lead, 43% of tin and 27% of zinc in 2007. For others, such as copper and nickel, China only accounts for six percent and five percent respectively of global production. Between 2003 and 2007, China's mined production also increased, especially for bauxite (131%), iron ore (171%) and to a lesser degree for lead (48%), zinc (50%) and copper (52%)[41].

Metals pass through various stages of processing, before they can be used as inputs in construction and manufacturing products. Different organisations report metal volume and usage at different stages of production, as well as different methods to trace consumption and demand of metals. It is therefore unfeasible to use production, consumption and demand data from different sources to calculate the gap between China's domestic production and consumption for a number of metals. Where information is available (Table 4.9), we note an increasing gap between China's production and consumption. In the case of Aluminium this gap is positive, with China producing more than its own consumption, leading to an exportable surplus[42]. In 1999-2001 China was consuming more aluminium than it was producing, but by 2004-06 it had a surplus of 678,000 metric tons. In the case of refined copper, the deficit of consumption over production has steadily increased, from 550,000 metric tons in 1999-2001 to 944,000 metric tons in 2004-06.

Table 4.9: China's Production and Consumption of Aluminium and Copper (1994-2006)

Time Period		Unwrought Aluminium		Refined Copper	
		'000 Metric tons	% of World	'000 Metric tons	% of World
1994 - 1996	Production	1755	8.8	979	8.2
	Consumption	1709	8.5	1045	8.7
1999 - 2001	Production	3125	12.8	1356	9.1
	Consumption	3306	13.8	1907	13.0
2004 - 2006	Production	7948	24.9	2594	15.7
	Consumption	7270	22.9	3538	21.0

Source: UNCTAD Handbook of Statistics

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[41] Source: USGS data accessed October 2008
[42] China was one of the largest exporters of refined aluminium products in 2007

Table 4.9 also indicates that China's consumption as a share of the world total has increased over the past decade, with aluminium rising from 14% of the world in 1999-2001 to 23% in 2004-06. For copper this increased from 13% to 21%.

The domestic production and consumption gap has been met by increasing imports of ores and metals. Even for metals such as zinc and lead, where China has a large domestic production, increasing imports indicate a growing gap between domestic production and demand. In terms of volume, China's imports of major metal ores have increased substantially over the past decade (Table 4.10). Between 1995 and 2000 iron ore imports increased by 70%, aluminium ores by 78% and copper by 270%. Between 2001 and 2007 these imports increased by a further 315% for Iron ore, 673% for aluminium ores, and 113% for copper ores.

Table 4.10: Percentage Increase In China's Import Volume of Major Metal Ores (1995-2007)

	Iron Ore	Aluminium Ores	Copper
1995-2000	70%	78%	270%
2001-2007	315%	673%	113%

Source: Author's calculations from COMTRADE via WITS accessed in March 2009

But is the increase in China's raw material imports a result of displacement of manufacturing activity from other industrial countries? China's exports of manufactures and assembled goods have to some extent taken over from other East Asian and European countries exports. If China's increased demand for metals is replacing demand from other economies, then the impact on total global demand should be cancelled out by loss in demand from other countries.

4.8 China in International Commodity Markets

increasingly China has led the global consumption of base metals, while other advanced economies have decreased their consumption in the 2000s. The level of fall in the consumption of metals of the advanced economy is much lower than the increase in consumption of China (Table 4.11). Even if there was a displacement of demand due to a shift in manufacturing centres, it would account for a very small change in China's overall consumption.

Table 4.11: World Copper and Aluminium Consumption Growth by Regions ('000 metric tons) (2000-2007)

	United States	Other Advanced Economies	China
2000	44	821	1017
2005	174	-434	1368
2007	-521	-506	4792

Source: World Economic Outlook 2008

Figure 4.8 shows China's share of the increase in global demand over the past decade. The figure accounts for the increase rather than total demand, and shows 'new' consumption over and above of what the global economy was using before. Between 1995 and 2000, China's share of new demand for base metals was less than 60%. However between 2000 and 2007, it accounted for nearly all the increase in global demand for copper, zinc and nickel, as well as around 60% of the increase in aluminium and steel.

Figure 4.8: Percentage Increase in Global Demand for Metals Accounted for by China (1995-2007)
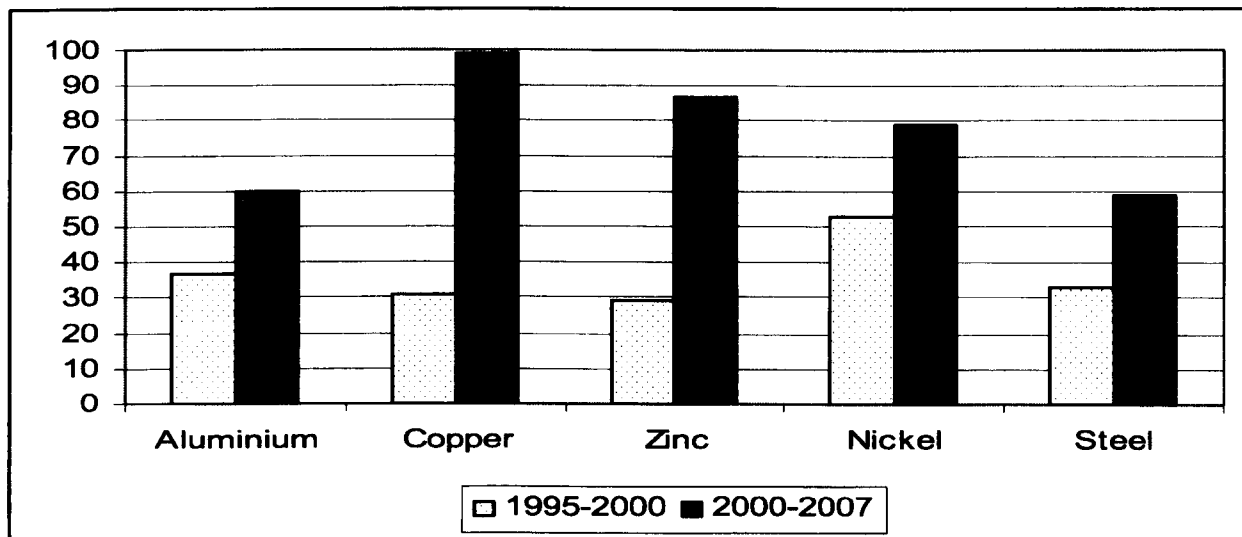
Source: Macquarie Commodities Research (2008)

Figure 4.8 is an indication of the role that China's demand plays. The substantial generation of 'new' demand and instead of a substitution for other economies indicates that global consumption of these metals has increased.

This increase in demand has been rapid: giving the supply side limited time to generate the physical commodity. The supply issues are discussed in detail in the next chapter. The scale of China's demand is important in order to understand why supply dynamics failed to respond. Although China's demand was increasing throughout the 1990s, the scale of this increase accelerated in the 2000s.

Table 4.12 shows China's share of global demand for a number of major metals. Between 1990 and 2000 China's share nearly doubled for copper, zinc, lead and Crude Steel and more than doubled for aluminium and iron ore. As substantial as this increase was, it is overshadowed by China's resource demand doubling again in just seven years between 2000 and 2007.

Table 4.12: China's Share of World Resource Demand and Average Growth Rates (1990-2007)

	Resource Demand as Share of World			Average Growth Rates (% p.a.)	
	1990	2000	2007	1990-2000	2000-2007
Aluminium	4.5	13.0	32.5	14.2	21.0
Copper	6.5	11.8	26.2	9.5	15.0
Zinc	8.2	14.9	31.3	9.4	15.3
Lead	6.7	10.1	30.6	5.8	21.1
Nickel	3.9	6.0	24.9	6.5	26.3
Iron Ore	4.1	15.6	48.2	17.2	27.3

Source: Macquarie Commodities Research (2008)

Annual average growth in demand in the 1990-2000 period accelerated further in the 2000 to 2007 period. For example, the share of copper demand was growing at an average of 9.5% per year in the first period, it accelerated to 15% in the latter period. Similarly, aluminium demand growth increased from 14% p.a. in 1990-2000 to 21% in 2000-2007. The rest of the major metals listed in Table 4.12 show similar accelerated growth in the 2000s, when compared to the 1990s. The growth in the latter period was unprecedented relative to the former decade, having major consequences for the supply side of the industry. This unprecedented rate of growth from a single country has had an impact on the overall demand levels. Given the large size of the country its increase in demand volume accounts for nearly all the increase in base metal demand in recent years. To appreciate

this impact, Table 4.13 traces the differences in growth rates of major metals with and without China.

Table 4.13: China's Impact on Demand Growth of Major Metals (1980-2006)

	Growth Rates	
	1980-2000	2000-2006
Total World		
Steel (mt.)	-0.7%	6.5%
Aluminium	2.5%	5.6%
Copper	2.4%	2.4%
Zinc	2.0%	3.7%
Nickel	2.6%	3.5%
Average	1.8%	4.3%
Total World Excluding China		
Steel (mt.)	-1.2%	2.9%
Aluminium	1.9%	3.0%
Copper	**2.0%**	**0.2%**
Zinc	**1.4%**	**0.3%**
Nickel	**2.4%**	**1.1%**
Average	1.3%	1.5%

Source: Adapted from Humphreys (2007)

Without the Chinese, growth rates for major metals would have been on average 1.5% in 2000-2006 as compared to the 4.3% with China. Metals such as copper, zinc and nickel would have seen almost no growth at all in demand, whereas with China demand grew at 2.4% for copper, 3.7% for zinc, and 3.5% for nickel in the 2000-06 period. This growth is not substituting consumption in other countries and has been responsible for a substantial demand shock in international commodity markets. Even though China follows similar patterns of growth to other countries, its size determines the volume of demand, which in turn disrupts global demand levels. The demand disruption from China was not the unanticipated increase in demand, but the unanticipated level of this increase that China generated (World Bank, 2006).

Impact on Commodity Exporting Developing Countries: With an increase in China's demand for commodities, increasingly developing countries are benefitting from increased exports to China.

The importance of China for commodity-exporting developing countries is rising, and vice versa (Table 4.14).

Table 4.14: China's Importance for Commodity Exporting Developing Countries (1990-2006)

% Share Region in Chinese Imports of Base Metals				
Region	1990	1995	2000	2006
Low and Middle Income	30%	46%	46%	56%
Latin America	9%	17%	18%	27%
Asia	6%	6%	8%	13%
SSA	6%	9%	6%	5%
% Share of China in Regions Exports of Base Metals				
	1990	1995	2000	2006
Low and Middle Income	2%	7%	11%	27%
Latin America	1%	5%	9%	24%
Asia	6%	18%	35%	80%
SSA	2%	10%	12%	26%

Source: Author's calculations from COMTRADE via WITS accessed in July 2009.

Low and middle income countries as a whole accounted for 30% of Chinese base metal imports in 1990. By 2006, they accounted for 56% of these imports. The largest increase was seen in the share of the Latin American region, which is China's main source of copper imports. Asia is China's major source of tin, where the regions share of base metal imports increased from six percent in 1990 to 13% in 2006. Sub Saharan Africa's share in Chinese imports has tended to remain stable over the past fifteen years.

As important as these developing regions are as a source of imports for China, the Chinese importance for these regions as a primary destination is also increasing. As the second section of Table 4.14 indicates, China increasingly accounts for the exports of these developing countries. In 1990, China as an export destination accounted for only two percent of developing country's base metals exports, by 2006 this increased to 27%. Asia's exports have seen the greatest export diversion from two to 80%, followed from Latin America (one to 24%) and SSA (two to 26%). As a Southern Engine of Growth, China's growing importance in commodity trade for developing regions

indicates it could account for a fresh wave of export revenues for developing countries. Whether this is beneficial in the larger terms of trade picture is discussed in detail in Chapter 7.

SECTION 4 THE FINANCIAL CRISIS AND CHINA'S GROWTH

At the end of 2008, the financial crisis hit the advanced economies, which then entered a recessionary phase. Between December 2007 and November 2008, the OECD Industrial Production index for the United States dropped from 108.4 to 102, The Euro Area from 113.2 to 105.6 and China from 117.4 to 105.4. Figure 4.9 shows the IMF's forecasts for global economic growth for the next few years. Economic growth is expected to contract for the world in 2009, before starting a recovery in 2010. The advanced economies are more likely to experience negative growth for a longer period of time. The emerging and developing economies will suffer from contraction in growth rates in 2009, but are forecasted to return to increasing growth rates by 2010.

Figure 4.9: Global GDP Growth Rates (1970-2011)
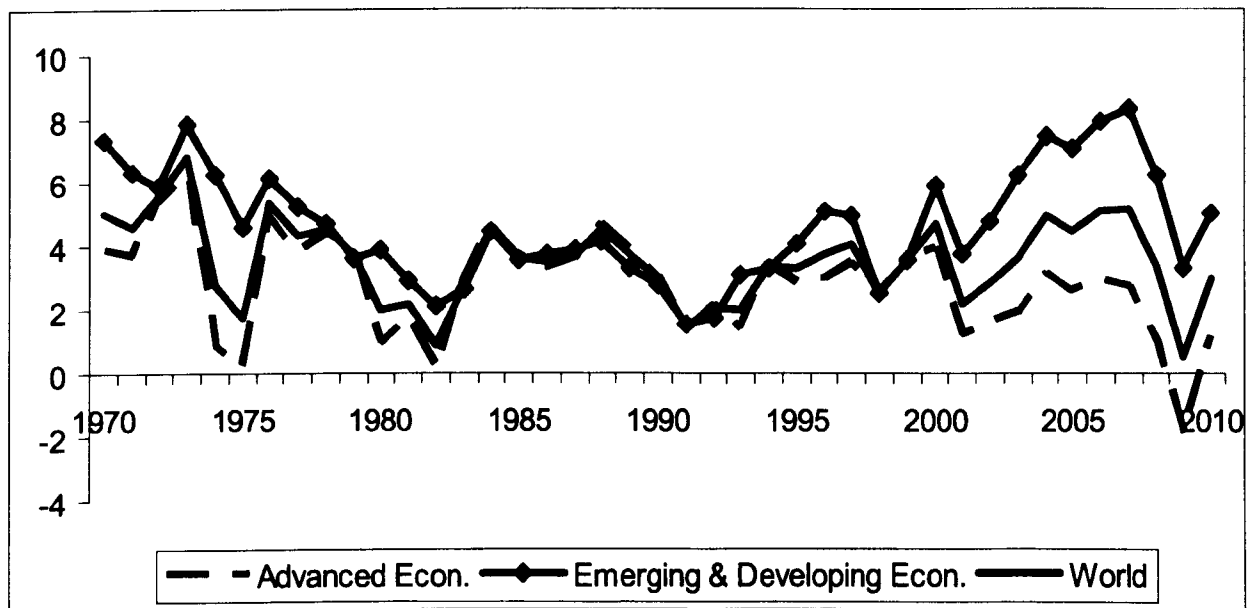
Source: IMF World Economic Outlook January 2009.

The fall in commodity prices after August 2008 was a result of the global financial crisis and the resulting credit crunch. With the economic recession in the European Union and the United States, the globalised transmission of this crisis also reached China. The World Bank lowered its forecasts for Chinese growth to 6.5% in 2009, compared to its own earlier estimate of 7.5% in November

2008. The fall in exports and shrinking private sector investment were the main reasons behind the lower expected growth.

The United States and the European markets have been its strongest export destination, accounting for 42% of China's exports in 2008. By February 2009, its exports had fallen by 25% compared to 2008. The contraction in exports, led to unemployment, with an estimated 15%, or 20mn internal migrant workers, being laid off. Export manufacturing was falling and firms were shutting down. Imports also declined, falling by 43% in January 2009 and a further 23% in February (The Financial Times 11th March 2009).

Currently China is aiming at an 8% GDP growth rate for 2009 and the government is focused on increasing domestic growth since its export markets have deteriorated. Part of this growth is expected to come from the stimulus package of $585 bn announced by the State in November 2008. The package includes infrastructure and construction projects as well as attempts to replace the loss of export markets by increasing domestic demand[43]. Salaries of teachers have been increased, and subsidies as well as higher support prices are being offered to rural communities to encourage demand. Export taxation is being brought to near zero levels and further assistance is being provided to the export sector to encourage employment and output[44].

The second part of domestic growth comes from the banking sector and fiscal stimulus. In 2007, one of the major concerns of the Chinese state was an 'over heating economy' with high inflation. From that year, China had attempted to control the level of lending in local currency of its banking sector. Therefore when the 2008 global financial crisis hit, the domestic banking sector was in good health. During the crisis, interest rates were dropped and lending was encouraged. The banks, with ample capital available, were able to comply much more easily than their western counterparts operating in OECD economies. Domestic banks have increased lending to manufacturers and the infrastructure sector in order to generate growth and employment. By November 2008, banking loans increased by 16% over the previous year, and by December 2008 they increased by a further 18.76%, running to a total of $ 113 bn (The Financial Times 20th Jan 2009).

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[43] The Financial Times 6th March 2009
[44] The Financial Times 11th March 2009

After running a once percent budget surplus for years, China is now looking at a budget defect of 3% of GDP in 2009. The country has large un-deployed deposits in its banks, as well as $2000 bn of foreign exchange reserves. China is one of the few countries in the world not facing a liquidity crisis, and can well manage a budget deficit for the short to medium term. In terms of how productive the spending by the government will be, it must be remembered that China needs roads and infrastructure. Construction in the real estate sector accounts for a larger expenditure than net exports in China. The stimulus package directly impacts growth and commodity demand. Fixed asset investment in January and February 2009 was 26.5% higher than a year ago.

Similarly investment in transport, a major area of the stimulus package, was 210% higher than in the same period last year. Investments in the property sector rose by one percent only. Apart from the large increases in bank funding, cement output also increased by 17% in January and February of 2009, indicating that the domestic sector is responding to the stimulus (The Financial Times 11th March 2009).

The quicker impact of the stimulus policy is also helped by the fact that many cities and provinces had already developed infrastructure plans, and that these projects have now been brought forward as part of the governments' efforts to increase domestic demand and spending. The low prices for base metals at the end of 2008 also provided for an opportunity to build strategic stockpiles for China. In December 2008, China announced its intention to buy one million tons of various base metals valued at $3bn[45]. China is able to absorb excess metal production by increasing its own stockpiles as well as by generating demand for metals through infrastructure spending.

By the end of June 2009, copper prices had risen by 61% from December 2008. Developments in China, which accounted for nearly a third of all copper consumption in 2008, remains central to the commodity markets. With the Beijing State Reserves Bureau activities shrouded in secrecy, the actual inventory levels with the State are unclear, there are speculations that China may buy up to 1.2mn tones of copper this year. Stocks held at the LME warehouses, especially in Asia, have

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[45] The Financial Times 2nd December 2008

fallen while inventory levels in Shanghai have increased. This is mainly from China building its strategic stockpile (The Financial Times 23rd March 2009).

The Baltic dry index, a measure of transport costs for dry bulk commodities, rose from 827 points, its lowest value in November 2008, to 3,757 by the end of June 2009[46]. Most of this rise comes as a reaction to Chinese imports of iron ore. An increase in the Baltic index is seen as a return of demand for shipping and hence a return of trade.

Stockpiling has helped metal prices to recover in the short term. The real demand factors, such as infrastructure and manufacturing indices, are only now beginning to show signs of improvement. Although the data are not clear as to establish a trend and the rate of recovery, the rate of decline had considerably slowed by April 2009. Market analysts feel that the cyclical trough for China may have already been reached. Until real demand returns any rise in prices of metals will not be sustained in 2009. 'Beijing's Rmb 4,000 bn ($585 bn) economic stimulus package is expected to have an impact on demand (of base metals), especially in the second half of the year, but it is not clear how big that impact will be' (The Financial Times 28th Jan. 2009). At this time, we are unable to confirm if this recovery is certain, but indications are positive.

4.9 Conclusion

Our first research question was: *What has been the contribution of China's economic growth in creating a demand pull effect on metal prices?* The country is moving through a resource-intensive stage of economic growth, with its focus on infrastructure building, urbanisation and manufacturing output expansion.

The pattern of resource intensity use in China is not very different from other economies that have experienced similar structural change. Its per capita consumption of metals in the manufactures and urbanisation sectors conform to what other countries, at similar income levels, have experienced. The share of infrastructure costs in GDP is high due to the large size of the country

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[46] Calculated from Bloomsburg website data July 2009

and hence greater demands of its urbanisation efforts. As a result of this volume, China accounts for nearly all the increase seen in demand of base metals in the past few years.

Given the low income elasticity for commodities, China's resource-intensive growth means that consumption as a ratio of income will be at a higher level relative to non industrial expansion growth. Coupled with the volume of demand, it becomes clear why China's consumption has had such a large impact on global commodity markets and why it is the main demand driver of price in the 2003-2008 boom. Even with the interruption of the financial crisis, China's demand for metals has not slowed down drastically.

China is sourcing its metals demand from a number of developing countries, which may account for a small share in Chinese imports; but the importance of China for these countries is growing. By increasingly becoming an important export destination, China acts as Southern Engine of growth for other countries in the South.

Although China is the second largest economy in the world, it is still far from reaching an advanced economy status. As a large developing country, China will continue to have a strong share of industry and manufacturing in its GDP, which are commodity intensive sectors. Only when the Chinese economy moves to the services sector, will its overall commodity demand decrease. Its continued growth will be resource-intensive for a medium to long term period.

Factors that can affect the slow down of the Chinese economy include a prolonged recession in the western economies, which are its major export destination. The current financial stimulus in China is being used to balance (to some extent) the loss in export markets with domestic demand. A prolonged recession in the West will limit China's ability to continue its growth rate, due to loss in export markets and FDI originating from the West.

Other factors include the possibility of protectionist measures being contemplated by western economies to protect their own manufacturing sectors and employment. In July 2009, economic summits between China and the United States were being held to ensure that both economies observe continued cooperation in economic policies to combat the global recession.

China has faced the global economic recession comparatively better than its western counterparts, China's foreign reserves (reported at $2 trillion in July 2009) ensures it has the resources to sustain its domestic economy despite the global slowdown. In our discussion in Chapter 3, we noted that both the 1951-1953 and 1972-75 commodity booms occurred in a period of global economic expansion, but it was crisis in the supply side and not demand that triggered the price boom. In the 2003-2008 period, it has been the unanticipated magnitude of Chinese demand in a global economic expansion that was a major driver of price rise.

DISRUPTIVE SUPPLY: THE GLOBAL MINING INDUSTRY

'A dash of luck can often be the difference between a working mine and a lot of expensive holes

in the ground[47].

Mining was an integral element of the industrial revolution in the 18th and 19th centuries. The mechanisation of industry and the steam engine helped transform production, the increasing use of refined coal in Great Britain provided an important fuel source for the expanding domestic and trade economy. In England, Germany and the United States, the mining sector not only advanced an industrial expansion, but was also central in a number of political and social movements. Two centuries later, mining continues to play an important role in the development of economies. During the industrial revolution domestic resources accounted for a majority of the supply, in the current globalised industry metals mined in South America feed industries in East Asia, and African mines provide raw materials to Europe and China. The mining industry in terms of its sourcing and destination has gone global.

The industry has evolved, expanded and improved over the years, but some of its features remain the same. The largest and most successful mining companies in the world today remain largely those within the North[48], even though they operate in developing countries. Technology and machinery have enhanced mineral extraction, and the sector remains a capital intensive process with long term investment horizons, often in the most hostile of climates[49].

In our discussion in Chapter 3 we noted that in both the 1951-1953 and 1973-1975 periods supply shocks were the main drivers for pushing up prices. But these shocks originated outside the industry, the major causes were environmental or political. In the 2003-2008 boom the inflexibility of supply lies within the industrial structure itself, and few external shocks were generated from outside the system. Supply and demand are the fundamental drivers of price. Given the intrinsic

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[47] Berryman (2009)
[48] Of the top 10 base metals mining firms, six have headquarters in either Europe or Australia
[49] When we refer to the mining industry, we are referring to the formal mining sector and not to small scale or artisanal mining

characteristics of the mining industry, supply tends to have low price elasticity. Other factors, such as spare capacity and production costs have a more important role in determining output. The limited capacity of the mining supply industry and the factors behind them are the main focus of this chapter. We examine the major characteristics of the mining industry and why it has been unable to respond to global demand increases in the 2003-2008 boom.

Our second research question was: *What has been the contribution of supply in the determination of metal prices?* In Section 1 we discuss the intrinsic characteristics of the global mining industry. In Section 2 we examine the industry's response to the commodity boom in 2003-2008, and in Section 3 we look at the fundamentals behind inflexible supply in the mining industry. Our focus is on the global mining industry and its key players and we do not attempt a country level examination of mining sectors.

SECTION 1 THE MINING SECTOR

In the face of accelerated demand if supply is able to keep pace a price shock will not materialise. To understand the lag in supply, the nature of the extractive industry needs to be understood. The industry is distinct from the manufacturing sector in terms of production processes, and its financial and non financial requirements. Apart from the geological and engineering concerns, there are often geopolitical, legal, environmental, social and financial considerations in any mining project.

In this section we highlight the mining production chain, and the factors behind its capital intensive nature. This helps to explain the project gestation periods of the industry, which in turn have implications for the time horizon of returns to investment. These factors also account for the structure of the global mining industry.

5.1 The Mining Production Chain

There are two major sources of supply for most base metals; the first is from primary production, and the second is from re-cycled metal. The latter is a secondary source but can be a large portion of overall supply. For example, in the 2000s 33% of copper consumption was from recycled metal.

The availability of scrap/re-cycled metal is dependent on primary supply and recycling rates of major consumer[50]. For this dissertation, we focus on primary production only, as it accounts for the major share of consumption in the advanced and emerging economies. The process of mining starts with the identification of an ore body, which if deemed financially feasible then proceeds to mine construction and ore processing. A simple production chain is described below[51].

Exploration: The exploration starts with a geological exploration team surveying areas with suspected mineral accumulation to locate a viable mineral deposit. These result in a mineral resource estimate outlining the grade quality and expected life of the mine. Once such a deposit has been located, the team or contractors will determine the profitability of the identified mineral resource and generate a feasibility report.

The time period between identification and actual output of the mine may vary by several years, therefore the financial feasibility takes into consideration expected future prices rather than current prices. Expected prices, both their level and variability, will have a large weight in determining whether a specific ore grade is profitable or not.

Mine Construction: When the ore body is judged to be economically profitable, the process of establishing a mine begins, carried out by a design team, construction and mining contractors. This requires designing the mine and necessary support structures to 'expose' the ore body. Once the mine itself is established the mining team or contractors can begin the removal of ore from the ground.

Ore Processing: The excavated product is either stockpiled or transported to the desired processing unit. The ore is processed to remove the required metal or mineral from the ore body, and the remaining residue is safely disposed. The output after refinement/smelting results in a product that can now be sold on to the market. It is the responsibility of the marketing team to maximise sales from the output.

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[50] Source: ICSG (2007)
[51] Summarised from http://www.mbendi.co.za/indy/ming/p0010.htm accessed March 2007

Divest: Once the mine has been used to its profitable limit, divestment takes place, where the mine and associated operations are shut down. After mine closure the mining area needs to be restored. This involves disposing of any left over waste material, filling mining shafts or pits and restoring land to its pre-mine state. This may be required by country regulations or be part and process of the mining firms own corporate social responsibility agenda. Mining and transport equipment will also be removed to other operations or will be disposed off.

The mining production flow may experience inflexibilities at several points. All exploration projects will not lead to the discovery of mineable deposits. Even when a deposit has been located, sufficient ore grade may not be present to make the mine financially feasible. Mine output is also influenced heavily by the capacity of the support structures, such as the carrying capacity of the infrastructure or processing capacity of the smelting units. For example, if the road linking the mine to the port has the capacity for 80 ton trucks, then mining output per day will be much lower relative to infrastructure that can support 100 tonne trucks. The refining capacity of the smelting unit will also determine the output of the mine. The capacity of support units will act to restrain capacity utilisation, optimal mine size and output.

5.2 Capital Intensity of the Mining Sector

The mining industry tends to be capital intensive, from the early stages of exploration to actual mine excavation and eventual closure. There is also a high degree of sunk costs associated with the sector. Sunk costs are defined as the difference between original investment costs and the salvage value at any given time. The mine establishment also requires support services and infrastructure, which can be capital intensive for investing partners. For example, a firm may agree to invest in a mining operation, while the host country is required to invest in infrastructure to support the mining site. Apart from services for the mine site, since ore processing often takes place outside the country of the mine itself, investments in port facilities are also important. Upgrading ports to be able to handle deep water ships requires large investments. If a country is land-locked, investments have to be made to ensure that once the ore has been mined, the structure to support the output

also exists. Investments from both the firm and the State are important for a successful mining project. Here we focus on the costs faced by the mining firm only.

Each stage of mining requires large amounts of capital. Table 5.1 illustrates the costs faced by firms at different stages of the production chain for copper. These examples are for illustrative purposes only and are not always a reflection of costs seen by other firms in other regions. The location of mining sites and access will cause variations in costs.

Table 5.1: Duration and Costs of Copper Mining Projects (2008)

Company	Location	Project State	Duration	Investment
Feasibility Study				
Fox Mining Company	Canada	Feasibility	-	$16mn
Mine Construction				
Jiangxi Copper Corporation	Afghanistan	Mine construction	5 years	
Anglo American	Panama	Production online in	5 years	$2.2bn
Expansion in Current Output				
BHP Billiton	Australia	Stage 1 of 5	6 years	$6bn
Codelco	Chile	Stage 1 Stage 2	2 years 5 years	$5bn
Restarting Operations				
EMED Mining	Spain	Restarting existing mine	1 year	
Copper Mountain Mining Corporation	Canada	Restarting existing mine	2 years	$428mn

Source: Author's compilation from various issues of the BME Copper Bulletin in 2008.

The initial feasibility stage requires the least capital expenditure for the firm, and is easier for small firms to entre in terms of investment. The estimated costs of preparing the feasibility study include exploration, engineering and access costs for the firm. In this example, the cost of the feasibility study for Fox Mining Company was $16mn and represents 22% of the market capitalisation of the company. Once a successful feasibility study has been done, small firms are likely to sell the project to larger firms who will carry out the construction and processing stages.

Mining operations and expansion involve costs in information acquisitions, training local partners and the exploration for minerals (Williamson, 1985). Construction of mines involves not only the mine site itself but also support structures around the mine, including upgrading port or road network facilities. In most cases the investment into infrastructure and transport will be shared by the two or three parties. Our example of Anglo American shows that the capital cost for mine construction was at $2.2 bn which is a sizeable investment commitment. The operating costs of a mine are also capital intensive. These not only include day to day costs, but repair and replacement of equipment and depreciation costs.

Mine expansion requires not only machinery and equipment, but also an expansion in support structures. A single mine operated in Australia by BHP Billiton was expected to cost $6 bn, while expansion in Chile by Codelco required an investment of $5 bn. Re-starting established mines that were closed down in periods of low profitability, also require spending, although less than construction. For example, the restarting of a copper mine in Canada cost up to $428mn.

Thus, capital outlays in mining investments tend to be fairly large with almost no salvage value and occur at all stages of the production process (Barham et al., 1998). This arises from the nature of these investments based on: physical structures, transaction costs and operations in remote areas.

Physical Sunk Costs: These refer to site and equipment costs. Investments in buildings, processing plants, mine shafts and roads are site specific and cannot be economically transferred to other sites (Eaton and Lipsey, 1990; Barham et al., 1998). Industry specific machinery tends to be 'lumpy', i.e. excavation equipment comes in 'groups' where a number of machines work together to operate and cannot be bought separately (Bunker, 1994; Williamson, 1985; Stuckey, 1983). The nature of mining equipment therefore makes initial investment costs high, and the salvage values of site investments tend to be limited.

Transaction Costs: These costs occur as a result of conducting feasibility studies, and when an exploration project does not result in a mineable ore body, the costs of the investigation cannot be recuperated (Barham et al., 1998). Minerals are often found in land that is owned by the State, and

negotiations with the government need to be carried out before mining rights are acquired. These negotiations can be prolonged and costly, and cannot be recuperated when the dialogue fails.

Remoteness: Extractive industry is usually set up in remote areas, away from urban centres. Investment involves the setting up of facilities to run the mine, including housing, schools, hospitals, roads and other related infrastructure. Barham *et al.* (1998) argue that remoteness leads to lower salvage values. First, the value of one asset affects the sale of the other asset. This is likely to happen within vertically integrated industries, where the closure of a mine will negatively impact the salvage value of the infrastructure around that mine. Secondly, a number of assets offered for sale in the same area cause the value of the assets to decrease due to competition. For example, at the time of mine closure a number of mining and transport equipment are offered jointly for sale, thus reducing their price levels.

Cost of Mine Closure: Whether the ore body has been exploited to its maximum profitable value or due to the business environment, mine closure may be required. This process itself requires capital outlay. Depending on environmental and other legislation of the host country, the safe disposal of ore residue and machinery can be a time and capital consuming task. For example, in Canada with strong environmental laws, mine reclamation will often involve 'removing, relocating or demolishing buildings and physical infrastructure, closing pits and shafts, stabilizing underground workings, soils and slopes, treating tailings and waste water, and re-vegetating land'[52]. In most cases it is more cost effective for a mine to function at less than full capacity than to abandon operations altogether (Radetzki, 2008).

Given that base metal ores are scattered across geographical regions, access to a mining site itself is rarely a barrier to entry. The high costs associated with entering the sector are more likely to be prohibitive. Unlike other manufacturing sectors, the technology and equipment related to mine production is easily available in the global markets. Processes and methods of mining and processing are fairly standardised and access to new technology is not restricted. The cost of owning this technology and equipment, acts as a primary barrier for new entrants. Large capital

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[52] http://www.nrcan.gc.ca/mms/scho-ecol/env/resto_e.htm accessed June 2007

outlays coupled with large firm size are required to achieve economies of scale. The required firm size, relative to the market size, can then act as a barrier to entry (Bain, 1956).

5.3 Project Gestation Period

The time line between exploration and production output tends to be long and even in periods of high demand for output, production may take several years to come on line (Table 5.1). The time between initial exploration investments and revenue generation is also long (Davis and Samis, 2006). Sillitoe (1995), studying mining projects around the Pacific Rim, found that the time between initial exploration and the first discovery drill hole was on average 14 years for base metals and 22 years for gold deposits. From sinking the first shaft to mined production takes on average another 13.5 years for base metals. The overall process from the start of exploration to the first point of revenue generation for base metals can take on average 27.5 years. Although as a rule they may not require such a long period. Table 5.1 shows that both expansion of existing facilities and the construction of new mines can be time consuming. Apart from the physical characteristics of the industry, the decision-making process can also produce a supply lag. Radetzki *et al.*, (2008) identify four factors for such lags: perception, decision, financial and regulatory.

The Perception lag refers to the time between an increase in commodity demand indicators and the response from supply side managers that an increase in supply is warranted. Due to the volatility nature of commodity prices, every increase in price is not perceived as a signal to increase supply.

The Decision lag is the time taken between recognising that a supply increase is warranted and the decision to go ahead and plan an increase in output. This process requires a close examination of fundamentals, expected future demand and price movements. Since mining is capital intensive the decision to invest further in new or current projects is not taken lightly.

Once a decision has been made to increase supply, the cost of these increases need to be calculated. The Financial lag occurs between the taking of a supply increase decision and the search for financial partners to fund this expansion. Even the largest of mining firms require

investment either through raising equity on international stock markets, or through institutional investors. Locating investors and raising capital takes time.

Given the possible social and environmental costs of mining, most countries have strong regulatory procedures for mining activities. The <u>Regulatory lag</u> occurs in meeting the legal, environmental and industrial directives that have to be fulfilled before mining operations can start. Radetzki et .al. (2008) estimate in their model that these time lags can take up to 13 years to resolve, leading to a capacity deficit and high prices for the period. The long gestation periods within the mining industry arise due to the physical process of production, the level of capital commitments and the decision process taken by the management of mining firms.

5.4 Returns to Mining Investment

Given the capital intensity of the sector and long gestation periods, the investment decision is not always a simple one. The Net Present Value (NPV) of future cash flows within the industry itself is stretched over a long time horizon.

The Net Present Value (NPV) of future cash flows: The NPV is a tool of appraisal designed to facilitate investment decisions. When returns are projected at some point in the future, knowing the present value of that return is essential before making an investment decisions. With any positive interest rate, one dollar earned in the future is worth less than one dollar today. A one dollar invested today can earn a positive return and will be worth more than one dollar earned in the future. The greater the time period and interest rate, the greater the value of one dollar earned today, relative to a one dollar earned in the future.

The difference in the present value of the return will depend on the time horizon and the discount rate (i.e. the profits/interest which could be earned on an alternate investment such as United States Treasury bonds). The higher the discount rate, the less the future income is worth and the lower it's NPV. The longer the time horizon, the smaller will be the worth of the return it generates.

Figure 5.1 illustrates the NPV for one dollar at three different interest rates (1%, 5%, and 10%) over a 30 year period. With a discount rate of one percent, a dollar earned 30 years from now will have a NPV of $0.94. However, if the rate of interest is five percent, the same dollar in thirty years would be equivalent to $0.81, and with a 10% rate it would be equivalent to $0.57. The higher the rate of interest, the less valuable the dollar earned in the future is relative to its present value.

Figure 5.1: Discount Value of $1 at Various Interest Rates.
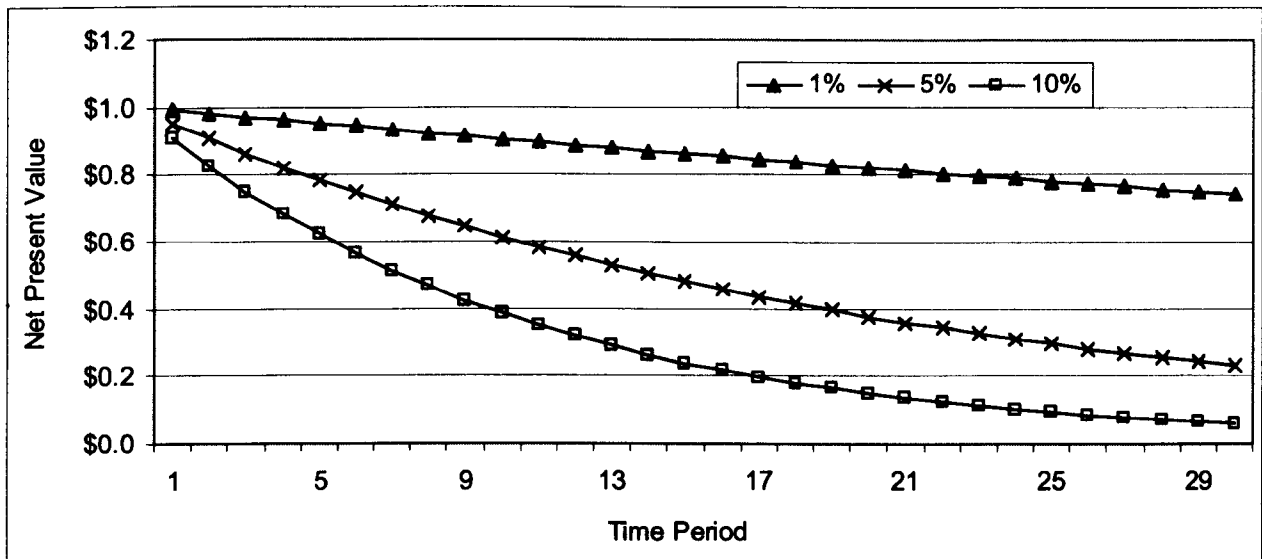
Source: Author's calculations

Another way of looking at the NPV is the time horizon. If one dollar is invested at 5% interest rate but has a 10 years project gestation its NPV is $0.6. The same one dollar invested at 10% interest but in a 20 year project has a lower NPV of less than $0.2. Thus even though the rate of return is higher in the second project, the gestation period before returns, lowers the overall return to capital.

Gestation periods are longer in mining investments, compared to other manufacturing units such as textiles, which can be setup in a couple of years. Even if a larger rate of return is to be found in the mining sector, because of the shorter time period involved in textiles, the latter's NPV is much higher than the former. Thus, when there is a choice in investing a dollar today and gaining a return in a mining investment later along the time horizon, even with a higher rate of return, mining may not be the first choice of investment

The long term nature of the mining sector indicates that even if its returns are comparable to other investments, the time horizon for the generation of these returns reduces the net present value of the capital. In general the discount rate is affected by the cost of borrowing and inflation, while that in the mining sector in particular reacts to the risk premium and increase in costs of production. The latter are discussed in detail in Section 2.

Over a long time horizon, price-cost risks are likely to surface. There is a time lag between the time when a mining project is initiated and when its output reaches the market. Although expected future prices are factored in during the feasibility study, price cycles and volatility may lead to lower than expected prices at the maturity of the project. Furthermore, cost structures can change over the initiation and maturity of the project. Discovery of new resources, technological changes in extraction or transport, development of synthetic substitutes, or unanticipated demand shocks can substantially reduce the future cash flow from a specific investment (Barham *et. al*, 1998). Mining operations carry an intrinsic price-cost instability risk.

Serven (1998) and Dehn (2000) argue that the impact of commodity price shocks and uncertainty on mining investment in developing countries is limited. Price uncertainty itself does not affect investment behaviour. Given the other factors that can produce uncertainty, such as political and cost risks, price uncertainty is not considered damaging to investor interests. Dehn (2000) also finds that extreme price shocks tend to have an asymmetric impact on investment in low income countries. With positive shocks there is a positive response, whereas a negative shock does not affect investment levels. Mining firms are likely to adjust by lower capacity utilisation when faced with negative price shocks, rather than curtailing operations or disinvestment.

Slade (2001) shows that although the focus on the price volatility of commodities is common, there are also fluctuations in the cost and resource side of the supply chain. Once an ore body is exposed the quality of ore grade may change. Technological improvements and the costs of smelting and refining will also affect costs. Valuations using the NPV method, which is more appropriate to safe asset pricing, may be impractical for the mining industry.

Although there is variation across mining firms as to which project evaluation methods they employ, there are some common themes. Slade (2001) reports that the mining industries still use NPV or Discounted Cash Flow (DCF) models, and tend to make *ad hoc* adjustments to calculations for risk valuation. Risk valuation adjustments in NPV or DCF are made by using 'hurdles' which are inflated discount rates. Slade (2001) also reports that most firms tend to use long term prices, often sourced from the same few consultant firms and thus have similar outlook for future price and supply.

5.5 Structure of the Mining Industry

Given the nature of the mining production chain and the economies of scale, firm size is correlated with the stage of participation in the production chain. Within the industry, large firms are referred to as 'Majors', followed by medium sized firms and small scale firms referred to as 'Juniors'. In 2006, more than 4,000 mining companies were in operation. Of these only 149 firms were classified as Majors, and 957 as medium sized firms. The rest (3,067) were classified as Juniors[53].

Small firms, or Juniors, will tend to concentrate on exploration and feasibility nodes, since the costs involved in these categories are smaller relative to downstream activities. The Juniors involved in exploration and development activity will rarely 'mine' a project, preferring to sell the rights to the bigger companies after establishing a viable project proposal[54].

Medium to large scale firms will be more involved in construction of mines as well as smelting and processing activities, since they require larger capital outlays. The industry benefits from vertical integration in the construction and output nodes of the chain. The Majors tend to be vertically integrated from mine construction on to processing units and marketing. Majors operate mining, smelting and refining nodes and account for some 60% of total non-energy minerals produced in 2006. The medium sized firms account for 40% of the production.

Given the structure of the mining industry, private investment remains the dominant form of financial inflows. Most mining projects are export-orientated revenue projects, and apart from China

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[53] Source: WIR (2007)
[54] Source: RMG in WIR (2007:108)

and India, mining output is rarely wholly consumed in the host country. Since investment projects often run in billions of dollars, developing countries on their own are unable to generate such finances to initiate projects. It is for this reason that MNCs, with access to capital, play an essential role in global mining.

Foreign affiliated companies account for more than half of the world production for bauxite, copper and gold, and substantial production of zinc, nickel and iron ore. MNCs are the dominant producers and the top eight privately owned transnational companies accounted for 25% of global production of metals in 2005. Within developing countries, MNCs account for a majority of the production: in 2005 they accounted for all the output in 33 major developing mining countries. Only in the cases of China, India, Brazil and Russia was output of less than 20% attributable to MNCs. State Owned enterprises exist, but tend to be limited. Of the top 25 metal mining companies in 2005, only one (Codelco, Chile) was completely state owned while a few of the others have partial state ownership (Alrosa, Russian State: 69%), (Debswana, Botswana State: 50%). The rest are mainly shareholder companies listed on international stock exchanges[55].

SECTION 2 THE MINING INDUSTRY AND THE COMMODITY BOOM

The intrinsic nature of the mining industry leads to supply inflexibilities in the short to medium term. The investment decisions are based on a long time horizon, and although risk valuation is built into these models, price and cost volatility can cause these valuations to be problematic. Output can be adjusted within a small range in the short run by increasing capacity utilisation. For longer term changes, expansion or scaling back of operations takes time and capital resources.

Commodity markets will suffer from a time lag in supply when an unanticipated change or shift in demand occurs and demand changes are transmitted through to the production chain. In Chapter 4 we showed how China's demand was unprecedented in magnitude, and therefore unanticipated. In this section we explore why the global mining industry was unable to respond to demand, and to increase output over the duration of the commodity boom.

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[55] All data in this discussion are from WIR (2007)

We use the production and price of copper to illustrate the slow response of the mining sector to both a rise and fall in prices over a thirty year period. Figure 5.2 shows the global production and price for copper for the 1980-2007 period. During the 1980s and first half of 1990s, the production of copper was stable at around nine million metric tons, while prices averaged at $2,900 per ton. Between 1996 and 2002, while copper prices dropped to an average of $1,800 per ton, production increased slightly to an average of 12.5 million metric tons. From 2003-2007, prices nearly doubled from the previous period (1996-2002) to an average of $3,700, but production increased by less than 20% to 14.8 million metric tons.

Figure 5.2: Copper World Production (mt. tons) and Unit Value (98$/ton) (1980- 2007)
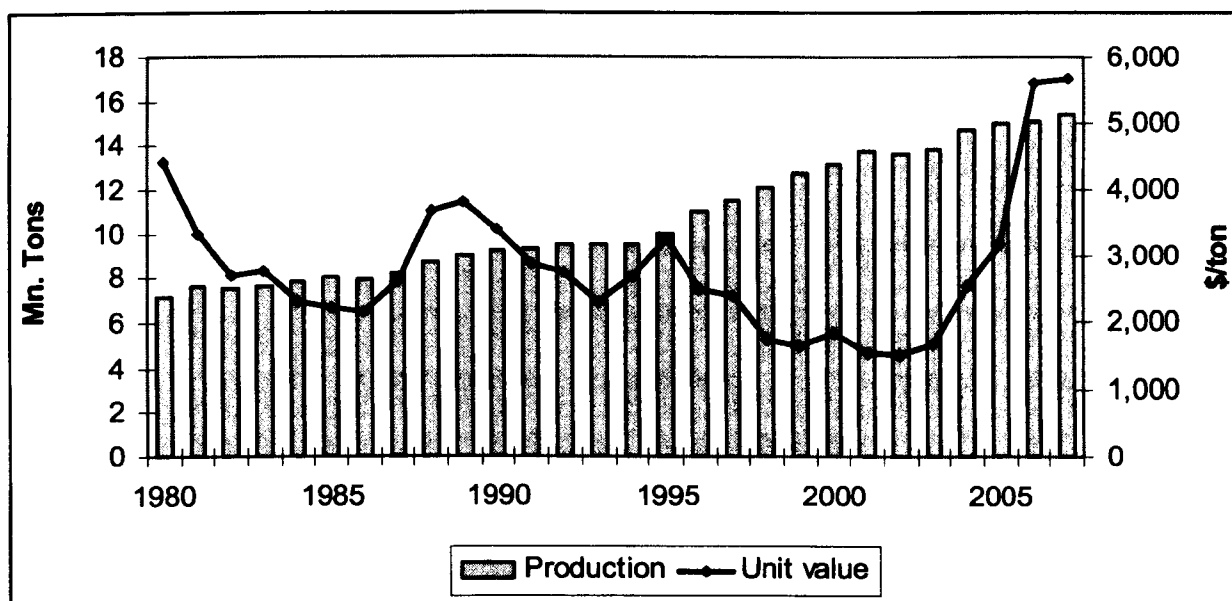
Source: Author's calculations from USGS data accessed July 2009.

Metals have low price elasticity of supply, but the behaviour of rising production in the face of falling prices, and insignificant supply response to rising prices needs further explanation.

5.6 Before the Commodity Boom

The 1980s and 1990s witnessed a downward trend for copper (Figure 5.2) and other base metal prices. With an economic recession in the 1980s and the break up of the Soviet Union in the 1990s, the demand for metals in this period was also lower relative to previous decades. Within industrial sectors, improvements in technology and more efficient use of metals also contributed to the slow-

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down in demand for metals. The declining demand was an important factor in dampening investment in this period.

There were two major forces at work in the 1980s and 1990s within the global mining sector that affected supply; the firm behaviour and the country behaviour. Independent mining firms aggressively pursued cost cutting measures, including slashing budgets to expand future supply bases. Financial engineering and mergers were pursued to manage firm costs. With uncertain future prices, long term global demand was ignored in favour of short term survival (Crowson, 2007). With economies of scale the output of these firms was not scaled back despite a fall in prices. It was more cost effective to continue production and recover some of the costs than to shut down.

On the country level, commodity-exporting developing economies were facing a debt crisis in the 1980s and 1990s. As part of the IMF and World Bank structural adjustment programs to cope with the debt crisis, there was an increase in commodity-exports from these countries (Aizenman and Borensztein, 1988; Gilbert, 1989). The overall commodity-exports in 1984-88 increased at an annual rate of 13%, at a much faster rate of acceleration of 4.8% that was seen in the preceding decade (Borensztein and Reinhart, 1994). State owned mining firms continued to invest, driven by social and political concerns rather than business ones. Profit maximisation is not always the priority of the mining sector (Radetzki, 2008). Employment generation was considered more important than profitability and these firms continued operations despite falling prices. This increase at the country level further added to the over-supply problems of the sector.

The recessionary metal prices in the two decades after the second commodity price boom curtailed new investments in mining and exploration. Firms were focused only on maintaining current operations as little was to be gained by expansion or upgrading. Investment in human resources, mining and processing capacity reduced the overall supply capacity of the sector. As Ericsson (1994:33) comments: 'It seems as if the major mining companies, strongly hit by deep recession, [were] concentrating on survival rather than mergers and acquisitions'. These cutbacks had consequences for limited expansion capacity in supply in the future. Apart from existing mines,

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there were very few large scale projects in the pipeline that could be speeded up once demand was to rise (Cuddington and Jerrett, 2008).

The combination of few supply cutbacks and falling prices in the 1980s and 1990s led to low returns in the sector and discouraged further investments. Figure 5.3 shows the returns for three alternative investments: the United States treasury bills, the Dow Jones Industrial Index and the Dow Jones Industrial Metals Index. The first serves as an indication of returns on the safest asset and therefore has the lowest returns. The second reflects returns in other industrial sectors, while the last reflects returns to industrial metals.

Figure 5.3: The US Treasury Bills Index, The Dow Jones Industrial Index and Industrial Metals Index (1991-2008) (1991=100)
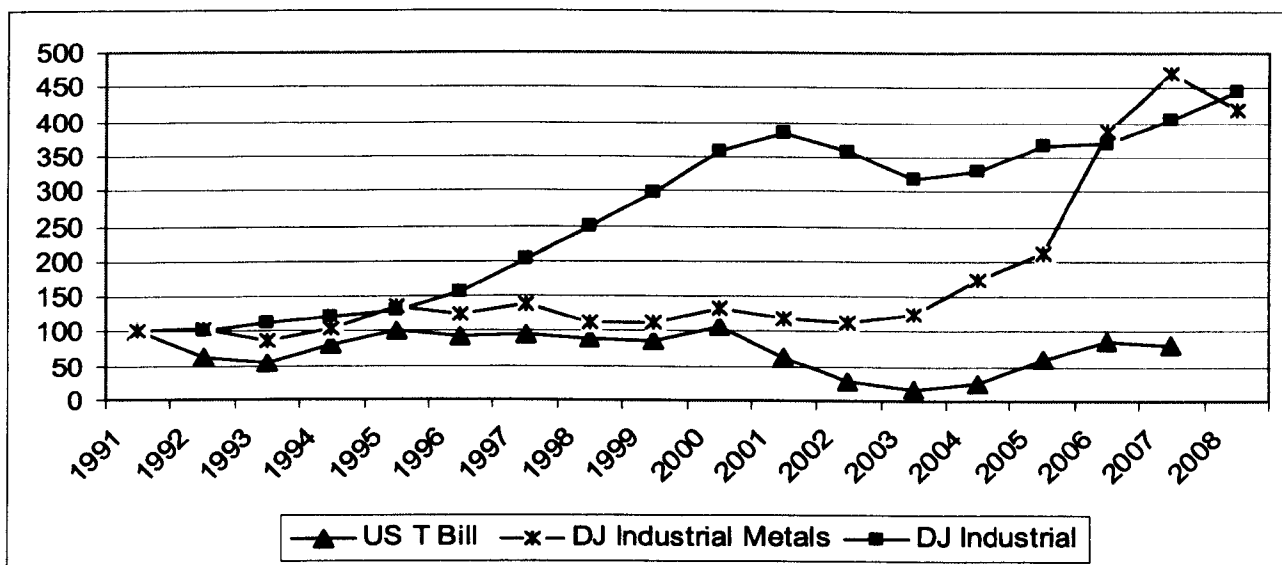
Source: Author's compilation from IMF Statistics and data from Dow Jones website.

The returns to industrial metals were comparable to those of the United States treasury bills for the early 1990s, and both were generally low. The Dow Jones Industrial Index outperformed the metals sector by a considerable margin during the 1990s. It was towards 2003, with an increase in commodity prices, that led to increasing revenues for mining firms and the Dow Jones Industrial Metals Index began to increase. The commodity boom was beneficial for mining firms. The returns on industrial metals outperformed the industrial index in 2007 and for most of 2008; the height of the commodity price boom. The metals sector had now become more attractive in terms of investment returns.

5.7 During the Commodity Boom

Given the past experience of low and volatile prices, the industry faced uncertainty as to the duration and amplitude of the price increase seen in 2003, and more importantly the future sustainability of such a rise. Furthermore, the increase in production costs associated with increasing output, discussed in detail in Section 3, set a cautious mood within the mining community in the first few years of the commodity boom.

The initial response of the largest mining MNCs to increasing revenues from metal prices was to consolidate their financial positions. This involved little increase in the global production of base metals. Higher revenues were spent on rebuilding cash reserves as well as expenditure on mine maintenance that had been postponed in the previous period of low prices (Crowson, 2007). Only towards the later half of the boom did the industry concentrate on increasing output through expansion and construction of mines. The response of the MNCs to the increased revenues during the commodity boom was to redirect earnings towards four major areas. These were primarily merger and acquisition (M&A) activity, shareholder dividends, exploration, and finally development of new projects.

Mergers and Acquisition Activity: Given that the 1980s and 1990s were unpopular decades for mining firms, their ability to attract investment was severely limited. When metal prices began to increase in 2003 the mining industry became profitable, and mergers and acquisitions became the major form of investment.

With mining firms awash in revenues the quickest approach to increasing firm revenues was to take over smaller firms with projects under way rather than to develop new mines. Since new mines take time to become operational, as does increasing capacity at existing ones, mergers and acquisitions are a useful short term measure to increase a firms output and revenue. The Financial Times (21st Nov. 2006) reports: 'High metals prices mean that mining groups are generating large amounts of cash, making it easier to launch takeover bids. There is a scramble to maximise metals production, and many companies are finding it easier to acquire assets than build new mines from scratch'.

After 2000 there was a marked increase in M&A activity. In 2001, the largest merger was valued at $28.7 bn, with the Australian mining firm BHP and its South African counterpart Billiton to create the second largest mining firm in the world. In 2007, Vale's offer for Xstrata was valued at $90 bn, while in early 2008 BHP Billiton offered $150 bn to take over Rio Tinto. There were a number of smaller value deals as the mining industry concentrated on consolidation. Table 5.2 shows the increasing value and number of deals in recent years. The total value of such deals increased by 92% in 2005-06, and increased further by 18% in 2007. The number and average values of mining deals dropped in 2007-08, mainly as a response to the financial crisis and companies employing policies to save cash.

Table 5.2: Total Mining Deals (2005-2008)

	2005	2006	2007	2008
Total Number of Deals	762	1026	1732	1668
Total Value (in $ bn)	69.8	133.9	158.9	153.4
Average Reported Value in ($ bn)	125.6	196.6	137.5	124.0

Source: PricewaterhouseCoopers, Mining Deals Annual Review (2008)

The profits from higher metals prices have been the main driver for such investments. The Financial Times (20th June 2007) reports: 'Cash funded acquisitions are generating rapid pay-backs and more hostile takeovers are expected due to hugely increased cash-flows in the sector, up 40 per cent to $76.7 bn last year [2006] for the forty largest companies in the global mining industry'.

Figure 5.4 shows that the rise in the metals price index has been accompanied by substantial increase in M&A activities. The bars indicate an increase in the value of M&A in gold and base metal firms on the left hand side. The metals price index is indicated on the right hand side and covers the 1990 to 2006 period. The increase in metals prices is accompanied by an increase in value of mergers and acquisitions. During periods of low process in the early 1990s and early 2000s, M&As were below $20 bn, but as metal prices rise, M&A rose rapidly to $40 bn in 2005, and to nearly $90 bn by 2006.

Figure 5.4: Mergers and Acquisition in Mining and Metals ($ Billion) and Metals Prices (1990-2006)
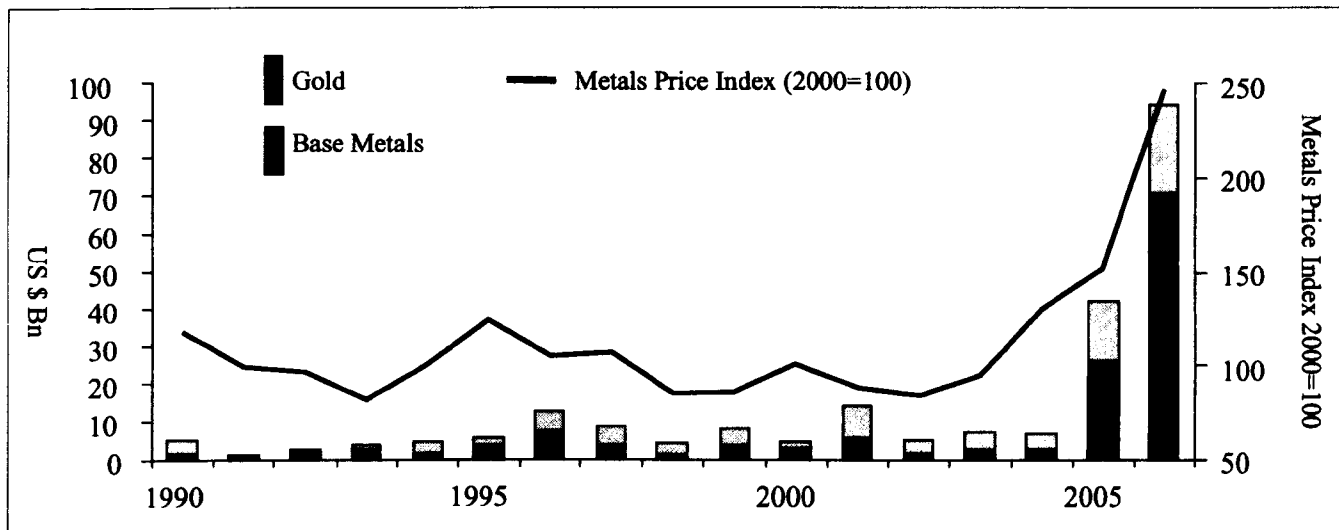
Source: Humphreys (2007)

M&A, while increasing the output from one firm as it now owns more assets, does not increase the overall production of the industry. Assets have simply changed hands, and although some increase in production may result from better use of management skills and resources, new production in the sector remains limited.

Shareholder Dividends: With low returns to mining investors in the early 1990s overall returns to shareholders were also low. Between 1977 and 1999 the shareholders return for the base metals industry averaged 5.7%, compared to United States government bonds at 6.7%[56]. Such low returns impacted company profiles and led to problems for mining firms in raising funds from banks and stock markets.

The post 2003 increase in metal prices resulted in higher company revenues and also increase in the share values of mining firms, which became one of the leading sectors on major stock exchanges. The profitability of extractive industry firms in the Fortune 500 companies increased from around 5% in 1995 to over 25% by 2006. Since 2002, these firms have outperformed

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[56] http://www.dundee.ac.uk/cepmlp/journal/html/vol9/article9-1.html accessed September 2008

pharmaceutical, beverages and telecommunication firms in terms of profitability and are well above the Global 500 median values[57].

The market capitalisation for the mining sector increased from $389 bn in 2003 to $791 bn at the end of 2005. The equity returns for the top 20 leading mining companies rose from 5% to 25% over 2002-05. The underlying profits for one of the largest mining firms Rio Tinto, increased by 11% amounting to a record value of $13.9 bn in 2006-07 (The Financial Times 14th Feb. 2008). A major share of the profits and revenues was returned to shareholders as dividends, with mining firms in the United Kingdom alone paying £118 bn as share buy-backs and special dividends between 2003 and 2007 (The Financial Times, 21st Feb. 2007).

There have been concerns in financial markets that mining companies are directing greater share of revenues to M&A activities and shareholder dividends, than they are towards exploration and mine development. It may seem counter-intuitive to spend less on increasing output while commodity demand is rising, but the restricted increase in supply can prolong the tight markets and perhaps the commodity price boom. As one mining banker remarked: 'The boom will continue for longer if mining companies give money back to shareholders or spend it on acquisitions rather than spend it on new projects'[58]. As long as the supply/demand gap remains, commodity prices are likely to stay high. However, there is little evidence to suggest that restraining supply is a strategy actively under consideration by large mining firms. The motive for dividend payments and share buy backs is centred on 'maximising shareholder value'. This may have had the side-effect of delayed spending on expansion and construction of new projects.

Investment in Exploration and Development: Within the mining industry the bulk of exploration is done by 'Juniors' who then sell these projects to 'Majors' for mining and production. Since Juniors tend to be small companies, their ability to source capital in international stock markets is a major determinant of the size of exploration budgets.

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[57] WIR 2007:89
[58] The Financial Times 21st February 2007

With limited investment activity in the 1980s and 1990s, the money available for exploration tended to be restricted as well. Since the larger mining firms were not interested in expanding output, Juniors could neither raise the capital nor client interest in feasibility studies. Therefore, overall exploration budgets remained low during this period. Exploration budgets in 1990 were $2 bn, and for the 1990-1999 period averaged at $3.2 bn per year (Figure 5.5).

Figure 5.5: Estimated Total World Wide Exploration Budgets ($ Billion) and IMF Metals Price Index (1990-2008)
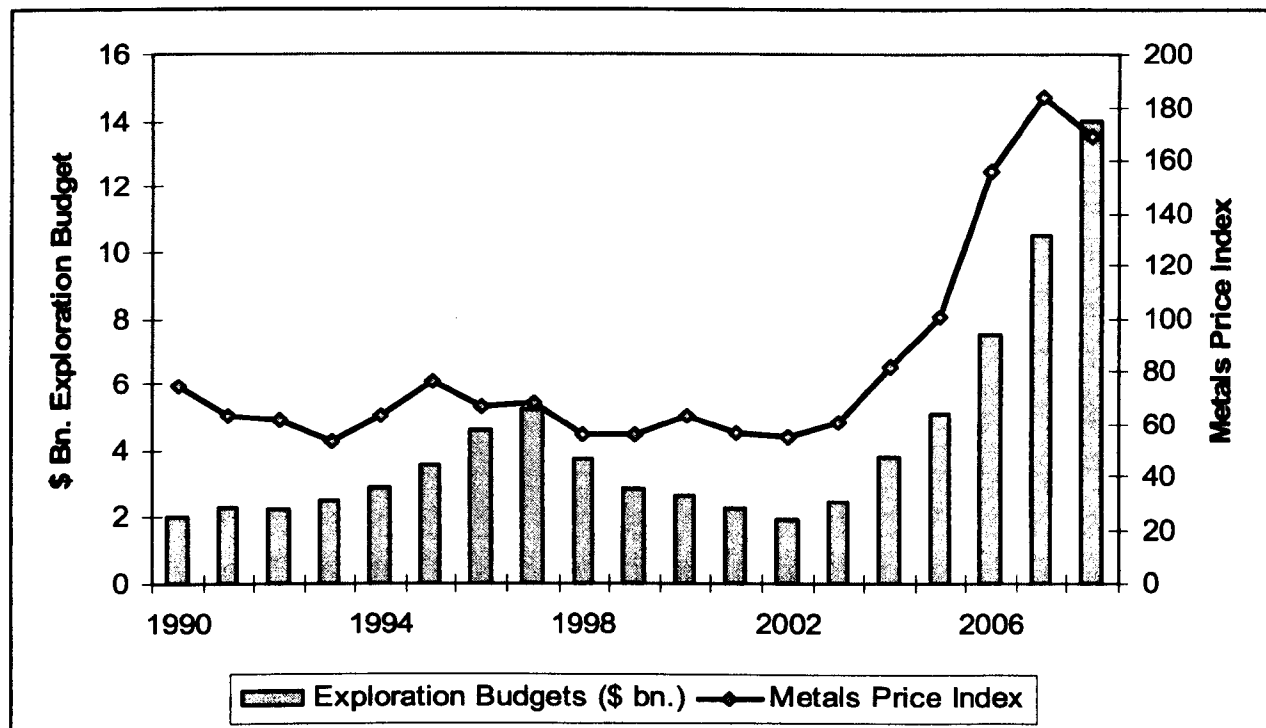
Source: Author's calculations from various reports of the Metals Economic Group and IMF Statistics

Even as commodity prices began to rise, with larger mining firms focusing on M&A and share holder dividends, an increase in exploration budgets was not seen at this time. It is only towards 2006 that we see these expenditures increasing; by 2008, exploration budgets were at an estimated $14 bn while the annual average for the 2000-08 period was around $5.6 bn per year. Traditionally exploration for gold deposits takes the highest share of exploration, but with an increasing interest in base metals post 2003, the latter's share in total exploration increased from 30% in 2002 to 40% in 2008[59].

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[59] Complied from various reports of the Metals Economic Group

Exploration budgets can be subdivided into three categories: the 'grass-root' projects which involve exploration for new fields, the 'late-stage' which involves drilling and pre-feasibility work, and 'mine-site' investments on the site area itself. Table 5.3 shows the share of each category in total exploration budgets for the 2002 to 2008 period. The budget for grass-root explorations has dropped from 47% in 2002 to 36% in 2008. The share of late-stage development on the other hand has increased from 34% to 42% over the same period. mine-site budgets have roughly retained the same share, increasing from 19% in 2002 to 22% in 2008.

Table 5.3: World Wide Non Ferrous Exploration Budgets By Stage Of Development (2002-2008)

Year	Total ($ Billion)	% Share of Total		
		Grass-root	Late Stage	Mine Site
2002	2	47	34	19
2004	4	42	36	22
2006	7	39	43	18
2008	12.6	36	42	22

Source: Author's compilation from various reports of the Metals Economic Group.

Although the share of grass-root budgets has dropped, since total budgets have increased by $10 bn over the period, the drop in percentage share does not indicate that less money is being spent on exploration. Overall, grass-root projects were consuming $4.53 bn in 2008, compared to $0.94 bn in 2002. Similarly the rise in share of late-stage development budgets increases masks the increase in spending in this area.

Table 5.3 reinforces the story of mining companies being inadequately prepared to expand the industry's supply base in the 2000s. In the low investment periods of the 1980-90s, few grass-root projects were able to meet the required rate of return to capital to qualify for investments (Crowson, 2007). The small and medium sized firms were unable to raise the finances for such projects. Therefore, as the commodity price boom appeared in 2003, the availability of 'off the shelf' projects was limited.

If exploration and feasibility studies had been conducted, the industry after 2003 would have been able to move directly into mine site development. The share of this category would have increased, instead it has remained stable. Higher budgetary commitments are being made to pre-feasibility and exploration work. The industry is only now beginning to look at expanding the supply base. Given the time lag between exploration and production, limitations due to lack of identified new projects remains a medium to long term problem for the industry.

Foreign Direct Investment: Global inward FDI flows in the extractive industry were estimated around $11 bn in 1988-1990, rising to $81 bn by 2003-2005[60]. Most of these flows were concentrated towards developed countries. FDI stocks increased from $118 bn in 1990 to $256 bn by 2000, and doubled again in another five years as the pace of investment picked up (Table 5.4).

A majority of these extractive industry investments include the oil and gas sectors, which tend to dominate overall investment flows. For the mining sector the Resource Material Group (RMG) estimates that total investments were around $104 bn in 2004. They doubled to $208 bn by 2006, rising to an estimated $409 bn by 2008[61].

Table 5.4: Inward FDI ($ Billion) in The Extractive Industry of Selected Countries (1990-2005)

	Flows			Stocks		
	1988-1990	**1998-2000**	**2003-05**	**1990**	**2000**	**2005**
Developed Countries	9	19	61	106	151	401
Developing Countries	2	20	20	11	105	165
World	11	39	81	118	256	566

Source: Author's calculations from WIR (2007) data

Financial considerations are an important issue when dealing with developing new supply of metals. With a large share of revenues in MNCs going towards M&A activities and returns to shareholders, the money being spent on exploration and capital assets of these firms has been limited. In 2006, Anglo American spent 37% of its total cash flow from operations on purchase of tangible assets, and 33% as dividends for minority interests and share holders. In 2007, BHP Billiton spent 42% of their total cash flow from operations on dividends and buy backs, and 37% on purchase of property

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[60] Source: WIR (2007) Shows data for selected countries only and is used as a proxy for global flows
[61] Various reports of E&MJ's Annual Survey of Global Mining Investment

and equipment. For Rio Tinto, in 2007, 40% was spent on purchase of property and equipment, and 25% was spent on dividends from total operations cash flows[62]. The spending on operations and explorations in most cases has been nearly equal to the revenue allocated for dividends and non-production resources. The expenditure towards production has not been the largest budget head, affecting the sectors ability to increase physical supply.

5.8 After The Commodity Boom

With the fall in commodity prices in mid 2008, the demand for commodities also decreased, and the mining sector was faced with three major issues as a result of the financial crisis. The first was the direct impact in loss of revenue due to falling prices. The second was the loss in demand volume due to the economic recession in industrial countries. The third was the financial credit crunch which dramatically reduced equity and bank financing for mining companies.

Fall in Revenue: Mining firms have seen falling revenues as a result of the fall in prices. This has resulted in major cost cutting measures being taken up by the industry. 'Majors', or the large mining firms, have slashed discretionary costs and are scaling back on operations and planned investments. For example, in 2009 Anglo American cut back its expenditure from an estimated $10 bn to between $4 bn to $5 bn in response to the financial crisis. Rio, another large mining firm was also expected to make 'significant cutbacks' after the crisis from its original $9 bn planned investment in 2009 (The Financial Times, 7th Dec. 2008.)

Mines with negative cash flows are being shut down. Mid level, medium sized firms with limited cash reserves, have been much harder hit, and are cutting back on exploration and deferring investments. Some of these companies are being targeted for acquisition as their financial problems make them comparatively easy to takeover. The 'Juniors', which are the smallest firms in the production chain, have nearly suspended all exploration projects and are in a 'survival' mode (Ernest & Young 2009). Support firms that provide mining equipment to the industry are also curtailing costs in face of the down turn. Firms such as Caterpillar, which supplies mining equipment, saw a 22 per cent fall in its sales, amounting to $9.22 bn by early 2009. As a response,

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[62] Various Mining MNCs Annual Reports

the company has shed 25,000 jobs in 2008-2009 and pursued aggressive pay cuts (The Financial Times, 22nd April 2009).

In the immediate aftermath of the financial crisis, the prices of some metals were below marginal cost of production. Bloomsbury Mineral Economics (BME) research suggests that by January 2009, nearly 80% of nickel and zinc, 90% of aluminium and 40% of copper production was taking place below the marginal cost of production. The fall in metal prices below their production costs cannot be maintained in the long run, as firms cannot continuously run in loss. If prices were to prevail below cost of production, it would force the weaker firms to shut down completely, forcing supply levels even lower. As Kosich (2009) points out, this in itself will cause prices to rebound sharply once the global economy recovers and demand rises.

Fall in Demand: With the financial crisis, many industrial countries experienced an economic recession, while growth rates in the emerging economies contracted. Therefore, the demand for metals has also fallen. In 2006 and 2007, aluminium consumption increased by 10%, while in 2007-08 this increase was 2.9%. For Copper, consumption grew by 2.2% in 2007-08 compared to 4.1% in 2006-07 (Ernest & Young, 2009).

Earnest and Young (2009) report that in the face of falling demand a number of mines have been put into 'sleep mode' where only maintenance work is carried out. With the sharp fall in demand in the latter half of 2008 there are concerns that the current cutbacks may exacerbate the supply constraints when demand returns in the future. The Financial Times (31st Oct. 2008) confirms this prognosis: 'The slashing of investment across the mining industry will have a dramatic effect on the supply of commodities over the next few years. Although 2009 is likely to bring depressed levels of demand, when economies turn around the world finally recover there could be shortages of metal'.

With lower consumption, the volume in demand has also decreased, and firms are cutting back on output. Figure 5.6 shows the magnitude of cutbacks that occurred between the last quarter of 2008 and the first quarter of 2009. Nickel and Aluminium production has been reduced by 15 to 20%, Zinc by 7% and Copper and Lead by less than 5%.

Figure 5.6: Proportion of Cut in Global Metals Output (Q4- 2008 to Q1- 2009)

Ni: Nickel

Ali: Aluminium

Zn: Zinc

Cu: Copper

Pb: Lead
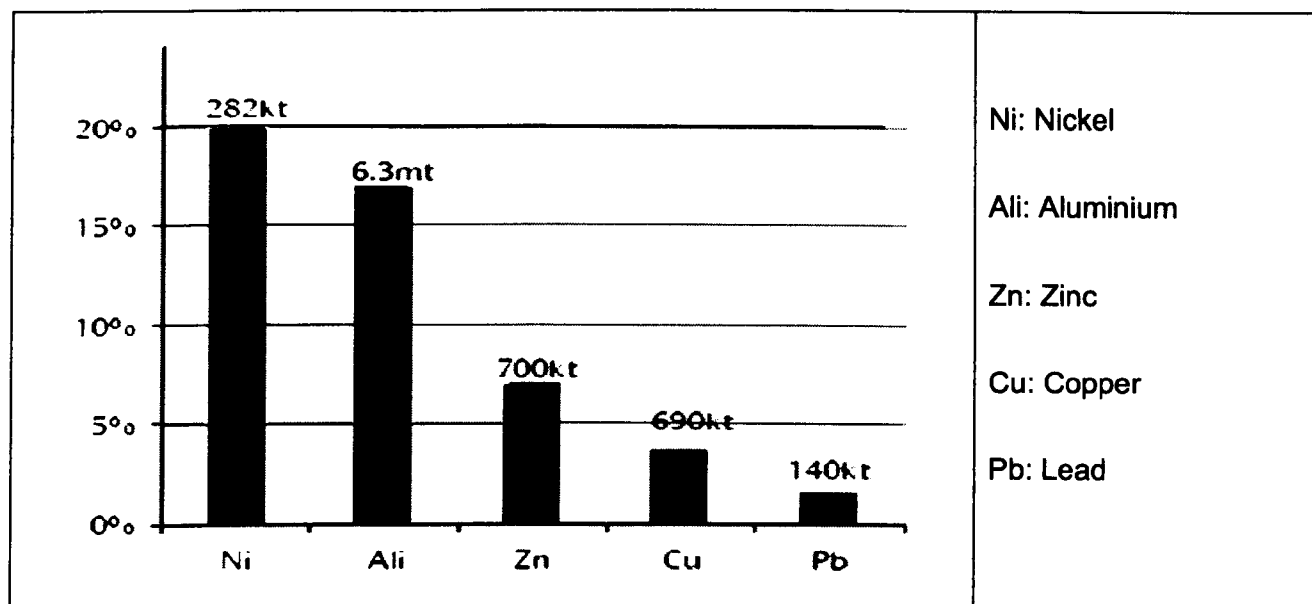
Source: Showdown (2009)

Fall in Capital Access: Highly liquid international financial markets, as those before the collapse of the system, provided ample credit and equity capital for mining firms. With the credit crunch, firms are finding it difficult to access investments. Even the large firms, have seen a sharp fall in their stock values. BHP Billiton, the largest mining MNCs had lost 59% of its share value between its peaks in May through to October 2008. Rio Tinto lost 68%, while Xstrata lost 78% of its share value over the same period (The Financial Times, 31st Oct. 2008).

During the 2003-2008 commodity boom, the high prices and generally high liquidity in the financial markets meant that Juniors had little trouble in raising capital for their needs. Since the Juniors are more focused on exploration and development of mines relative to firms, their role in generating new sources of mineral supply is more important. According to the Metals Economics Group (MEG), these firms took more than half of the global exploration for minerals in the last few years.

With the financial crisis and the resultant lack of credit, the Juniors are the first casualties in the mining industry. The Financial Times (31st Oct. 2008) reports: 'The fall in commodities prices and freeze in finance are forcing miners to drop exploration and development indefinitely. This creates a long term threat: fewer new mines coming on stream means fewer minerals will reach the market – and the possibility for price spikes several years from now when growth picks up and supplies

become depleted'. Thus, as funding for smaller mining groups becomes virtually nonexistent, with limited capital reserves to fall back on, and difficulties in raising new capital, these firms have cut back their budgets and postponed new projects.

Although the response of the mining sector has been swift in terms of cutting output and costs, this has been at the cost of future expansion of the supply base. Cutbacks in exploration, deferral of projects and investment delays signify that once demand returns to the markets, these firms will be once again be unable to increase supply quickly. Snowdown (2009) estimates that even with slow recovering demand in 2009, aluminium copper, zinc and nickel have a two to four percent market surplus, which relative to demand is small by historical standards. BME predicts that refined copper markets will be in deficit again by 2010[63].

SECTION 3 INFLEXIBLE SUPPLY: THE FUNDAMENTALS

Post 2005, mining firms began to increasingly invest in expansion and construction of new mines. While the commodity boom provided high revenues and a positive investment environment, issues on the fundamentals side were more constrained. In this section, we examine the problems currently facing the mining industry that has led to delayed supply increases and increasing production costs. These include higher risk premiums, increasing costs of production, and lags in the support sectors of the mining industry.

5.9 Higher Risk Premiums

Mineral and metal ores are point specific commodities, as they can only be found in particular geographical locations. Although minerals tend to be widely distributed across the globe, there are pockets of ores rather than a general dispersal. Initially, mining activities were focused on areas that were easily accessible, and where political and social conditions made operations easy. Mining investment is influenced by finding a country of 'least resistance', in terms of being able to enter and maintain mining operations with some degree of certainty and safeguard. The political risks of operating in countries such as Australia and Canada are much lower than those of operating in

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[63] Source: BME Copper Briefing April/May 2009

some of the more fragile African states. The Democratic Republic of Congo holds some of the largest reserves of copper in the world, but the political risks associated with operations there are much higher than those in Chile[64].

The risks involved in working in socially fragile or conflict prone areas as well as issues linked to placing expatriate employees in underdeveloped countries affect risk premiums and production costs. During the low investment periods of the 1980s and 1990s, mining firms focused their attention on 'World Class' assets. Such rare mining assets tend to produce high grade ore with low extraction costs (Crowson, 2008).

Some of the largest regions of unexploited resources are in Africa, often in fragile states, with low infrastructure and support systems. Table 5.5 shows Africa's share of global production and reserves. Its share of global production is low compared to the share of reserves it holds. As mining firms are forced to search for other mining sites, less than 'World Class' assets, they will increasingly turn towards less explored but also fragile regions, thus the associated risk premium in new projects is likely to rise.

Table 5.5: Africa's Percentage Share of Global Mineral Production and Reserves

Mineral	Production	Reserves	Ratio
Gold	20	42	0.48
Manganese	28	82	0.34
Cobalt	18	55+	0.33

Source: Author's calculations from African Development Bank (2008)

As demand for metals continue to grow, mining firms are being forced away from their traditional digging grounds. LME (2006:102) comments: 'Traditionally, mining activity was focused on Australia, Canada, South Africa and the United States. But deposits have become harder to find in these countries and the combination of rising metal prices and persistent demand has prompted miners to widen their search for new reserves'.

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[64] Interviews with key industry informants at Copper Day 20:20 Investor Series 2007

FDI in Green Field projects in the extractive industry increased from 234 projects (2002) to 469 projects (2006)[65]. Increasingly these projects are based in developing countries with higher risk premiums associated with production.

5.10 Higher Costs of Production

Similar to the structural shift in global demand from Chinese resource-intensive expansion, a structural shift may well be occurring on the supply side as well. In periods of low prices, firms are forced to improve their efficiency levels, in order to save costs. In 1980 to 1986, when copper prices were low, the United States copper industry doubled its labour productivity and survived through a difficult period for the industry (Tilton and Landsberg, 1999). In contrast, in periods of high prices the pressure for cost reducing technologies is much lower.

Crowson (2007) suggests that although the industry is overcoming its capacity constraints, the structure and level of costs are changing. The changes will allow supply increases to eventually match demand, and prices will start to settle from their peaks close to marginal costs. However, the changing structure of costs means that these marginal costs will be higher than pre-boom levels, and therefore the overall market clearing prices for metals will also be higher.

The MEG in their World Exploration Trends Report (2009:2) state, 'Increased demand for services such as drilling and assaying, and rising input costs on everything from fuel to geoscientists, have significantly increased the costs of exploration'. They further argue that despite the increase in exploration budgets in recent years, the high costs of these activities has led to a less than proportionate increase in activities on the ground.

Some increases in costs have been metals specific, while others have occurred for the industry in general (Crowson, 2007). An increase in labour costs, capital and energy are structural costs that apply for all mining sectors. The cost of energy will have a higher impact on aluminium, as it intensively uses electricity for production. Gold, in contrast, would not experience such a similar cost increase.

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[65] Source: WIR (2007)

Table 5.6 shows the percentage increase in various costs in production of metals in 2007-2008. On the one hand, the cost of energy increased rapidly affecting the entire industry, as have raw material prices such as Coke and Sulphur. On the other, transport costs have fallen by 43% over the 2007-08 period, and was beneficial for the overall cost structure faced by mining firms. The changes to costs from fluctuations in foreign exchange are also important and the devaluation of the dollar can produce a positive impact for lowering costs. However, this is dependent on the currency of the host country.

Table 5.6: Percentage Increase in Production Costs of Base Metals (2007-2008)

	15th Sept 2008 Price ($)	Yearly Change
Energy		
EEX Electricity	118	155%
Coal	174	90%
Diesel	279	26%
Natural Gas	7	17%
Transport		
Baltic dry freight index	4,747	-43%
Raw materials		
Coke	782	147%
Sulphur	675	463%
FX Costs		
USD/EUR	0.676	-5%
USD/CAN	1.036	3%
USD/AUS	1.185	4%

Source: Adapted from LME Metals Week 2008 (presentation by Berry)

The increase in prices over the 2007-2008 period has been substantial, especially in the energy sector and some aspect of this is permanent. For example, even though oil prices fell from $180 a barrel at their peak in 2008 to $31 a barrel in the latter half of 2008, in the long run oil prices are expected to be between $60 to $80. This is a permanent increase in price compared to the $38/barrel value in 2004[66].

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[66] Source: International Financial Statistics (IMF)

Since metals are also inputs into the mining sector, higher metal prices also indicate a rise in the cost of inputs for the industry. Humphreys (2009) and Domanski and Heath (2007) argue that such changes have led to a permanent increase in the marginal cost of production. When base metals prices fell in 2008, they remained above their pre-boom levels for this reason. Furthermore, Tilton (2007) suggests that as pressures increase to incorporate the environmental and social costs of mining, prices may be further pushed up in coming years.

5.11 Lags in Support Sectors

Once a decision to construct or expand a mine has been taken, the firm will focus on the design and implementation of the project. The company needs to order appropriate machinery and employ labour to carry forward its project. Given the low demand for mining related equipment and labour in the 1980s and 1990s, the ability of mining support industries to provide for the growing mining sector in the 2000s was severely restricted.

Equipment Constraints: During the 1980s and 1990s, when low prices forced mining companies to aggressively follow cost cutting measures some of the pressure was passed on to the ancillary industries. This included pressuring manufacturers of mining equipment and machinery to lower prices (Crowson, 2007). These support industries were forced to reduce their own expansion and capacity enhancement plans. Thus, when demand for machinery returned from the mining firms in the 2000s, the support industries were also ill equipped to increase production.

Mine construction requires equipment and machinery that is very specific to the sector. In 2008, it was estimated that global demand for specialised mining machinery and equipment would increase at a rate of 5% every year until 2011, generating revenues worth $30 bn for the sector[67]. The United States, one of the leading producers of mine related equipment, exported machinery worth $23.67 bn in 2008, an increase of 21.3 % over the previous year. Despite these figures, the mining industry as a whole is facing delays in delivery of equipment (Table 5.7).

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[67] http://www.marketresearch.com/product/display.asp?productid=1724742 accessed September 2008

Table 5.7: Supply Lead Times in Selected Examples of Mining Equipment (in months)

Machinery	Pre-boom	Early 2007
Grinding Mills	20	44
Draglines	18	36
Barges	24	32
Locomotives	12	26
Power generators	12	24
Wagons	12	24
Rope shovels	9	24
Reclaimers	8	24
Tyres	0-6	24
Large haul trucks	0-6	24
Crushers	16	24
Ship loaders	8	22

Source: Rio Tinto 2007 in WIR 2007

Lead times in months, when compared before the boom and in early 2007, have increased for grinding mills (120%), draglines (100%), power generators (100%), crushers (50%) and ship loaders (175%). Delay in new equipment and replacement of old machinery interrupts production and therefore delays supply further.

With an increase in orders for mining services across the board, the support industry was unable to respond quickly. With delays in procurement and delivery of equipment, mining firms were also unable to increase their own output (Crowson, 2007). The delays consequently pushed up costs of production for mining firms. The RMG[68] estimates that in 2006, projects that were in the pipeline before 2006 experienced a rise in costs from 20 to 25% in 2006. Some of these costs are linked to delays in construction due to delays in procuring equipment.

Human Resource Constraints: The investment in human resources in the mining sector was limited in the decades preceding the 2003-2008 boom. A mining related degree can take up to nine years to complete. With limited opportunities in the industry during the 1990s, the number of students studying for such degrees was low. Marcus Randolph, the chief organisation development

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[68] In Crowson (2007)

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officer at BHP Billiton, in reference to the pre-boom period says: 'The industry was suffering a depression, and the best and brightest didn't join'[69].

Today, 10 years later, with the increase in mining projects and the teams required to support them, there is a void of trained personal. In Canada, where the mining sector has been growing at twice the rate of the economy, a shortfall of 92,000 workers is forecasted for the next decade. The labour force within the industry is also ageing, with over 50% expected to retire in the next 10 years[70]. In Australia, the estimates are for an additional 70,000 employees: next to the 120,000 it already has in the mining sector in order to fulfil demand by 2015[71].

Dennis Wheeler, chief executive of Coeur d'Alene Mines Corp. believes lack of human resources is affecting everyone in the mining industry: 'Finding people is a big issue, an across-the-board need'. Colin Benner the Vice-Chairman of Lundin Mining Corp agrees: 'Good geologists... and on the mining engineering and metallurgical side, in particular, it is very, very tight'. Firms are now willing to hire people who might not have been trained in the geology and mining, but have any experience that could be related to the mining industry[72].

Untrained personal can slow down mine production. With experienced personal stretched across projects, the scope of learning under instruction is also hindered. Salaries in the mining industry have risen by 20% in 2005-2007, but the lack of personal and the higher salary costs are affecting costs of production and completion dates for projects (Crowson, 2008).

Labour unrest and strikes in a number of major commodity producing countries have also affected output levels. Peru, Mexico and South Africa witnessed major strikes in 2007, while Chile's copper mines faced labour strikes in 2008. Strikes have been based on issues as wide ranging from wage levels to safety concerns. Workers observing the high revenues being generated by mining companies are asking for a similar increase in their wages (Cuddington and Jerrett, 2008). A

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[69] http://www.nytimes.com/2007/02/27/business/27miner.html accessed September 2008
[70] http://www.bcminerals.ca/pdf/HR%20Task%20Force%20Backgrounder%20-%20May%202008.pdf accessed September 2008
[71] http://www.nytimes.com/2007/02/27/business/27miner.html accessed September 2008
[72] http://www.reuters.com/article/GlobalMiningandSteel07/idUSN2436107820070524?pageNumber=1 accessed September 2008

number of accidents in mining facilities, sometimes leading to fatalities, have also led to mine closures. In South Africa, 199 workers died in 2004 and another 202 in 2005, leading to extended mine closures.

The Probable and the Possible: Given the difficulties in increasing supply there is a gap emerging between forecasts and actual production. Radetzki *et al.* (2008) argue that investors tend to underestimate future needed capacity, and therefore when supply capacity is geared towards underestimated future demand, gaps in the market remain. Figure 5.7 shows the loss resulting from the difference between planned and actual production for copper over the past few years. The increase in losses in 2005 and later is one indication of the inability of the sector to operate at full capacity. As mines and equipment were forced to produce at or near full capacity, the unanticipated breakdown and replacement of equipment forced frequent mine shutdowns and loss of planned production. With greater demands on the sector post 2003, there is increasing loss of planned production as operations were pushed to the limits.

Figure 5.7: Copper Mine Production Gains and Losses (4Q prior year Forecast vs. Actual)
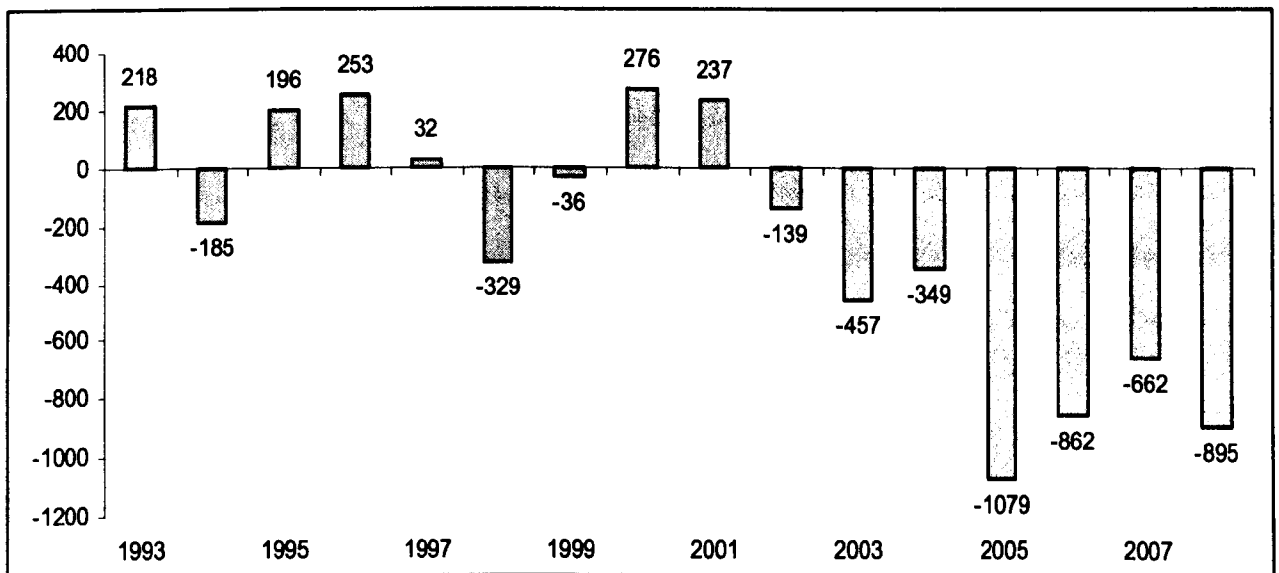
Source: Macquarie Commodities Research (2008)

With the initial burst in demand, mining operations were able to ramp up production in the short period. However with time, capital equipment wore down and replacement downtime increased. Labour strikes also delayed production. In the case of new production coming on line, higher lag

time in equipment delivery and lack of trained personnel also led to production dates being postponed. With rising input costs and delays in sourcing equipment, projects are taking longer to finish than planned and also cost more than originally anticipated (Crowson, 2007).

Such issues have led to the many mining operations operating at less than full capacity. The global utilisation rate for copper mines in 2001 was 88.6%, rising to 89.2% in 2004, before falling to 86.9% in 2007 despite the boom in prices and demand. Similarly copper refineries saw capacity utilisation rates fall from 86.5% in 2001 to 81.5% by 2007[73]. Project delays and losses from planned output have been a major concern for suppliers. Planned production can be lost due to unanticipated problems, putting further pressure on tight markets. The gap between expected production and the actual production leads to more constrains in supply, in an already tight metals market.

5.12 Conclusion

The mining industry has played a crucial role in the industrial revolution in the 18th and 19th century. In the 20th century, the nature of the industry became more global, with MNCs acting in different regions of the world to provide raw material to industrialising countries.

The industry itself is characterised by large capital expenditures, long gestation periods and returns to investment over a long time horizon. The structure of the industry, in downstream activities, where economies of scale are important, tend to be dominated by large firms. Upstream activities, such as exploration require relatively smaller capital investments and fall to smaller firms. The larger mining firms tend to have a larger control over output than smaller firms, and it is the former's investment decisions that have a larger impact on the level of global supply.

The low metals prices during the 1980s and 1990s led to depressed investment expenditure within the industry. While costs were pushed down, expenditure on cultivating long term supply sources was not carried out. The increase or decrease in mining output tended to remain steady for over three decades, showing little response to changing price levels.

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[73]Source: BME Copper Briefing Service March 2009

In the 2003-2008 commodity boom, mining firms responded first by pursuing financial consolidation and only later towards increasing supply. Given the neglect of the fundamentals for so long, the ability to expand physical supply was inadequate. Coupled with rising production costs and delays, the lag in supply was a contributory factor to the price boom. In Chapter 3, we noted that the 1951-1953 and 1973-1975 commodity booms were a result of perceived and actual supply insecurities that arose from war and natural disasters. In the 2003-2008 boom, political or economic events have not been the main source of supply inflexibility, but the intrinsic nature of the sector itself has contributed to a slow supply response.

Before supply increases could match demand, the financial crisis in 2008 once again led to low metals prices. The response of the industry in the short term was a swift cutback of output and costs. However, that has also contributed to the continued weakness in fundamentals that existed before the boom. With an expected return to global economic growth in 2010, the mining industry will again face supply inflexibilities as experienced during the boom.

We can now answer our second research question: *What has been the contribution of supply in the determination of metal prices?* The inflexible nature of the mining industry, coupled with behaviour of the leading mining firms during the initial stages of the boom has led to a lagged supply response. The fundamental weaknesses in the industry remains, and when economic growth returns, these weaknesses will continue to have a supply pull effect on metal prices.

DISRUPTIVE FINANCE: COMMODITY MARKETS AND FINANCIAL INVESTORS

'I don't know absolutely if speculative money is causing price rises or not but what I do know is that there are hundreds and billions of dollars that did not exist in these markets a few years ago' [74].

The Spice Trade was perhaps the earliest form of commodity exchange involving the transportation of goods over large geographical regions. Originally in Asia, these routes grew to cover Arabia and Africa. By the 15th century, Vasco de Gama and 'Voyages of Discovery' by other European navigators brought commodities trade across to Europe. Initially only commodities with a high value to bulk ratio were transported, but as shipping technology improved, especially with the introduction of refrigerated cargo in the late 1800s, the volume of commodities trade increased. By the 2000s, efficient super tankers and large cargo carriers deliver commodities more cheaply and quickly.

This long history of international transactions has contributed to establishing an 'international' pricing system for commodities. Ports, surrounded by warehouses, acted as trading hubs where incoming shipments would be stored before being sold on to consumers. Traders would gather in coffee houses around major ports, joined by producers and consumers to exchange goods and share information. Since commodities tend to be homogenous products, their quality and volume could be easily standardised, and commodity contracts were simple to trade. Gradually these gatherings became more formal and were later institutionalised. The major international commodity exchanges are still housed in New York and London.

A commodity exchange was an ideal platform for consumers and producers to gather to reach a transparent price through open auction. Traders would participate and act as middlemen to bridge the gap between producers and consumers. The current commodity exchanges still function on the same principle and are used to arrive at an 'international' price for commodities that are a benchmark for a majority of bi-lateral contracts signed outside the exchange.

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[74] A Commissioner at the United States Commodity Futures Trading Commission quoted in the Financial Times 8th July 2008

Although the structure of an international commodity exchange has evolved over the centuries its basic function remains as a platform for price discovery. The process relies as much on the fundamental side of the commodity sector, as it does on the financial side. Whereas producers and consumers value the physical demand and supply side, the trader (now investor) evaluates the financial side of the equation. Thus the price setting mechanism at an exchange brings the dynamics of financial markets to the fundamentals of the physical market. As much as the fundamentals drive price change, the actual setting of price, in the case of metals, is in the financial commodity exchange and not in physical markets. The fundamental determinants of price, demand and supply, have been discussed in the previous chapters, and we now focus on the financial evaluation of commodities.

In this Chapter we address our third research question: *What role has the financialisation of commodity markets played in the determination of metal prices?* In Section 1 we explore the mechanisms behind commodity pricing and the role of investors. Section 2 looks at the nature of recent investment activity in commodity markets during the 2003-2008 commodity boom, while Section 3 looks at the impact of these changes on the price discovery mechanism.

The major metals trading platform is the London Metals Exchange, established over 130 years ago, its roots going as far back as the opening of the Royal Exchange in London in 1571. It currently accounts for nearly 95% of all international exchange contracts in metals. The functioning of the exchange is based on offering Spot and Future contracts for six major metals (aluminium, copper, lead, nickel, zinc, and tin) in pre-defined ore grade and weight contracts. The LME warehouses stockpile physical output, which can then be received by the purchaser of the contract. We concentrate on the functioning of the LME for the remainder part of this chapter.

Data Limitations: The issues surrounding the degree of impact of financial/speculative activity on price is hampered largely by the absence of detailed data sets of investor behaviour in commodity markets. The first issue is differentiating financial investors from producers and consumers at the LME. Since contracts are traded through the LME members, who release information on the

number of contracts traded and not the category of their clients, one cannot distinguish between physical producers, consumers and the financial investor activity.

Secondly, small to medium investors such as Managed and Hedge Funds are not under regulations that require publication of their investment portfolio allocations, or the amounts invested directly and indirectly into commodity markets. Their trading strategies are business 'secrets' and not available in the public domain. Larger institutions tend to use price models, and again the weights assigned within models are not available in the public domain.

Thirdly, the numbers of financial vehicles that directly and indirectly engage with commodity prices are numerous, and their exposure to commodity prices changes over the short and medium term. Again the amount of finance exposed to commodities and trading strategy is not available in the public domain.

These data limitations restrict our ability to gauge the amount of financial liquidity attributable to speculative investors alone and its direct impact on price. This also inhibits a clear cut distinction for before and during boom delineation of investor behaviour. We therefore examine the major trading strategies that investors employ and estimate the possible effects on price these strategies may have.

SECTION 1 THE VALUATION OF COMMODITIES

Commodities as investment products are usually standardised agreements that outline the delivery of a fixed volume and quality of a commodity at a predetermined price. A product may be for immediate delivery (spot contract) or for delivery at a later time (futures contract)[75]. The first is valued by the spot price, while the second by the future price. We concentrate on the futures contract and price, since this involves hedging and speculative activity that is of interest to us.

For producers and consumers the demand for a futures contract is linked to gaining some level of price security, i.e. hedging. Since commodity prices can be volatile, the consumer of the contract is

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[75] Forward Contracts also exist, but they are an option to buy/sell and not a commitment. We focus on the Futures Contract for this dissertation.

assured of the price he will pay/receive for this product in the future. Speculative activity is the other side of the contract, where an investor takes on the risk of future price movement for the hedger. He receives a risk premium for his behaviour. The previous two chapters have discussed the fundamental side of commodities, i.e. demand and supply. In this chapter we concentrate on the financial side. Therefore, any reference to demand and supply is in terms of financial actors, unless specified.

6.1 The Commodity Exchange

The market for a commodity contract is the commodity exchange. Traditionally a commodity exchange functioned on an open auction platform to achieve a transparent price. The LME still maintains small time periods in 'The Ring', where members use the outcry methods for transactions, but electronic trading has now taken over the majority of contract operations. Investors act as the middlemen for consumers and producers of commodities. They bring liquidity into the exchange and hence ease friction between demand and supply pressures.

Commodity Market Differences from Other Financial Markets: A commodity exchange has several distinguishing characteristics in relation to other asset exchanges such as the stock market. The first is that a commodity contract can go through to physical delivery of products, unless closed before maturity. Essentially that means that if one has bought a three month contract for copper, at the time of maturity, one owns the copper in the exchange warehouse. The contract can be 'closed' by either selling the contract in the exchange or taking an offsetting contract, to avoid taking physical delivery. Since a contract can go to delivery it ensures that an arbitrage is maintained between the physical and the financial markets, allowing for one price to balance the overall commodity market (Harris, 2005).

Secondly, commodities are divided into sub-sectors, such as energy products, agricultural raw materials, food and metals. These sectors and their prices are largely un-correlated to each other. Factors that impact agricultural products will not affect metals. Investments in commodity portfolios will produce very different returns depending on the composition of the portfolio (Kazemi *et al.*, 2008). There is no commodity ranking similar to the S&P 500 or the FTSE at stock exchanges,

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which ranks stocks according to performance, and all stocks tend to be impacted by financial indicators such as interest rates.

Commodities have returns and risk factors that are different from other assets and therefore generally show little correlation to other financial assets. Commodity contract pricing tend to act positively to an increase in inflation rates, and have a negative correlation to stock and bond markets (CISDM, 2006).

Price Setting: It is at the exchange that demand and supply indicators for the present and the future are analysed, forecasted and often speculated upon. The behaviour of the financial actors becomes crucial in the determination of price. The financial valuation of commodities is based on two principles: their fundamental value and their financial value. The first derives from their demand in physical markets, while the second from their value as an asset in itself. The asset value of a commodity is its worth for reasons other than production or consumption. For example, gold and silver are used as ornaments for personal consumption but they also carry value as financial assets. The case for other metals such as copper and iron ore is less straightforward, as they are inputs into products and not directly consumed[76]. But as an asset, a commodity is evaluated on returns generated, usually due to changes in the difference between the expected and actual future price, rather than the physical use of the product.

6.2 Commodity Investment Products

Commodity contracts and related investments can be traded through a number of 'vehicles'. The term investment vehicle or tool refers to the means available in the financial sector to invest in commodity markets. This investment may take a direct form, such as buying commodity contracts on the exchange, or indirectly in indices that track commodity prices with no direct interaction in the physical markets. Vehicles will often bundle commodities into categories such as energy, metals, and agricultural goods rather than tracking individual commodities. As the number of vehicles in the market can be large, we outline the main tools, while others will fall somewhere between them.

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[76] Gold and silver are used in minor ways as inputs into electronics

Commodity Contract: A commodity contract is the simplest and most direct form of investment in a commodity. A spot or future contract is bought which gives the owner the rights to the physical metal. The contract specifies the grade, volume and time of delivery as well as price. A contract at the LME goes to delivery, i.e. at the maturity of the contract the owner is obliged to provide/receive the stated goods at an LME designated warehouse. To avoid delivery, a contract may be closed off before maturity, i.e. an off-setting contract is purchased. The value of LME contracts in 2007 was $9,500 bn.[77]

Commodity Indices: A commodity index is composed of a basket of commodities that are granted different weights in the overall bundle reflecting their importance in world markets. The index then tracks the price of the bundle, and weightings are reviewed to ensure that the index is tracking the more important commodities over time. Some institutional investors, banks and pension funds, which are not allowed to directly invest in commodities, invest in indices and therefore such derivatives are of particular interest to them. The most prominent indices are the Goldman Sachs Commodity Index (GSCI) introduced in 1992, the JP Morgan Index in 1995 and the DJ-AIG index introduced in 1998. The value of trade in the GSCI and DJ-AIG commodity indices was estimated at $ 56.4 bn in January 2009 (The Financial Times, 18th Feb. 2009).

Over the Counter Derivatives (OTC): An OTC derivative is a contract between any two financial actors, be it a large institution, or a hedge fund, that essentially places a bet on future price movement of an asset. OTC's have been used in stock, currency and interest rate markets and more recently in commodity markets. An OTC is used for both hedging and speculation purposes and its success depends on finding a counterparty that is willing to take a position opposite to your own. An OTC is negotiated between the two parties and is not regulated by a clearing house. In the United States, in 2000 the Commodity Futures Modernization Act by the government effectively prohibited regulators from examining activities in the OTC markets. OTCs have become increasingly important in commodity markets in recent years, with an estimated $ 9,000 bn in OTC commodities in 2008 [78].

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[77] The Ringsider (2008)
[78] The Ringsider (2008)

Exchange Traded Funds: The ETF is an example of the new investment vehicles targeting commodities. An ETF combines a number of financial assets such as stocks, currency trade, and recently commodities into a single bundle. The ETF then sells shares of its own, returns on which are linked to the performance of the entire bundle rather than the specific assets it holds in its portfolio. The return on an ETF is therefore based on the value of the total assets/securities, while it profits from arbitrage opportunities within its owned bundles. The ETF shares are then traded on the exchange and are usually bought and sold by large institutional investors such as banks, and not by small investors. The ratio of commodities included in various ETF bundles is not available in the public domain. The value of commodities in ETFs was estimated at $ 51.9bn in January 2009[79].

Other Vehicles: Currently all financial tools dealing with commodities either have direct exposure to contracts, or include some weighted component within a larger portfolio. Given the complexity of new instruments, layers upon layers of investment strategies are built upon each other, acting as buffers between the commodity exchange and the investor. Customised instruments have been created to bring in new investors to commodities, such as the introduction of Structured Notes that now include the performance of commodity prices in their returns, to entice the traditional Bond investors. This allows for a larger number of investors to be exposed to a larger number of commodities.

The list of such vehicles is long, but they are variations on the same principle. They all provide exposure to commodity prices, where investors 'speculate' on future price movements based on their own knowledge, models or computer generated algorithms.

6.3 The Financial Actors

The financial actors within commodity exchanges traditionally were middlemen or investors who take up the opposite side of the buy/sell contracts required by consumers/producers. They bring in much needed liquidity, which is essential for the functioning of the exchange. Investors include small individual investors and those trading on their behalf, as well as larger institutions such as banks and pension funds. Until recently, large investors would not participate in commodity

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[79] The Financial Times 18th February 2009

exchanges, as low liquidity meant they could not move in and out of positions with ease. Given the spectrum of small to large investors involved in commodities, we concentrate on two major groups. The first is the small to medium sized managed funds, and the second are large institutional investors.

Managed Funds: These are small to medium sized firms pooling money from a number of other individual small investors. The defining character of managed fund operations is their reliance on 'human' generated trading strategies, rather than reliance on computer generated algorithms (Mayer, 2009; UNCTAD, 1996). The managed fund relies on the expertise of its chief strategist, who identifies and invest in high return opportunities. Some managed funds are also referred to as Hedge Funds and have become very popular in the past decade. A number of managed funds may pool their resources to purchase portfolios. These are referred to as Fund of Funds. However the amount of money invested by such funds tends to remain small when compared to larger institutional investments. Although hedge funds accounted for $2.3 trillion in the global fund management industry in 2007, they were responsible for three percent of the overall value of the industry. The rest was covered by other funds and larger financial institutions[80].

The impact of an individual fund is small given the sum of money they control in relation to other institutions, but the number of managed funds has steadily increased in the past years. The number of global hedge funds increased from 3,500 in 1998 to nearly 12,000 by 2007. Similarly, overall assets under their management increased from $221 bn in 1998, to $2.3 trillion by 2007. However, by the end of 2008 the number of such funds had dropped to below 10,000 as did their assets under management to around $1.5 trillion.

Hedge funds tend to be short to medium term investors, and their characteristic strategy is moving small amounts of money within short periods of time which can lead to volatility in prices of assets in which they invest. Due to nature of financial regulations in Europe, hedge funds are not required to report the sum of money that they manage, nor the portfolio division of their investments.

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[80] All data in this section from IFSL Commodities Report (2008)

Therefore, accurate data as to their activities remains limited, but we can confirm there has been growing investment by these funds in commodity markets.

Institutional Investors: Institutional investors are large investment firms, banks, insurance firms and pension funds. Institutional investors tend to have medium to longer term investment strategies and are more conservative in risk assessments than hedge funds. They also control larger sums of money than managed funds. The overall assets under management by major institutions totalled $78 trillion in 2007. Insurance companies accounted for 33%, while retail and investment banks accounted for another 31% of total funds under management in the United Kingdom in 2007[81].

Given the investment time line and the larger value of investments, institutional investors tend to follow a medium to long term investment strategy as opposed to that of hedge funds (Mayer, 2009; UNCTAD, 1996). Pension funds have been known to develop trading strategies that mature after 20 years. Pension funds were estimated to hold $250 bn in commodity related investments in 2008, compared to just $10 bn in 2000 (The Financial Times, 8th July 2008). In order to comply with regulations while generating a competitive return, the trading strategies developed by institutions tend to be highly complex. With the recent rise in metals prices, commodities have become a popular addition to their portfolios. As part of these strategies, financial institutions have been at the forefront of designing financial vehicles that offer exposure to commodities directly and indirectly. Due to reporting regulations and confidentiality of trading strategies, data in the public domain relating to the exact nature of the institution's exposure to the commodity sector remains limited.

6.4 The Determinants of Price

Commodities are priced on 'spot price' and 'futures price'. The futures price may be in 'backwardation' or 'contango' relative to the spot price. Backwardation implies that the futures price is lower than the spot price while contango implies that the futures price is higher than the spot price. Commodities such as oil are normally in backwardation, while gold is in contango. A commodity price may shift from contango to backwardation and vice versa, depending on the markets perception of future price movements.

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[81] Source: IFSL Commodities Report (2008)

Differences in spot and future prices are determined on the basis of the stock held and convenience yields that may occur as a result of holding such stocks. Storage or carrying costs for non-ferrous metals would include the interest rate, a risk premium for holding stocks, and the cost of storage minus the convenience yield. Convenience yield from a consumer's point of view is the ability to smooth out production processes, but also the ability that a stock can be sold whenever the market price justifies it. In a simplistic model, where there are no hedging costs, with high stocks the difference between the future and the spot price is the cost of carrying that stock. When stocks are low, spot prices may exceed future prices, as the commodity price reflects immediate consumption rather than the cost of storage. Brenner and Kroner (1995) argue that the costs associated with carrying an asset will have an impact on its spot price. Since spot prices are used to predict/forecast current future prices as well as on future spot prices, the cost of carry will therefore impact all of the latter.

There are a number of factors in determining the value or price of metals, some from the physical side of the market, while others are based in the financial sector. In 2005 and 2006, the process of asset valuation of metals saw the introduction of two new investment actors. These were the commodity index funds and the creation of various commodity based derivatives. These have increased investment activity in commodity markets and brought in new trends in commodity trading.

Figure 6.1 outlines the major variables affecting prices. The physical variables include demand, supply response and the stock levels at the exchange, while the financial side focuses on the value of the US Dollar in international markets. These remain the basic determinants of price, but in recent years other variables have also surfaced.

Figure 6.1: Conceptual Basis for Understanding Metals Pricing at an Exchange
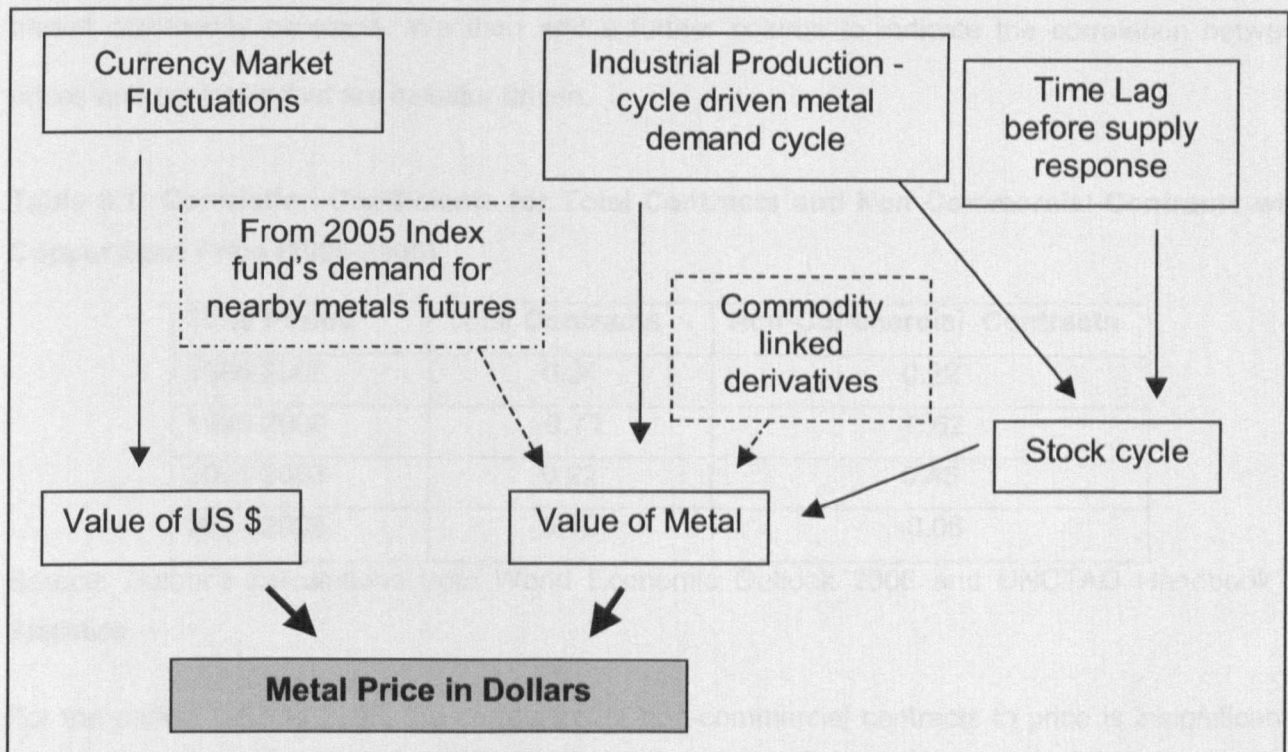
Source: Adapted from Bloomsbury Mineral Economics Company Presentation (2007)

The fundamental or real factors behind metal valuation is reflected by the demand, supply and stock levels of metals, while the financial indicators are the value of the US dollar, and the behaviour of new commodity related investment tools. Both sides will influence how commodity prices are formed, one as the intrinsic value of metal while the other balances it against the value of other assets. One of the questions we initially raised in the first chapter of this dissertation was the impact on commodity prices of the increasing participation of the financial markets.

Given the issues with data limitations from commodity exchanges, differentiating between speculative and hedging interests, as well as physical producers and consumers of metals, and pure investor interest, it is difficult to sort the impact of investors from that of the fundamentals on price. Using the number of contracts traded by non-commercial actors, i.e. other than producers and consumer of commodities, we can approximate the level of investor participation. These do no necessarily indicate speculative activity, since investors may well be hedging contracts. Contrasting the number of contracts being traded by investors with the total number of contracts in copper markets we approximate investor interest in commodity markets. To establish a baseline the first

column in Table 6.1 is calculated to show the correlation between commodity prices and total traded commodity contracts. We then add a further column to indicate the correlation between prices and contracts that are investor driven.

Table 6.1: Correlation Coefficients for Total Contracts and Non Commercial Contracts with Copper Spot Price (1995-2006)

Time Period	Total Contracts	Non-Commercial Contracts
1995-2006	0.24	0.22
1995-2000	-0.71	-0.62
2001-2003	0.22	0.45
2004-2006	0.12	-0.06

Source: Author's calculations from World Economic Outlook 2006 and UNCTAD Handbook of Statistics

For the period 1995 to 2006, the correlation of non-commercial contracts to price is insignificantly different from that of total contracts. For 1995 to 2000 both sets also show a strong negative correlation to price. However, in 2001-03 the correlation of price to non-commercial contracts starts to diverge from the one for total contracts, with the gap between the two increasing further post 2004. Given the change in how investors value commodity prices, we now focus on the three major fundamentals driving price change: the industrial production Index (IP), exchange inventory levels and the US dollar index. The influx of investors in commodity markets should strengthen the 'asset value' pricing strategy for commodities, rather than being purely driven by the fundamentals. This would show as a weakening in the correlation between traditional factors and price.

The Industrial Production Index (IP): Metals demand is related to their use as inputs in manufacturing and infrastructure developments. Therefore, the level of Industrial Production (IP) is a good proxy for determining metal demand in the economy. Although there are a number of other variables that can be used to gauge current and future metals demand, the IP index remains the base variable in most models estimating price for investment firms. An expansion in the IP index indicates increased demand for metals and will tend to have a positive impact on price.

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The IP Index of the OECD countries has historically been widely used to gauge metals demand, as these countries account for nearly 80% of global manufactures production. Figure 6.4 shows the average price of copper at the LME and the changes in the OECD IP index. In the period 1999 to 2003, when the OECD IP index was low (below 100), copper prices were around the $3,500/ton level mark. Industrial production in China was well above the 100 mark at this time, but had little influence on price. After 2003, when the OECD index begins to pick up, copper prices also increased.

A cursory examination of Figure 6.2 indicates that copper prices seem to be more responsive to changes in the OECD economies than to changes in China's industrial index. This has traditionally been the case, but in recent years China has become more central to the commodity markets. This aspect has become more important since the start of the economic recession and commodity markets tend to act strongly to information coming out of China in recent months.

Figure 6.2: The Industrial Production Index and Copper Prices (1999-2008)
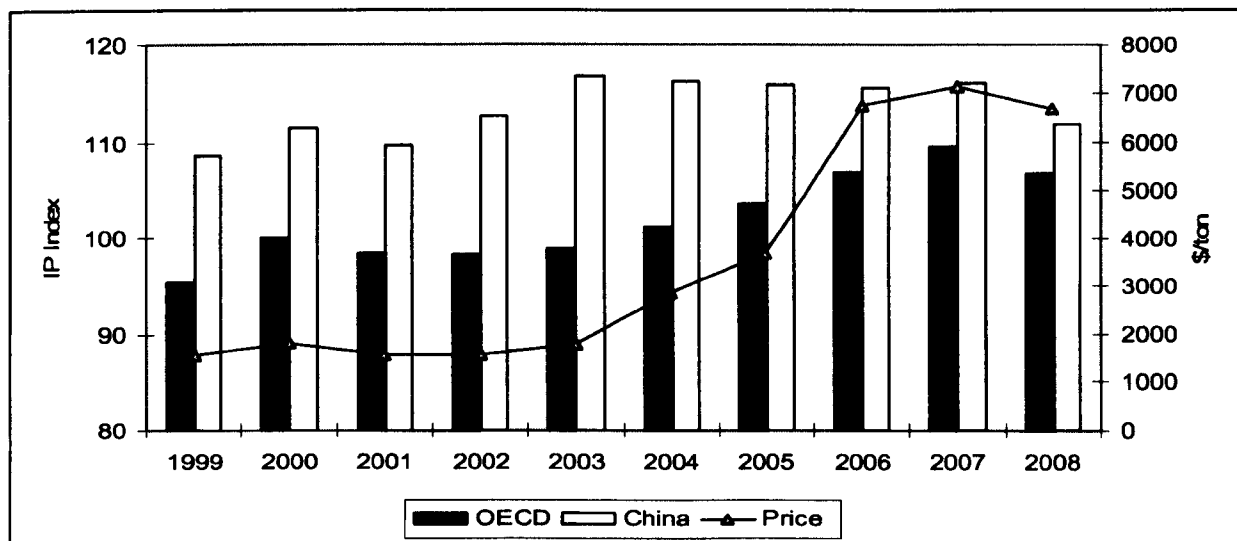
Source: Author's compilation from OECD and LME price data

Since the OECD economies have been the largest consumers of copper in the past decade, and their industrial production is used as a measure of metals demand, it follows that their IP index changes would be reflected in copper prices. The correlation between the OECD IP index and copper prices for the period 2000 to 2008 is very strong at 0.98. Financialisation of the commodity

markets gained strength post 2005, and the IP index experienced a slight weakening in the correlation after that time, dropping to 0.91 during 2005-08.

Stock Levels at the Commodity Exchange: The nature of metals supply allows producers and consumers to accumulate inventory of metals in order to meet their consumption needs in the case of the first, and stock accumulation in the case of the second. The LME has designated warehouses all across the world, where producers of metals may deposit their output. Producers of metals will tend to place their output in LME warehouses when they cannot find buyers for their products. Increasing LME stockpiles show supply to be greater than demand.

Depleting stockpiles on the other hand indicate consumers purchasing from the LME, suggesting their traditional suppliers are unable to meet their requirements. This would indicate demand rising ahead of supply. Thus, the LME stocks are considered to be a proxy for world markets; an increase in stock levels is an indication of a surplus market, while stock depletion is an indication of tightening markets. The correlation between the stock levels and prices is therefore a negative one.

Figure 6.3 shows the monthly Copper stocks and prices at the LME. In the period 2002 to 2004 inventory levels were high while copper prices were still low relative to the rest of the period. As the commodity demand gained strength stock levels were brought down to fuel demand. As stock levels fell during 2004-2008 copper prices tended to rise.

Figure 6.3: Monthly Average of LME Copper Inventory and Spot Prices (Jan. 2002 to Apr. 2009)
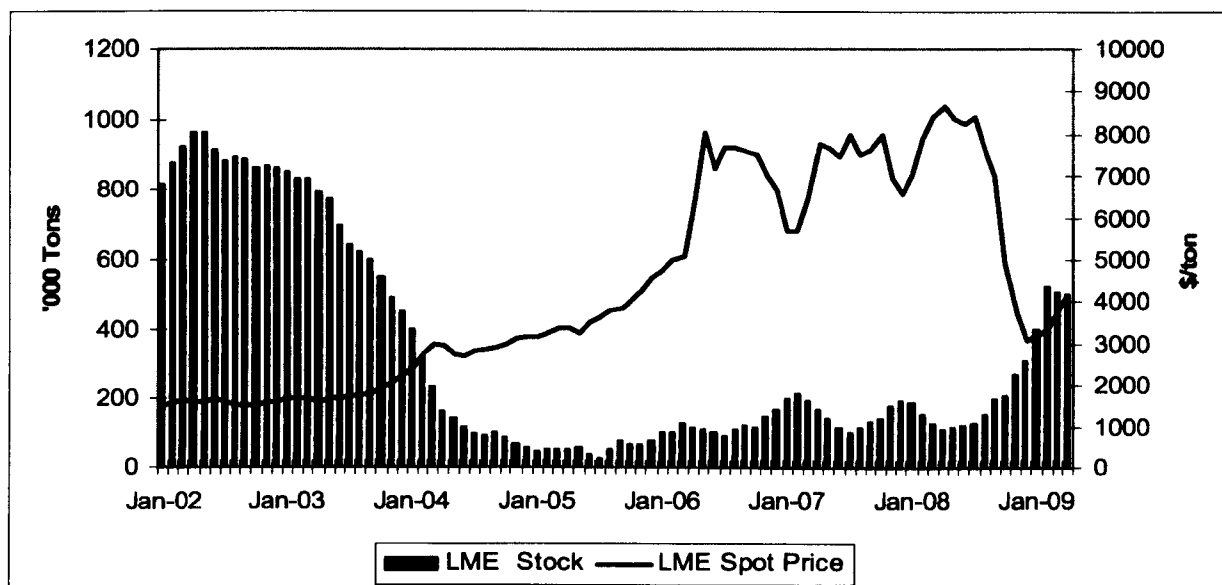
Source: Author's compilation from LME data

Given the approximation of LME inventories as world inventories, the correlation coefficient between the two for 2002-09 was strong at -0.66 (Table 6.2). However, when examined in the period before and after increased investor participation, we find very different results.

Table 6.2: Correlation Coefficients for Monthly LME Copper Price and Stocks (2002-2009)

Time Period	Correlation Coefficient
2002-2009	-0.66
2002-2004	-0.87
2005-2009	-0.15

Source: Author's calculations from LME data

The coefficient of correlation between 2002 and 2004 is -0.87, but falls heavily for the 2005-09 period to -0.15. Similar to the case of the IP index and price, we find weaker correlations being shown in the 2005-2009, period where greater investor activity in commodity markets was seen than before. This weakening can be interpreted by the 'Pinch Point' effect in the physical markets. This refers to the condition when stock levels fall below a certain consumption level and price becomes inelastic in response to changes in inventory level.

Figure 6.4 shows the monthly levels of copper stocks and prices for 2002-2009 at the LME. In the 2002-2004 period, copper stocks were falling gradually and hit low inventory levels at 200,000 tons. At this point, a further fall in inventory levels did not push up prices, as the pinch point had been reached and prices became unresponsive to deterioration in stock levels.

Figure 6.4: The Pinch Point for Monthly LME Copper Inventory Levels (Jan. 2002 to Apr. 2009)
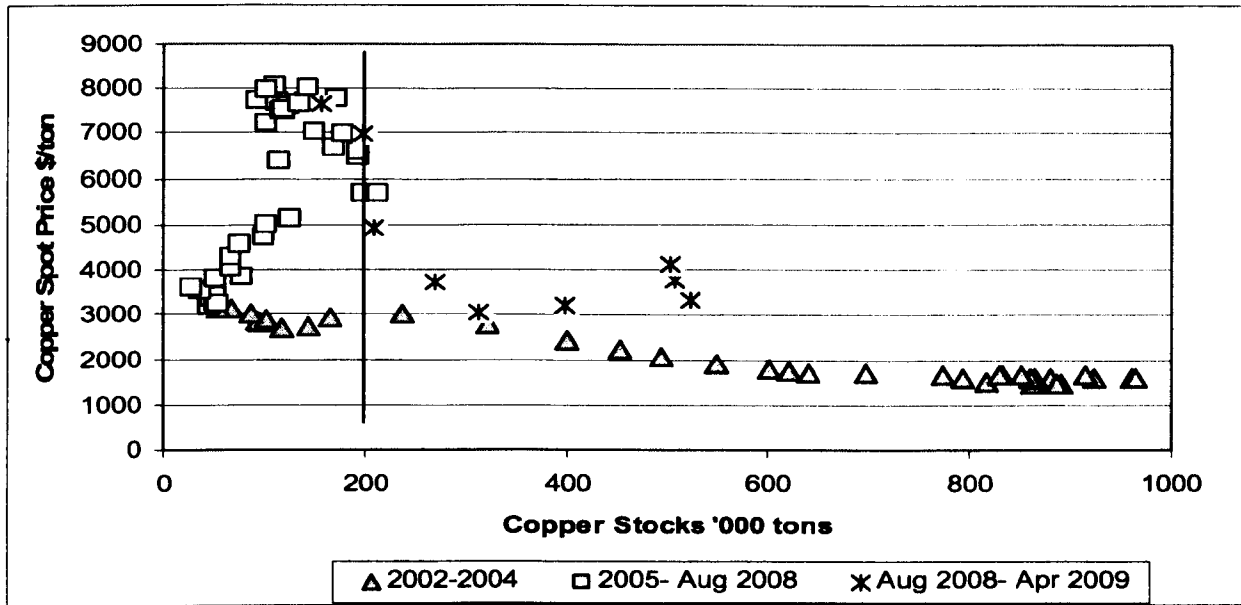
Source: Author's calculations from LME data

From 2005 to August 2008, when copper prices peaked, inventory levels tended to remain below the pinch point threshold. However, prices were considerably higher for the same level of inventory when compared to the previous period of 2002-2004. For example, in June 2004, the corresponding price level for stocks of 118,000 tons was $2,687/ton. In October 2006, the same levels of stock were priced at $ 7,500/ton.

In the period between January 2005 and August 2008 inventory levels reach the pinch point at 200,000 tons, and the monthly price levels cluster between the $6000 and $ 8000/ ton mark. For the period 2002-2004 this price level for the same inventory level was around the $ 3000/ton mark. In both cases, prices have become inelastic to changes in inventory at low levels, but the price level is much higher in the period of active investor participation (2005-2008) as compared to before

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(2002-2004). The 'pinch point' has moved to a higher price level in a period of increased investor activity, suggesting that increasing liquidity has had some contribution to price increases.

The data points for August 2008 to April 2009 are too few to establish a clear trend: However, even as stock levels increase, the price experienced in this period was higher than that for similar stock levels in 2002-04. There are many reasons behind the increase in price levels, including the higher costs of production discussed in Chapter 5. Although more time must pass before we can make a more informed judgment in this regard, the existing data does show that even though prices have fallen in the past six months, they have remained higher than their pre 2003-2008 commodity boom levels. The significance of this is discussed in the next chapter.

The US Dollar Index: A key financial variable impacting commodity prices has been the value of the US dollar. All international commodity prices are quoted in US dollars while production costs are dependent on the currency of the country of production. Therefore, any changes in the value of the dollar would instantly affect the revenue stream of producers. Traditionally, there has been an inverse relationship between the US dollar index and commodity prices, shown in Figure 6.5. In recent years this has begun to change.

Figure 6.5: The US Dollar Index and Copper Prices (1995-2009)
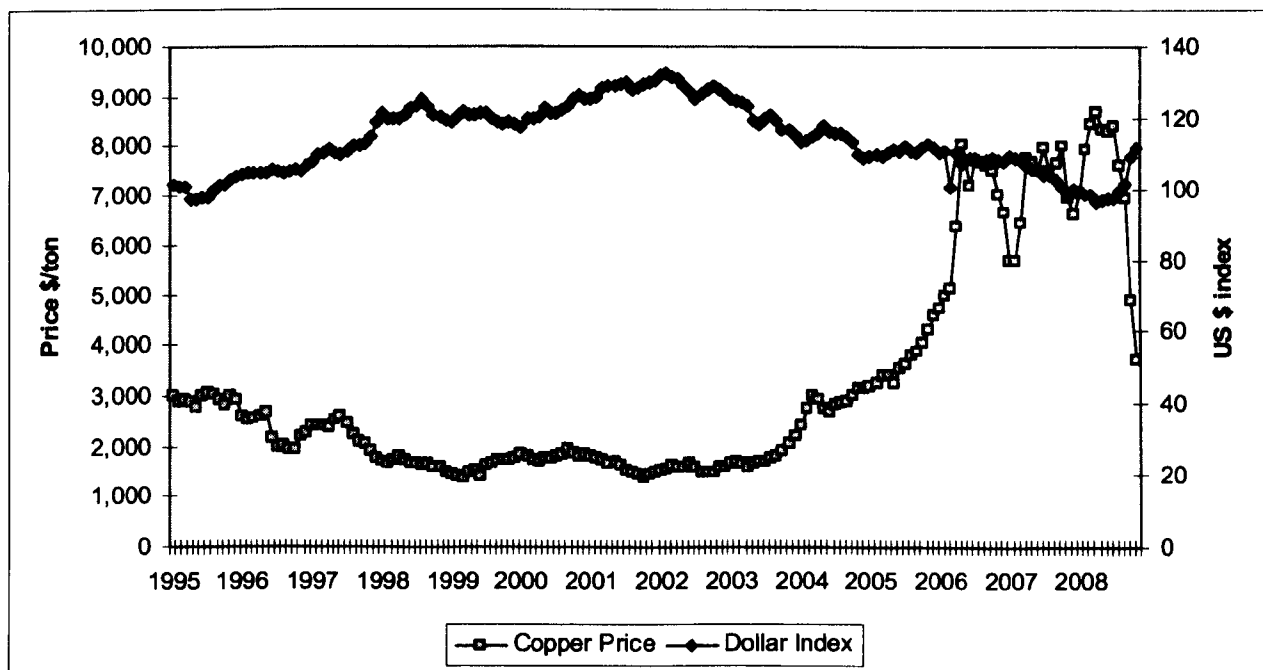
Source: Author's calculations from LME copper prices and FRB Atlanta data.

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The LME, which is based in London, also quotes all prices in US dollars. Once the 'value of metal' has been determined in the markets, the dollar denominated price of metals will be set, taking into account the value of the currency itself. Changes in the value of the dollar will impact commodity prices. If the dollar depreciates with respect to other countries, non-dollar countries will find metals to be cheaper since they are paying less in their domestic currency for the dollars that are used to buy the metals. Similarly, in case of the dollar appreciating, metals become more expensive as more domestic currency is required to purchase the dollars to pay for these metals.

From 1995 to 2003, a negative correlation exists between copper prices and the dollar index. As the dollar looses value, copper prices increase as producers and consumers will compensate for changes due to the value of the currency on the fundamental value of the physical product. Post 2003, especially in the 2005 to 2008 period, with increasing copper prices and volatility, the dollar index appears to have little or no impact on prices.

The correlation between the US dollar Index and LME copper prices for the 2000-2008 period was -0.88, which is as expected. However, as Table 6.3 shows, the 2005-2008 period shows a weaker correlation (-0.72) between the two when compared to the period before.

Table 6.3: Correlation Coefficients for Monthly US Dollar Index and LME Copper Prices (2002-2009)

Time Period	Correlation Coefficient
2000-2008	-0.88
2000-2004	-0.84
2005-2008	-0.72

Source: Author's calculations from LME and FRB Atlanta data

Again the weakening of the relationship indicates that the traditional determinants of price valuation, although still existent and significant, were now accounting for less of the valuation process. There were new factors influencing price related to increased investor activity.

SECTION 2 INVESTOR BEHAVIOUR AND THE COMMODITY BOOM

Traditionally the commodity markets were considered an 'alternative' investment to main stream financial markets such as the stock exchange, oil and gold futures and government bonds. Developments in traditional financial markets indicators were 'transmitted' to commodity markets by financial traders responding to changes in interest rates, treasury rates and stock market performance. Investors looking to hedge against inflation, loss or uncertainty in other markets would also turn to commodity contracts.

Commodity investments profit from three major benefits as opposed to stocks and bonds. There is a positive correlation between inflation and commodity indices, therefore the latter serve as a hedge against inflation (UNCTAD, 1996). In relation to other commodity linked equity investments, such as investing in stocks of commodity producing companies, commodity futures trading provides an uncorrelated return. Kazemi *et al.* (2008) find only moderate correlation between direct investments into equity securities in particular commodity sectors (such as the S&P energy and oil index) and commodity indices (such as the GSCI). They also find that between 1991 and 2007, commodity indices performed well on average in periods when the S&P 500 was showing its worst performance. In the 2001 to 2007 period, portfolios that contained commodities had the highest Sharp Ratios, i.e. their reward to risk ratios. Such observations are confirmed by other studies (Rogers, 2004; Lewis, 2005; CISDM, 2006; Domanski and Heath, 2007).

Returns on Commodities: The increased popularity of commodity assets lies in the returns they have generated in relation to other financial markets. As returns from commodities grew, more investments were attracted to the sector. Between 1990 and 2007, (Table 6.4) the annual returns in the commodity sectors were very close to those generated in the stock market, with the GSCI returning 10.8% to the S&P 500's[82] 11.7% and above that of the bonds sector (7.4%) shown by The Lehman Brothers United States Aggregate index. Overall, inflation was also much lower at 2.8%[83], further confirming the real value of the high returns witnessed in the commodities sector.

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[82] The Standard and Poor's 500 Index tracks the largest companies on the United States stock markets
[83] Figures for the United States economy

Table 6.4: Average Annual Returns to Commodities and Other Investments (1990-2007)

Index	% Return
GSCI	10.8
S&P 500	11.7
Lehman Brothers US Agg. Index	7.4
Inflation (CPI)	2.8

Source: Author's compilation from Lehman Brothers, Standard and Poor's and Bloomberg.

The returns from the commodity sector were robust in relation to those being generated in other financial markets, but they were not simply a result of strong performance in the stock markets spilling over to 'alternative' commodity investments.

With rising commodity prices post 2003, the sector has begun to attract increased investors and investments (Domanski and Heath, 2007). The interest in commodities as 'alternative' investment began to change and they emerged as an asset class of their own. The increase from the financial side of the commodity markets can be evaluated by the trading strategies of investors, as well as the level of liquidity they have brought to commodity markets. We examine the relation between these variables and commodity prices before, during and after the commodity boom in 2003-2008.

6.5 Efficient Market Hypothesis

The major neo classical theory that accounts for investor behaviour in commodity markets is the Efficient Market Hypothesis (EMH). The EMH argues that when there is a valuable commodity to be traded, buyers and sellers will come to form a 'market' that will allow them to exchange information, and therefore cut down on wasteful resources that result from incorrect information (Bachelier, 1900; Samuelson, 1965). The Samuelson Effect (1965, 1976), suggests that futures prices become less volatile the further the maturity date of a contract. Information released today will have little affect on future prices in contracts that are further away than it would have on future prices of contracts close to their maturity dates. Anderson and Danthine (1983) further add that volatility will depend on the level of uncertainty that has been resolved through new information. The larger the uncertainty left as the maturity date for a contract arrives, the more volatile the prices will be. The

EMH proposes that since the markets are efficient, speculative activity will not have an impact on price as any deviation from fundamentals will be balanced by the other investors. However, the validity of the EMH has been challenged by a number of authors (Hirschleifer, 2001; Barberis and Thaler, 2003; Van der Saar, 2004).

The increasing complexity of financial investment in commodities has to some degree impacted the relationships between the traditional variables, as seen in Section 1. Southwood (2008) argues that the increasing complexity of investment strategies changed the price discovery mechanism in the exchange. In the case of aluminium, in 1978-1982, price discovery was largely dependent on the performance of fundamentals in the previous quarter. As information flows began to improve, the 1983-1987 period saw price discovery concentrate more and more on the current quarters expected fundamentals. However by 1988-1993 the estimates of future quarter's fundamentals became more important than current performance. By 1994-2003, forecasting tools had become complex enough to look at fundamentals 6 to 9 months in advance. In the current investment climate (2004-2008), price discovery has begun to rely on multifaceted information.

Informed Traders and Uninformed Traders: Investors can be divided into Informed and the un-informed trader with different levels of access to information. The former, also known as fundamental traders have greater access and will be spending resources in developing their research and analysis activities. The latter, also known as noise traders, tend to follow simple rules, if the market goes up they invest, and vice versa. Grossman and Stieglitz (1980) argue that due to the cost of accessing information, prices of goods do not always reflect all the information available. If access to information comes at a cost, and buyers of this information are able to benefit from it in markets (due to a variety of reasons) there is a rationale for them to continue to pay for this information. If the information is equally available to all, then little or no scope will be left for capital gains, and therefore would not interest investors.

Reitz and Westerhoff (2006) model investor speculation and the effect on prices, based on whether investors use a 'trend-extrapolating chartist' model or a 'fundamental analysis' model. The 'trend extrapolating chartists' will assume that prices will tend to follow a given historical trend. Therefore,

if prices increase (decrease) these speculators will tend to buy (sell) commodities. The 'fundamental analysis' approach assumes that prices will converge towards their long run equilibrium, and if prices are assumed to be under or over valued, these speculators will respectively buy and sell in the commodity markets. The former is assumed to be less stabilising, while the latter approach carries more mean reversion potential and is more stabilising.

Westerhoff and Wieland (2004) find that the role of the speculators can be both stabilising and destabilising, depending on the market conditions, and hence tend to produce some of the erratic bull and bear markets that are seen in commodities. When price is close to fundamentals, the chartist model tends to be popular and investors focus on trends. But this drives prices away from the fundamentals. As the price moves further away from fundamentals, the market 'consolidates' its position. Using a fundamental model, drives prices back towards the physical market balance.

When prices return close to fundamentals, investors switch back to chartist models and the cycle repeats itself. This tends to produce the erratic bull or bear markets seen in commodity markets. Using monthly data for six commodities (two hard, four soft) Reitz and Westerhoff (2006) find the influence of the two types of speculators does not seem to be consistent over time. 'If the price is close to its fundamentals value, the market impact of fundamentals is relatively low. In such a situation, the presence of destabilising chartists and/or random shocks may cause a new (temporary) bull or bear market' (2004). Furthermore, a single investor may apply both technical and fundamental trading techniques, at various points in the market (Hommes, 2001).

Mayer (2009) suggests that even informed traders, who have access to information on current and future market fundamentals rely on limited market indicators. They tend to focus on a small number of indicators, usually using similar pricing models. This tends to exaggerate herd behaviour and a focus on past price movements. Noise traders, or uninformed traders, are likely to make changes in their strategies at idiosyncratic times and irrespective of the market indicators. Menkhoff and Schmidt (2005) also argue that managed fund traders tend to be more aggressive than institutional investors, and will consider non-fundamentals information while trading in commodity markets.

Passive Trading Strategies: Other investors do not rely on price signals alone, and their trading strategies are driven by other advantages of commodities investments. These include commodity futures ability to act as an effective hedge against inflation, low correlation to other asset markets and portfolio risk diversification. Passive trading strategies are carried out by large institutional investors who will earmark a share of their capital to be invested in commodities regardless of price. The investment in GSCI and AIG indices are examples of such passive strategies.

A passive strategy works on the principle of 'rolling over' or maintaining a 'long only' position in commodity contracts. 'Long only' refers to being the purchasers of contracts rather than the sellers. The 'Rollover' process is when banks/firms purchase future contracts for commodities when the maturity date of the first contract nears. The banks will 'rollover' their contracts, i.e. transfer a contract that is near to expiry into the next contract period. This involves selling the current contract and purchasing a similar number of contracts for the next period. Thus, an institution continuously rolls over its purchase into the next period, repeating the process when the purchased contracts near maturity. In the long term, it is always holding contracts rather than making them available for sale. Such Buy and Hold strategies tend to be more risk averse and tend to follow a bench mark evaluation of prices (Menkhoff and Schmidt, 2005).

6.6 The Weight of Money Argument

Financial markets tend to respond much more quickly to price signals, while physical demand and supply tends to be inelastic in the short term for commodities. Although liquidity in commodity exchanges can help with transactions, too much liquidity can actually dampen price signals. The 'weight of money' in commodity related exchanges allows for the possibility of speculative bubbles to appear in commodity prices, as the financials generate demand and supply signals that do not support price discovery in the physical markets (Mayer, 2009).

The growing recognition of commodities as an asset class, accompanied by increasing investor participation, and financial tools dealing with commodities has led to an influx of money into commodity exchanges. The IFSL Commodities Report (2008) estimates that between 2003 and 2007, trading in OTC commodity derivatives increased by 530%, while exchange trading increased

by 213%. In contrast, physical exports of commodities increased by only 17%. The Bank for International Settlements estimates that value of OTC commodity derivatives was $6.4 trillion in mid 2006 (Domanski and Heath, 2007).

The exact level of liquidity however is difficult to pinpoint, as most actors are not required by regulation to declare their investment levels. Furthermore, the term 'commodity' tends to cover metals, energy products, agricultural products as well as precious metals, and it is difficult to distinguish which sub sector of the commodity market has received most investment. Given these limitations Table 6.5 is constructed to illustrate, to some degree, the magnitude of liquidity in the commodity markets. The table is not a complete representation of liquidity in commodity markets as some investments are not publicly declared, while producer and consumers, who invest to protect against price risk, are also not included. Furthermore, there will be a tendency for some of the categories to overlap. For example, hedge funds may use OTC derivatives to expose funds to commodities.

Table 6.5: Investments in Commodities through Various Vehicles ($ Billion) (1998-2007)

Year	1998	2000	2003	2005	2006	2007
OTC derivatives [1]	408	662	1,406	5,434	7,115	8,998
Global derivatives exchange trading [2]	7,806	4,160	2,833	2,800	4,400	4,300
Sovereign Wealth Funds [3]	1,154	1,188	1,408	1,617	1,836	2,100
Managed Funds (assets exposed to Commodities)[4]	540	660	1,020	1,410	1,440	-
Commodity Trading Advisor Funds [4]	40	40	90	130	140	-
Capital Investment Commodity Indices [5]	-	10	25	80	105	145
LME Contract Turnover [6]				4,500	8,050	9,500
1. Bank of International Settlements						
2. Futures Industry Association, United States						
3. IFSL estimates						
4. Touradji Capital Management Presentation March 2007						
5. Societe Generale						
6. The Ringsider 2008 (LME)						

Source: Author's calculations from various sources; IFSL reports, LME and Investor presentations

Despite these problems of transparency, it is clear that the liquidity in commodity exchanges has increased dramatically since 2000, with sharp increases being seen post 2003. The average annual increase in the OTC and Commodity Index markets was 78% and 50% respectively between 2003 and 2007. The LME saw contract turnover value double between 2005 and 2007 from $4,500 bn to $9,500 bn. Although the physical side of metals has seen increased production, the level of liquidity has increased much faster, leading to the old problem of too much money chasing too few goods.

6.7 Before and During the Commodity Boom

Before the emergence of the commodity price boom in late 2003, investor interest in commodity markets was limited. Commodity markets were considered important for risk diversification and hedging purposes. Most of the investment vehicles that we have discussed in the previous section are relatively new creations, and did not exist before the 1990s. As commodities became more popular, it led to a larger number of financial instruments that allowed investment directly or indirectly in commodities and hence encouraged rising liquidity. Higher liquidity also encouraged larger institutions to invest in the market, as they could now move in and out of contracts with ease given the larger number of actors in the sector.

The number of investors and the level of liquidity increased further as the price boom continued. Chapters four and five have shown that the fundamentals behind the commodity boom were strong, and a demand pull/supply push impact on prices played a pivotal role in the price boom. We argue that with a strong price movement from the fundamental side, the increase in investor activity accentuated the price movement, and was not a cause of the boom itself. However, given the role of investors in commodity markets, they must be considered as an important variable in commodity price determination.

Figure 6.6 shows the futures and options contracts that were traded on commodity exchanges for the past two decades. The number of contracts is a proxy for investor participation, and indicates the volume of trade rather than value. For the 1990s and early 2000s, investor activity was fairly stable. The increase in contracts were only marginal in 2003, but accelerated very quickly post 2005. This is the same time period, as the one of weakening relation between price and

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fundamental determinants such as inventory levels and the US dollar index, discussed in section one. Furthermore, although there is a dip in contracts towards the end of 2008, we see a return in volume as 2009 progresses.

Figure 6.6: Futures and Options Contracts Outstanding on Commodity Exchanges (Millions of Contracts) (Dec. 1993 to March 2009)
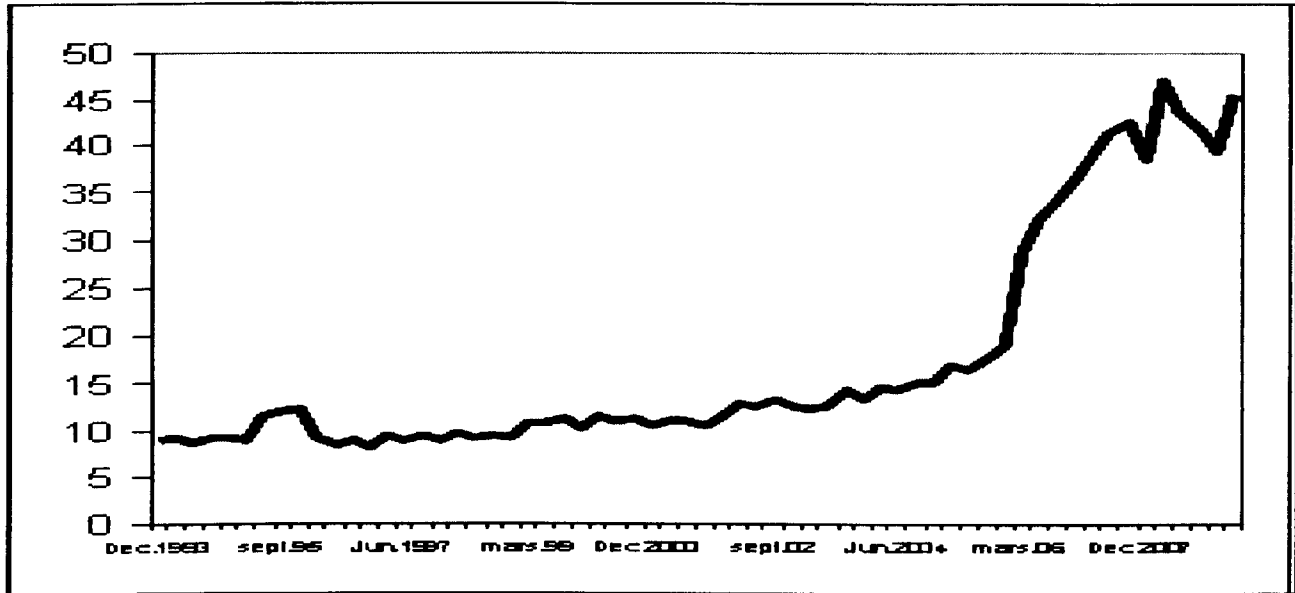
Source: Mayer (2009)

Given the increase in volume of interest, the value of capital entering commodity markets has also increased. Figure 6.7 indicates that assets exposed to commodities by investors were below $200 bn for most of the 1990s and early 2000s.

Increased liquidity has resulted from a number of different sources, such as the small and medium hedge funds, as well as the larger institutional investors such as pension funds and banks. Corresponding to the increase in commodity prices in 2003, the value of assets exposed to commodities began to rise and by 2005 had doubled in value. Commodity index funds have been growing, but the Hedge Funds remain the largest investors[84].

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[84] This may appear to contradict information in previous sections where Commodity Index Funds were shown as the largest investors. The discrepancy arises as both data sets are estimates based on consultant calculations and no data base exists where investors report their exposure.

Figure 6.7: Total Assets Under Management Exposed to Commodities (1993-2006)
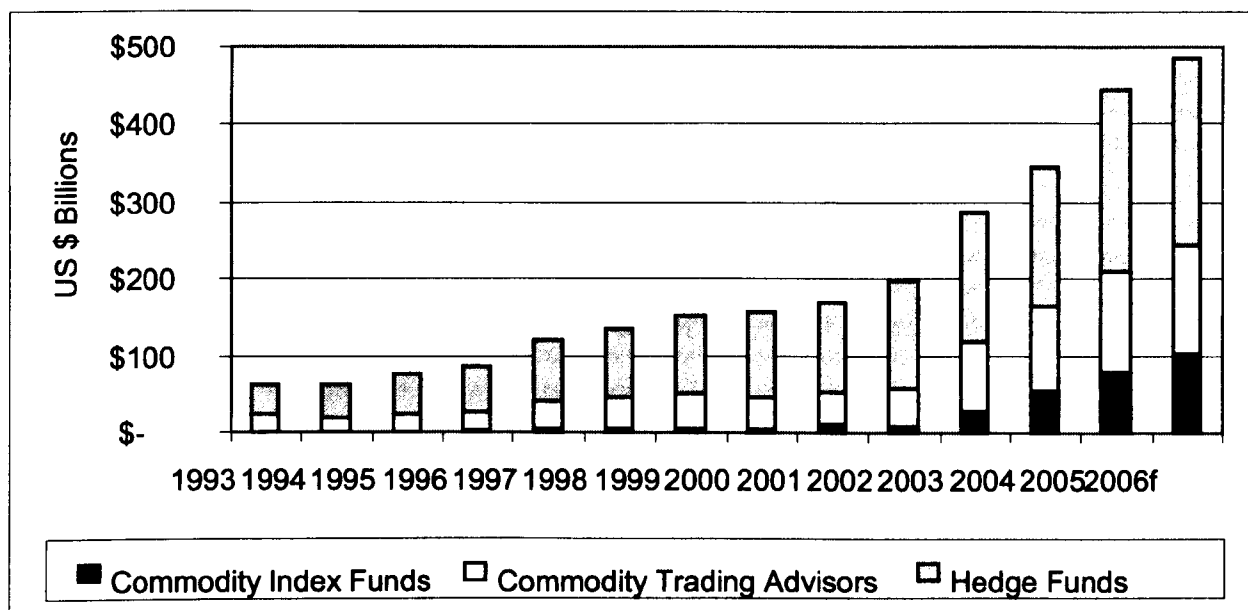
Source: Brown (2006)

A number of metal investor consultants believe that a large portion of these assets are thought to be of speculative interest alone, but data does not allow us to confirm this. Brown (2006) estimates that in 2006, almost 40% of the investment in nickel was held by speculative interests. Williamson (2007) estimates that speculative investment in commodities was near $50 bn in 2007, with a near equal proportion coming from small to medium scale investors such as commodity trading advisors (36%) and hedge funds (37%). The large scale institutions contribution to the speculative pool was lower at 27%.

Although it would be simple to draw a link between the increase in volume and value of investor participation and the increase in commodity prices, the result would be flawed. One element, whether it is demand, supply or financialisation, will rarely account for the increase in commodity prices. Several factors converge to produce the price increase.

To be able to delineate the 'investor' element from the 'fundamental' element in the price increase is hampered by lack of data. Exchanges and investors do not distinguish between investor, or fundamental buyers and seller of contracts, nor do they list the actual value of funds committed to commodity markets. Investors do take into account movements in fundamentals, and their

behaviour also reflects the physical side of the market. Therefore, at this stage we can be confident in saying that investors have an influence on prices, but not to what extent and magnitude.

6.8 After the Financial Crisis

The financial crisis towards the end of 2008 in some ways is helpful in illuminating the role of commodity investors in price determination. The financial crisis unfolded in September 2008, with the crash of one of the largest financial institutions in the United States, Lehman Brothers. This triggered a wave of bailouts for a number of financial institutions both in the United States and Europe. In the latter half of 2008, capital was wiped out for a large number of banks and investment firms, and the very liquid financial markets of the 2000s became highly illiquid. The 'credit crisis' emerged with very few institutions willing to lend to either clients or each other and governments had to step in to increase liquidity.

The impact of the credit crisis on investors in commodity markets is three fold. First, the amount of credit pool available to these investors to fund their trade in commodity related investments decreased dramatically. Secondly, faced with uncertainty as to when economic recovery will begin, investors moved their capital to safer assets such as gold and government bonds. Thirdly, a number of investors, especially in the Hedge Fund industry, were forced to liquidate positions, to meet client demands. For a period, from October 2008 to June 2009, we therefore have a glimpse of commodity markets with reduced investor activity. The behaviour of commodity prices in this period allows us to make some comments of the impact of investors on price.

Table 6.6 shows the movement of commodity prices from June 2008 to May 2009. The sharp acceleration in the fall of prices in August 2008, with the largest falls seen in October 2008, cannot all be attributed to the fundamentals. Between August 2008 and December 2008, the price index on average fell by 15% a month. Although the United States was in recession, the global economy was not. Contraction in Europe and elsewhere was not considered a risk until towards the end of 2008. Therefore, the sharp fall in prices cannot be accounted for by the fundamentals only, and is more likely the result of investors rapidly liquidating investments in commodity markets.

Table 6.6: Percentage Change in Monthly IMF All Commodities Price Index (June 2008 to May 2009)

Time	IMF Index		% Change MoM	
	All Primary Commodities	Metals	All Primary Commodities	Metals
Jun-2008	215	186		
Jul-2008	219	188	2%	1%
Aug-2008	195	175	-11%	-7%
Sep-2008	176	164	-10%	-6%
Oct-2008	139	131	-21%	-20%
Nov-2008	115	116	-17%	-12%
Dec-2008	98	103	-15%	-11%
Jan-2009	102	104	4%	1%
Feb-2009	97	101	-4%	-3%
Mar-2009	100	104	3%	3%
Apr-2009	104	113	4%	8%
May-2009	114	118	10%	4%

Source: Author's calculations from IMF Statistics, accessed July 2009

The immediate fallout of the lack of liquidity impacted investor trading commodities, especially those based outside of exchanges such as the OTCs market. A number of contracts have been moved to exchanges, where a clearing house guarantees the contract will be honoured and provides safeguards against bankruptcy of the opposing contract holder. This has also contributed to a rise in exchange stocks. LME reports an increase of 45% in contract turnover in October 2008 over September 2007, as new business contracts were generated due to the influx of bilateral contracts being converted into exchange contracts.

Financial institutions such as Goldman Sachs, and Morgan Stanley were large players in commodity markets. Their lack of liquidity and change in portfolio holding has also led to liquidity constraints in commodity markets. It is only recently (April 2009) that Goldman Sachs switched its ratings for commodities from 'under weight to 'neutral' as opposed to 'over weight' during the commodity boom. Since a number of investors track the Goldman Sachs commodity index, their

increase in valuation of commodity markets is likely to increase other investor participation in the sector as well.

As investors re-engineer their trading strategies, one aspect has been the move from passive commodity indices to more active investment vehicles. Exchange Trade Funds (ETFs) which were relatively less popular than commodity indices during the boom years, have now become more popular. Barclays Capital estimates that by the end of January 2009, commodity related ETFs had $51.9 bn assets under management as compared to the $56.4 bn in Commodity Indices such as the S&P-GSCI and DJ-AIG. Others estimate the ETFs will double their assets in commodities in a year to more than $100 bn. The flexibility offered by the ETFs is much more attractive in the current climate than passive index funds, thus attracting a larger number of investors. In essence, this signifies a change in the vehicle of investment and not the withdrawal of investors from commodity markets overall. It remain to be seen what impact these ETFs with more active investment strategies will have on commodity prices (The Financial Times 18th Feb. 2009).

At the time of writing, indicators are emerging that economic recovery is near or has begun. There are still wide day-to-day fluctuations in stock markets and commodity prices in reaction to new information. This makes the task of offering a comprehensive analysis of the aftermath of the financial crisis difficult. However, it is clear that as investors gain confidence in global financial markets again, they are returning to commodities as well.

SECTION 3 FINANCIALISATION AND THE IMPACT ON COMMODITY PRICES

The fact that there is increased investor interest in the commodity markets cannot be denied, but what is its impact on price volatility? In examining arguments for and against speculative interests, Antoshin and Samiei (2006) suggest that evidence has shown correlation rather than causality. Investor activity could lead to accentuation of price movement, but also provide necessary liquidity to the markets. They conclude that there is little evidence of causality between speculative activity and price levels, and the evidence that exist points to causality running in the other direction i.e. from price levels to speculative activity.

Buckley (1996) argues that depending on the trading strategy of the investor and the condition of the markets, they can have a smoothing effect or increase volatility of prices. If investors 'anticipate' trend changes based on fundamentals information, they can smoothen the price process. However, if a number of funds act towards moving prices away from fundamentals, especially in tight physical market conditions, they will increase price volatility.

Without detailed information on trading strategies, it is difficult to assess which sides of the 'trade' investors are on. If there is a near equal distribution of investors on both sides of the trade, i.e. those expecting prices to increase in relation to those expecting prices to decrease, the impact on price will be limited. If a larger number of investors take one side of the trade, price fluctuations will be more volatile.

The increased liquidity in the commodity exchange has brought its own risks. The nature of demand generated by investors tends to be on the same side of the market, hence they may actually push price away from fundamentals rather than help balance the market. Furthermore, as hedge and pension funds look for newer strategies to increase returns from this sector, they may generate physical demand for commodities. Williamson (2007) estimates, that given the weightings assigned to copper in various index funds, an investment of $6.32 bn in 2006-07 accounted for 795 kilo tons. of copper, nearly 28% of refined global copper stocks at that time.

6.9 The Fundamentals vs. The Financials In Commodity Markets

The main issue with investors taking the same side of the trade is that it results in distortion of price signals. An increase in price of metals indicates demand exceeds supply, and will encourage producers to increase their output while consumers will find ways of reducing their consumption. If prices rise high enough and fast enough, demand destruction to some extent will also take place.

As opposed to the fundamental side, an increase in the price of metals encourages investors to demand more contracts for metals rather than less. That is, price changes in speculative markets become self-reinforcing both upwards (2005 to mid 2008) and then downwards (post July 2008). They view an increase in price as higher demand for the paper asset rather than consider the

physical commodity. Given that contracts have to be backed up by actually physical product, an increase in demand for contracts will increase the demand for metals. This runs counter intuitive to the fundamentals of the markets.

Here lies the tension between the 'traditional' users of the commodity exchange and the 'new' actors. With the advent of investors who react rather differently to an increase in price, the equilibrium between the two markets shifts over or under the price dictated by fundamentals. Where producers and consumers have both retracted future contracts demand due to the high spot price, investors will have actually increased demand for future contracts. Authers (2008) summarises the impact of such activity:

> The natural state of the commodity futures is "backwardation"- their prices are below the expected spot price for the underlining commodity. This makes sense because they grew up as a form of insurance. [...] The entry of investment should have brought this *(future price)* into balance, but instead, the flow of money was so powerful that commodities moved into "contangos"- where prices are higher than the expected spot price. This entailed changes on the ground, as it encouraged producers to accumulate large inventories...demonstrating that the entry of large and liquid investments into the sector had the ability to cause market prices to diverge from the levels predicted by fundamentals.

The two markets, physical and the financial, react in opposite directions in tight markets with rising prices. When faced with higher prices, expected to continue in the future, metal consumers prefer to buy on the spot at the exchange and accumulate their own inventories. Metal producers prefer to sell their output if the spot price is high and do not accumulate inventories at stock exchanges. Where a price rise indicates to producers and consumers to take their stocks off the exchange, it brings higher demand pressures into the exchange from the investors who demand more contracts when prices are high.

The futures price in commodity exchanges is anchored to the physical markets through the long run marginal cost of production and the level of inventories (Domanski and Heath, 2007). Even if short

term prices fluctuate from these, given the arbitrage opportunities between the physical and financial markets, the situation should not remain for long. However, our simple correlations in Section 1 indicated that for almost a two year period (2005-2007) the relations between the physical anchors and price was substantially weakened.

Commodity specialists estimate the impact of investor trading on prices has changed in the past few years. Table 6.7 shows estimates from CRU Metals, a leading commodity trader, on the estimated impact of investors on the price of aluminium in the past few years.

Table 6.7: Impact of Commodity Investors and Fundamentals on Aluminium Price (All values in $) (2006-2008)

	2006	2007	2008	2008	2008
	May	Sept.	March	July	Sept. est.
Market Price Factors					
Commodity Trading Advisors	150	-115	50	50	-75
Hedge Funds	250	-150	100	75	-50
Indices	190	255	140	150	100
Fund Influence	**590**	**-10**	**290**	**275**	**-25**
Industry Factors					
Weak US $	180	300	380	445	375
Energy Prices	290	335	480	620	450
Supply/Demand/ Inventory	1865	1825	1900	1800	1700
Fundamentals	**2335**	**2460**	**2760**	**2865**	**2525**
3 month LME Price in $/mt	**2925**	**2450**	**3050**	**3140**	**2500**

Source: Southwood (2008)

Table 6.7 separates the estimated impact of financial factors and market fundamentals on the price of aluminium at the LME. In May 2006, at the $2,925/mt LME price, $590 of the total price was accounted for by financial investors or market price factors, which were higher than that predicted by market fundamentals. A negative investment in aluminium by the financial markets in September 2007 was responsible for the price dropping below what market fundamentals predicted. This pattern continues for the remaining three contract periods as well. Table 6.7 illustrates the impact

that financial activity has on metal prices, often overshooting or under performing fundamental price levels.

The post 2003 influx of investors in commodity markets may be considered 'friendly' to supply and demand fundamentals on the grounds that they provide liquidity. Liquidity helps to ensure that when buyers are looking for sellers of futures contracts, there are actors to take the opposing contract. However, if the pressure generated from these investments is unidirectional, for example, most hedge funds taking the same side in the market, this increased liquidity may prove damaging. George Soros, the billionaire investor, in testimony to the United States Congress in 2008, stated his firm belief that institutional investors, using commodity indices, were exaggerating price rises in the sector[85].

A large number of investors also bring market depth. Coupled with increasing liquidity, these factors should allow for lower price volatility. Despite the anecdotal evidence of speculative activity contributing to volatility, no firm empirical evidence has been established in this regard. However, this may as much be a result of lack of data rather than the absence of the fact. Volatility refers to both the amplitude of price change and the frequency of this change. Cashin and McDermott (2002) report that since the collapse of the Bretton Woods system in the 1970s, which was accompanied by greater freedom in financial markets, price volatility has increased due to increase in frequency of price movements as compared to increase in amplitude. Figurola-Ferretti and Gilbert (2001) and Slade (1991) argue that metals price volatility increased in the 1980s, relative to the 1970s as most metals moved from producer pricing to being exchange traded.

Contrastingly, Lees (2009) in examining price volatility in exchange traded metals as opposed to non-exchange traded metals, concludes that although both sectors saw volatile prices, the exchange traded metals were relatively less volatile in terms of amplitude. Between January 2006 and January 2009, LME traded metals (copper, aluminium and zinc) experienced price volatility between a 100 and 200% of their January 2006 prices. Non-exchange traded metals (cobalt, iron ore and ferro-chrome) experienced price volatility between 250 to 450% in the same period.

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[85] The Financial Times 8th July 2008

Whether investor participation has increased frequency of price cycles, as opposed to increasing the amplitude of price volatility is an important issue. Large fluctuations can be more damaging to developing country export revenues, as opposed to smaller more frequent fluctuations. This issue is discussed in Chapter 7.

6.10 Conclusion

This chapter outlined the traditional price setting mechanisms for commodity markets, and we are now ready to answer our third research question: *What role has the financialisation of commodity markets played in the determination of metal prices?* An increase in financial actors and tools that now have access to commodity exchanges and commodity related derivatives has led to an increase in liquidity within commodity markets. The use of commodities as an asset class in addition to their hedging or diversification role means that commodities now attract major investments from individuals and institutions. Our discussion on the financial actors has led us to conclude that the increased liquidity has led to accentuation of price swings, both upwards and downwards.

The disruption to price discovery in exchanges comes from two main sources, the first was the changing relationship between the traditional variables as investment activity increased over 2005-2007 in comparison to the 2002-2004 period. The second was the introduction of new investors leading to tension between the physical markets and the investor's response to price increases, generating higher demand pressures on price.

Given the limitations to data related to investor activity in the public domain, it is difficult to pinpoint the degree to which investors have caused prices to over or under shoot from the fundamental markets.

The major factor driving the disruption of price setting mechanism from its traditional format is the use of commodities as assets. When commodities become assets of their own, the traditional demand and supply forces with investors as the transmission mechanisms is challenged. An increasing number of actors are no longer comparing commodity price to commodity fundamentals,

but commodity returns to returns in other assets. This signifies that trading strategies in commodities take on a more main-stream asset focus rather than a physical market focus. Increase in prices no longer signify a demand for physical metal, but also an increasing demand for metal as an asset. Higher prices result in higher returns, encouraging further investments into commodities. This would accentuate the upward swing in commodity prices.

However, the same mechanism will accentuate the downward price movement. As the financial crisis began to take hold, the ability of investors to participate in commodity markets was curtailed. Commodity prices in the immediate aftermath of the Lehman Brothers collapse, fell much faster than fundamentals could have dictated.

With the financial crisis and the subsequent credit crunch, the flow of money out of commodity prices initially pushed prices below the marginal cost of production. By June 2009, commodity prices have begun to regain momentum, although they remain well below their peak levels at the height of the boom. The continued interest of financial actors in commodity markets indicates that they will continue to play a role in the future prices setting, and therefore must be considered when examining price behaviour of commodities.

The financial side of the commodity markets has expanded far more steadily than the physical side of the market. This has disrupted the traditional mechanisms for price discovery at the exchange and investment strategies now have an impact on international commodity prices.

REVISITING COMMODITIES IN DEVELOPMENT

'Anyone who claims to understand economic development completely, or to have found 'the' key to 'the' secret of economic growth, is likely to be a fool or a charlatan or both' [86].

In September 2008, the commodity price boom appeared to be effectively over. By the end of the year The UNCTAD All Price Commodity Index had fallen by 38%, while metal prices had decreased by 47% from their heights in mid 2008. The longest period to experience a sustained commodity price increase since World War II, some believed, had come to an end. The research focus of this dissertation was to examine the changes in the drivers of price in this commodity boom. Having considered demand, supply and financial drivers in detail, we now bring these variables together to understand the 'big picture' in commodity markets and the implications for development policy. The four research questions we introduced in Chapter 1 were:

1. What has been the contribution of China's economic growth in creating a demand pull effect on metal prices?

2. What has been the contribution of supply in the determination of metal prices?

3. What role has the financialisation of commodity markets played in the determination of metal prices?

4. With the financial crisis in late 2008, how persistence is the influence of these drivers on long term prices?

Chinese Demand: In Chapter 4 we examined structural change in the Chinese economy, with its focus on infrastructure building, urbanisation and manufacturing. Within the resource-intensive stage of economic growth, China's pattern of resource intensity usage at this early stage of industrial and infrastructure development is similar to that of other developing countries. It is China's high volume of demand that sets it apart from other countries, and that accounts for the increase in global demand of base metals seen in recent years. As China continues to follow the pattern of

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[86] Herrick and Kindelberger (1983)

'normal growth', its demand for commodities will continue to be high in the medium term, relative to the near future, given its low per capita income levels.

As a Southern Engine of Growth, China's sourcing of raw materials from other developing countries, and its ability to absorb large volumes of commodities has a positive impact on the commodity-exports of developing countries.

Mining Supply: In Chapter 5 we examined the global mining industry. Weighed down by years of low prices and investment levels in the 1980s and 1990s, the sector was slow in increasing output at the start of the boom. The accompanying lowering of stocks post 2003 (discussed in Chapter 6) led to the lowest inventory levels at exchanges for decades. There were two elements to the slow supply response. First, the inflexibilities intrinsic to the industry such as long gestation periods, high capital intensity and sunk costs. Secondly, the response of the largest mining firms to an increase in revenues was towards non-productive spending such as M&A activity and shareholder dividends. Only towards the later half of the boom were exploration budgets increased and new mines were sought.

With neglect in developing new supply bases, lack of personnel, equipment, escalating costs of input and the increasing marginal costs of producing in geographically and politically challenging areas ensures that supply inflexibilities will remain. The inability of supply to respond quickly will contribute to a market deficit for most hard-commodities in the medium term.

Financialisation of Commodities: In Chapter 6 we examined the role of the financial markets and commodity related investments. The increase in the number of investors and the funds flooding commodity markets increased the liquidity within the sector. The traders' investing strategies coupled with the weight of money, led to accentuation of price movements in commodity markets. With the financial crisis and the subsequent commodity crunch, the flow of money out of commodity prices initially pushed prices down. However, by June 2009 commodity prices have begun to regain momentum, although they remain below their peak levels at the height of the boom.

Increased investor behaviour may have brought shorter price cycles and therefore increased price volatility in terms of frequency, but may have contributed to smaller amplitudes in price movements.

After the Boom: With the financial crisis and subsequent recession, the future of commodity prices is linked to when and how economic recovery will take place. We limit this discussion to events in the global markets till the end of June 2009.

There are two segments of the global economy that may act as drivers for recovery: the traditionally strong western economies and the new emerging Southern Engines of growth such as China and India. The role of China has already been discussed, and here we outline some of the events in OECD economies.

Within OECD economies, there are considerable signs of the slowing down of the recessionary processes and even some signs of recovery. Although leading manufacturing and financial indicators may still be falling, the rate of fall has decreased, leaving some to argue that the bottom of the cycle has been reached, or is imminent in the next few months. By June 2009, contraction in GDP in the major western economies had slowed down and the IMF, The European Commission and the European Central Bank forecast a euro zone recovery in 2010.

Market analysts expect recovery to be slow and take the shape of a shallow U. Others suggest that recovery could be V shaped as in a strong rebound, or W shaped with a sharp rise followed by a fall, before recovery takes hold. The likelihood of an L shaped recovery is now low. Ormerod (2009) suggests that despite the pessimistic forecasts of recovery in the western economies, historical recessions rarely last for more than a year and when recovery takes place it is often very quick. Of the 255 recessions seen in the western economies since the late 19th century, 164 lasted for about a year, and only 32 have lasted for more than two years. Even when considering severe cases of economic slow down where the fall in GDP was more than six percent, two thirds of these recessions ended within a year.

The financial markets are also beginning to show more confidence, with investors moving out of safer assets, such as the bond markets in the United States, where yields have recently begun to

rise. The fall in yield occurs when investors flock to treasury bonds as a safe haven from riskier assets in currency, stock and commodities markets. The yield on ten year United States treasury bond was 2.1% in December 2008, but by May 2009 the rate had climbed again to 3.5%[87]. The rise in yield is an indication of investors returning to other markets and moving out of treasuries, and is considered an indication of growing investor confidence in other assets. Recovery in mainstream markets has also been seen with global equities at their highest levels in June 2009 since the start of the year.

Currencies of major mining countries have also seen resurgence, and by June 2009 were showing strengths similar to that seen before the Lehman Brothers collapse in September 2008. Some of this confidence comes from the belief of financial markets that China's economic stimulus is working. The renewal in demand for commodities and therefore for commodity linked currencies has resulted in Australia, Russia, Canada , South Africa, and Brazils' currencies to rise against the dollar in early 2009[88].

Although the shape of the economic recovery is not clear at the moment, the fact remains that the financial crisis has not resulted in a 'Great Depression'. The rate of future economic growth is as much dependent on the West as it is on the East. China's performance as a strong economy in the current crisis and for future global economic growth is important, but one should not underestimate the role of the OECD economies. Global growth will not return to before-financial-crisis levels until recovery begins within the OECD countries. China's role is more important in the case of commodities, since its demand will play a crucial role in commodity markets. Sam Walsh, head of Rio Tinto iron ore unit agrees: 'What is unshakeable, however, is our belief that China and India and other emerging economies, will be the key engines to any return to world growth and commodity demand growth' (The Financial Times, 28th May 2009).

Although commodity demand and economic recovery is expected to resume in the coming years, historical analysis suggests that debt cycles may negate the positive aspects of recovering prices. Reinhart and Rogoff (2008) in analysing long term financial data sets for the period 1800 through

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[87] The Financial Times 2nd June 2009
[88] The Financial Times 3rd June 2009

the to 2000 show that commodity prices spikes have invariably been followed by waves of sovereign defaults. This is a result of commodity-exporting countries borrowing in times when the terms of trade are in their favour due to high prices, but turning into defaults as prices fall. In the aftermath of the financial crisis the IMF did offer budgetary support to a number of countries and sovereign defaults have not resulted until June 2009. However, an increasing government external debt burden is a possibility as a result of falling commodity prices.

Having examined the factors behind the 2003-2008 commodity boom we can now move to answering our last research question: With the financial crisis in late 2008, how persistence is the influence of these drivers on long term prices? The fundamentals behind commodity prices discussed in Chapters four through six are examined together to ascertain their medium to long term persistence and the possibility that we are currently experiencing the expansionary phase of a Super Cycle. In Section 1 we examine the concept of the Super Cycle and how the 2003-2008 period can be seen in this context.

Having answered all our research questions by the end of Section 1, we then move to Section 2 and re-visit the issues of commodities in development that were raised in Chapter 2. In Section 3 we look at the policy implications arising from our research and in Section 4 we identify areas that require further investigation.

SECTION 1 THE SUPER CYCLE

A Super Cycle is defined as a trend rise in commodity prices near a decade or more. Apart from rising prices for a medium term, prices will tend to be driven by growth in an emerging economy (Heap, 2005). The 'Super' part of the term implies that cycles are 5 to 35 years long in their expansionary phase, indicating that the complete cycle may be as long as thirty to seventy years, when considered from trough to trough. Prices are driven by growth in an emerging economy, as their growth tends to be more resource-intensive than other economies. However. other processes, such as rebuilding efforts after a war, can also lead to an increase in commodity demand and hence price pressures.

Radetzki *et al.* (2008) argue that a super cycle will occur when there is 'an unanticipated shift from one path of demand growth to a higher one'. Thus, demand would be generated from an economy experiencing resource-intensive growth, as it moves from a primary sector based economy to one led by the industrial sector. Jerrett and Cuddington (2008) point out that a super cycle involves a wide range of non-renewable resources, such as metals and minerals. A super cycle will not arise due to price pressures in a single metal or commodity sector, for resource-intensive growth makes demands on a large number of raw materials.

Commodity super cycles are based within the theory of long waves, where waves of expansion and growth are followed by periods of slowing down. Kondratieff and Stopler (1935) argued that while we tend to focus on business cycles, usually with durations of seven to eleven years, they are embedded within larger cyclical movements, i.e. the long wave which can last up to fifty years. This was linked to the intrinsic nature of the capitalist economy[89]. Changes in the discovery and the economic use of technology in production, the opening up of new countries to international trade, as well as wars and revolutions were linked to the various stages of the long wave.

Possible commodity super cycles in the past 150 years have been identified first in the late 1800s through to early 1900s, and the second between 1945 and 1975 (Heap, 2005). Cuddington and Jerrett (2008) argue for three periods with super cycles in expansionary phases: from 1890 to 1911, from 1930-1951 and finally from 1962 to 1977. They believe the latest super cycle began as early as 1999 and had not reached its midpoint by the middle of 2006. These time periods coincide with the development of the United States, in the early 1900s, with the reconstruction in Europe, and development in Japan in the 1960s and early 1970s.

The UNCTAD Monthly Metal and Mineral Ores Price Index (Figure 7.1) has been rising steadily on a trend since 2002, peaking in mid 2008, crashing and then begin a slow recovery in 2009. We argue the demand from China, inflexible supply from the mining sector and the financialisation of commodity markets have all contributed to this rise.

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[89] Kondratieff (1935) did not clarify what these characteristics were

Figure 7.1: UNCTAD Monthly Metals and Mineral Ores Price Index (Jan. 2000-Apr. 2009)
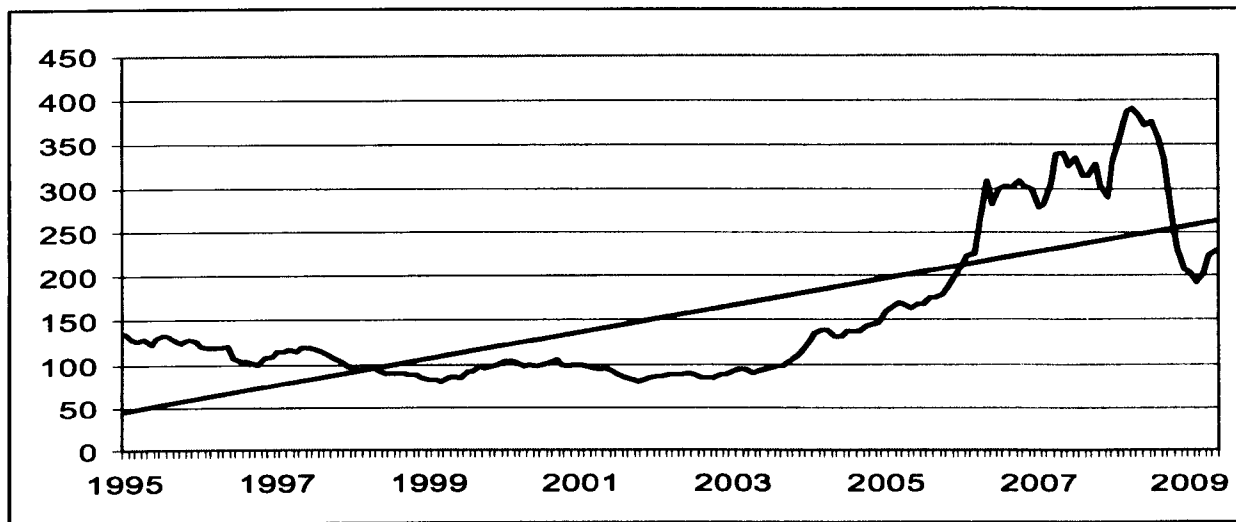
Source: UNCTAD Handbook of Statistics

Heap (2005) argues that the current catalyst for the Super Cycle is China and its growing economy. In 2003-2008 it was the largest emerging economy. Its GDP (PPP) doubled in size from 2000 and 2007, from nearly $3,400 bn to $6,600 bn. Although China's GDP growth rates have averaged around nine percent for almost two decades, chapter four showed how the GDP growth post 2005 is more resource-intensive than before the 1990s. The structural nature of Chinese demand, with its focus on infrastructure and metals intensive growth, indeed resulted in unanticipated shifts in volume of commodity demand from the past few decades.

This resource-intensive stage coincides with the period of increasing commodity prices as seen in Figure 7.1. Emerging demand from India is expected to follow China's growth. India too is a large country, with limited natural resources. In the future, when India begins to approach a resource-intensive stage, with concentration on infrastructure and construction, its resource demand will also exhibit higher income elasticity for commodities. Like China, it will have to access international commodity markets, since domestic resources are limited. Even after the Chinese economy moves out of its resource-intensive stage, we have the other Asian Driver to pick up demand. Therefore, upward commodity demand pressures will remain for the medium to long term.

As discussed in chapter three, rising demand or economic expansion on its own will not generate price pressures, if supply is able to keep pace with demand. A trend increase in price as experienced within a super cycle, implies that sustained supply lags exist in commodity markets.

Only when enough investments are made to increase the capacity and output of the sector to absorb demand, will prices be brought down.

The inflexibilities in supply, contributing to tight markets, have been beneficial to mining firms in the short term. Increased revenues have helped to attract higher investments to the sector, and as the stock prices discussed in chapter five indicate, the industry benefitted from high returns. Radetzki *et al.* (2008) argue that the mining industry experienced super normal profits during the 2003-2008 boom, which will encourage investments in the sector. As output increases bring markets into balance, price pressures will decrease and profits will come down.

However, as we have seen a lack of capital is not the only issue holding back output increases. The inability to quickly increase supply was the result of the mining industry being ill-equipped to increase production, under-estimation of needed capacity and hence under investment. Chapter five has highlighted other reasons such as increasing risk premiums, costs of production and lagging support industries. The previous and continued lack of attention paid to expanding the supply will hamper supply increases in the future. Combined with a continued rise in demand, this will result in tight markets for a medium to long period.

The financialisation of commodity markets in recent years, discussed in detail in Chapter 6, does not appear to be a short term phenomena. Investor interest did increase during the 2003-2008 high price period, and investors did withdraw from commodity markets immediately after the financial crisis. But by 2009, they are beginning to return to commodity markets again. Apart from hedge funds, who control smaller amounts of money in commodity markets, the large institutional investors have also committed investments to commodities. Their trading strategies are not always linked to price, but other attributes such as hedging against inflation and volatility in stock markets. Given the increase in number of trading tools now available for commodities, these institutions have easier access to commodity markets relative to the 1990s and before. These factors ensure investor presence is likely to remain in commodity markets, and their participation in the 2003-2008 period was not a transitory phenomena.

Tight commodity markets will also ensure that investor interest remains, since this was the major reason they attracted investors in the first place. When prices began to rise in 2003, inventory levels were just starting to be brought down, and they reached near minimum levels in 2005-2008, coinciding with the period where investor activity was greatly increased. Therefore, the state of the fundamentals will be a major motivator for continued financial market participation in commodities. Their trading strategies will also continue to accentuate price movements.

The recent rise in price trend has been interrupted by a business/financial cycle in mid 2008, but within a year there are increasing signs of recovery in major economies. We acknowledge that there is no firm evidence that recovery has begun in earnest in the OECD economies, but the consensus in financial news does indicate that the trough of the recession has been reached. Therefore, global economic recovery by 2010 is probable. Given that super cycles can extend over decades, price downswings can co-exist within the larger trend movements. Super cycles can be interrupted by financial and business cycles. Jerrett and Cuddington (2008) comment: 'Trends and super cycles can be obscured for rather long periods of time by business cycles and intermediate cycle effects'.

The behaviour of the 2003 to 2008 commodity boom supports the hypothesis that this period was indeed the start of a Commodity Super Cycle. The interruption caused by the financial crisis is being over-come, and pressures for commodity prices to resume their upward trend are present and are likely to gain strength by 2010-2011. As the super cycle continues its expansionary phase, prices for commodities are likely to continue on their upward trend for five to twenty years into the future. It is now time to look at the broader implications of this rising trend for developing countries.

SECTION 2 COMMODITIES IN DEVELOPMENT

In chapter one we identified three main events in development that arose post 2000. The first was the emergence of a large developing economy (China) experiencing a commodity intensive growth phase. The second was the increase in commodity prices and finally increasing financialisation of commodity markets.

In contextualising these events we addressed four key issues in development and commodities literature, with our focus on hard commodities. The first was the income elasticity of demand for commodities in relation to resource-intensive growth of a large economy. Secondly, the inflexibility of supply in relation to price increases. Price volatility was our third issue and finally the impact of a commodity price increase on terms of trade. We revisit these issues in light of our research findings.

7.1 Income Elasticity of Demand for Commodities

In general, as per capita income increases the demand for commodities increases by a lesser proportion. The increase in income leads to higher proportions of spending on manufactures and services. The higher demand for manufactures increases the demand for commodities as inputs. However, since commodities are a small fraction of the production costs in manufactures, they will not experience a proportionate rise in input demand to the final output demand.

In this context, the income growth in China has three major repercussions for the elasticity of demand for commodities. First, given its resource-intensive stage of growth, its income elasticity of demand for commodities is relatively higher than other countries. This elasticity varies with the resource intensity of income growth. Low and high income countries will consume fewer commodities for every percentage growth in income, relative to resource-intensive growth in emerging economies. Since China is making higher expenditures on infrastructure, construction and urbanisation, it exhibits higher elasticity of demand for commodities. This elasticity will eventually taper off as they achieve advanced economy status. Apart from urbanisation and infrastructure elasticity, the per capita income levels within China are currently low. As its population becomes more prosperous, the demand for manufactures is going to rise, and with it the derived demand for commodities as inputs. Therefore, income elasticity of demand is high due to the nature of the sectoral growth and the domestic per capita income levels.

Secondly, we noted in chapter four, China's is close to trend when it comes to percentage share of costs of metals in infrastructure, urbanisation and manufactures. It is exhibiting a 'normal pattern of growth'. The scale at which China consumes is un-precedent in recent years. Its share of global

commodities demand and the scale of increase in volume imports make a large impact on global markets.

Third, given the large geographical area of China, its consumption of commodities will be higher than that of similar income, but smaller, emerging economies. With its commitments to urbanisation, infrastructure and manufacturing in the current and future period, this scale of commodity consumption is not a momentary phenomenon, but will continue for a long period.

The combination of a relatively high income elasticity of demand, with large volume and size of the country, means that the traditional argument for low income elasticity of commodities can no longer account for the commodity pessimism in development. In our discussion in chapter two, the premise that rising incomes will not be accompanied by a proportional rise in demand for commodities meant that as the North grew, it would demand less of the South's exports. Thus, the growth in resource-exporting developing countries would not gain from rise in incomes in the North. We argue that with a Southern Engine of growth, a rise in income due to higher resource-intensive income elasticity and a large demand volume, allows China a far larger capacity to absorb the commodity-exports of developing countries, than did the North in previous decades. With this resource intensive, high consumption state to continue for China in the medium term, resource-exporting countries can benefit from rising incomes in China.

7.2 The Global Mining Industry

In considering the general characteristics of the global mining industry, we noted that it tends to be capital intensive, with long gestation periods. The growth of the mining sector is linked with global economic growth as metals are an intermediate product. Only a demand pull effect will increase prices and the pressure to extend supply. With both advanced and low income countries having low consumption of commodities post 1970, the demand pressures in global markets did not emerge to fuel an expansion in the supply industry. With commodity demand pressures increases in the 2000s, and the emergence of a super cycle, the industry has the impetus to expand investment. Since developing countries, such as those in Africa have a high proportion of unexploited mineral resources, they now have the opportunity to benefit from increased interest in their natural

resources. The current and continued increase in commodity prices is an opportunity to attract investments and generate capital for the rest of the economy.

The scale of China's demand is expected to grow in the future, and to be sustained over a medium term. Its capacity to absorb large amounts of metals balanced against the 'adding up problem' of a collective increase in exports from developing countries is unknown at the moment. Within the boom period, Chinese demand was absorbing large volumes of commodities, it is reasonable to assume that once global recovery is underway a similar situation will arise.

In chapter two we also raised the issue of resource extinction. Tilton (2007) argues that such an event is unlikely given that reserves and resources of metals are large. The more important determinant of exploitation is the improvement of technology to lower costs in the sector. In periods of high prices, cost cutting is not high on the agenda of mining firms, while in periods of lower prices, contraction of production is used to cut down on costs. If a sustained period of high prices and continued demand is expected, efforts to improve supply and the supply base will continue.

Therefore, higher prices are conducive for the global mining industry to expand and bring investment opportunities for developing countries. The growing presence of Chinese mining interests in Africa have received much attention in the past years with growing concerns around China's commodity seeking behaviour (Kaplinsky and Farooki, 2009). This provides both opportunities and risks.

The inflexibilities within the mining industry, in terms of capital intensity, risk premiums and access are a major bottleneck in expanding supply. We noted the importance of non-production expenditures of the largest Mining MNCs during the commodity boom. The role of Chinese mining companies to offset the lack of investment from the Western MNCs can be instrumental in unclogging the supply chain. For example, China's increasing resource based presence in Africa can contribute to increasing supply. Although we cannot go into detail in the practices of the Chinese mining firms in Africa at this time, we do acknowledge that while they provide an opportunity they also bring risks. Rising commodity prices are positive for mining firms and can generate the investment to tackle the fundamentals behind inflexibility of supply.

The global mining industry in the near future is looking at expansion in output and high investment levels. With increased competition to seek assets, the opportunities offered in terms of employment, investment, and growth in ancillary industries, mining may well shed some of the shackles of its enclave nature. The growing international pressures to make it a more responsible in terms of the environment and human rights, the industry may well be more beneficial to host countries than in the 1960s. Issues concerned with how it promoted 'backwardness' or suppression, are being effectively challenged. In the 1950s, the Prebisch led push for Import Substitution Industrialisation was another reason for marginalising mining, but this policy is no longer considered a valid industrialisation policy. Increasing commodity prices ensure that commodities can be a lead sector in generating capital for an economy.

7.3 Commodity Price Volatility

Commodity price volatility has increased post 1970, largely linked to the increasing frequency of cycles. Commodity prices since then have increasingly moved away from producer price setting, and on to terminal markets such as commodity exchanges. In the recent 2003-2008 period the increase in prices can be attributed to two reasons: the level of liquidity in commodity markets, and the nature of investors. The level of high and consequently low liquidity tends to accentuate nominal price changes in fundamental prices. Investors are now drawing upon a much larger bank of information to assess future price trends than before. Therefore, expected changes in fundamentals are quickly transmitted to price. Investor activity in commodity markets can cause more frequent price cycles as changes are reflected faster in prices, while fundamentals take a longer time to adjust. We also noted that investor activity can contribute to dampening the amplitude of price cycles.

Investors also bring liquidity into commodity markets, which contribute positively to reducing frictions of transactions between consumers and producers. With low liquidity levels, large investors were unwilling to invest in these markets as it limited their investment strategies. With increased participation from these institutions, which tend to have passive trading strategies, they can balance the short term movements from the smaller hedge fund investors as well.

In a perfect world, commodity prices could be accurately forecasted, giving countries time and space to adjust their budgets and effectively plan for their resource revenues. Price volatility remains an issue, but the nature of this volatility may not be as large a cause of concern in development as before. High amplitude volatility results in large windfall gains and losses, leaving resource-exporting developing countries ill prepared to adjust quickly to changes in their revenues. Higher frequency, but with smaller amplitudes would still be problematic, but would allow for more space in policy planning. Price volatility in a smaller band of fluctuation could be considered a more preferable option to wide fluctuations.

The issue of public debt rising due to a fall in commodity prices, while borrowing was at a time of high commodity prices remains a major policy concern. The issue of price volatility and its impact on development has not been completely resolved, but if investor activity can dampen the amplitude of price fluctuations, then their role will be a positive one in commodity markets. However, regulation and monitoring of financial activity is important to ensure that speculative positions do not push prices away from the fundamentals, and that exchange markets remain anchored to physical markets.

7.4 Terms of Trade Reversal

The terms of trade are a ratio between manufacturing and commodity prices, factors affecting either or both are likely to change the ratio. This dissertation has focused on changes in commodity prices and we now take a brief look at the other variable in this ratio, namely manufactures prices. Chapter four highlighted the role of the Chinese manufacturing sector in GDP growth, as well as the strong manufacturing component of its exports. The literature discussing how and why China has been able to produce cheap manufactured products is extensive and space does not permit an in-depth analysis here.

Generally speaking, the Chinese manufacturing sector combines a market economy with a strong State participation (Nolan, 2005; Shenkar, 2005). State-owned-enterprises, as well as subsidies and financing for private companies investing abroad, have delivered on growth. Such a combination on this scale has rarely been seen in other industrialised economies. Tull (2006)

argues that the combination of state participation and support has allowed Chinese firms to be less risk-averse and to think on longer time horizons than their western counterparts. The innovative capability of the Chinese economy has been pooled with a large labour force and low wage rates. Again this combination of low wages and innovative capabilities provides a distinct economic structure to Chinese manufacturing (Gereffi *et al.*, 2006; Kaplinsky, 2005). The method by which China acquires innovation capabilities from abroad, as well as generating capacity within, ensures that its manufacturing capabilities and growth are likely to be sustainable (Altenburg *et al.*, 2008).

Given China's economic characteristics, its combination of state and market production has led to a fall in the prices of manufactures over a period time. This is confirmed by unit price analysis in Kaplinsky and Santos-Paulino (2006) and by Cashin and McDermott (2006:20) who argue: 'With China and other Asian economies emerging to join the global economy, there is an ever expanding level of capacity of manufactured production that is putting downward pressure on manufactured good prices around the globe'. Kaplinsky (2005) examining European Union imports indicates that the largest number of sectors that experienced declining prices were those in products imported from China (Figure 7.2). Kaplinsky (2008:14) further argues of the 1988/91 to 2000/01 period that 'the greater China's participation in global product markets for manufactures, the more likely prices will fall'.

Figure 7.2: Percentage of Sectors with Negative Price Trends by Country Groupings (1988/9 and 2000/2001)
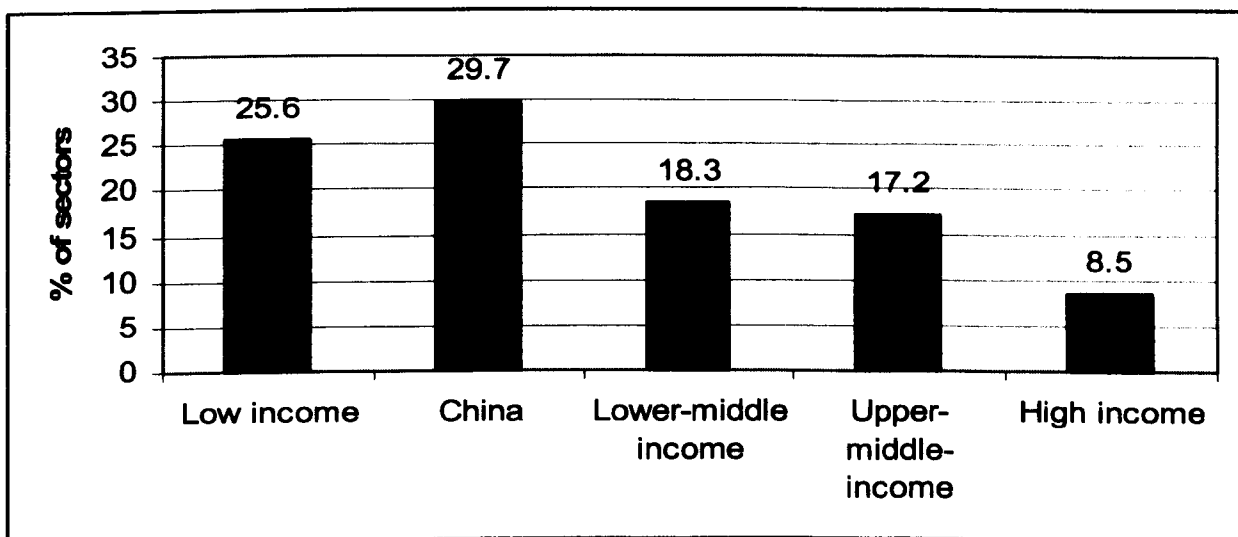
Source: Kaplinsky (2005). Based on an analysis of 151 eight-digit products, selected on the basis of their contribution to LDC exports to the European Union

The fall in prices of manufactures has linkages to generate higher commodity demand. Household consumer items such as TVs or metal intensive products such as cars became accessible to a larger share of the world population because of lower prices. This would tend to increase the demand for manufactured outputs. Not only can a larger population afford manufactures, but where consumers could afford one fridge they can now afford two. As the decrease in manufacturing prices has increased the demand for manufactured products, at the same time the amount of metal inputs now required to build these products has also increased. Humphreys (2009) argues that this potential suppression of manufacturing prices has implications for the relative prices of commodities. With low cost labour being available to the manufacturing sector, the prospective of more manufactures to buy a given amount of commodities is very real.

Commodities are in an expansionary phase of a super cycle and we concluded that they will trend upwards in the near to medium term. Manufactures prices on the other hand, have been decreasing over the past decade. In chapter two we noted, that the evidence of terms of trade was either a downward slope or no trend at all. The possibility of a rising terms of trade was not considered. The two recent changes observed in the price trend of commodities and manufactures, for the first time since the Prebisch-Singer Hypothesis, indicate the possibility of rising terms of trade for commodities in relation to manufactures. With the terms of trade data that is available (Table 7.1), we see that advanced economies saw an annual average improvement of terms of trade in 1990 to 2000 of 0.03%, but a deterioration of 0.63% in 2000-2008.

Table 7.1: Average Annual Percentage Change in Terms of Trade (1990-2008)

|	Advanced Economies	Emerging and Developing Economies
1990-2000	0.03	0.10
2000-2008	-0.63	2.97

Source: Author's calculations from World Economic Outlook April 2009

Emerging and Developing Economies saw an annual average improvement of 0.1% in 1990-2000, rising to nearly three percent improvement in 2000-2008. An improvement for emerging and developing economies would suggest that terms of trade, during the commodity boom years have

moved in their favour. However, it is difficult to gather whether the manufactures exporting developing countries have been the main beneficiaries or commodity-exporting countries. A large number of developing countries are also manufactures exporters, and research results from Wood (1994) and Kaplinsky and Santos-Paulino (2005) shows that their manufactured products have also experienced declining prices.

If we look at the commodity terms of trade for major commodity-exporters and manufactured exporters in the developing world, there are indications that terms of trade are moving in favour of commodity-exporters. Figure 7.3 shows the commodity-manufactures terms of trade for a range of countries (WEO, 2008), with a value over 100 showing an improvement in terms of trade for commodities. For our purposes we take Africa to represent major commodity-exporters while developing Asia is used as a proxy for manufacture exporting developing countries.

Figure 7.3: Commodity- Manufactures Terms of Trade for Africa, Developing Asia and the Advanced Economies (1990-2007)
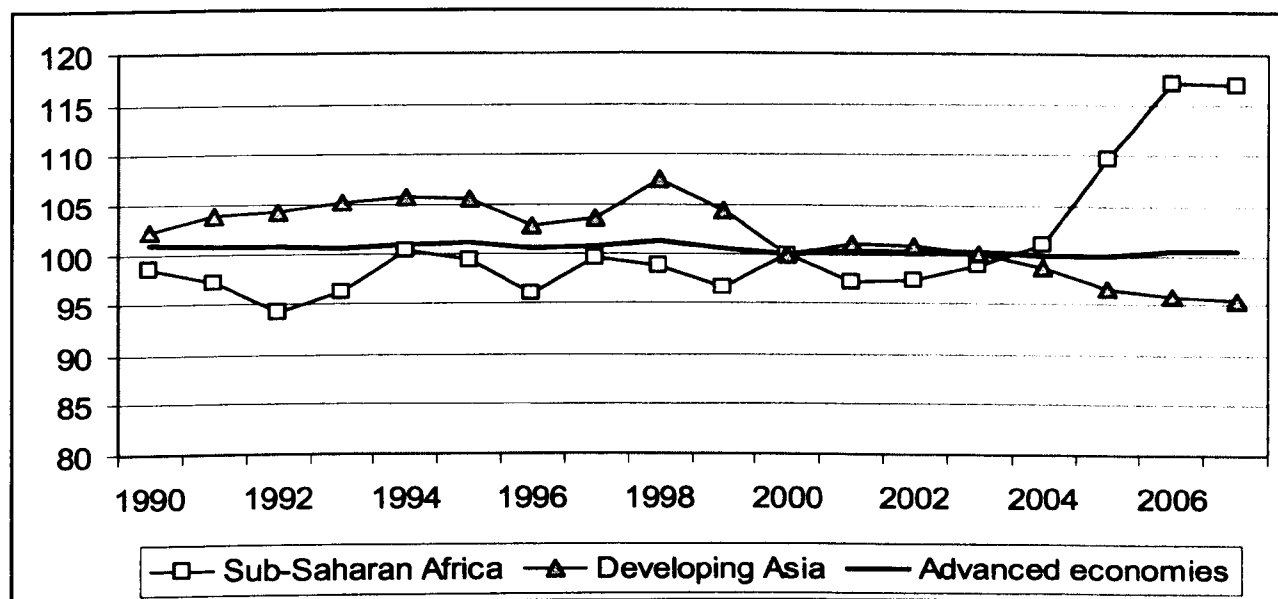
Source: Author's compilations from World Economic Outlook 2008

The commodity price boom started in early 2003 and gained momentum after 2005, it is too early to ascertain if there has been a change in the overall trend of commodity prices in this short period of time. Trend analysis requires atleast a decade or more of data to be compared to previous trends to

ascertain if there is a change[90]. For a reversal to occur, not only will commodity prices need to retain their trend rise, but the price of manufactures must also fall. The decline in prices is not necessarily in nominal terms, but relative to the price of commodities.

Since 2003, the commodity terms of trade have been steadily improving for Africa, our representative commodity-exporters, while deteriorating for developing Asia, our representative manufacturers exporters. The advanced economies seem to be largely unaffected, as their trade structure have smaller shares of imports of commodities and manufactures from the developing countries. Given China's manufacturing capabilities, we can expect downward pressure on these prices to exist in the medium and long term. We have already argued for a rise in the prices of commodities for the future. These two forces combined, make the probability that we will be experiencing a terms of trade reversal in the future very real.

Our analysis of the major drivers of the changing patterns in commodity prices behaviour, demand, supply and financialisation, have indicated that these are not short term disruptions, and that they are likely to continue into the future. How the financial crisis itself will impact manufacturing prices in the future is subject to further analysis, as is the development pattern from China.

SECTION 3 IMPLICATIONS FOR POLICY

The re-examination of issues related to commodities in development in Section 2, indicate that the changes in drivers and behaviour of prices since the 2003-2008 commodity boom give us reasons to see commodities in a more optimistic light than in previous decades. Within the larger context of agricultural and mineral commodities, since the research area and conclusions were firmly based in the hard-commodity sector, our policy implications are also for relevant for the metals and the mining sector only. Given the differences in the nature of demand and supply for agricultural goods, our research results cannot be generalised to the commodity sector as a whole.

The increase in prices is advantageous for natural resource abundant countries in attracting a higher price for their exported product and increased investments in their commodity sectors. A

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[90] In conversation with David Sapsford, July 2008

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change in the direction of their terms of trade, driven by growth in the Southern Economies, brings new opportunities of growth not completely driven by the North. Considering this affirmative role of commodities in development does not mean that all issues around failure of commodities to assist growth are now neutralised. Our dissertation focused on the global aspects of commodity demand, supply and price. There are still country level issues that will affect the utilisation of commodities in growth. This section highlights some of the policy issues that remain within the context of rising commodity prices.

Dealing with Rent Seeking Behaviour: One of the issues we raised in chapter two was the rent seeking behaviour by the State. Such behaviour would not allow for mineral wealth to be shared for the benefit of the entire population. Development is impeded when royalties from mineral resources received by the State are not transferred to the population through expenditure on health, education and other services. The general population will also suffer if the State uses its mineral wealth on non-development expenditure such as presidential palaces and luxury vehicles for the state officials. Finally, the State in receiving resources from outside the country, will not consider itself accountable to its own people. This often leads to non-democratic state behaviour. In extreme cases, conflict and civil war may break out with opposing factions trying to take control of the centre to which resource rents are paid. A number of studies have made the connection with rent seeking behaviour and natural resource dependence (Baland and Francois, 2000; Auty, 2001; Verdier, 2006; Caselli, 2006).

Such rent seeking has caused conflict in a number of countries, and with increasing commodity prices there is now more wealth to fight over. We cannot offer a thorough policy analysis to deal with rent seeking behaviour in this dissertation. We do however stress, that developing country governments, as well as the mining MNCs who deal with them, must be aware of the dangers. Recent efforts to circumvent rent seeking states have included the Chad-Cameroon pipe line supported by the World Bank (Pegg, 2005; Heller, 2006). Rents from the resources were earmarked for specific development sectors from the beginning, and monitoring and evaluation teams were trained to ensure that the funds flowed to their appropriate budget heads. There are also other successful cases such as Angola, where the African Development Bank has been

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assigned a key role in monitoring resource revenues. Such policy options can be used to ensure that development from mineral resources is delivered to a wider population, leading the entire country to benefit from its natural resources.

There are two issues arising from an increasing trend in commodity prices for rent seeking behaviour. First, the promise of increased revenues means that the gains are greater for whoever controls the centre, and therefore more violent conflict situations arise. With firms looking to reduce risk premiums in a period of high costs, countries with conflict will not be given preference for investments. Stable governments are more likely to attract investment. As seen with the Angola example, increased institutional support is available and being given to assist States to make the most of their resource revenues.

Secondly, as mining firms, both in the West and from China, seek to expand their supply base, the competition for host countries can lead to better deals being offered. Developing country governments can negotiate, as many have already done. For example, a large share of the investment in Africa from China is in the resource materials sector.

The mining supply industry needs to increase output, and will be increasing by looking at resources in as yet unexploited regions in developing countries. With higher competition for these resources, and assistance from international institutions, rent seeking behaviour can be addressed, but still requires strong political and policy intervention. With regards to exploiting natural resource Collier and Venables (2008b) argue that the present system whereby governments sell extraction rights before discovery takes place, puts a high social cost on the economy. Similarly negotiations as opposed to more transparent auctions for extraction rights may prove to be more beneficial to governments.

The case of the Democratic Republic of Congo (DRC) is the first example, and probably more will follow, where mining investment deals have come under strong scrutiny by other international financial institutions. The DRC negotiated a mining investment deal worth $9 bn with China, giving the latter extensive mining rights in the region. A sum of $3 bn was to be invested in the mine area itself, while the remaining money was to be divided further into two tranches, to be spent on

developing roads, railways, hospitals and universities. Although this was the largest investment in the DRC, the IMF and Paris Club were cautious about the negative impact of this deal on the DRC's debt repayment obligations. After tense negotiations the deal has gone ahead, however the $3bn for infrastructure support has been suspended[91]. The negotiations involving the African host country, the Chinese and the IMF indicates the growing scrutiny that new mining deals are receiving, and the importance being given to ensure that such investments are not harmful to the country in the long run.

Collier and Hoeffler (2008) find that democracy tends to grow more rapidly in the absence of resource rents confirming the resource curse hypothesis. Resource rents can be accompanied by a positive growth effect as long as a country has good institutions (Collier and Goderis, 2007; Mehlum et al., 2006). Fasano (2002) documents the case for United Arab Emirates which spent its resource rents on modern infrastructure and education turning the curse into a blessing. Acemoglu et al. (2003) offer similar findings for resource rich Botswana. Arzeki and van der Ploeg (2007) and Mehlum et al. (2006) confirm this for a number of countries, using empirical evidence to show a negative impact of resource dependence on growth rates only when the quality of institutions is worse than a critical level.

Dealing with the Dutch Disease: The Dutch disease has two major vectors: the first is the de-industrialisation of the economy due to the domestic resource sector crowding out other sectors. The second is from the appreciation of the exchange rate, which makes the non-resource sector unable to compete in international and domestic markets. However, as the Netherlands has shown, with a comprehensive industrial and monetary policy, these affects can be dealt with effectively. Industrial and trade policy can address issues of de-industrialisation within the domestic economy and support the non-trade sector. Malaysia has used a balanced approach to develop its natural resource and manufacturing sectors together with success. New Zealand and Australia are both examples of commodity-exporting countries that have diversified their economies without abandoning their resource sectors.

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[91] The Financial Times 18th August 2009

The de-industrialisation problems associated with the Dutch Disease also need to be considered in the context of the economies of the resource-rich developing countries. Some of these countries do not have a domestic manufacturing sector to speak off, such as those in Africa[92]. Concentration on their commodity-exporting sector may further exacerbate problems in the fledgling manufacturing sectors. With China's high income elasticity of demand for commodities, the absorption of their commodity-export output is largely guaranteed. The balancing act between export sectors that will generate high revenues for the medium term, at the cost of further ignoring the manufacturing sector, becomes even more important for these developing countries. This is not an easy policy debate, but for the present we propose that effective policy support is required by these countries to mitigate the effects of the Dutch Disease. The use of industrial and monetary policy in these cases to dissipate the impact of a strong commodity-exporting sector with state intervention, is highly recommended (Ross, 1999, 2001; McMahon, 1997, Saaraf and Jiwanji, 2001).

Collier and Goderis (2007) find that although resource dependent economies tend to suffer from a decline in production in the non-resource sector it is avoidable. Trade and well developed financial and institutional governance can help dissipate a resource curse impact on growth. Arzeki and van der Ploeg (2007) find countries with more open and liberal trade policies can lessen the impact of the resource curse, while Van der Ploeg and Poelhekke (2008) argue that a well developed financial system can also help achieve similar results. Avendaño et al. (2008) looking at the macro management of resource-exporting countries in Africa and Latin America during the latest boom, find that countries using pro-cyclical fiscal policies, retiring costly debt while improving their credit profiles have made a positive contribution to their development.

Collier and Venables (2008a:18) advise that for low income countries to benefit from their resource revenues, governments should:

i) Distribute to the private sector through citizen dividends or through the tax/ benefit system.

ii) Increase public spending, either on public consumption or the construction of public assets.

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[92] For a detailed discussion see Kaplinsky and Morris (2008)

iii) Retain as a government financial asset, but lend on to the domestic private sector, either by government lending (e.g. development banks or mortgage lending) or by reducing existing public debt.

iv) Retain as a government financial asset and lend to foreigners, by foreign reserve accumulation or establishing a sovereign wealth fund.

To Industrialise or Not to Industrialise: Industrialisation has long been held as a panacea for development and is evidenced to have delivered growth for a wide range of countries. Now that the rise in commodity prices can also contribute to growth, should natural-resource abundant countries still focus on industrialisation? This is a difficult question to answer. Natural resources certainly are now in a better position as a sector to assist growth, but transforming commodities into growth is not an easy task. Political and economic factors at the country level must be brought into line to make this happen.

The enclave nature of the mining sector with limited forward and backward linkages tends to restrict its multiplier effect within an economy. Given its capital-intensive nature, it tends to make abundant use of a developing country's scarce factor. Mining will also not generate the same amount of employment as does the manufacturing or agricultural sector. This requires strong State intervention. In the late 1800s and early 1900s, commodity exploitation and industrialisation moved in parallel, and with the right policy mix and state intervention, growth was possible in a number of countries (Wright and Czelusta, 2004).

This dissertation focused on resource-rich developing countries, particularly those exporting minerals and metals. However, there are a large number of resource-poor developing countries. During the high oil and food prices in mid 2008, most of them suffered from ballooning import bills, while facing intense competition in their manufactures export markets from China. These countries do not have the luxury of exploiting natural resources. At the same time manufactured exports from China are a direct threat to their domestic manufacturing sector and an indirect threat in their export markets.

It is difficult to offer a simple answer as to whether these countries should continue to industrialise. A helpful way forward is offered by Kaplinsky (2009) in analysing the impact of China's growth on African countries. If Africa exports what China imports then Africa benefits, as is the case when China exports what Africa imports. This leads to a win-win situation. For example, Africa's exports of minerals and metals are beneficial as Chinese demand for these products has increased prices and can generate revenues for African countries. In the case of Chinese exports, low cost manufactured items, from shoes, clothing and household electronics, when imported into Africa, benefit domestic consumers. Therefore, the benefit to the African consumers of low cost Chinese imports, while the revenue from high price commodity-exports can result in a win-win situation.

However, domestic policy issues have to ensure that cheap Chinese imports do not severely challenge or destroy local manufacturing capacity. In signing agreements over mineral rights and concessions, the State has to ensure that an equitable distribution of rents takes place, and the benefits are passed on to the local communities. Environmental and labour standards also need to be enforced. Therefore, while Chinese engagement may bring opportunities, the African governments need to ensure that policies are in place to fully benefit from these ventures.

Kaplinsky (2009) also points out that there are indirect trade vectors that may harm Africa. This is likely to occur when Africa exports the same goods as China, or when Africa imports the same commodities as China. For example, China's demand for oil has had some impact in increasing oil prices, which has also increased the oil import bill for African countries. While Angola and Nigeria may benefit from high oil prices, the rest of the African nations are oil importers. Similarly textiles and clothing are a major African export to the United States under the Africa Growth and Opportunity Act (AGOA). With increased Chinese exports after the removal of the Multi-Fibre Agreement in 2005, exports from the AGOA region declined by 21% between 2005 and 2007[93].

The context of commodities and growth cover complex political and economic policy issues, and the most important component of this engagement has to be the response of the developing country governments. The policy proposals, agreements and implementation by these States are in large

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[93] For a detailed discussion see Kaplinsky and Morris (2008)

part going to determine how beneficial economic engagement based on commodities will be. As Arzeki and van der Ploeg (2007:26) state: '[...] bad policies in general are likely to aggravate a resource curse and good policies may turn a resource boom into a blessing'.

SECTION 4 ISSUES FOR FURTHER RESEARCH

Our analysis of the drivers of commodity price change has led us to re-examine a number of issues within development economics, and policies related to the role of commodities in development. There are certain issues that require further research.

How long will the Expansionary Phase of the Super Cycle Last? Our research has confirmed that the 2003-2008 period was the start of the expansionary phase of a super cycle, and suggests that despite the financial crisis this phase will soon resume. China is going through a resource-intensive stage of development and it is still far from reaching a mature economy status. We estimate this stage to be years away, but we do not know how many years. Further research needs to be carried out to understand the pace of structural change in the Chinese economy and estimate when a decrease in its resource intensity is likely to take place.

China is just one of the emerging economies, with India expected to follow its path. Other large developing economies such as Russia, Brazil and South Africa are also showing signs of growth. India's large geographical mass will also require similar infrastructure and construction patterns to that of China. Russia, Brazil and South Africa are resource-rich countries in their own right. How will these emerging economies impact global resource demand? In how many years are we likely to see this demand emerge? Will their demand produce an impact similar to that of China and therefore extend the duration of the super cycle even further?

How Long will the Supply Inflexibility Exist? Our research has indicated that the global mining industry is facing supply inflexibility in the current and near future. As the industry moves towards increasing output, how will the higher costs of production impact its capacity? With the growing recognition of environmental and social costs associated with mining, will these issues be incorporated into price structures making the cost of mining permanently higher? Higher commodity

prices are also likely to cause demand destruction, encouraging more effective use of minerals and metals and possibly lowering demand for these products. At what price levels will the global mining industry be able to supply markets without leading to demand destruction?

Within the global mining industry, traditionally dominated by the North, how will the increased participation of Chinese mining firms, competing in resource-rich countries, impact the structure of the global mining industry? What will be the impact of this competition on the prices and commodity supply? Since the 1970s the mining industry is coming under renewed focus, and the time line for the lag in supply will be a contributory factor to the duration of the super cycle. The current and future changes within the industry have implications for commodity prices and markets.

What is the Magnitude of the Impact of Financial Markets on Price Volatility? The growing participation of financial markets in commodity related investments has been clearly established, as has the link between liquidity levels and accentuated price movements. The magnitude and nature of this link remains unclear. Will investor behaviour in commodity markets be similar to their behaviour in stock and bond markets? What consequence will this have for short and long term price volatility? An examination of how mainstream investors are trading within commodity markets and commodity based derivatives needs to be further researched.

The current crisis highlights the growing integration between the financial markets and the real economy. Crisis experienced in the stock markets in 2001and in the currency markets in 1997, did not have the same impact on global output as has the current crisis. Granted that the current crisis was seen in banks and financial institutions that have a much greater reach than either of the other two, the fact remains that financial market behaviour has had a deeper impact on the real market, including commodity markets. To what extent this relationship will continue to intensify in the future or whether it will be weakened because of lessons learnt from the current crisis remains to be seen. We have established that financial markets are playing a stronger role in commodity pricing, further research is required to ascertain the strength and possible implication of that strength in the future for the real economy.

We highlighted the different groups of investors within commodity markets, and the differences in their liquidity levels and investment strategies. The financial markets must be considered to comprise of non-homogenous actors and the differences in impact of these actors needs to be further researched.

To What Extent will Growth in the South Lead growth in Developing Economies? In 2005 to early 2008, there was a growing belief that the economies of developing countries, particularly that of China, were de-coupling from Western economies. Decoupling implies that growth within these countries could be generated and sustained without having to rely on the North as a major driver of growth through FDI and trade. Thus, an economic or financial crisis in the North would not have a large recessionary impact on the South.

This had two important implications for developing countries. First, recessions originating in one part of the world would not be automatically be transmitted to the rest of the world. Secondly, countries such as China could continue to drive growth in other developing countries, which had traditionally depended on the West for trade and growth. The emerging economies could then be counted on to sustain global economic growth even when advanced economies were facing a recession.

Further research needs to be carried out to ascertain to what extent regional growth in the South can sustain growth in the developing world and how important a role are advanced economies likely to play. China has certainly emerged as a leading economic power, but the OECD economies still occupy a central position in the global economy. To what extent is their role has being taken over by China and other Southern Engines of Growth?

7.5 Conclusion

China's resource-intensive expansion led to an increase in the demand for commodities, increasingly being sourced from resource-rich developing countries. With its size and current state of development, China can absorb the exports from developing countries. As a Southern Engine of Growth, it plays an important role in generating development for others in the South.

However, the world of commodities is not a bi-lateral South to South trade event. The largest mining firms are still based in the North, even if they operate in the South. Their investment decisions affect the ability of supply to meet Chinese demand. When and how they choose to invest affects the level of gains for resource-rich developing countries.

The financial markets in the North, through their systems of investment and their strategies, affect the level of commodity prices and the volatility they experience. Again, the South is often outside this decision making process, especially when the financial commodity markets break free from the anchorage of the physical commodity markets.

As much as the 2003-2008 commodity boom was a reaction to Chinese demand, its continuation and behaviour is influenced by the global mining and investment community's response to this demand. These two factors are heavily based on decisions in the North.

The Southern Engine of Growth was the first influence to push hard-commodity prices, and as its demand pressures grew it led to disruptions in supply and financial markets. If China's demand did not exist, pressures on the supply industry would not exist at the current level. Without tight hard-commodity markets and the resulting price increase, financial actors would not have been attracted to these markets at the levels they currently exhibit. The subsequent pressures in the supply industry and the movements within financial markets have effectively disrupted price setting mechanisms that existed in hard-commodity markets before the rise of China.

China's 'disruption' to global hard-commodity markets is the change to the centre-periphery relationship that Prebisch was so concerned with. Between the resource-exporting countries in the South, and the advanced industrial economies in the North, now lies a strong resource-intensive growing economy. The disruptions it creates allow for an opportunity for resource-rich developing countries to benefit from their natural mineral wealth, an opportunity that did not seem to exist for the past fifty years. It is now an opportune moment to make the most of commodities.

China's Metals and Minerals Intensive Export Product List.

SITC Code	Product Name	SITC Code	Product Name
274	Sulphur and unroasted iron pyrites	694	Nails, screws, nuts, bolts etc. of iron
277	Natural abrasives, n.e.s	695	Tools for use in hand or in machine
278	Other crude minerals	696	Cutlery
281	Iron ore and concentrates	697	Household equipment of base metal
282	Waste and scrap metal of iron	699	Manufactures of base metal, n.e.s.
286	Uranium, thorium ore, concentrate	711	Steam and other vapour generating boilers
287	Ores and concentrates of base metal	712	Steam and other vapour power units
288	Non-ferrous base metal waste and sc	713	Internal combustion piston engines
289	Ores and concentrates of precious met	714	Engines and motors, non-electric
663	Mineral manufactures, n.e.s	716	Rotating electric plant and parts
671	Pig iron,spiegeleisen,sponge iron	718	Other power generating machinery an
672	Ingots and other primary forms, of iron	721	Agricultural machinery and parts
673	Iron and steel bars, rods, angles	722	Tractors fitted or not with power t
674	Universals, plates and sheets of iron	723	Civil engineering and contractors
675	Iron, steel hoop, strip	724	Textile and leather machinery and par
676	Rails and railway track construction	725	Paper and pulp mill machine
677	Iron/steel wire, whether/not coated,	726	Printing and bookbinding mach. and parts
678	Tubes, pipes and fittings, of iron or	727	Food processing machines and parts
679	Iron and steel castings forgings	728	Mach.and equipment specialised for pa
681	Silver, platinum and other metals	736	Mach. tools for working metal or met
682	Copper	737	Metal working machinery and parts
683	Nickel	781	Passenger motor cars, for transport
684	Aluminium	782	Motor vehicles for transport of goo
685	Lead	783	Road motor vehicles, n.e.s.
686	Zinc	784	Parts and accessories of 722--,781--,
687	Tin	785	Motorcycles, motor scooters, invalid
688	Uranium depleted in u235 and thorium,	786	Trailers and other vehicles, not motor
689	Miscellaneous non-ferrous base metals	791	Railway vehicles and associated equip
691	Structures and parts of structure ;iron	792	Aircraft and associated equipment and
692	Metal containers for storage and transport	793	Ships, boats and floating structures
693	Wire products and fencing grills	812	Sanitary, plumbing, heating, lighting

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