

# **I. Commodity Risk Basics**

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“Throughout its long history, futures trading has been primarily associated with commodities having major seasonal patterns of production and inventory accumulation and liquidation. Prices of seasonally produced commodities are speculative.”

Thomas Hieronymous (1977)

*“An investment operation is one which upon thorough analysis, promises safety of principal and a satisfactory return. Operations not meeting these requirements are speculative”. “It is only where chance plays a subordinate role that the analyst can properly speak in an authoritative voice and accept responsibility for the results of his judgments ... the value of analysis diminishes as the element of chance increases”.*

Benjamin Graham and David Dodd (1934, p.54, p.26)

## 1.1 The Commodity Risk Landscape

### *A. Basic Definitions and Concepts*

#### **What is a Commodity? A Legal Definition**

Definition and bibliography are essential elements of effective scholarship. Unless key concepts are accurately defined, it is not possible to situate the contribution within the landscape of journal articles, books and other media related to the subject. The value added of any individual research contribution is, at best, only incremental. Improvement is measured relative to the bibliography of sources used to assemble the project. With this in mind, commodity risk management requires a number of key definitions, such as: what is a commodity? and, what is commodity risk? Using a legal definition, a commodity could be defined by the Commodity Exchange Act (7 U.S.C. 1a):

COMMODITY.—The term “commodity” means wheat, cotton, rice, corn, oats, barley, rye, flaxseed, grain sorghums, mill feeds, butter, eggs, *Solanum tuberosum* (Irish potatoes), wool, wool tops, fats and oils (including lard, tallow, cottonseed oil, peanut oil, soybean oil, and all other fats and oils), cottonseed meal, cottonseed, peanuts, soybeans, soybean meal, livestock, livestock products, and frozen concentrated orange juice, and all other goods and articles, except onions as provided in Public Law 85–839 (7 U.S.C. 13–1), and all services, rights, and interests in which contracts for future delivery are presently or in the future dealt in.

The phrase ‘and all other goods and articles’ involving ‘contracts for future delivery’ includes a much larger universe of products than those listed, such as: food and fibre products, e.g., cocoa, coffee and sugar; metals, e.g., gold, silver and copper; energy products, e.g., crude oil, natural gas and propane; and, financial securities, e.g., stock indexes and fixed income securities.

Legally, the definition used to identify a commodity in US law provides a binding limitation on the authority of the Commodity Futures Trading Commission (CFTC). A decades old conflict with the Securities and Exchange Commission (SEC) over jurisdictional authority is founded on the definition of a commodity. Are financial securities to be considered as commodities? Is a derivative contract on a stock index different from such a contract for wheat or copper? Is commodity risk distinct from financial risk? Do theoretical tools useful for financial risk management also work for managing commodity risks? And so it goes. Failure of the CFTC effort in 1998 to extend authority over OTC trading in financial derivatives – a key element in the financial market collapse of 2008–2009 – can be attributed to a definitional dispute over what constitute ‘commodity futures’ and related derivative security contracts. This failure reflects the limitations of using a legal definition to capture essential elements of contracts associated with commodity trading activity.

The legal definition of a commodity embodied in the CEA is driven by the types of contracts associated with the trading of commodities. An alternative to the legal definition of a commodity is to isolate the essential features that distinguish commodities and financial securities. More precisely, in contrast to financial securities, commodities are physical goods that are costly to store and produce. As a consequence, commodities can generate a convenience yield for stocks of the

commodity. The behaviour of the convenience yield will differ across time and commodities. In a derivative security pricing context, factors such as costs of storage and convenience yield fundamentally restrict the execution of long dated cash-and-carry arbitrages for physical commodities. This has direct implications for the liquidity and price discovery properties of long dated derivative security contracts. The limit of the definition is provided by commodities such as gold that have near zero storage costs, a plentiful stock of gold available for lending to short sellers, and cash and carry yields that are close to those of financial securities. In turn, the strategic risk management problems confronting, say, a silver mine operator are similar to those of a copper mine, not an investment bank. Something more is required of the definition.

### **What is a Commodity? A Functional Definition**

The definition of a commodity used in this book distinguishes between financial securities and physical commodities. This distinction has fundamental implications. For example, the cash and carry arbitrage conditions that determine derivative security prices differ substantively. While the subject of financial risk management has been exhaustively considered in a seemingly countless parade of academic journal articles, books and other contributions, there is a comparative absence of sources on non-financial, commodity risk management. In turn, the bulk of these sources seek to extend techniques developed for managing financial risks to non-financial risks. The result – financial engineering or portfolio management with physical commodities – is primarily of use to investment bankers, market makers and others involved in intermediating the risk management and investment products on offer to retail and institutional investors. An airline seeking to manage the price and volume risk of future jet fuel purchases receives little guidance. Similarly, a corn farmer or feedlot operator worried about future price movements for corn receives only general guidance with little practical impact. Even the general guidance being given can sometime provide dubious recommendations that fail to capture key economic impacts of the risk management decision on the underlying strategic business decision problem.

Requiring a commodity to involve costly production and storage provides essential structure to the search for optimal risk management solutions considered in this book. Financial ‘commodities’ such as stock indexes, sovereign government debt securities and Euro-currency deposits are specifically excluded from this definition. The dividing line between financial and physical commodities is provided by the physical commodity with the greatest financial use, gold, which is considered a physical commodity in this book. In other words, in this book ‘commodity’ is used as a shortened form of ‘physical commodity’. Examining commodities coming within this definition reveals other common aspects, such as being consumable, costly to produce and having variation in supply. In more technical terms, the commodity risk management decision can involve both price and quantity risk. There are also elements of Keynesian uncertainty associated with the production, storage and consumption decisions involving specific commodities that fundamentally impact the risk management decision. Included in these elements is the increasing financial securitization of commodity transactions, especially storage, for certain commodities that has had unintended consequences for the individuals and firms directly involved in those markets, e.g., United States Senate Permanent Subcommittee on Investigations (USSPS 2007, 2009).

## Elements of Commodity Risk

Developing a framework for adequately identifying and managing the range of commodity risks confronting the non-financial corporation is not possible. There is too much variation across the types of risk encountered by the numerous commodity producing and consuming firms that a general framework is unhelpful at best, and could be misleading. Some method of simplifying the process is needed. One possible method is to classify the types of risks encountered. The modern approach to risk management typically proceeds by classifying risks into the following categories: business or commercial risks; market risks; credit risks; liquidity risks; operational risks; and legal risks. Of these categories, commodity risk management is fundamentally concerned with the interaction between commercial risk and commodity price risk, whereas financial risk management is concerned with the interaction of financial price risk, credit risk and liquidity risk. While non-financial corporations involved in the production and consumption of commodities do recognize financial risks in the financial statements, it is commercial and commodity price risk that are the central elements of the 'commodity risk management' decisions confronting such firms.

For example, consider each of these categories that appear in the listing of risks from the 2010 Annual Report (2011) for BHP Billiton, one of the largest mining companies in the world. In approximate order of appearance, these risks are: fluctuations in commodity prices and impacts of the global financial crisis (market risk); currency exchange rate fluctuations (market risk); commercial counterparties may not meet their obligations (credit risk); failure to discover new reserves, maintain or enhance existing reserves or develop new operations (business risk); reduction in Chinese demand (business risk); actions by governments or political events in the countries in which we operate (legal risk); health, safety, environmental and community incidents or accidents and related regulations (operational and legal risk); reduced liquidity and available sources of capital in financial markets may impact the cost and ability to fund planned investments (liquidity risk); breaches in our information technology (IT) security processes (operational risk); and, breach of our governance processes may lead to regulatory penalties and loss of reputation (operational and legal risk). It is not pedagogically possible for 'commodity risk management' to deal systematically with all such risks.

The degree to which specific firms are severely impacted by a particular type of risk can vary dramatically. Consider the difficult environmental and regulatory risks of the Canadian mining company Galactic Resources operating the Summitville gold mine Colorado. The breach of a heap leach mining pad in 1989 led in 1993 to the company filing for bankruptcy due primarily to Summitville environmental risk liabilities. Another Canadian mining company, First Quantum Minerals, faced severe political risk with the expropriation of the Kolwezi, Frontier and Lonshi projects by the government of the Democratic Republic of the Congo in 2009 and 2010 under mysterious circumstances.<sup>1</sup> These types of specific risk can be contrasted with the weather related risks faced by wheat farmers during planting time or to the risk for cantaloupe growers associated with the listeria outbreak in Oct. 2011. It is not possible to deal in a systematic fashion with all such elements of commodity risk. As a consequence, in what follows attention will focus on the strategic interaction of market risk and business risk for non-financial firms involved in the production and consumption of commodities. While some attention is given to FX risk, the essential element of

market risk is associated with the variation in commodity prices.

## Methods of Commodity Risk Management

Stretching back to antiquity, forward contracts with option features have been used to manage commodity risk. The need to acquire sufficient future supply of a commodity by consumers and the assurance of a profitable price for risky, costly and time consuming production can provide strong cash market incentives to engage in the use of such contracting procedures. More generally, the economic basis for the use of contracts with contingencies arises from the process of exchange in commodity markets. This process involves two steps. First, a buyer and seller agree on a market clearing price for the goods involved in the transaction. Second, the transaction is completed, typically with a cash payment being made in exchange for adequate physical delivery of the goods involved. In small rural markets and bazaars, both steps occur at the same time. In many large commercial transactions, time can separate the pricing agreement, the cash settlement or the delivery of goods. For example, a forward credit sale involves immediate pricing, delivery at a later date as specified in the forward contract and settlement dates dependent on the credit conditions extended by the seller.

The traditional subject of ‘risk’ management as portrayed in financial economics, e.g., Merton (1993), Tufano (1996), Poitras (2002), Chance and Brooks (2010), emphasizes controlling risk through: diversification; hedging; and, insurance. Applications of ‘free standing’ derivative securities to risk management situations are emphasized. This approach is somewhat misleading, as it disguises the problem of specifying the risk management situation and gives the appearance that the risk involved can, somehow, be managed in a systematic and unambiguous fashion using derivative security contracting. In emphasizing pro-active management techniques, methods needed for risk avoidance and risk absorption are often not examined. The various risk management approaches also differ in applicability to specific cases. In some situations, such as the Tufano (1996) gold mining sample, the firms involved may have little opportunity to exploit diversification opportunities to manage risk. Situations vary and the identification of an optimal risk management strategy depends on the objective function specified. Similarly, the management of “risks” disguises the importance of the “uncertainty” contained in random future events. It is difficult to formulate general rules. Even if general rules can be derived, such rules rely crucially on information about the properties of the relevant random variables, i.e., the types of risks being managed

The “insurance principle” approach used in actuarial science provides an excellent source of general insights into certain types of risk management problems, e.g., Trieschmann (2005). By design, the insurance principle approach examines situations where only the chance of loss or no loss is considered. This is a restriction on the properties of the random variables being modeled. As such, there is only partial overlap with the situations of commodity businesses, where the random variables involved in risk management, such as corporate profits or changes in shareholder wealth, can take both positive and negative values. Whereas insurance problems seek to reduce risk, it may be desirable to increase certain commercial risks if the potential gains significantly outweigh the possibility and size of loss. Given these qualifications, Vaughan (1982) suggests the following insurance principle methods for handling the risks faced in actuarial science: *risk can be avoided*, e.g., by foregoing the writing of a policy; *risk may be retained*, e.g., by self-insuring; *risk may be*

*transferred*, e.g., through hedging; *risk may be shared*, e.g., through the purchase of reinsurance; and, *risk may be reduced*, e.g., by increasing audit surveillance.

The contrast between the actuarial science approach and that suggested by financial economics is revealing. There is some close correspondences. Risk reduction can be equated to diversification, risk transference to hedging and risk sharing to insurance. This leaves risk avoidance and risk retention not counted. These omissions are significant. Financial economists tend to approach risk management by emphasizing applications of the various risk management products which are available in the financial marketplace, e.g., Aretz et al. (2007), Servaes et al. (2009). Limited attention is given to identifying methods of self-insuring or risk avoidance. Yet, these methods do receive attention in studies outside the financial risk management arena. For example, a number of strategic management studies, e.g., Oxelheim and Wihlborg (1997), propose techniques for strategic hedging, which can lead to self-insurance as an outcome of active risk management. Similarly, strategic risk management preaches risk avoidance through natural hedging. These different potential approaches to risk management tend to take different views on the types of randomness and commercial situations that face decision makers.

Assessing the relevance of these different views becomes more complicated when it is recognized that actuarial science, the mathematical science of insurance, is not concerned with the range of risks that are conventionally encountered in commodity markets. Actuaries are typically concerned with the probability of loss versus no loss.<sup>2</sup> Many of the risks encountered in commercial markets are *speculative risks*, where there is a possibility of loss, as well as a possibility of gain. Such risks can be distinguished from *pure risks* which involve situations with only the chance of loss or no loss (Vaughan 1982, p.8):

The distinction between pure and speculative risks is an important one, because normally only pure risks are insurable. Insurance is not concerned with the protection of individuals against those losses arising out of speculative risks. Speculative risk is voluntarily accepted because of its two-dimensional nature, which includes the possibility of gain.

It is apparent that the study of risk management requires a careful and detailed discussion of the definition and classification of the types of risks that are going to be managed.

From the 2010 Annual Report for Tim Hortons Inc.

### **Commodity Risk**

We purchase certain products such as coffee, wheat, edible oil and sugar in the normal course of business, the prices of which are affected by commodity prices. Therefore, we are exposed to some price volatility related to weather and more importantly, various other market conditions outside of our control. However, we do employ various purchasing and pricing contract techniques in an effort to minimize volatility. Generally these techniques include setting fixed prices for periods of up to one year with suppliers, setting in advance the price for products to be delivered in the future and unit pricing based on an average of commodity prices over the corresponding period of time. We purchase a significant amount of green coffee and typically have purchase commitments fixing the price for a minimum of six months, and we also typically hedge against the risk of foreign exchange at the same time. We do not generally make use of financial instruments to hedge commodity prices, partly because of these contract pricing techniques. As we make purchases beyond our current commitments, we may be subject to higher commodity prices depending upon prevailing market conditions. While price volatility can occur, which would impact profit margins, we and our franchisees have some ability to increase product pricing to offset a rise in commodity prices, subject to franchisee and customer acceptance, respectively.

In addition, we currently have purchase contracts in place for at least the first half of 2010 covering key commodities such as coffee, wheat, sugar, and cooking oils. As we have stated previously, we may be subject to higher commodity prices depending upon prevailing market conditions and foreign exchange rates at the time we make purchases beyond our current commitments. Higher commodity costs could also impact earnings from our joint venture operations.

### **Risk Management: Speculation and Investment in Real Assets**

Businesses that produce, transport and consume commodities require real assets to conduct these activities. As such, the production, transportation and consumption of commodities require capital investments in hard assets. Because the expected return on such investments will depend on commodity prices, there is a fundamental connection between the speculative element in commodity risk management and the associated capital investment decision problem. This permits commodity market participants to be notionally segmented according to the degree of participation in the underlying commodity cash market. This contrasts with financial markets where a functional distinction is made between intermediaries – depository institutions, investment banks, asset management companies – and end users, the lenders and borrowers using financial products that are relatively costless to produce, transport and consume. This functional difference extends to commodity risk management versus financial risk management. More precisely, the need to

understand the strategic commercial implications of risk management decisions is distinctly different in commodity markets than in financial markets.

At a more general level, the process of understanding and interpreting the implications of strategic commercial decisions is an essential part of the ‘fundamental’ approach to the valuation of equity securities, e.g., Graham and Dodd (1934); Poitras (2011). In turn, the commodity risk management strategies pursued by firms involved in the production of commodities have substantive implications for valuing the equity securities of those firms. Applying fundamental valuation techniques to assess the commodity risk management strategies of specific firms leads to consideration of the definitional distinction between speculation and investment that is fundamental to the work ‘value investors’, such as the prominent equity security analysts, Benjamin Graham and Warren Buffett. This distinction has a helpful extension in commodity risk management where, as the chapter opening quote by Hieronymus reflects, decisions involving commodity price risk are inherently speculative. The widespread application of financial risk management techniques to manage commodity risks ignores this distinction, e.g., Stoll and Whaley (2010).<sup>3</sup>

The distinction between speculation and investment in fundamental analysis roughly corresponds to the notional distinction between ‘speculation’ and ‘hedging’ identified in CFTC (2008, p.2) and numerous other sources. For example, in the *Intelligent Investor* (1949, p.), Graham observes:

The distinction between investment and speculation in common stocks has always been a useful one and its disappearance is a cause for concern. We have often said that Wall Street as an institution would be well advised to reinstate this distinction and to emphasize it in all dealings with the public. Otherwise the stock exchanges may some day be blamed for heavy speculative losses, which those who suffered them had not been properly warned against.

This statement has a direct parallel in the commodity ETFs currently offered on stock exchanges to provide ‘efficient diversification of investment portfolios’. The eventual collapse in prices precipitated by ‘investor’ dis-hoarding contains the ‘seeds of blame’ for heavy speculative losses by commodity producing firms that made unhedged capital investments based on higher ‘expected’ prices, sustained by the implicit assumption that investor demand would continue unabated over the life of the capital investment.

Despite being a widely used concept, subtle and not-so-subtle differences in the definition of speculation abound. For example, the American Heritage dictionary recognizes two general uses. There is the colloquial usage: “1. Contemplation or consideration of a subject; meditation; 2. A conclusion, opinion, or theory reached by conjecture; 3. Reasoning based on inconclusive evidence; conjecture or supposition”. In addition, there is the commercial usage: “1. Engagement in risky business transactions on the chance of quick or considerable profit; 2. A commercial or financial transaction involving speculation.” Of these, the most relevant to commodity risk management – “Engagement in risky business transactions on the chance of quick or considerable profit” – fails to adequately recognize fundamental elements of speculation. Similarly, the definition of speculation given on the popular internet site *Investopedia* focuses on expanding the commercial dictionary definition: “Speculation: The process of selecting investments with higher risk in order to profit from an anticipated price movement.” The following explanation is also provided: “Speculation should not be considered purely a form of gambling, as speculators do make an informed decision before



choosing to acquire the additional risks. Additionally, speculation cannot be categorized as a traditional investment because the acquired risk is higher than average.”

As reflected in standard dictionary definitions, laymen associate speculation with ‘high’ or ‘higher’ risk transactions.<sup>4</sup> This view of speculation contrasts sharply with the legal definition contained in the CEA and employed by regulators. For example, CFTC (2008, p.68) states that “speculator” means “a trader who does not hedge, but who trades with the objective of achieving profits through the successful anticipation of outright price movements or through relative price movements in the case of spread trades.” In contrast, ‘hedgers’ seek to manage the price risks associated with the sale, purchase, or use of a commodity. Investigating ‘excessive speculation’ in the wheat futures market by commodity index traders, USPSI (2009) recognizes the difficulties of distinguishing between hedging and speculative motivations:

“Hedging” is the term used to describe the activity of someone who is using the futures market to manage the price risks associated with the sale, purchase, or use of a commodity. Hedging has sometimes been described as an activity undertaken by the producer, merchant, or end-user of a commodity as opposed to a speculator who does not produce, use, or consume the commodity. Since there are numerous strategies and approaches to managing price risks, however, it often is impossible to distinguish, from an economic perspective, whether a particular transaction is, in fact, hedging or speculation. The line between minimizing risks – which is what the term “hedge” connotes – and maximizing profits – which is what the term “speculation” connotes – can be exceedingly difficult to draw.

Table 1.A.a captures the current distinctions between different types of traders made by the CFTC in the useful weekly *Commitment of Traders* (COT) report that decomposes the Tuesday open interest.

INSERT Table 1.A.a  
CFTC Commitment of Traders, Wheat and Crude Oil

In 2006, the CFTC undertook to make changes to the COT report. The reasons for this review were given as (CFTC 2008a):

Over time, for some commodities the nature of the positions carried in the COT reports has changed significantly. Prior to 1991, both the long and the short side of the commercial open interest listed in the COT reports represented traditional hedgers (producers, processors, manufacturers or merchants handling the commodity or its products or byproducts). Since that time, trading practices have evolved to such an extent that, today, a significant proportion of the long-side open interest in a number of major physical commodity futures contracts is held by so-called non-traditional hedgers (e.g., swap dealers), while the traditional hedgers may be either net long or net short (more often, the latter). This has raised questions as to whether the COT report can reliably be used to assess overall futures activity by persons who are directly involved in the underlying physical commodity markets.

Following the 2006 review of the COT, new categories for ‘managed money’ and ‘swap dealer’ categories appear in the revised COT (see Table 1.A.a). These additional categories represent a substantive improvement over the ‘legacy’ COT reports that only gave results for ‘Commercial’, ‘Non-Commercial’ and ‘Non-reportable’ positions.

## **B. Commodity Characteristics**

### **Overview**

It is conventional to identify and categorize various risks that may be encountered in financial and ‘non-financial’ commercial operations. Important categories typically include: Credit risk; Market risk; Liquidity and funding risk; Operational risk; Regulatory and legal risk; and, Reputation risk. While such categorization of risk is insightful for financial firms, it is market risk that usually predominates in commodity risk management, e.g., Bartram (2005). To be sure, as discussed in Section I.3, there are significant operational risks. In addition, certain commodity producers, e.g., heap-leach gold miners or oil sands miners, face substantial regulatory and legal risk. Junior mining companies, small grain and oil seed farmers and junior oil and gas exploration companies often face substantial liquidity and funding risks. And so it goes. Such risks are specific to a particular commercial situation. What is common to commodity risk management situations is a concern about ‘market risk’ or, in other words, the behaviour of the commodity price over time. As a consequence, ‘commodity risk management’ requires understanding of the basic characteristics of commodity prices relevant to the commercial situation at hand.

INSERT Figure 1.B.a CME Website

The number of commodity prices in the world is overwhelming, especially if variation in commodity quality and location are taken into account. Some method of classification and simplification is indicated before commodity price characteristics can be identified. For this purpose, standard ‘complex’ classifications employed by the derivative security industry can be used. These classifications focus on sectors of commodity production: the agriculture complex; the energy complex; and, the metals complex. Each ‘complex’ contains a number of categories. For example on Oct. 30, 2011, within the agriculture complex on the Chicago Mercantile Exchange (CME) there is contract trading for: grains and oilseeds; livestock; dairy; forestry; soft commodities; and commodity indexes (see Figure 1.B.a). Tunnelling into, say, ‘livestock’ reveals contracts for live cattle, feeder cattle and lean hogs. The date is relevant because the contracts listed for trade change over time, sometimes significantly. For example, on July 18, 2011 the CME de-listed the frozen pork bellies contract due to lack of trading volume. Yet, during the 1960's the success of this contract was primarily responsible for the survival of the CME as an exchange following the Congressional ban imposed on trading the onion futures contract, e.g., Castaldo (2011).

Classifying commodities into ‘complexes’ is not without difficulties. Commodities within a given complex share some basic price characteristics, e.g., commodity prices in the metals complex are usually sensitive to levels of industrial production. However, there is sufficient heterogeneity that it is usually necessary to consider characteristics specific to a particular commodity within a

complex. For example, in the energy complex the characteristics of natural gas prices have been distinct from those of crude oil in the last three years (see Figures 1.B.b and 1.B.c) due to, among other factors, rapid change in natural gas drilling technology. Consider also the impact of geographical location. Different infrastructure requirements for production, transportation and consumption impact on natural gas pricing and availability differently than for crude oil (see Figure 1.B.d for oil pipeline infrastructure-). With this in mind, only price characteristics of specific commodities relevant to the discussion in Parts II and III of this book are examined in this section. More precisely, the commodities considered are within: the energy complex – crude oil and natural gas; and, the metals complex – base metals and precious metals. Some information on the agricultural complex – primarily US grains and oilseeds – is provided in section 2.3.C.<sup>5</sup>

INSERT Figure 1.B.b Natural Gas and Crude Oil Prices

INSERT Figure 1.B.c Impact of Events on Crude Oil Prices

INSERT Figure 1.B.d Oil Pipeline Infrastructure

## The Economics of Resource and Reserve Deposits

The classification of resources and reserves is an essential part of valuing the real assets associated with: mines and mining deposits, e.g., BHP; and, oil and gas exploration and production companies, e.g., CNQ. Various standards and codes have been introduced in different jurisdictions to determine the information about resource and reserve deposits that listed companies can claim (Rudenno 2009). For the case of mineral resources and reserves, in Australia the Joint Ore Reserves Committee (JORC) – established in 1996 by the Australian Institute of Mining and Metallurgy, the Australian Institute of Geoscientists and the Minerals Council of Australia – has determined the code of mineral classification for Australian companies. In Canada, the code is referred to as National Instrument (NI) 43-101 which was established by the Canadian Securities Administrators – the association of provincial securities regulators – in response to the Bre-X debacle of 1997. In South Africa, the South African Mineral Resource Committee (SAMREC) code was introduced in 1994 following the report of a committee formed by the Geological Society of South Africa (GSSA) in response to the Council of Mining and Metallurgical Institutions (CMMI). These codes are similar and are accepted by security regulators in other listing jurisdictions such as Hong Kong and London.

The problem of accurately determining the characteristics of a mineralization are often daunting. As Rudenno observes: “every orebody is unique, and the total exploration data may only represent as little as one-ten-millionth of the total resource, the classifications are much more qualitative than quantitative”. For this reason, available codes require a ‘competent person’ to prepare resource and reserve estimates. With this in mind, the codes make a distinction between *inferred*, *indicated* and *measured resources*. Such estimates refer to the physical characteristics of the mineralization that have been identified by drilling or other methods. Resource estimates do not take account of the economic viability of the deposit but, rather, attempt to determine size and continuity. A measured resource has enough data to confirm size and continuity of some part, possibly all, of the mineralization. An indicated resource does not meet the threshold of a measured resource but is supported by sufficient data to reasonably expect mineralization continuity. An inferred resource has little or no data but is being ‘inferred’, usually from the presence of ‘measured’ and ‘indicated’

resources in the same general location.

While resource estimates deal with physical characteristics of the deposit, **reserve** calculation is concerned with economic viability of resource recovery. In addition to mining and metallurgical considerations, reserve estimates also have to take environmental, economic and legal considerations into account. Reserves are classified into two categories: proven and probable. An economically viable indicated resource is a **probable reserve**. An economically viable measured resource is a **proven reserve**. The conversion of resources into reserves depends fundamentally on the price of the commodity involved. Significant changes in prices can change the mine-able supply dramatically, both for individual companies and for the whole industry.

Calculation of resources and reserves for oil and gas companies follows much the same lines as for mineral deposits. However, the codes employed are typically those set out by the American Society of Petroleum Engineers and the World Petroleum Council. Reserves can be proved, probable or possible. Proved reserves have reasonable certainty of economic recoverability. Probable reserves are less certain than proved reserves but are more likely than not to be economically recoverable. Possible reserves are associated with insufficient data about the specific reservoir. Recognizing that oil often occurs in familiar basins and geological formations gives possible reserves more meaning than would be the case for most mineral deposits. Contingent **resources** have been discovered but are not yet economically viable while prospective resources are potentially recoverable but not yet subject to drilling activity. There is also allowance for 'unproved reserves' which for technical, political or regulatory reasons cannot be classified as proven. The relevance of these various definitions for strategic decision making of specific firms is apparent when evaluating the economically important Canadian oil sands deposits.

### Canadian Oil Sands Deposits

For commodity risk management purposes, variation in the characteristics of a given commodity can have significant implications. Commodity geographical location, method of extraction and transportation, quality variation and so on can affect whether and how a firm will manage commodity risk. For example, an open pit metallurgical coal mine with low relative cost of production and accessible to bulk transportation networks may make different commodity risk management decisions than an underground thermal coal producer with high relative cost of production and increasing transportation costs due to a loss of local customers arising from a shift to natural gas from coal for electricity production. Crude oil from the Canadian oil sands provides a useful example of the variable characteristics of crude oil. Resource location, differences in extraction technologies and quality of crude produced are all elements that impact the characteristics of crude oil extracted from the Canadian oil sands. Figure 1.B.e illustrates the different composition of refinery output from different qualities of crude oil.

#### INSERT Figure 1.B.e Composition of Refined Output

Various estimates have been proposed for the size of the oil reserves contained in the Alberta oil sands. Haines (2001, p.32) quotes Alberta government estimates of 1.6 trillion to 2.5 trillion barrels of bitumen. In contrast, Reynolds (2005, p.53) argues such figures are "poor and confusing

information”. In some calculations, the total supply of bitumen available in the Alberta oil sands reserve base is larger than the world’s proven reserves of conventional oil deposits. However, due to the presence of clay, sand and other earth elements mixed with the bitumen, oil sands do not have the same production economics as for conventional oil reserves. For example, the separation of the clay or sand from the bitumen and obtaining sufficient viscosity in the bitumen for extraction requires heating which adds substantially to the extraction cost.

The oil sands ‘reserves’ are located in the Cold Lake, Athabasca and Peace River areas of Alberta (see Fig. 1.B.e, Map 1.a and Map 1.B below). Only about 18% of these ‘reserves’ are surface reserves that can be mined. The surface reserves are located primarily in the Athabasca region which is situated north of Fort McMurray. Even though the size of the surface reserves is small relative to the total oil sands resource, the substantially higher recovery rate of bitumen from surface reserves and the high yield of synthetic crude oil (SCO) from the bitumen makes these reserves a larger exploitable portion of the oil sands resource base.

INSERT FIGURE 1.B.f  
Physical Composition of oil sand  
INSERT MAP 1.a  
bitumen\_in\_alberta.jpg

Casual inspection of Figure 1.B.g and Table 1.B.h reveals that the widely respected estimates of world oil reserves produced annually by BP reflect the difficulties of classifying resource or reserve value to the oil sands. A significant amount of the increase for Canada between 1998 and 2007 in Table 1.B.h is due to the addition of about 16 billion oil sands reserves to the Canadian total which is below that for Libya and the Sudan. This compares to reserve estimates of around 175 billion barrels of economically recoverable crude oil produced by the Alberta government, an estimate accepted by the US Energy Information Administration. If accepted, this would place Canadian oil reserves behind only Saudi Arabia. This highlights the difficulties with straight forward assessment of the world oil market by examining supply and demand factors. The actual supply of economically recoverable oil varies with the assessment of market price and the costs of oil recovery. As this spread widens, previously uneconomic reserves become feasible. This tipping point toward profitability occurred for the early Alberta oil sands producers when WTI crude oil traded above \$20 per barrel.

INSERT Fig. 1.B.g  
BP Oil reserves chart  
INSERT Table 1.B.h  
Proven Oil Reserves

### **What are the Oil Sands?**

The Canadian oil sands are an immense resource located primarily in the province of Alberta, e.g., Chastko (2004). An oil sand is a naturally occurring mixture of bitumen, water and clay or sand (see Figure 1.B.f). Following, Atkins and MacFayden (2008, p.80), it is:

important to realize that Alberta's oil sands and heavy oil deposits are not homogeneous ... Among the important ways in which deposits differ are: specific gravity (some crudes are heavier than other oils), bitumen concentration (the proportion by weight or volume which is bitumen, ranging from 1% to 18%) and depth (where shallow deposits – usually up to 75 metres deep – are regarded as amenable to mining operations).

Bitumen is a sticky, viscous type of crude oil with low API gravity compared to other types of crude. A light sweet crude, such as the West Texas Intermediate (WTI) that is the deliverable commodity for the widely followed NYMEX crude oil futures contract, has an API gravity of not less than 37° and not more than 42° while a heavy crude, such as that produced in Saudi Arabia, has an API gravity of 10° to 20°. <sup>6</sup> Even with the sand, clay and water removed, bitumen still has an API gravity well below 10°. For example, the low sulphur, upgraded Syncrude sweet blend (SSB) produced by Syncrude prior to 2007 only obtained an API gravity of 30° with the Syncrude sweet premium blend produced since 2007 being slightly higher. Because oil from conventional drilled wells has to travel up the well bore in order to be recovered, the API gravity determines the potential recovery rate. Light sweet crude deposits have a recovery rate of about 30% while heavy crude deposits have recovery rates up to 20% using conventional recovery methods. The API gravity of bitumen depends on the depth of the deposit. In addition, the composition of refinery output for heavy and light crude oils results in higher value products being obtained from light crude (see Fig. 1.B.e).

Unlike conventional crude oil and heavy oil deposits that are accessible only by drilling, approximately 18% of the Alberta oil sands are at depths from the surface down to 245 feet. Even though this surface oil sand bitumen has an API gravity of from 0° to 10°, “the first two commercial oil sands mining plants built in Alberta ... produce a little over 0.8 of a barrel of syncrude per barrel of bitumen” (Atkins and MacFayden 2008). Allowance made for loss of bitumen in the slurring process, which depends on the richness of the oil sands being mined, produces an additional loss of about .15. As a result, about 65% of the crude oil contained in the surface oil sand can be recovered because the resource at this depth range can be open pit mined. Oil sands at depths below 245 feet usually have an API gravity about the same as heavy crude and have to be recovered through drilling and *in situ* (in the formation) methods. While these deposits have a recovery rate of between 25%-75%, the costs of loosening up the solid oil sand for extraction makes for much higher recovery costs than for oil sands mining which, in turn, is considerably more expensive than conventional oil. Though a number of extraction techniques of bitumen deposits below 245 feet are being explored, steam assisted gravity drainage (SAGD) has proven to be the most popular to date (see Figure 1.B.j). This technology requires considerable energy to generate the steam. There are few alternatives to the use of steam, e.g., Toe-to-Heel Injection method used at the Whitesands project.

INSERT Figure 1.B.j Steam Assisted Gravity Drainage

## History of the Oil Sands

The Alberta oil sands have fascinated people for centuries.<sup>7</sup> The early European explorers and fur traders were impressed by the presence of large surface pools of bitumen in the Athabasca region of northern Alberta. For example, the famous explorer, Alexander Mackenzie, travelling through

the region in 1788 recorded in his journal:

At about 24 miles from the fork (of the Athabasca and Clearwater Rivers) are some bituminous fountains into which a pole of 20 feet long may be inserted without the least resistance. The bitumen is in a fluid state and when mixed with gum, the resinous substance collected from the spruce fir, it serves to gum the Indians' canoes. In its heated state it emits a smell like that of sea coal.

The first geological survey of the area was conducted in 1875 with further exploratory efforts being made in 1882 and 1889. The first attempts to commercially develop the oil sands in the Athabasca region were initiated in 1906 by the entrepreneur Alfred von Hammerstein. This project was based on the assumption that the surface bitumen was originating from pools of oil deep beneath the surface. In an attempt to locate these pools, a series of well holes were drilled in the area north of Fort McMurray where the bulk of surface bitumen in the Alberta oil sands is located. This drilling activity continued from 1906 to 1917, with a total of 24 wells being drilled. Due to the faulty initial assumption, none of the drills holes was successful at finding oil. However, the drilling activity did discover salt deposits which became a major industry in the Fort McMurray area for 50 years, until it was eclipsed by the oil sands developments.

INSERT Figure 1.B.k  
Bitumen Recovery Process

Since the early attempts at locating conventional oil deposits by drilling, there have been ongoing attempts to identify a commercially viable method of extracting the surface oil in the region. The process that is used in Syncrude and other heavy oil mining projects involves the use of a hot water flotation method to separate the bitumen from the sand (see Figure 1.B.k). The development of this method for processing oil sands has a long history. Early onsite research on this method began around 1913 when Sidney Ells, a federal Department of Mines engineer, began a series of experiments on the viability of applying this technique to the oil sands. Ells continued this work until 1945. One of these experiments involved shipping mined bitumen to Edmonton for use as road paving material. While it was demonstrated that paving material was a feasible use for the separated oil sand, the costs of application were not competitive with imported asphalt and the project was dropped. Another commercial attempt to develop the oil sands using the hot water floatation method began in the 1920s when an entrepreneur, R.C. Fitzsimmons, used the process to produce bitumen for roofing and road surfacing at a plant near Bitumount, 80 kilometres north of Fort McMurray. Financial difficulties eventually forced Fitzsimmons to sell the operation in 1942.

Much of the early history of oil sands development using the hot water flotation method involves research done by the federal and Alberta governments. In addition to the work of Sidney Ells, during the 1920's Dr. Karl Clark, a scientist with the Alberta Research Council, also conducted experiments with a hot water flotation process which involved mixing oil sand with hot water and aerating the resulting slurry. This separates the oil sand into a floating bitumen froth and a layer of sand that settles to the bottom of the holding tank. In 1948, the Alberta government acquired the Fitzsimmons plant to investigate the application of extraction methods, such as those investigated by Clark, using

large scale equipment. By 1949, the plant was processing 450 tonnes of oil sand daily. While an experimental success, the plant was closed because the Alberta government was not motivated to launch a commercial venture. Data from the experiments was used as the basis for a major study of the viability of commercial production. The resulting Alberta government report indicated that crude oil production from the oil sand could be a profitable venture. Though this created some commercial interest during 1950's, it was not until the 1960's that major commercial ventures began to come on-stream.

The research of the Alberta government about the possibility of commercially viable extraction of crude oil or oil byproducts from the oil sands was not without practical foundation. In 1936, an entrepreneur, Max Ball, founded Abasand Oils Ltd that used a plant west of Fort McMurray to produce diesel oil from the oil sands. Despite the relatively small scale and commercially unproven technology, there was a considerable interest in his project, especially during World War II when diesel oil was in short supply. During the War, the plant was sold to the federal government and soon thereafter the plant burned down and the project died. Commercial oil production from the oil sands did not come to fruition until the Alberta government launched an initiative in 1962 that resulted in the Great Canadian Oil Sands Project (GCOS). Though GCOS experienced a number of ownership changes after its incorporation and prior to the construction decision, by 1963 ownership of the project resided with the Sun Oil Company (later Suncor Energy). It was this Suncor project that came on stream in 1967 to become the world's first commercial oil sands operation. The GCOS was soon followed by the Syncrude consortium that was formed in 1964.

### **The Syncrude Project and Oil Sands Mining**

Together with Suncor, Syncrude is one of the first two entrants into oil sands production in Canada. The initial objective of Syncrude was research on the technical and commercial feasibility of mining the surface bitumen from the oil sands in the Athabasca region north of Fort McMurray. Despite having grown into the largest single crude oil producing entity in Canada prior to the merger of Suncor and Petro-Canada in 2009, the history of Syncrude to the present has involved a substantial R&D effort to lower the costs of production through technological innovation. After an initial startup phase, Syncrude's proposal for a commercial production facility was eventually approved in 1969. Construction commenced on the Syncrude site in 1973. After five years of construction, the first barrel was shipped on July 30, 1978. This event was followed by the official opening of the Syncrude Project on September 15, 1978. Production has steadily increased since that time. On April 16, 1998, the billionth barrel was delivered to the consortium members, five years ahead of schedule. The production facilities have progressively expanded in phases.

In 2001, phase 3 expansion was approved by the consortium. Scheduled for completion in 2004-5 and expected to add 100,000 barrels per day to Syncrude output, the initial estimated cost of this phase was C\$4 billion. Consistent with previous and subsequent experience in oil sands developments, this cost estimate gradually increased through the life of the expansion. Each consortium member is responsible for their pro rata share of the development costs. After a number of delays, the phase 3 expansion was finally brought on-line in Aug. 2006 at a final cost of \$8.55 billion. Syncrude's production facilities now have the design capability to produce approximately 375,000 barrels per day "when operating at full capacity under optimal conditions and with no



downtime for maintenance or turnarounds. Under normal operating conditions, scheduled downtime is required for maintenance and turnaround activities and unscheduled downtime will occur as a result of operational and mechanical problems, unanticipated repairs and other slowdowns” (COS 2008 Annual Report, p.5-6). When allowances for downtime are included, the designed productive capacity of Syncrude’s facilities is approximately 350,000 barrels per day, on average. Actual output since 2006 has been somewhat less than this.

Syncrude is a joint venture partnership owned, at year end 2011, by Canadian Oil Sands (36.74%), Imperial Oil Ltd. (25%), Suncor Energy (12%), Sinopec (acquired from ConocoPhillips Oil Sands Partnership in 2010) (9.03%), Nexen Oil Sands Partnership (7.23%) Mocal Energy Ltd.(5%), and Murphy Oil Company (5%).<sup>8</sup> Syncrude was the world’s largest producer of crude oil from oil sands until the Suncor PetroCanada merger was completed in 2009. In 2008, Syncrude produced about 289,000 barrels per day or 105.8 million barrels for the year of SCO at an average cost of \$35.26 per barrel. In 2010, the numbers were similar at 291,000 bbd. and a \$36.76 per barrel costs. The numbers for the first three quarters of 2011 are 311,000 bbd. and \$36.56 in costs per barrel. Syncrude output is usually below potential output for a number of reasons, including the need to conduct comprehensive scheduled turnaround and circulation problems in the coker. Costs per barrel do fluctuate. For example, for the second quarter of 2009 COS reports: “operating costs averaged \$50.23 per barrel compared with \$41.92 per barrel in 2008. For the six-month period, per barrel operating costs were \$43.66 and \$38.90 in 2009 and 2008, respectively” (COS, Q2-09 report). Lower production volumes are significant because “Syncrude’s operating costs are largely fixed, so changes in production volumes significantly impact per barrel operating costs.”

Syncrude is not the only operator working the oil sands, but it is the largest and, together with Suncor, one of the two oldest (see Map 1.B). The original oil sands project run by Suncor Energy Inc. produced about 228,000 barrels per day (bpd) in 2008 compared to 235,600 bpd in 2007. Recently, a number of other on-stream bitumen mining projects in the same area have come onstream including: the Athabasca Oil Sands Project – also called Shell Albion Sands – a joint venture by Shell Canada (60%), Chevron Canada (20%) and Marathon Oil Corp. (20%) with the Muskeg River Mine entering production in 2002 and full production achieved when the Scotford upgrader in Fort Saskatchewan, Alta. came onstream in 2003. With an original design capacity of about 155,000 barrels per day, there is currently a 100,000 bpd expansion underway that received regulatory approval in 2006. Other projects just completed include the Horizons Oil Sands project owned by Canadian Natural Resources (CNQ) that has an eventual project design capacity of about 255,000 bpd. The initial stage has a design capacity of 110,000, and came onstream in Feb. 2009 at a cost of just under \$10 billion and was producing an above design capacity 120,000 bpd by July 2009.

#### INSERT MAP 1.B Syncrude Oil Sands Leases

In addition to completed and currently producing projects, there are a number of projects at various stages of the development process. Escalating costs and other factors have contributed to a significant slowdown in development. Consider the Fort Hills Oil Sands Project where the original leases were owned by two junior oil and gas explorers: 78% by True North Energy, a full owned subsidiary of Koch Industries; and, 22% by UTS Energy. In April 2004, UTS agreed to acquire 100% control from True North. Not long after acquiring the company, UTS was able to get

companies capable of bringing an oil sands project to completion involved by having PetroCanada purchase a 60% share and Teck Cominco a 20% share. The initial True North project plans were to have the Fort Hills project producing approximately 95,000 barrels per day starting in 2005, with plans to ship the bitumen to a Koch refinery near St. Paul, Minn. for processing. These plans have changed a number of times. Current initial stage plan is for only a bitumen mining operation, with design capacity of 160,000 bpd, and use of Suncor upgrading facilities. The ultimate objective was a 280,000 operation and upgrader in place for 2014. Due to increase in costs of 50% or more that took final costs to over \$20 billion, the Fort Hills mining project was delayed indefinitely in Sept. 2008.

Oil sands mining operations are immense, easily one of the largest materials handling operations in the world. The Syncrude operation alone has an output equal to approximately 13 percent of Canada's petroleum requirements. The bitumen is mined using open pit techniques. A site is prepared for mining by removing the 'overburden'. This requires the use of 'supersized' trucks and shovels to expose the oil sands. Due to the progressive development of mining and extraction technology, original mines at Syncrude and Suncor use somewhat different and more costly mining and extraction techniques than more recent operations. For example, the original Base Mine at Syncrude uses two draglines to mine the oil sand, which is piled in windrows along the sides of the mine pit. The oil sand is dug from the windrows by bucketwheels and placed on a conveyor system that transports the material to the extraction plant. The North Mine was the next to be developed. The extraction technology at this mine uses trucks and shovels in conjunction with two hydrotransport pipelines. The ore from the truck and shovel operation is crushed and then mixed with hot water. This produces an oil sand slurry that is screened to remove large materials and then pumped through the hydrotransport pipeline to the extraction plant.

The mining technology used at the Base Mine during the extraction phase differs from that used at the Aurora mine. The bitumen from the Base Mine is extracted from the oil sand at the Base Plant where the oil sand from the Base Mine is fed into tumblers -- large horizontal rotating drums -- and mixed with steam, hot water and caustic soda in preparation for bitumen separation. The slurry from the tumbling phase is screened to remove large rocks and other such material before being pumped into four primary separation vessels (PSV's). At this stage, feedstock from the slurry coming from the North Mine hydrotransport system can be added to the process. A distributor directs the North mine slurry to any or all of the four PSV's, where it supplements feed from the tumblers. In addition to the Base Mine extractor, there is also an extraction plant at Aurora North. This extraction plant uses a low energy extraction process developed by Syncrude that is designed to operate at 25° Celsius. Included in the Syncrude technological innovations used at this plant are the hydrotransport of high-density slurry, froth underwash, lean froth recycle, and air injection to enhance flotation. The resultant froth from Aurora North is transported to the Base Plant via a pipeline for further processing at the froth treatment plant. At this stage, the frothy bitumen from the extraction plant is diluted with naphtha and cleaned using a combination of centrifuges and inclined plate separators.

Following the bitumen extraction phase, the naphtha treated bitumen froth enters the upgrading phase that eventually results in the output of SCO. The first step in upgrading is naphtha recovery for recycling back to the froth treatment plant. The naphtha reduced bitumen is then fed into two fluid cokers and one LC-Finer hydroprocessor for upgrading. The LC-Finer breaks down bitumen by adding hydrogen with the aid of a catalyst to produce gas oil. Gray (2002, p.53) describes the

relevance of this step: “Hydroconversion processes, such as LC-Fining ... , use catalyst and hydrogen to control coke formation and maximize yields”. Residuum from the LC-Finer are sent to the fluid cokers where it is mixed with bitumen. Each of the cokers can process up to 105,000 barrels of bitumen per day. High temperatures in the coker reactors cause the cracking or decomposing of the bitumen molecules into various products. The lighter products, primarily naphtha and gas oils, become the main ingredients of crude oil. Carbon is rejected in the fluid coking process as coke, some of which is burned to generate heat for the bitumen cracking process, while the remaining coke is stored in coke cells. Over time Syncrude has made improvements in the design and efficiency of the cokers and the LC-Finer to permit the processing of a heavier feed derived from the vacuum distillation unit (VDU). Following start-up of this unit in 1999, the gas oil extracted now is directed to the hydrotreaters.

The products from the cokers, the LC-Finer, and the gas oil from the VDU are processed in hydrotreating units that adds hydrogen using fixed bed catalytic reactors. This stabilizes the products, removes the nitrogen and sulphur and reduces product density, making SCO a highly desired feedstock for oil refineries. This is a crucial step as Gray (2002, p.53) observes: “The contributions of various reactions show that sulphur and nitrogen removed in the coke have the biggest impact on product density. Higher sulphur and nitrogen removal and lower hydrogen losses increase volumetric yield and product gravity”. Though all this discussion of extraction and upgrading may seem more appropriate to a chemical engineer than a security analyst, the relevance lies in the potential for: improvements in SCO quality; and reducing the cost of the extraction and upgrading process. The Syncrude project requires substantial amounts of energy to produce steam and hydrogen for the catalytic reactors. Internally generated fuel gas is used as the primary source of energy to generate electricity and steam, while natural gas is used mainly to produce hydrogen. Potential energy savings or reduction in hydrogen loss and the like by technological improvements will translate into gains for unitholders.

What are the physical limits to technological improvements in the upgrading process? Efforts to answer the question are an active area of research in chemical engineering. Because a number of different chemical reactions are occurring at once in the different stages of the upgrading process, it is difficult to predict precise outcomes. The bitumen entering the Syncrude upgrading process is typically around 7° API with 4.75% sulphur and 0.42% nitrogen. The LC-Fining hydroconversion process removes about 65% of the sulphur and 15% of the nitrogen but produces about 5.3% light ends. The delayed coking process removes only 37% of the sulphur, little or no nitrogen and produces about 2.0% light ends. Following Gray (2002, p.53): “any change in the coking process that increases sulphur and nitrogen concentration in the coke will enhance volumetric yield and product quality ... if hydrogen lost to light ends and to coke were halved, the volumetric yield of liquids would increase 1.8% and product gravity would increase by 2° API ... More effective catalysts for nitrogen removal would give significant benefit in product yield”. On balance, despite the potential for some improvement in API gravity and product yield, there is an underlying problem that adding more hydrogen to improve sulphur removal also tends to increase the amount of coke produced. Though some future gains are possible, physical limitations dictate that sizable increases in API gravity or product yield in the future do not seem too likely.

## Basics of Non-Ferrous Metals and Gold

The exact classification of ‘base’ metals varies somewhat. In chemistry, base metals are distinguished by physical characteristics. A base metal oxidizes or corrodes and reacts variably with diluted hydrochloric acid (HCl) to form hydrogen. This classification includes iron, nickel, lead, and zinc, with copper also included due to oxidation, even though copper does not react with HCl. In historical usage, ‘base’ metals are common and ‘low’ value by weight, while precious metals are rare and expensive by weight. One goal of medieval alchemists was to discover a method for transforming a base metal into a precious metal. In mining, a distinction is made between: non-ferrous base metals, primarily, copper, lead, nickel, aluminum and zinc; the ferrous metals, iron and steel; the precious metals, primarily gold, silver, platinum and palladium; and, rare earths such as lithium, vanadium and chromium. One of the most detailed information sources on minerals and metals, the *Minerals Yearbook* prepared by the US Geological Survey, does not use the ‘base metal’ terminology. Instead, ‘non-fuel minerals’ are decomposed into: ‘metals’, which includes ferrous, non-ferrous and precious metals; and, ‘industrial minerals’, which includes a wide range of minerals such as cement, salt, lime and phosphate.

For present purposes, it is sufficient to adopt the ‘non-ferrous metal’ definition of base metals used in mining. Though low in value relative to precious metals, base metals are higher in value than iron ore. In turn, the geology and economics of iron ore production combine to produce a capital intensive industry dominated by a small number of large producers and consumers. While the co-production value of other metals and minerals is largely irrelevant in iron ore production, such issues are often central to base metal mining. For example, many zinc mines also co-produce lead and other metals. The world’s third largest copper mine, the Freeport McMoran Grasberg mine in the Papua province of Indonesia, is also the world’s largest gold mine. In contrast to iron ore, demand and supply for base metals is sufficiently dispersed to sustain exchange trading, most notably at the London Metals exchange where futures, forward and options contracts are traded for aluminum, copper, tin, nickel, zinc, and lead. As risk management for base metal miners depends fundamentally on coordinating market prices and costs of production, the presence of actively traded derivative security contracts provides a viable method of managing market risk. However, upon closer inspection, the risk management activities of base metal mines are decidedly more complicated than simply placing transactions hedges to protect against price risk.

Being low in value relative to weight, base metal mining is inherently capital intensive. Accessibility to bulk transport by rail or sea and location of power lines and refining facilities can be as important as ore grade in determining mine feasibility, operation and profitability. Unlike the iron ore industry where three ‘major’ firms – Rio Tinto, Vale and BHP Billiton – control about 2/3 of the seaborne trade in iron ore – the base metal mining industry is populated by a combination of ‘major’ and ‘minor’ producers. Given the high relative cost of underground shaft mining, it is conventional for base metal mining to use surface mining techniques such as the open pit method of extraction. In particular, base metals usually occur in ore concentrations that are too low to warrant underground extraction methods. For example, the four largest Teck Cominco copper mines have ore concentrations varying from 0.26% at the copper-molybdenum Highland Valley mine in B.C. to 1.11% at the Antamina copper-zinc mine in Peru. The total amount of global copper resource is vast, estimated at  $10^{14}$  tons in the top kilometer of Earth's crust, about 5 million years

worth at the current rate of extraction. Estimates of copper reserves available for mining vary from 25 years to 60 years.

Being highly capital intensive the viability of such base metal mining operations ventures depends fundamentally on the price obtained for mine output. Even if the cost of production does not exceed revenues, i.e., the mine is viable, return to shareholders on invested capital will still depend on base metal prices. As illustrated in Fig. 1.B.L volatility in the price of copper has been remarkable over the last 5 years. As is common with base metals due to the capital intensiveness and scale of production, Fig. 1.B.m indicates that global copper mine production increased at a steady pace over the same period from about 15 million to 16 million metric tonnes. Combined with refining of scrap copper, there was an steady increase in the global supply of refined copper from 17.3 million tonnes to just over 19 million tonnes. In the last two years of data in Fig. 1.B.m refined output was more than matched by usage of refined copper resulting in a small decrease in global stockpiles. The volatility in copper prices has apparently happened without comparable disturbances in the supply of copper to the underlying cash market. Figures 1.B.n and 1.B.o illustrates the increasing importance of Chinese and Asian demand in the global copper market. The process of copper purchasing by the Chinese government is discussed in more detail in sec. 1.3.A.

INSERT Fig. 1.B.L Copper Prices and Stocks, 2000-2010

INSERT Fig. 1.B.m World Refined Copper Production

INSERT Fig. 1.B.n Major Users of Copper

INSERT Fig. 1.B.o Refined Copper Usage by Region

INSERT Fig. 1.B.p Refined Copper Production by Country

INSERT Fig. 1.B.q Copper Mine Production by Country

Casual inspection of the time series of copper prices provides strong evidence for the potential use of active commodity risk management strategies to enhance firm profitability. The long term risks to invested capital from future price movements is difficult to ignore. As indicated in Figs. 1.B.m, 1.B.n and 1.B.p, Chinese domestic copper production is unable to meet consumption demand. In turn, as indicated in Fig. 1.B.q, the bulk of available global supply is produced primarily in Chile, by a small collection of global mining companies in conjunction with domestic Chilean companies, especially Codelco. In the current global copper market, it is very difficult to predict prices using a traditional assessment of market fundamentals. In addition, copper is not without substitutes. If prices continue to increase, at some undetermined price point alternatives become attractive for some of copper's many uses (see Fig. 1.B.n). Copper pipe in plumbing can and is being replaced by plastic piping systems. In electrical applications, aluminum can be substituted. And so it goes.

INSERT Fig. 1.B.r Zinc Prices and Stocks, 2005-2011

INSERT Fig. 1.B.s Zinc Production

INSERT Fig. 1.B.t Zinc Usage

The situation in the global copper market can be contrasted with zinc. Contrary to popular perception, prices of base metals do not move together. Comparison of Fig. 1.B.L with Fig. 1.B.r reveals that zinc prices began falling in 2006 well prior to collapse in copper prices that began in

2008. Zinc prices have also not recovered to the levels reached in 2006 while copper prices have already exceeded previous highs, before falling back. Though zinc is the fourth most common metal in the earth's crust, with more than 50 countries mining zinc ore, much of global production is concentrated with the largest producers (see Fig. 1.B.s): China, Australia, Canada, Peru, and the United States. Ore grades for zinc are decidedly higher than for copper resulting in approximately: 80% mined underground; 8% mined in open pits, and, about 12% mined as a byproduct in combination with other metals. For example, the open pit Teck Cominco Red Dog zinc-lead mine in Alaska, arguably the world's largest single zinc producing mine with the largest reserves, has an ore grade of about 17%-19%. Unlike copper which has many uses, zinc is primarily used in galvanizing (see Fig. 1.B.t) and, to a less extent, in the production of bronze, brass and die castings.

INSERT Fig. 1.B.u, 1.B.v, 1.B.w 3 + 10 + 24 year gold prices  
 INSERT Fig. 1.B.x Commitments of Traders, COMEX

The contrast between non-ferrous metals and gold is striking. Figures 1.B.u, 1.B.v and 1.B.w detail the three year, 10 year and 24 year US\$ spot gold price. The longest time series corresponds to the time period following the collapse of the international gold standard. As reflected in the price chart for gold since the introduction of the most popular gold ETF (GLD) since late 2004, there is some appealing evidence to attribute the incredible accelerating run up in gold prices over the first decade of the 21<sup>st</sup> century to the rise of ETF trading. The first gold ETF was listed in Australia in 2003. Originally listed in 2004, the SPDR gold ETF (GLD) is the largest and most liquid gold exchange traded fund. At the end of 2011, GLD held 1,254.57 Tonnes of gold, representing 40,335,690.64 oz., valued at US\$63,484,275,822.93. Unlike some ETF's for other commodities that use futures markets to maintain positions in the commodity, e.g., oil and wheat, almost all gold ETFs issue shares against physical gold holdings. However, as reflected in the commitment of traders report (see Figure 1.B.x) there is still considerable long holdings of gold futures by managed money traders. However, the corresponding physical size of the long position in managed money gold futures on COMEX is less 1/3 the size of the physical holdings of the SPDR gold ETF.

INSERT Fig. 1.B.y Gold Demand  
 INSERT Fig. 1.B.z Historical Gold Demand  
 INSERT Fig. 1.B.aa Gold Demand by Category

Inspection of Figures 1.B.y, 1.B.z and 1.B.aa reveals that there is more to the impressive decade long run of gold prices than the emergence of global trading of physical gold on stock market venues using ETFs. Rather, a voracious demand from India and China for jewellery, bars and coins has fuelled a large uptake in available supply. For cultural reasons, these geographical regions have traditionally used gold as a store of value. Jewellery is typically sold with high gold content, e.g., 22 carat, and gold dealers actively buy and sell gold items at prices close to gold content. Unlike the base metals where global industrial and construction demand drive price movements, gold pricing is being driven by speculative 'investment' demand and culturally based South and East Asian demand for gold as a store of value and sign of social status. Recent annual fluctuations in jewellery demand from these regions is comparable to, if somewhat less, than fluctuations due to the

combination of ETF and bar and coin ‘investment’. Dis-hoarding by gold ‘investors’ associated with the eventual end to gold price appreciation contains the seeds of an inevitable precipitous collapse in prices.

INSERT Figure 1.B.bb Market Supply for Gold

INSERT Figure 1.B.cc Gold Production by Country

INSERT Figure 1.B.dd World Gold Production 2009-2010 (metric tonnes)

Against this demand backdrop, the supply situation is also complicated (see Figures 1.B.bb, 1.B.cc and 1.B.dd). Mine output alone is incapable of meeting current levels of demand, e.g., 3812 tonnes demanded versus 2572 tonnes produced in 2010. Mine output is costly to increase. Marginal additions to mine output are achieved by bringing higher cost mines into production. This is occurring at the same time that the reserves of lower cost mines currently in operation are diminishing. To be sure, there are still immense stocks of gold, primarily held by central banks and other governmental entities. These gold stocks are sufficient to supply the market for more than a decade at current levels of demand, with no mine output, and for three decades at current levels of mine output with no recycling. Yet, traditional sellers of gold from reserve stocks, central banks have recently become net buyers. Significantly, current levels of mine output are approximately equal to the jewellery plus technology usage. The continuing additions to private ‘speculative’ stocks of gold through ETFs and bars and coins provides an increasingly larger overhang of stocks that will threaten to come into the market at a time when prices are weakening.

### ***C. Studies on Commodity Risk Management***

Using the definition of a commodity given in section 1.1.A as a guide, an available and relevant literature on the management of ‘commodity risk’ can be identified. Despite being small in number relative to studies on financial risk management, the volume and breadth of the literature on commodity risk management is still immense, defying an inclusive and brief description. Three general sources of contributions can be identified: ‘academic studies’, contained in an increasingly expanding number of academic journals and books; ‘government studies’, that includes government reports and related government sponsored risk management program publications; and, ‘industry studies’, that include publicly available trade publications from the derivative exchanges, industry associations, investment banks, and commodity dealers and brokers. This category also could include publications in print and digital news media. Taken as a whole, this literature reveals a heterogeneous collection of approaches to commodity risk management. This heterogeneity appears for risk management prescriptions and practices across commodities, e.g., Pennings et al. (2008) and for a given commodity, e.g., Pennings and Leuthold (2000).

Not surprisingly, there is difficulty in classifying studies by the employment status of authors or type of publication instead of by some other method. There considerable overlap between these three general types of contributions. For example, some studies with ‘academic’ content are produced by employees of government agencies. Classified in terms of practicality, ‘academic’ studies of commodity risk management generally lack the immediate practical content that motivates contributions in government and industry studies, e.g., Katchova and Miranda (2004); Bertus et al.

(2009). This is not to say that all commodity risk management studies produced at universities and research institutes or appearing in academic journals lack immediate practical content. Quite the contrary, there are numerous threads of traditional academic empirical research that are helpful to practitioners. When possible, some such studies will be identified. However, the bulk of studies appearing in ‘academic’ outlets, e.g., Journal of Finance or Journal of Futures Markets, aim to conform to the epistemological norms of scientific inquiry (see sec. 2.1.A). Such studies form the bulk of contributions in the ‘academic’ category.

## Academic Studies

“Various risk-management strategies can be justified based on theoretical analyses ... Yet academics know little about corporate risk-management practices and how they relate to theory. Our knowledge about producers' risk-management practices also is incomplete”

Tomek and Peterson (2001, p.953)

Most industry and government studies emphasize the real time reporting of market conditions and commodity characteristics. In addition, there are descriptions of risk management practices and application of financial products and techniques that can be used in risk management activities of firms. In contrast, academic studies aim to provide a ‘scientific’ approach to commodity risk management, with mixed results. As Mackay and Moeller (2010) observe: “What risks do firms hedge? How much do they hedge? How far ahead do they hedge? What determines corporate hedging policy? Should firms hedge at all? Can corporate risk management create value? As straightforward and important as they might appear, these questions are still largely unresolved.” At least since Smith and Stulz (1985), academic studies have been seeking and proposing answers to such questions, e.g., Brown and Toft (2002). Yet, helpful academic guidance is still lacking.

Theories of ‘optimal’ commodity risk management still feature a wide range of competing strategies. Carter et al. (2006b, p.21) summarize these notions:

Finance theorists have proposed a number of ways that hedging and, more generally, risk management can increase corporate market values. Stated briefly, risk management has the potential to add value by (1) reducing corporate income taxes; (2) reducing the probability and expected costs of financial distress; and (3) preserving management’s ability and incentives to carry out all positive-NPV projects (incentives that can otherwise be distorted by the pressure for near-term cash flow faced by financially troubled firms).

As for representative studies of each of these identified categories of value enhancement: Graham and Smith (1999) examine corporate tax motives; Smith and Stulz (1985) theorize that by reducing the probability of bankruptcy, risk management can increase firm value – Haushalter (2000) extends this to the degree of financial leverage; and, Froot et al. (1993) extend the bankruptcy cost hypothesis to include under-investment by firms requiring outside financing when internal cash flow is sufficiently low – risk management allows additional cash in times when cash flow is squeezed, thus circumventing the under-investment problem, allowing the firm to “carry out all positive NPV projects”. Additional theories not identified by Carter et al. (2006b) include DeMarzo and Duffie



(1991) where information asymmetry can make it cost-effective for the firm to hedge on behalf of the shareholders. In addition to bankruptcy costs, Smith and Stulz (1985) also theorize managerial risk-aversion can generate corporate risk management activity. More recently, Adam et al. (2007) and Haushalter et al. (2007) find product market competition and dynamics can impact the hedging decision.

Empirical testing of theories is an essential component of the scientific method. While there has been a number of studies with limited support for a particular theory, e.g., Tufano (1996), Allayanis and Weston (2001), Adam (2002), Carter et al. (2006a, b), Adam and Fernando (2006, 2008), Mackay and Moeller (2007), other studies report no impact in terms of operating or financial performance measures, e.g., Graham and Rogers (2002), Jin and Jorion (2004), Brown, et al. (2006). The observations of Tomek and Peterson (2001, p.955) about academic risk management studies in agriculture seem well placed for other commodity sectors:

Well-developed models of price behavior exist, but appropriate characterization and estimation of the probability distributions of commodity prices remain elusive. The literature contains numerous models of optimal marketing portfolios because so many alternative specifications of farmers' objective functions are possible, but these diverse models and results have not been unified in a way that provides useful generalizations for decision-makers.

Even the optimistic review by Smithson and Simkins (2006, p.15) is only able to conclude: “Is there any direct evidence that risk management increases firm value? The answer is yes, but the evidence is fairly limited as yet.”

Seeking sources of homogeneous ‘factors’ across firms, academic theories have been incapable of explaining why firms in the same commodity industry are observed to pursue hedging policies ranging from unhedged to conditionally hedged to operationally hedged. Smithson and Simkins (2006) hint at the strategic heterogeneity of risk management decisions as an explanation: ‘is there some kind of “self-selection” process in which successful firms are more likely to have the capital and other resources needed to run a derivatives program?’ In various academic studies, there is only limited differentiation between the underlying commodity markets involved in empirical work. The search for empirical support for general theories supporting the use of commodity risk management tools lumps gold mines from Tufano (1996), with airlines in Carter et al. (2006a,b), with oil refineries in Mackay and Moeller (2007) and so on. As Bertus et al. (2009, p.737) observe: “The airline industry provides motivation for our analysis but our results may be applied to any firm with similar exposures.” This ‘generalist’ approach stands in contrast to more traditional, largely agriculturally inspired academic risk management studies that examine risk management practices in specific commodity markets without seeking to confirm the validity of general theories such as the Froot et al. (1993) under-investment hypothesis.

A classical example of the traditional approach to managing commodity risk is Hieronymous (1977) where detailed study of the characteristics of commodity producers, merchandisers and consumers is used to motivate risk management practices for specific agricultural commodities, e.g., corn, wheat, cotton and soybeans. Other older studies include Heifner (1972) for cattle feedlots and Hayenga and DiPietre (1982) for pork producers. Recent examples with elements of the traditional

approach include: Mohan (2007) and Gemech and Struthers (2007) for coffee producers; Wilson et al. (2007) for bakeries; Harrington and Niehaus (2003) for United Grain Growers; van Duren et al. (2003) for food processors; Dahlgran (2000) for cottonseed; Bielza et al. (2007) for Spanish potato growers; Wilson (1987) for sunflowers; Bergfjord (2009) for Norwegian aquaculture producers; Buguk and Brorsen (2005) for Turkish cotton; Costa and Turner (2001) for peanut meal; Mohapatra et al. (2010) for strawberries; and, Menachof and Dicer (2001) for the liner shipping industry. The traditional approach also includes studies where use of a specific risk management product is detailed or proposed, e.g., Muller and Grandi (2000) and Chantararat et al. (2007) on the use of weather derivatives; Hart et al. (2001) for livestock revenue insurance; and, Turvey (2006) for commodity-linked credit instruments.

### **Government Reports and Programs**

The traditional approach to commodity risk management is the focus of government reports and programs. Studies vary depending on the commodity complex involved and the audience for which the report is prepared. Reports originating from legislative agendas, such as those prepared by the US Senate Permanent Subcommittee on Investigations, typically examine specific events such as a perceived disruption in the commodity price discovery process. These reports can be prepared by legislative staff or by government agencies that are mandated to produce a report on a specific issue or event, usually for submission to a legislative committee. A recent example is a June 2009 report by the US Senate Permanent Subcommittee on Investigations (USSPS 2009) that examined excess speculation in the wheat market. Another example is the report prepared by the staff of the CFTC on commodity swap dealers and commodity index traders (CFTC 2008). Yet another recent example is the Interagency Task Force on Commodity Markets (ITFCM 2008) report on “the recent surge in crude oil prices”. Such reports can provide invaluable information that would usually be considered proprietary or difficult to obtain.

#### **INSERT Figure 1.C.a    USDA Webpage**

Other types of government reports originate from the mandate of specific government agencies. For example, the USDA has an extensive list of reports dealing with risk management in agricultural production (see Figure 1.C.a). Similar agencies are available in other jurisdictions, e.g., in Canada Agriculture and Agri-Food Canada provides some basic information and a few reports, substantially less than the considerable information available from the USDA (see sec. 2.3.C). Reports for other government agencies and departments may only provide background information to those involved in the cash market without giving specific attention to risk management. This is generally the case with the metals and energy complex commodities. For example, the Department of Energy features information on developments in science and technology. There is little information on specific energy markets and no information on risk management for energy producers.

More detailed information about energy and metals markets but not commodity risk management is available from the U.S. Geological Survey. Information on bio-hazards and similar risks is provided by the National Research Council. While again no specific information about commodity market risk management is provided, there is substantial analysis available on environmental

hazards. In addition to government departments and agencies, commodity market regulators such as the CFTC provide ongoing information on laws, regulations and industry oversight. The weekly ‘Commitments of Traders’ report is one such publication by the CFTC. However, there is again no specific information on risk management practices and prescriptions.

The final source of government reports and programs of relevance to commodity risk management is international agencies and NGOs. Producers of occasional research reports in the agricultural arena include: the Food and Agriculture Organization of the UN; International Fund for Agricultural Development; UN Commission on Trade and Development; the World Food Program of the UN; the World Bank; the WTO; the International Food Policy Research Institute; and, the UN High Level Task Force on world food policy. Together with the IMF and OECD, these agencies together released an important policy document (FAO 2011) dealing with risk management responses to recent price volatility in food and agricultural markets which have severely impacted less developed countries. The World Bank, the IMF and other entities occasionally publish studies relevant to commodity risk management in regularly published periodicals such as the World Bank Observer, World Bank Economic Review and IMF Staff Papers, e.g., Larson et al. (2004); Faruquee et al. (1997). Though often concerned with agricultural development in less developed countries, there are also occasional studies relating to commodity risk management in general, e.g., Larson et al. (1998).

## Industry Studies

In the digital era, every commodity sector has numerous websites that are invaluable sources of information about ‘real time’ commodity characteristics and, in a few cases, also providing practical guides or policy positions concerning risk management practices for the specific commodity at hand. An indication of the scope of available websites applicable to farming in North America includes: American Farm Bureau website ([www.fb.org](http://www.fb.org)); American Feed Industry Association; American Soybean Association; Agricultural Retailers Association; Animal Agriculture Alliance; Arkansas Rice Farmers; Canadian Canola Growers Association; Grain Growers of Canada; National Agricultural Marketing Association; National Corn Growers Association; United Soybean Board; U.S. Grains Council; and, the U.S. Meat Export Federation. Though a useful starting point, this list is far from including all relevant sites. Being lobby and information entities, few such agricultural sites provide substantive information about risk management. When views on risk management are expressed, it is often to promote a particular policy position. Fig. 1.C.b is an example of a policy promotion for agricultural revenue insurance by the Canadian Canola Growers Association.

### INSERT Fig. 1.C.b Canadian Canola Growers

Similar, though less numerous, websites are available for other commodities and commodity complexes. For example, in copper the International Copper Study Group (ICSG), centred in Lisbon Portugal, “was established in 1992 in order to promote international co-operation on issues concerning copper by improving the information available on the international copper economy and by providing a forum for intergovernmental consultations on copper”(www.icsg.org). The ICSG is an essential source for copper statistics and market information. The twenty-two member states

include the largest producing (Chile) and consuming (China, US, EU) countries. Each country is represented by the government department responsible for 'copper', e.g., for Chile, the Chilean Copper Commission; for the US, the US Geological Survey; and, for China, the National Bureau of Statistics of China. In addition to the ICSG, there are a number of other copper industry groups: the Copper Development Association ([www.copper.org](http://www.copper.org)), a US entity to promote copper usage and applications; and, the European Copper Institute, a similar entity in Europe. Copper associations are also represented in the International Council on Mining and Metals (ICMM), a collection of mining industry groups and large mining companies. Little if any information about commodity risk management is provided, however the ICMM does provide substantial information on health and environmental risk management in mining, e.g., ICME (2001). Like copper, nickel has the International Nickel Study Group and, for lead-zinc, there is the International Lead-Zinc Study Group.

In contrast to the lack of studies on commodity risk management from industry associations, there are volumes of proprietary studies on offer from the commodity risk management consulting industry. In addition to the large investment banks that make markets in OTC commodity derivatives, a partial listing of firms in this global industry includes: Cargill Risk Management; Commodity Risk Management.com; Commodity Advisors (Sweden).com; Greenwich Treasury Advisors; KPMG; Deloitte; PricewaterhouseCooper; Bunge (UK); Commodity Risk Management Associates (USA); and, Oliver Wyman (subsidiary of Marsh McLennan). There are also various banking related consulting entities including: SunTrust; Gibson Capital; Commonwealth Bank (Australia); and, Westpac Banking Corp. (Australia). Some of these sites have useful and relevant information on aspects of commodity risk management, e.g., PricewaterhouseCoopers (2005). Many commodity producing and consuming firms lack expertise in the use of derivative security products to manage commodity risk and, as a consequence, rely heavily on the consulting industry to design and administer such risk management programs. Not wanting to make human capital and market intelligence freely available, the consulting industry is not a source of freely available studies.

#### INSERT Figure 1.C.c LME Education Webpage

In contrast to studies by firms in the consulting industry, the commodity exchanges provide a wealth of useful and helpful information for commodity risk management, mostly accessible for download from the exchange websites. For example, the London Metals Exchange has: an on-line store for purchase of publications such as The Official LME Guide to Managing Metals Price Risk; mostly free downloads of statistical and other market information about commodities traded on the exchange; and, links to training courses put on by the LME (see Fig. 1.C.c). The CME Education webpages are particularly impressive with mostly free downloadable material on all commodities traded ranging from elementary to advanced presentations. In addition to traditional text format, a variety of video content is also available. The exchanges, particularly the CME, also sponsor various conferences and seminars for practitioners and academics throughout the globe, e.g., the Commodity Price Risk Management 2011 conference held in London. The only significant proviso about the wonderful and essential information provided by the exchanges is the presence of an understandable bias toward enhancing usage of exchange products. Commodity risk management methods that do not involve derivative security trading receive little attention.

## 1.2 A Brief History of Commodity Risk Management<sup>9</sup>

### A. *From Antiquity to 16<sup>th</sup> Century Antwerp*

The roots of commodity risk management stretch back to antiquity. Commercial transactions in early markets often involved a sale agreement structured as a forward contract with option features. The contract could vary from loosely structured to formal and notarized. Unstated terms and conditions of such agreements were often governed by merchant convention. An agreement for a future sale would typically have a provision that would permit the purchaser to refuse delivery if the delivered goods were found to be of inadequate quality when compared to the original sample. As reflected in notarial protests stretching back to antiquity, disagreement over what constituted satisfactory delivery was a common occurrence. Some of the earliest examples of written language, the Sumerian cuneiform tablets, contain such notarial protests. See, for example, Figure 2.A.a which provides a picture of a Sumerian tablet circa 1750 BC from the British Museum collection. The description provided is: “A letter complaining about the delivery of the wrong grade of copper after a Gulf voyage.” Widell (2005) has further information about Sumerian and Babylonian business practices.

INSERT FIGURE 2.A.a Sumerian cuneiform Tablet

Evidence that the use of contracting for future delivery was common in ancient times appears during the Greek civilization. Aristotle in his *Politics* provides a reference to the use of future delivery contracting involving a successful speculation by the philosopher Thales. Aristotle's specific reference to Thales in *Politics* is in Book I, Chapter 11, sections 5-10:

There is, for example, the story which is told of Thales of Miletus. It is a story about a scheme for making money, which is fathered on Thales owing to his reputation for wisdom; but it involves a principle of general application. He was reproached for his poverty which was supposed to show the usefulness of philosophy; but observing from his knowledge of meteorology (so the story goes) that there was likely to be a heavy crop of olives [next summer], and having a small sum at his command, he paid down earnest-money, early in the year, for the hire of all the olive-presses in Miletus and Chios; and he managed, in the absence of any higher offer, to secure them at a low rate. When the season came, and there was a sudden and simultaneous demand for a number of presses, he let out the stock he had collected at any rate he chose to fix; and making a considerable fortune he succeeded in proving that it is easy for philosophers to become rich if they so desire, though it is not the business which they are really about.

Unfortunately, this often referenced Aristotelean anecdote is somewhat lacking in detail. For example, it is not clear how Thales, who seems to have been a pure speculator rather than an olive grower, was able to accurately forecast the bumper olive crop in Miletus six months in advance. The

precise nature of the contract is also not clear. Presumably, the payment of “earnest-money” was to take options on the use of all available olive presses in the surrounding area for the harvest season, rather than as a down payment associated with a forward contract. What if the bumper crop had not materialized? Would Thales still be required to take up the presses even though he was not able to lease the presses at a substantial premium? Aristotle rationalizes the limited examination of the details of the transaction: “the various forms of acquisition ... minutely and in detail might be useful for practical purposes; but to dwell long upon them would be in poor taste” (Book I, ch. 11, sec. 5).<sup>10</sup>

While Aristotelean anecdotes provide interesting evidence of the use of contracting for forward delivery to manage commodity risk in ancient times, tracing the evolution of commodity risk management practices through time is complicated by the similarity of derivative security contracts to other types of agreements such as gambles that often drew ecclesiastic sanction. Yet, some method of contracting for forward delivery has been an essential feature of commerce since antiquity (e.g., Poitras 2000, ch.9; Bell et al. 2007). With the expansion of trade and the rise in the importance of urban centres, forward contracting became essential to urban merchants dealing with agricultural producers for crops prior to harvest or with fisherman for catches prior to arrival in port. Such contracts would have a range of implicit and, possibly, explicit buyer and seller option provisions that related to delivery dates, acceptable quality at delivery, and so on. As noted, the two most important buyer options concerned ‘refusal’ to take delivery and the privilege of ‘putting’ the deliverable back to the seller at a predetermined price. A key point in the development of derivative security contracts is where market liquidity was sufficient to permit the securitization of contingent claims associated with forward delivery and the privileges of ‘put’ and ‘refusal’. As early as Ehrenberg (1928), it has been recognized that this required the emergence of sufficient speculative trading to sustain market liquidity.

### **Emergence of Free Standing Derivative Contracts**

In the history of contracting for future delivery, the emergence of exchange traded, free standing derivative security contracts to manage commodity risks is more recent. In contrast to ‘over-the-counter’ (OTC) style trading where the quality of delivered goods and the parties to the transactions were specified in a non-transferable contract, exchange trading required methods of grading and handling to facilitate transferability of the contract. There also had to be some method of ensuring that the ultimate parties to the contract either could consummate delivery or there was a settlement offset method that permitted the delivery to be delayed or cash settlement to be effected. Though OTC style contracts in early markets were often initiated at an exchange venue, it is the element of transferability that characterizes ‘exchange traded’ contracts. In early markets, there were kinship, social norms and other methods for preventing ‘failures to deliver’ for both transferable and non-transferable contracts. Issues surrounding the usage of exchange traded or OTC methods of contracting for future delivery survive to the present.

Following van der Wee (1977) and Gelderblom and Jonker (2005), the first instance where a contingent claim was unbundled and traded as a separate security on an exchange was the transferable ‘to arrive’ commodity contracts traded on the Antwerp exchange during the 16<sup>th</sup> century. This event signifies the depth of liquidity and degree of trading sophistication associated with commodity transactions at a time when most commercial sales employed non-transferable forward

contracts with multiple delivery dates. These contracts were typically executed as private deals between two signatories, usually employing *escripen*, notaries and “scriveners” to formalize the contract. As Malynes (1622, p.126) observes, if a broker was involved, a verbal contract could be used:<sup>11</sup>

Verbal contracts are made between party and party, or by means of Brokers or Mediators, and that only by word without writing. Such are the daily buying and selling of commodities either for ready money, or payable at some dates of payment, wherein the mediation of a Broker is most necessary: For as it would be troublesome to use Scrivners in every bargain; so is it commodious to use the means of Brokers, the commodities are not only bought and sold with more credit and reputation, but all controversies which do arise by misadventure or otherwise are sooner determined, and a sworn Broker is taken as a double witness, if he do produce his book, with a *Memorandum* of the bargain, as the same was agreed between both parties, whereby many variances are reconciled, and differences (like to fall out) are prevented.

This brief discussion on the use of brokers in commodities transactions follows a longer discussion by Malynes (1622, p.124-6) regarding the use of “notariall contracts” in the trading business of the regulated company of “Merchant adventurers” where the systemic use of forward contracts in their commercial transactions is apparent.<sup>12</sup> In modern vernacular, the 16<sup>th</sup> and 17<sup>th</sup> sales contracts that Malynes describes for the sale of English cloth goods arranged on the exchanges in Antwerp, Bruges and other important centers were structured as non-transferable forward contracts with multiple delivery dates and option features.

‘Exchange traded’ requires ‘exchange’ to be defined. This is not as easy as might be expected as a number of conventional and technical definitions for an “exchange” are possible, e.g., Lee (1998, p.322-3). Almost all modern definitions identify an exchange with a physical location or building. One exception is Ehrenberg (1928, p.54) where the following definition is provided:

A bourse or exchange is an assembly meeting at frequent intervals, usually daily, consisting of the merchants and other persons, who meet for the purpose of dealing without exhibiting, delivering or paying for their goods at the same time.

For historical purposes, this definition is more adaptable as some exchanges, such as the important Amsterdam exchange prior to 1611 or the London stock exchange prior to 1773, conducted trading at different locations until moving to fixed quarters.<sup>13</sup> This definition is also sufficient to distinguish an exchange from, say, a marketplace selling produce and is preferable to definitions that identify an exchange only as a physical location where buyers and sellers meet to trade goods.<sup>14</sup>

Given this, exchange trading of a contract needs to be distinguished from a situation where a buyer and seller meet at, say, the Royal Exchange and agree to a forward sale of goods with a contract then drawn up by a ‘scrivner’. In this situation, it is the goods that are being traded, not the forward contract. An exchange traded contract requires transferability and an exchange clearing mechanism to settle positions. In turn, transferability requires standardized contract terms and relatively homogeneous deliverable commodity. A transaction where merchants meet at an exchange and

agree to a non-transferable forward contract with multiple delivery dates would correspond, in modern terms, to an over-the-counter (OTC) derivative security transaction. As such, a technical distinction is being made that corresponds to the modern difference between trading on exchanges or OTC.

The beginning of exchange trading of derivative security contracts occurs when the parties involved in the completion of the contract are different from those initiating the contract. With this condition, a traded contract could be created for which there was no intention of completing the underlying goods transaction; in effect, the seller may not have possession of the goods and the buyer may not intend to take delivery. In this case, a contract can be created for which there is no resulting delivery of goods. This requires a clearing method for determining and settling gains and losses on contracts. Various prerequisite conditions are required for such trading to occur. The evolution was gradual, not dramatic, and depended on a range of informal restrictions on those participating in the trade. Recognizing that initial trade was in the bulk commodities of herring, whale oil and wheat – commodities that require special warehousing, grading and handling facilities – initial trade was associated with dealers directly involved in the bulk commodity trade willing to execute ‘to arrive’ forward contracts for which there was no associated goods transactions, seeking to offset the position prior to delivery or, if necessary, cover the position in the spot market upon arrival of the fleet or delivery of the harvest. Given the vagaries of market liquidity, in the event the contract could not be transferred, both parties to the contract needed to be able to complete delivery.

### **The Antwerp Exchange**

The evolution of exchange trading in free standing derivative security contracts for bulk commodities revolved around two important elements: enhanced securitization of the transactions; and the emergence of speculative trading. Both these developments are closely connected with the increasing concentration of commercial activity, initially at the large medieval market fairs and, later, on the bourses and exchanges. Securitization of bulk commodity transactions was facilitated by applying trading methods that had been in use for centuries in the market for bills of exchange.<sup>15</sup> In addition to being focal points for goods trading activities, the medieval fairs were also important financial events. The fairs, such as those at Champagne, featured well organized money markets conducting manual foreign exchange transactions and substantial dealings in bills of exchange (de Roover 1954, p.204).<sup>16</sup> Because the larger fairs involved transactions between merchants from a number of different regions, it was not practical to settle all transactions using manual exchange of coin. This was a primary impetus for dealings on credit, as de Roover (1949, p.110) observes:<sup>17</sup>

Today banks discount the trade acceptances or the promissory notes of merchants who are in need of credit. Such a procedure was ruled out as long as contracts involving the payment of interest were unenforceable at law. It is true that usury laws could be circumvented by various subterfuges. However, the easiest method for securing short-term credit was for merchants to “take up” money by exchange and not at interest. The result of this practice was that commercial credit was tied to the exchange. This point, although obvious, is so fundamental that its importance should be stressed ... the credit system rested on the exchanges.



As such, methods for clearing bill of exchange transactions were fundamental to the smooth operation of the international commercial and financial system.

Though the precise origin of the practice is unknown, 'arbitration of exchange' first developed during the Middle Ages. Around the time of the First Crusade (1095-1099), Genoa had emerged as a major sea power and important trading centre (Einzig 1964). The Genoa fairs had become sufficiently important economic and financial events that traders from around the Mediterranean were attracted. To deal with the problems of reconciling transactions using different coinages and units of account, a forum for arbitrating exchange rates was introduced. On the third day of each fair at Genoa, a representative body composed of recognized merchant bankers would assemble and determine the exchange rates that would prevail for that fair. The process involved each banker suggesting an exchange rate and, after some discussion, a voting process would determine the exchange rates that would apply for that fair. Similar practices were adopted at other important fairs later in the Middle Ages. At Lyon, for example, Florentine, Genoese and Lucca bankers would meet separately to determine rates, with the average of these group rates becoming the official rate. These rates would then apply to bill transactions and other business conducted at the fair. Rates typically stayed constant between fairs in a particular location providing the opportunity for arbitraging of exchange rates across fairs.

The actual clearing process differed from fair to fair (Parker 1974, p.546). At the Lyons fairs, clearing involved the participation of all merchants attending the fair. At other fairs, such as the fairs of Besançon or Medina del Campo, clearing was controlled by a restricted group of merchant-bankers who were responsible for setting exchange rates and for handling the book-transfers between the accounts of merchants at the various clearing member banks. Ehrenberg (1928, p.284) describes the clearing process used in Lyons:<sup>18</sup>

Before the merchants attended the fair they entered in their 'market book' ... all the payments due from or to them in the fair. At the beginning of the fair these payments books were compared with one another. In the case of every entry found correct the person from whom the payment was due made a mark which was taken as a binding recognition of the debt; later he had to sign his whole name. The bill – for, generally speaking, there was no question of anything but bills – was *accepted* in this way. If an item was not recognized, the owner of the book would write by it 'S.P.' (*sous protest*).

After the acceptance of the old bills there followed the new business with foreign markets, which originated wither at the preceding fair or as the result of the acceptance, or otherwise. Here we meet for the first time a peculiar arrangement, the settlement of an official average price for each species of bill, the so-called Conto.

(T)he Conto in Lyons was done as follows: The bill dealers met on a certain day and formed a circle (*Faire la Ronde*); the Consul of the Florentines then asked the dealers of the different nations in turn what they thought the price ought to be. The answers were noted and an average taken. This was the official rate for bills which was noted in the bulletins ... and sent abroad. The dealers themselves were naturally not bound by this, their business was left free to bargaining. Yet the Conto at the beginning had some meaning for the market itself, as previously many transactions had been concluded at the average rate which had not yet been settled ...

The payment proper closed the fair. It was affected chiefly by *viremant de parties, giro* or *scontro*, as follows: Two persons were commissioned to collect and compare ... all the fair books. They then canceled the payments against one another, and only paid the balances in cash ... The fair payments at Lyons owe their form to the Florentines, a fact which is clearly shown by the development of the Lyons Bourse.

Various features of the clearing process at Lyons were not only adapted for use at other important fairs, but also had an impact on the methods later employed on the Lyons bourse. The method of offset used in the end-of-fair settling process was later reflected in the *rescontre* system adopted to settle exchange trading of shares in 17th century Amsterdam and 18th century England.

The Lyons fairs first assumed importance circa 1463 due to the explicit mercantilist policies of Louis XI. As early as 1419, various French kings had granted privileges to merchants doing business in Lyons in an attempt to counteract the success of the fairs held in Geneva. These privileges included freedom to engage in various financial transactions, such as manual exchange of coin and dealing in bills of exchange, activities that were tightly regulated elsewhere in France. Even more than the economic benefits associated with the commodities trade, the French monarchs were motivated by the gains associated with the financial dealings of the fairs. By the 15th century, the capital that could be raised at important fairs such as those of Geneva was substantial. This capital was essential to securing financing for the military adventures in which the national monarchs were, almost continually, engaged. The extension of commercial liberties beyond the time period of the fairs contributed significantly to the emergence of bourse trading. As early as the end of the 13th century, the dukes of Brabant encouraged the growth of Antwerp by granting privileges to alien merchants visiting the city (van Houtte 1966), such as not requiring that local brokers be used to transact commodity business. Such merchants trading in Bruges, the northern centre of European commerce during the 14<sup>th</sup> century, were required to use local brokers.

While the fairs served an important step in the growth of trade and payments, by the late 15th century economic activity was outgrowing the restrictions of the fixed fair dates. A network of international merchants had established permanent offices and warehouses throughout the key commercial centres of Europe. To support the associated trading activities, sizeable communities of foreign merchants were established. These changes meant that liquidity was sufficient to support trading throughout the year. This growth sustained the creation of bourses in various cities, designed to facilitate dealings in both physical and financial commodities. The bourses were, effectively, meeting places for merchants of various countries to transact financial and commodities business. The use of the term 'bourse' (beurs) is indicative of the historical development, the term being taken from a square in Bruges, named for an inn on the square owned at one time by the van Beurs family, where the Florentines, Genoese and Venetians had their consular houses. This inn was a popular meeting place for foreign merchants. Though exchange trading of derivative securities was yet to come, some essential characteristics of exchange trading are discernible at the beginnings of the bourses: a self-regulating collection of merchants -- both brokers and dealers -- meeting for the mutual gain of enhanced liquidity. For the early bourses, access to credit and foreign exchange facilities were also important factors.

Bourse trading was a major development on trading at fairs and markets for at least two reasons. First, trading at the fairs was restricted to specific time periods. While initially useful as a method

of concentrating mercantile activity, the growth of trade soon surpassed the narrow time windows provided by the fairs. Bourse trading involved both financial transactions and trading in goods. These two activities were complementary. Commercial trade in goods generated financial transactions, activities that were both facilitated by the concentrated activity of the fair. Yet, as evidenced in the activities of merchant bankers in centres such as Bruges (e.g., de Roover 1948), there were other reasons for financial activity independent of goods trading, such as trading in bills of exchange for investment and market making purposes. These financial activities formed the basis of an element of bourse trading that can be traced back to the Middle Ages in southern Europe, starting in the trading centers of Italy. By the 14<sup>th</sup> century, financial bourse trading can be found in certain northern European centers, most importantly Bruges (Ehrenberg 1928, p.55):

in the trading cities of Italy, [bourse trading] arose from the business which developed at the banks of the money-changers native to the city, when the notaries likewise had stalls in the open air ... there arose ... the characteristics of the exchange business as early as the fourteenth century ... In the countries north of the Alps bill business ... developed in closest connection with the factories of the Italians. The streets and market places where they lived, and more especially where they had their consular houses or Loggias, were the localities where the bourse business first developed.

Bruges was geographically well situated to have the first significant bourse trading in northern Europe. The opening of seaborne trade routes through the Straits of Gibraltar contributed to the decline of fairs along the land trade routes, such as the Champagne fairs. In addition, the Hansards developed important seaborne trade from northern Europe. All this growth in seaborne commodity traffic contributed to the initial rise of Bruges as “the greatest market of Christendom in the fourteenth century” (van Houtte 1966, p.37).

In addition to being a main seaport, Bruges was also the locale for one of the five fairs of Flanders. The importance of Bruges peaked in the mid-1300s. The comparatively faster subsequent growth of commercial markets and bourses in other centres being due to two primary local factors: the silting of the waterway connecting Bruges to the ocean; and, the various restrictions imposed by Bruges on foreign merchants trading there. The international growth of trade meant that Portuguese, Spanish, South German and Italian merchants had sufficient reason to establish permanent colonies in locales such as Bruges and Antwerp whereas, before, these merchants sojourned to the fairs. In addition to geographical factors, the freedoms granted to alien merchants played a key role in determining where bourse trading was concentrated.<sup>19</sup>

From the beginnings of bourse trading there was competition between exchange venues for business. A second factor favouring bourse trading was that fairs required goods to be transported to the fair's geographical location for inspection in order to conclude specific transactions. The goods were then transported to another district to be sold. As trade expanded, factors such as acceptable levels of standardization and the growth of mutual merchant confidence allowed goods transactions to be made without actual inspection of goods at the time the sale was completed. In turn, exchanges were located geographically close to the center of the underlying bulk goods trade. Such factors significantly reduced transactions, transport and other costs. By providing enhanced liquidity and cheaper execution, bourse trading was an essential impetus to the emergence of speculation in commodities which, ultimately, progressed into exchange trading of derivative securities.

Though the transition from fairs to exchange trading was gradual, the 16th century does provide a transition period: at the beginning of the century, the fairs still played an important role in providing fixed dates and locations at which concentrations of liquid capital were assembled; by the end of the century, general economic activity was such that bourse and exchange trading predominated. During the century, the emergence of exchange trading in Antwerp and Lyons was especially important, though by the end of the century both these centres were in decline. Of these two centers, Antwerp was initially most important for trade in commodities while Lyons for trade in bills of exchange. In 1531, Antwerp opened a new exchange building designed exclusively for trading of commodities and bills of exchange. Tawney (1925, pp.62-5) describes this international market of the 16th century:

In its economic organization the machinery of international trade had reached a state of efficiency not noticeably inferior to that of three centuries later. Before the most highly-

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Poitras (2000, p.109-110) provides the following discussion The Merchant of Venice by William Shakespeare.

“Being such a richly layered literary effort, the *Merchant* contains various elements of modern interest to historians of financial economics. In addition to reflecting 16th century social attitudes toward usury, the *Merchant* contains scattered references to the business practices of the time. Recently, Markowitz (1999) has uncovered such a reference and uses this as a basis for attributing a place for the *Merchant* in the history of portfolio theory. Specifically, Markowitz references a statement that Antonio makes (I.1.41):

My ventures are not in one bottom trusted,  
Nor to one place, nor is my whole estate  
Upon the fortune of this present year;  
Therefore, my merchandise makes me not sad.

Markowitz (1999, p.5) claims that: ‘Clearly, Shakespeare not only knew about diversification but, at an intuitive level, understood covariance.’ However, given the later developments in the *Merchant*, it is not at all clear that Antonio's understanding of covariance was as deep as Markowitz claims.”

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organized economic systems of the age were ruined by the struggle between Spain and the Netherlands, and by the French wars of religion, there were perhaps ten to twelve commercial centres whose money markets were the financial power-houses of European trade, and whose opinion and policy were decisive in determining financial conditions. In the Flemish, French and Italian cities where it reached its zenith, and of which England was a pupil, the essence of financial organization of the sixteenth century was internationalism, freedom for every capitalist to undertake every transaction within his means, a unity which had as its symptom the movement of all the principal markets in sympathy with each other, and as its effect the mobilisation of immense resources at the strategic points of international finance. Its centre and symbol was the exchange at Antwerp, with its significant dedication, '*Ad mercatorum cujusque gentis ac linguae*' where ... every language under heaven could be heard, or the fairs at Lyon which formed, in the words of a Venetian, 'the foundations of the pecuniary transactions of the whole of Italy and of a good part of Spain and of the Netherlands'.

The public good characteristic of a centralized exchange location as in Antwerp was recognized and adapted in other centers, with Sir Thomas Gresham personally advancing the funds for the building of a similar exchange in London, the Royal Exchange, opening in 1571. By 1613, trading had fully started at the new building for the Amsterdam Exchange.

Fully developed exchange trading in commodities emerged in Antwerp during the second half of the 16th century (Tawney 1925, p.62-5; Gelderblom and Jonker 2005). The development of the Antwerp commodity market provided sufficient liquidity to support the development of trading in 'to arrive' contracts associated with the rapid expansion of seaborne trade during the period. Various sources report that speculative transactions in 'to arrive' grain that was still at sea were particularly active, with trade in whale oil, herring and salt also being important (Gelderblom and Jonker 2005; Barbour 1950; Emery 1895). Unger (1980) provides detailed information on the herring industry during this period. The Dutch herring trade to the Baltic was intimately connected to the grain trade to southern Europe. Due to a number of technological developments introduced over the fourteenth to sixteenth centuries, the Dutch herring fleets dominated this trade until the second half of the 17<sup>th</sup> century. The evolution of the herring fishery depended on increased capital requirements; as a consequence the role of brokers also evolved: "By the mid-fifteenth century the brokers were becoming owners and operators of ships as well. They were merchants with an interest in more assured supplies of preserved fish ... even individuals with no direct connection with fishing can and did invest in the boats and their supplies" (Unger 1980, p.258).

That 'to arrive' contracts came to be actively traded by speculators also directly involved in trading the underlying physical commodity is not surprising. Because transport by sea was a risky business and information about cargoes to arrive at a later date could be sketchy, the quality and quantity of physical commodity available for delivery could not be known prior to arrival of the fleet; a forward sale of such cargoes would be inherently speculative. Such speculative trade facilitated the legitimate hedging activity of other merchants. The concentration of speculative liquidity on the Antwerp Exchange centered around the important merchants and large merchant houses that controlled either financial activities or the goods trade (van der Wee 1977). The milieu for such trading was closely tied to medieval traditions of gambling and insurance where wagering on the safe return of ships, a rudimentary form of early insurance (Lewin 2003), was often connected with the

conclusion of commercial transactions. A key step in the evolution of exchange traded contracts came when trading in ‘to arrive’ contracts involved standardized transactions in fictitious goods for a future delivery that was settled by the payment of ‘differences’.<sup>20</sup> Purchasers of such contracts would speculate on the rise in prices before the due date. If such a rise occurred, the contract could then be sold and the speculator pocketed the difference in price. This ‘difference dealing’ was also conducted by goods vendors, selling for future delivery betting that prices would fall.

The development of difference dealing was accompanied by the emergence of ‘premium contracts’ where: “The buyer made a contract for future delivery at a fixed price, but with the condition that he could reconsider after two or three months: he could then withdraw from the contract provided that he paid a premium to the vendor (*stellegelt*)” (van der Wee 1977). Little is known about the precise evolution of the contracts used for speculative trading, but the premium contract appears well suited to difference dealing by speculators. The ‘premium’ form of contract for forward sale became a staple of European trade into the 20<sup>th</sup> century, e.g., the contract for the German *prämienengeschäfte*. Such contracts differ from the options traded in modern markets which have inherited characteristics associated with historical features of US option trading. Following Emery (1896, p.53), the *prämienengeschäfte* “may be considered as an ordinary contract for future delivery with special stipulation that, in consideration of a cash payment, one of the parties has the right to withdraw from the contract within a specified time”.<sup>21</sup> As such, this option is a feature of a forward contract with a fee to be paid at delivery if the option is exercised. Circa 1908 on the Paris and Berlin bourses, the premium payment at maturity was fixed by convention and the ‘price’ would be determined by the setting the exercise price relative to the initial stock or commodity price, e.g., Courtadon (1982).

Characteristics of exchange trading of derivative securities contracts in Antwerp formed the basis for later trading at other venues. Elements of that trade are of still of contemporary relevance. While access to the Antwerp exchange was unrestricted, those unconnected to the bulk commodity trade and seeking to speculate required a broker to establish a position. Brokers could also be dealers in the commodity. The exchange was a largely self regulatory entity with broker-dealers clearing derivative security trades with other broker-dealers. Rules of conduct for trading were largely governed by merchant convention, e.g., Malynes (1622). Penalties for violations involved loss of reputation and an ensuing inability to conduct business. The State provided official recognition to certain ‘sworn brokers’ and established a civil court system for settling disputes. Physical infrastructure and a sympathetic legal and taxation environment were provided to promote the development of trade. Difference dealing was facilitated by the use of premium contracts. Following traditions developed in the bill of exchange market, the clearing of positions in difference dealing was done by brokers coordinating with other brokers.

INSERT Fig 2.A.b Houghton Price Quotes

## ***B. From Amsterdam to Chicago***

### **Commodity Trading in 17<sup>th</sup> Century Holland**

The collapse of Antwerp in 1585 and the resulting diaspora of important merchants contributed substantially to the rise of the important exchanges in Amsterdam and other centres such as London,

where the Royal Exchange was established in 1571 (see Fig. 2.A.b). While Amsterdam had developed as an important commercial center prior to 1585 (van Dillen 1927; Gelderblom and Jonker 2005), the establishment of the Amsterdam bourse in 1611 marks a symbolic beginning of Dutch commercial supremacy. During the 17th and 18th centuries, trading of forward and option contracts on the Amsterdam exchange exhibited many essential features of exchange trading in modern derivative markets. By the middle of the 17th century trading on the Amsterdam bourse of derivative securities had progressed to where contracts with regular expiration dates were traded (Wilson 1941; Gelderblom and Jonker 2005).<sup>22</sup> By the 18<sup>th</sup> century, in addition to commodities, the trade involved both Dutch joint stock shares and “British funds”. This trading on the Amsterdam bourse is the first historical instance of exchange trading in financial derivative securities. “With the appearance of marketable British securities, and the application to them of a speculative technique that was already well understood, the Amsterdam bourse became the scene of international finance at its most abstract and most exciting – gambling in foreign securities” (Wilson 1941, p.79).

While information about derivative security trading in Antwerp is scattered and sparse, detailed accounts of such trading in Amsterdam are available in Josef de la Vega (1688) and Isaac de Pinto (1762). Both sources discuss trading of joint stocks; trading in commodities is not directly examined, though following traditions developed in Antwerp, the commodities trade was also a common source of speculative trading. As such, exchange trading in Amsterdam marks the beginning of the distinction between derivative securities for bulk commodities versus financial assets, in particular shares in joint stock companies. While trading of derivative securities in the bulk commodity trade was controlled by a network of brokers and dealers directly connected to the underlying goods trade that made speculation difficult for ‘outsiders’, the same was not the case with shares. Amsterdam is the first instance in the history of exchange traded derivative securities where the distinction between financial assets and bulk commodities as deliverables assumes importance. Though there was speculative trade in bulk commodities – grain, herring, spices and whale oil– the trade in shares apparently captured the bulk of this activity by the later 17<sup>th</sup> century.

Circa 1602, the Amsterdam Exchange was held in the open air on the New Bridge. It was not until 1613 that trading completely moved to a building dedicated for the Amsterdam exchange. Trading in shares was initially only a small portion of the general activity on the exchange, which was predominately in bills and commodities. By the beginning of the 17th century, it was apparent that trading in Amsterdam had become the successor to the Antwerp bourse that had fallen on hard times due to a combination of political, geographic and economic factors. In conjunction with the shift in trading activity, many of the traders also eventually relocated from Antwerp to Amsterdam and brought with them the trading techniques that had been successfully developed on the Antwerp exchange. Included among these techniques was speculative trading for future delivery. This technique, almost immediately, was applied to trading in Company shares. Ehrenberg (1928, pp.358-9) provides some fundamental insight into the advantages of speculative trading in shares over commodities:

From the beginning, the speculation in shares ... as a means of gain depending on taking advantage of future price changes, made it appear extremely desirable to postpone the fulfilment of the bargains. In the case of bears, who had sold shares which they did not possess, this was an absolute necessity.

Speculative future dealings made possible a twofold simplification of the technique of dealing. First, speculative dealings could be realized before the date of delivery. Secondly, settling days made it possible to use the same procedure that had done so much in the methods of payment, namely, set off. Both together resulted in an incalculable increase in turnover, since now only a little ready money and stock were required for very large dealings.

Significantly, “it was speculation which made the first modern stock exchange”. Speculators provided the liquidity essential for continuous trading and ‘accurate’ pricing. In turn, hedgers and traders seeking to acquire or dispose of stock positions provided the ‘honest’ liquidity needed to clear the market. De la Vega (p.164) suggests that the relative composition of the speculative trading population changed over time, whereas “formerly twenty speculators ruled the exchange ... Today there are as many speculators as merchants”.

Kellenbenz (1957, pp.139-42) provides a useful summary of de la Vega's discussion of the various types of transactions in the Amsterdam share market which likely also corresponded with practices in the exchange of commodities:

- a. There were sales of real stock against immediate payment of cash.
- b. There were comparable sales where the money to cover payments was borrowed from individuals, up to four-fifths of its value.
- c. There were transactions in which future settlement dates were specified – that is, beyond the regular monthly settlement dates. These future contracts were seemingly used for both speculative and hedging purposes, both by speculators and by the lenders on securities. De la Vega implies that the latter parties always hedged by means of such contracts. Hypothecation, which was mentioned as early as 1610 (in the edict of that year), was permitted to the seller presumably during the period of the forward contract. Arrangements also were possible, and were fairly frequently resorted to whereby the date of the termination of a future contract could be postponed, apparently by mutual consent of the parties. This action was called 'prolongation'. A large proportion of the foregoing future sales were really sales 'in blanco' – or short sales, as we would label them – even though such transactions were prohibited by laws of the state and of the city
- d. There were options contracts. These were at least of the ‘call’ and ‘put’ varieties, which have persisted ever since ... Option contracts were utilized sometimes for hedging purposes by *bona fide* investors, but more commonly for mere speculation ...

Trading for forward delivery was essential to the 17th century trade in commodities and shares on the Amsterdam bourse (Barbour 1950).<sup>23</sup> For shares, such trading was necessary because the delivery and settlement process was much different than the modern process. Though shares could be transferred, the process required the seller to be present at the Company offices for the transfer and to pay a transfer fee. The practice of same day settlement, delivery and transfer, as practiced in modern stock markets, was not usually possible – even for trades arranged at the transfer office. Agreements to sell shares typically included a future settlement and transfer date which could be months in the future, though delivery dates longer than one month in the future were discouraged by statutes dating from 1610.



Perceived speculative abuses of the delivery process appeared almost from the start of trade in Dutch East India Company (VOC) shares in 1602 (van Dillen et al. 2007). This included the activities of a bear ring, formed “in early 1609 ... to challenge the company on the exchange. It is not clear that the ring did more than help to hold down the already slumping prices, but the company lodged a protest with the States of Holland and West Friesland in the summer of 1609 to have a ban placed on the sale of shares ‘in blanco’” (De Marchi and Harrison 1994, p.51). The result was the Dutch edict of 1610 banning short sales ‘in blanco’, where, at the time of the short sale, the seller does not actually possess the shares or the commodity being sold. In addition, the edict required that share transfers be made within one month of the sale date. Transactions dated to correspond to a future goods delivery were conventional in the legitimate commodities trade. The ban on short sales was not permanent and the ‘occasion of renewal brought out anew sentiment for and against VOC’ (p.51). Despite opposition, the ban on ‘selling in the wind’, or *windhandel* trade, was repeated in 1624, 1630, 1636 and 1677. It is important to recognize that the *de facto* impact of the ban on in blanco short selling was to make such contracts unenforceable in the courts. There was no direct criminal penalty for entering into such contracts which provided the basis for difference dealing.

### **The Tulipmania of 1635-6: The Historical Context<sup>24</sup>**

Together with the South Sea Bubble and the Mississippi scheme, the tulipmania is considered to be a classic example of a speculative mania. Information that is available on the tulipmania provides valuable information on trading practices at that time for commodities, in general, and tulips, in particular. The modern identification of these three events for special attention is likely due to the resurrection of Mackay (1852), even though the tulipmania has some decidedly different characteristics than other speculative manias. In particular, the tulipmania was not a financial crisis. The commodity of interest in the mania, tulip bulbs, had rather unique characteristics, such as uncertainty as to quantity, quality and even storability. The main point of interest to the history of commodity risk management was the apparent abuse of forward contracting procedures by uninformed speculators unconnected to the actual tulip trade. There is strong evidence that this speculative trade did temporarily disrupt pricing in the cash market where some unexplainable price increases were observed.

For an event which has received such substantial attention in modern times, the Dutch tulipmania of 1634-7 has been surprisingly misrepresented. Malkiel (1985, p.29-32), for example, makes the following comments:

The instruments that enabled tulip speculators to get the most for their money were "call options" similar to those popular today in the stock market. A call option conferred on the holder the right to buy tulip bulbs (call for their delivery) at a fixed price (usually approximating the current market price) during a specified period. He was charged an amount called the option premium, which might run from 15 to 20 percent of the current market price. An option on a tulip bulb currently worth 100 guilders, for example, would cost the buyer only about 20 guilders. If the price moved up to 200 guilders, the option holder would exercise the right; he would buy at 100 and simultaneously sell at the then current price of 200. He then had a profit of 80 guilders (the 100 guilders' appreciation less

the 20 guilders he paid for the option).

As happens in all speculative crazes, eventually prices had been going higher for long enough time that some people decided they would be prudent and sell their bulbs.

And what of those who had sold out early in the game? In the end, they too were engulfed by the tulip craze. For the final chapter of this bizarre story is that the shock generated by the boom and collapse led to a prolonged depression in Holland. No one was spared.

Malkiel also relates an anecdote about a sailor unknowingly eating an expensive tulip bulb thinking it was an onion.<sup>25</sup> Though more detailed, elements of Malkiel's discussion can be found in numerous modern references to the tulipmania.

The reference to call option trading during the tulipmania, which appears in numerous modern sources, is difficult to support. There is considerable evidence that forward contracts -- varying in form from the rudimentary to notarized contracts with embedded option features -- were the method used in trading for future delivery during the tulipmania. Malkiel (1985, p.352) claims: "My discussions of the tulip-bulb craze... rely heavily on Mackay's description". However, Mackay makes numerous references to "bargains", which was a conventional reference to forward contracting. Mackay (1852, p.95) describes a typical trade:

Confidence was destroyed, and a universal panic seized upon dealers. A had agreed to purchase ten *Semper Augustines* from B, at four thousand florins each, at six weeks after signing the contract. B was ready with the flowers at the appointed time; but the price had fallen to three or four hundred florins, and A refused either to pay the difference or receive the tulips.

Malkiel (1985, p.31) also seems confused on the point, making the statement that: "Dealers went bankrupt and refused to honour their commitments to buy tulip bulbs". If Malkiel is correct about option trading, this problem would only be a problem if put options were being traded, not call options.

What actually did happen during the tulipmania? Garber (1989, 1990) and Posthumus (1929) are academic sources which detail the events and market activities. Prior to these studies, information about the tulipmania could be derived from various sources. Due to the attention given by modern sources such as Malkiel (1985), Mackay (1841, 1852) has received considerable credit for chronicling the event. Similar treatments of the tulipmania are reflected in other sources from this period, such as Francis (1850). Garber correctly observes that much of Mackay's relatively brief discussion is plagiarized from Beckmann (1846). The most essential primary source for Beckmann was the Gaergoedt and Waermondts (GW) dialogues, which are a series of three pamphlets (1637), written in dialogue form by a now anonymous author.<sup>26</sup> An English translation of key parts of the GW dialogues is contained in Posthumus (1929).

The tulip was first imported into Europe from Turkey. Early reports have tulips in eastern Europe during the 1550's. By the later part of the 16th C. the tulip had appeared in the northern Netherlands. The tulip trade expanded quite rapidly, being centred around Haarlem where, even today, the tulip

fields extend north and south for forty or more miles. Though it is possible to propagate tulips from seed to flowering bulb over a seven to twelve year cycle, the primary method of propagation is from bulbs. During a growing season, which goes from September to June, the bulb which was planted will be propagated into a new bulb, a clone of the first. If all goes well, the new primary bulb will also have some additional buds, outgrowths referred to as excrescences. By this process, it was possible to increase the tulip stock of normal bulbs "at a maximum annual rate of from 100 to 150 percent".

Trade in tulips is done with bulbs. In certain cases, excrescences can also be traded but this is riskier. The outgrowth has to be separated from the motherbulb and, depending on size, can take from 1 to 3 years to flower. An additional risk with excrescences is that growing into a flowering bulb is not certain. Two general categories of bulbs can be distinguished based on an important quality difference between various bulbs. "Pound goods" are run-of-the-mill bulbs which were sold by weight (pounds or thousand *azen*), by the bed, or by the garden.<sup>27</sup> "Piece goods" are the rarer varieties of tulips which are sold by the bulb. Heavier bulbs would have more outgrowths and would, as a consequence, be more expensive. Because the propagation process produces clones, a rare bulb would eventually become common as more bulbs were produced from the original bulb.

The process of creating rare bulbs created an additional source of uncertainty. The rare bulbs originate from "breaking", the invasion of the bulb by a virus which produces unique colouring patterns on the flowers. Though it is now recognized that the virus is spread by aphids, this was not known in the 17th century and there was considerable mystery about the breaking process. What was known is that breaking could not be replicated with seed propagation, only bulbs retained the unique colour pattern. Because breaking is due to a disease, 'broken' bulbs had generally lower propagation rates and, possibly, could fail to survive entirely. Because heavier bulbs were more likely to have a larger number of excrescences, a heavy bulb with a unique and valued colour pattern would be a very unusual commodity. It was these bulbs which commanded seemingly outrageous prices.

Bulbs can safely be removed from beds in June, but had to be replanted by September. Conventional practice in the cash market for tulips was to trade physical bulbs during the summer. In addition to cash market trading, forward trading was also common:

It often happened that the price was not fixed in money; the most heterogeneous lot of goods was accepted in payment, such as cows, fruit, wine, yards of cloth, clothes, silver dishes, horses and carriages, land, houses, shops, and paintings. The usual condition was for these various goods to be delivered at once, often long before the bulb had been taken out of the ground. (Posthumus 1929, p.439).

In effect, the tulip trade was conducted using forward contracting methods which were common practice in agricultural areas, albeit adapted to the special features of the tulip. However, a new type of 'bulb trading' appeared during the tulipmania which was, decidedly, unconventional.

The tulipmania was precipitated by the entrance, around the end of 1634, of purely speculative buyers into the tulip market:

People who had no connection with bulbgrowing began to buy after [early 1634]. Among these were weavers, spinners, cobblers, bakers, and other small tradespeople, who had no

knowledge whatsoever of the subject. About the end of 1634...the trade in tulips began to be general, and in the following months the non-professional element increased rapidly. Rumours about rising prices paid for tulip in Paris and the North of France accelerated the movement. New ways of selling were organized... Towards the boom in 1636...buyers of bulbs often know that the seller possessed none; so they did not pay or deliver their goods till they were certain the tulip would really come into their possession. At the height of business most transactions took place without any basis in goods. The trade in (forward positions) had degenerated into purest gamble, the seller selling bulbs he did not have against a counter value, mostly money at this period, which the buyer did not possess. Each succeeding buyer tried to sell his ware for higher prices; and, in the general excitement, one could make a profit-- at least on paper-- of several thousand florins in a few days. The craze spread rapidly with these high profits. All classes of population ended by taking part in it-- intellectuals, the middle classes, and the labourers. (Posthumus 1929, p.438-40)

GW trace the collapse to Feb. 3, 1637. By the end of Feb. 1637, there was widespread default on forward contracts. After a short period of political and legal wrangling, the bulk of contracts outstanding at the time of the collapse were voided on the basis of 'appeals to Frederick', the common reference to the ban on *in blanco* short selling. Where payments of differences were made, these payments were almost always in the 1-5% range.

What did the price of tulips do during the tulipmania? Drawing primarily on GW, Garber (1989, 1990) provides detailed information on certain extreme price movements during the speculative updraft in prices. Yet, the bulbs examined by Garber are selective. GW report the following prices for the period from 1635 to early 1637:

To mention a few out of so many, just as you know the lion by its claw. A plant Gheele en Root van Leyden of 515 aces had been sold in the first instance for 46 gld., and then for 515 gld.; a Gouda of 4 aces first for 20 gld., later for 225 gld.; and Admiraal de Man of 130 aces first for 15 gld., then for 175 gld.; a Generalissimo of 10 aces first for 95 gld., and then for 900 gld.; and so on with the other plants. This only lasted for a month or six weeks; then they started selling by the thousand ace and by the pound. A pound yellow Croonen could be bought first for 20 or 24 gld.; in a month's time it was 1,200 gld. and over. A pound of Switzers first cost 60 gld., later 1,800 gld. A pound of White Croonen first cost 125 gld., later 3600 gld....

GW report similar price behaviour for various other bulbs. Garber (1989) has evidence from a small sample of bulbs indicating that, as is common in speculative frenzies, there was a steep increase in prices in the last couple of months prior to the collapse. In any event, the price increases reflect the temporary social obsession that speculating in tulip bulbs had in Holland

The claim about widespread options trading during the tulipmania is puzzling, especially as there is a fairly detailed record of the types of contracts used. The tulip trade during the mania period was conducted using a number of different methods, from the "promises and vouchers" of the most speculative and uninformed traders, to the formal notarized written contracts of tulip dealers. GW provide numerous examples of the text of contracts. Some are quite basic, such as: "Sold to N.N.

a quarter of Witte Kroonen for the sum of 525 gld. when the delivery takes place; and four cows at once, which may be now taken from the stable and led to the seller's house." A more detailed example for the forward sale with option features of a piece good is:

I, the undersigned, acknowledge to have bought from N.N., on conditions hereunder mentioned, one Gouda of 48 aces standing planted in N.N.'s garden, for the sum of 520 gld. in sterling. But in case 8 days after the notifying, the buyer were not to come to take the bulb, the seller may take it out of the ground, in the presence of two praiseworthy persons, and seal it in a box. And if a fortnight after this, the bulb has not been fetched by the buyer, the seller may sell it anew. If he gets more for it, the first buyer will not profit by it, and, when less, has to pay the difference. In case of any obscurity or misunderstanding or dispute arising out of this transaction, it will remain with two praiseworthy people, who know these things and who live in the place or town, where this transaction has taken place. And by default of payment of the aforesaid sum, I hereby engage all my goods, movable and immovable, submitting same in the power of all rights and magistrates; all this without arch or cunning. Have signed this. Act in Haarlem on December 12th, 1636.

Perhaps some speculative fringe players in the tulipmania engaged in pure gambles which were configured as an options transaction. However, such deals, if any were ever done, were only obscure incidents in the tulipmania.<sup>28</sup> Evidence for such dealings is not available in important primary sources, such as GW, or in key secondary sources.

One interesting feature of the speculative mania was the trade which developed among groups of speculators called "colleges" meeting in numerous taverns where speculating was combined with eating and drinking. As the mania gained steam an increasing number of uninformed speculators were gathered to the trade, the cumbersome trading method of using notarized contracts became problematic. The colleges developed a method of trading with few rules, though what rules there were appear to be much the same from college to college. Garber (1989, p.557) observes "...the college [forward] markets suffered from a lack of internal control over the nature of contracts... These markets consisted of a collection of people without net worth making ever-increasing numbers of 'million-dollar' bets with each other with some knowledge that the state would not enforce the contracts."

What lessons can be drawn from the tulipmania? Aside from the obvious observations about the social and economic consequences of mania, there are the fundamental insights about the relationship between forward contracting and the underlying commodity being traded.<sup>29</sup> The mania was largely driven by the excesses induced by forward trading by uninformed speculators. Significantly, because the forward contracts were traded on bulbs which were in the ground, the underlying commodity had elements of **non-storability**. Insofar as there was an insufficient supply of unplanted bulbs available for purchase during the period from October until June, there was no possibility of doing cash and carry arbitrage either for piece goods or pound goods. This permitted the forward price to be determined, almost exclusively, by the uninformed speculators unconnected to the tulip trade who dominated the tulip market between 1635 and 1637. The upshot of this participation by uninformed speculators was severe dislocation of the price discovery process for tulip bulbs.

## **Tulipmania: The Modern View**

The tulipmania of 1634-7 in Holland is often cited as a classic example of a 'speculative bubble', though Garber (1989, 1990) has recently attempted to challenge the conventional wisdom. Garber bases his position on two, somewhat incongruent, claims. The first claim (1989, p.557-8) speaks to a general epistemological point about using observed data to sustain theoretical claims regarding:

...the impossibility of distinguishing empirically between hypotheses that asset price dynamics are driven by a rational speculative bubble and that researchers have not adequately measured the future market fundamentals anticipated by market participants. More generally, data will not distinguish between a claim that market participants suffer from some mania because behaviour does not conform to the prediction of some researcher's theory and a claim that the theory is flawed or misspecified. Because of this observational equivalence, economists who take a position in the debate over the existence of bubbles are making a commitment that cannot be based on the analysis of experience.

While academically interesting, this claim speaks more to the difficulty of theoretical modelling than to whether there was a tulipmania. The inability of theoretical models to verify whether a mania happened or not does not mean that a mania did not occur. Precisely what type of evidence Garber requires to verify the occurrence a mania is unclear. Since David Hume (1711-1776), philosophers have recognized that such sceptical empiricism is a slippery epistemological slope. 'A mania by any other name is still a mania'.

Garber's other claim is that there is insufficient evidence to support the hypothesis that there was a tulipmania:

While lack of data precludes a solid conclusion, the results of the study indicate that the bulb speculation was not obvious madness, at least for most of the 1634-7 "mania". Only the last month of the speculation for common bulbs remains as a potential bubble, although the nature of the market, the contractual commitments, and the surrounding events are unclear enough that one could seriously embrace one side of the fundamentals versus bubble dispute only on the basis of strong prior beliefs.

Garber bases this claim on an apparently detailed analysis of the empirical evidence. After a useful review of previous studies on the tulipmania, the institutional structure of the tulip market is examined and the price performance of various types of tulips over long time periods presented. From an examination the long time period price data Garber concludes that: "...the magnitude of prices for valuable bulbs and their patterns of decline are not out of line with later prices for new varieties of rare bulbs." Garber also indicates "the absence of descriptions of economic distress in accounts of the period not engaged in antispeculative moralizing".

Is Garber correct about the tulipmania? Has a 350 year old myth been exposed? The crux of Garber's empirical argument is that observed prices for rare tulip bulbs, so-called 'piece goods', were consistent with typical market pricing for this type of bulb. This conclusion is based largely on a

comparison of the rate of price depreciation of selected piece goods prices over three periods: from the peak of the mania in Feb. 1637 to 1642; and, for 1707-1722 and 1722-39, neither of the 18th century periods being associated with a tulip speculation or crash. Observing that the average piece goods depreciation rate of 32% for the 17th century period was comparable to a 28.5% average for the two 18th century periods, Garber concludes: "...the crash of February 1637 for rare bulbs was not of extraordinary magnitude and did not greatly affect the normal time series pattern of rare bulb prices."

There is considerable ground to cover in order to debunk Garber's somewhat incongruent dual hypotheses: that the tulipmania was not a real mania; and, that it is impossible, based on an examination of empirical evidence, to sustain any conclusion about speculative manias, in general, and the tulipmania, in particular. Evaluating whether the tulipmania qualifies to be called a 'mania' or, to use a modern expression, a speculative bubble, is complicated by the limited amount of data available. That there is insufficient evidence about an event that happened over three hundred and fifty years ago is not surprising. As Garber recognizes, both piece goods and pound goods prices suffer from a number of practical limitations. For example: "With the end of large-scale bulb trading after February 1637, records of transactions prices virtually disappeared." The 1642 prices that Garber uses were obtained from the records of a single sample of purchases later revealed at a 1643 estate auction.

Despite this paucity of data, Garber chooses to ignore empirical evidence which would seem to support the possibility of a mania. Like a good prosecutor, Garber highlights those facts which support a conviction, leaving facts which favour the defense for presentation by the defense attorney. In particular, while the information about depreciation rates is interesting, isn't the main issue with the inexplicably rapid increase and dramatic collapse in prices for a wide range of bulbs. GW provide numerous instances of bulb price increases from 20 gld. to 225 gld. or from 95 gld. to 900 gld., values which could be justified in terms of Garber's depreciation analysis, leaving reasons for the tenfold increase and subsequent retrenchment of prices still unexplained. GW indicate that these prices are for actual bulbs, not from trading in the colleges.

## **US Markets during the 19<sup>th</sup> Century**

By the beginning of the 19<sup>th</sup> century, a number of characteristics associated with exchange trading of derivative securities trading had emerged. In particular, the exchange clearing process imposed self regulatory requirements on exchange participants needed to ensure settlement of positions. Both informal and formal rules were introduced to control access to the exchange process, e.g., the use of sworn brokers; restrictions on participation in the clearing process; private ownership of the exchange building. When exchange trading of derivative securities was concentrated around a small group of merchants directly involved in the goods trade, self regulation was generally sufficient to prevent speculative excesses. However, as trading expanded to include those unconnected to the trade, government oversight was required to prevent speculative abuses and unscrupulous practices associated with OTC style derivative security trading, where deals were directly done between counter parties. The connection of exchange trading of derivative securities for bulk commodities to the underlying goods trade restricted speculative participation in comparison to such trading in stocks and shares. Competition among exchanges was muted by the need to locate trading

geographically close to the associated goods trade, e.g., the wholesale goods market for commodities.

Though primary sources are scarce, it is likely that some form of derivative security trading in the US was present from the 18<sup>th</sup> century beginnings of trade in securities, perhaps earlier in the produce markets, e.g., Markham (1987, 2002). Significantly, over time this trade developed differently from Europe due to differing settlement practices. In the US, “each day is a settling day and a clearing day for transactions of the day before ... This is a marked difference from European practice” where “trading for the account” involves monthly or fortnightly settlement periods with allowance for continuation of the position until the next settlement date (Emery 1896, p.82). The continuation process for a buyer seeking to delay delivery involves the immediate sale of the commodity or stock being delivered and the simultaneous repurchase for the next settlement date. As this transaction would involve the lending of money, an additional ‘contango’ payment would typically be required.

Daily or short dated settlement had dramatic implications for derivative security trading in the US commodity and stock markets. In the stock market, instead of trading for time, it was more expedient to speculate by buying and selling (shorting) stocks on margin. As a consequence, the venue for evolution of derivative security trading was in the bulk commodity markets where, during the 19th century, exchange trading of derivative securities experienced a revolution that can be attributed to the subtle impact American culture had on specific business practices. Writing in 1896, Emery (1896, p.7) captures the main theme: “The American people are regarded by foreigners as the createst of all speculators.” This drive to speculate facilitated American innovations in derivative securities. “It was not until the (19th) century ... that the system (of dealings for time) became widely developed and not until the great expansion of foreign trade in the last fifty years that it became of great importance.”

An important theme in progress of exchange trading of derivative securities is the public good benefits provided by enhanced participation of speculators in the exchange process. Among other benefits, enhanced speculation increases market liquidity and can improve price discovery. Yet, speculative activity in derivative security markets can have decided disadvantages, such as the increased incentive and ability to manipulate markets using the inherent leverage such contracting methods provide. Periods of turbulence in specific markets – where price discovery apparently failed – are often associated with the entrance of speculators not directly connected to physical trade in the underlying commodity. The availability of leverage associated with derivative contracts allows speculators operating with significantly less capital than needed to participate in cash trading to distort market pricing for private gain.

Though there was time dealings being conducted in a number of centers throughout the 19th century, the beginning of exchange trading of derivative security contracts in the US commences with futures contracts traded on the Chicago Board of Trade (CBT) in mid-19th century Chicago, a city which was first incorporated as a village in 1833 growing into a city of 4,107 by 1837. In order to promote commerce, the Board of Trade of the City of Chicago was founded on April 3, 1848 with 82 members. This event, in itself, was not particularly noteworthy. The usefulness of boards of trade in promotion had been recognized for quite some time. For example, around 1700 John Law of the infamous Mississippi scheme promoted the creation of a board of trade for the city of Edinburgh (Murphy 1997).

Inherent conflicts between the exchange as a promoter of trade and interests of members and the exchange as a self-regulatory entity were not recognized, e.g., Lurie (1972, p.221):



A basic purpose of the Board was to facilitate profitable economic activity by members. Thus its directors had to sense with some accuracy how far they could go in the areas of rule enforcement. If rules were enforced too harshly, board members could either ignore them or decline to remain in the organization. Yet, another purpose of the exchange was to rationalize the commodities market through efficient and effective regulation. The efforts of the directors to reconcile this inherent tension between private economic activity and an ordered national market represent a recurring theme throughout Board history.

The CBT initially served as a marketplace for members of the grain trade. A system of wheat standards was developed together with a system of inspecting and weighing grain. In 1859, the Board of Trade was authorized by Illinois state to engage in the measuring, weighing and inspecting of grain, effectively corn and wheat. As Hieronymous (1977, p.73) observes: "The development of quality standards and an inspection process and the substitution of weighing for the measurement of grain greatly facilitated trade. The substitution of weight for volume measures made the development of grain handling machinery possible. Increase in physical efficiency was important in the development of Chicago as a great grain terminal." These developments facilitated the handling of grain in bulk, through the use of grain elevators. This permitted interchangeable warehouse receipts to be introduced, instead of having to deal in unstandardized, specific lots. Not unlike the bulk commodity trade in 16<sup>th</sup> century Antwerp and 17<sup>th</sup> century Amsterdam, conditions in the goods market were evolving to where standardized contracts on physical commodities could be traded.

The grain trade of that time typically involved merchants at various points along major waterways such as the Illinois-Michigan canal purchasing grain from farmers which was then held in storage, often from fall or winter into spring. In this operation, the merchants' capital investment involved: paying the farmers for their crops at delivery; costs of building and maintaining storage facilities; and, providing funds for shipment of grain when required. In order to avoid the risk of price fluctuation and to satisfy bankers, merchants started to go to Chicago and make contracts for future, spring delivery of grain, at prices which were determined that day. While there was ad hoc OTC style forward trading of grains previously, the first "time contract" in Chicago was made on March 13, 1851 calling for delivery of 3000 bushels of corn in June at one cent below the March 13 cash price. The time contracts called for delivery of a standardized grade at a later delivery date. Similar contracts for wheat appeared in 1852. However, while there were similarities to exchange traded futures contracts, the absence of other conditions such as a clearing mechanism, the contracts were specific to the original parties to the transaction and created with the objective of delivery. As such, the initial trading in time contracts did not quite qualify as exchange trading.

The development of futures markets in Chicago was significant because, in the years immediately following the introduction of time contracts, individuals not connected to the grain trade became interested in taking positions. The resulting contracts often changed hands numerous times before being purchased by a market participant actually interested in taking delivery of the grain. This marks the introduction of a fundamental feature of futures markets, the essential participation of speculators not concerned with completing the underlying commodity transaction. Exchange trading and purely speculative participants were characteristics not associated with trading in the often non-transferable 'to arrive' contracts and 'privileges' which had characterized American commodities

trading previously (Williams 1982). This trade was concentrated primarily in flour. To arrive contracts in wheat, corn, rye and pickled hams were also conducted with activity centering on New York. In contrast to time bargains, to arrive contracts typically featured short delivery dates, limited standardization of the deliverable commodity and the expectation that delivery would be completed. While there is some evidence of limited speculative dealings in these 'to arrive' contracts and 'privileges' associated with the flour default of May 1847, participants to these transactions usually involved merchants directly involved in the commodity business. In keeping with use of such contracts in Liverpool, cotton trading did employ 'to arrive' contracts that had elements of futures contracts (Forrester 1931).

The increasing interest in time contracts led the Board of Trade to introduce a number of resolutions to curb abuses. Many of the abuses were consistent with speculative participation and longer delivery dates. "It seems that when time for settlement arrived some of the contracting parties were difficult to locate." (Hieronymous p.76) Out of the early self regulatory process came the beginnings of formal trading rules for futures contracts. In 1863, the Board adopted a rule which suspended the membership of anyone failing to comply with a contract, either written or verbal. On Oct. 13, 1865 the General Rules of the Board of Trade explicitly acknowledged futures trading and adopted rules which included all the essential elements of a modern futures contract including: standardized contract terms; restriction of futures contract trading to exchange members; margin deposits to guarantee performance; and, standardized delivery procedures. Prior to this date, individual traders had been responsible for establishment and enforcement of the terms of the contract. This development followed a similar move in 1864 by the Liverpool Cotton Brokers' Association introducing formal regulations for 'to arrive' contracts in cotton (Forrester 1931).

Exchange trading of derivative security contracts progressed dramatically since the first corn futures trade on the CBT in 1865. Many other futures exchanges emerged in the period between the Civil War and World War I. The New York Cotton exchange was formed in 1870 and the New Orleans Cotton Exchange in 1871, though time contracts did not play an important role on the latter exchange for almost a decade. In 1874, the Chicago Produce Exchange was formed by dealers trading in produce of various kinds. The Coffee, Sugar and Cocoa Exchange was initially founded in 1882 as the Coffee Exchange of New York City with the specific intent of trading in time contracts for coffee. Initially founded in 1872 to trade in butter, eggs and cheese, a decade later the exchange acquired its current name, the New York Mercantile Exchange (NYMEX).<sup>30</sup>

In 1898, a subgroup of the produce exchange known as the Produce Exchange Butter and Egg Board withdrew from the Produce Exchange and formed the Chicago Butter and Egg Board. This group is of present interest because it had established an active trade in time contracts for eggs, even though such trade was only a small proportion of the Butter and Egg Board's activity. When margin rules for time contracts were finally written in 1911 there was considerable controversy among the members. Finally, in 1919, a complete set of futures trading rules were written and the mandate of the Butter and Egg Board was changed to include futures trading. The end product was the emergence of the Chicago Mercantile Exchange, which started contracts for trading butter and eggs on Dec. 1, 1919.

The late 19<sup>th</sup> century Renaissance in exchange trading of derivative securities was accompanied by a rash of speculative manipulations that ultimately led to vociferous attacks from agrarians and Populists, e.g., Cowing (1895), Hicks (1961), Jacks (2007). Though referred to as 'anti-option' bills,

the focus of the attacks was futures contracts. The anti-speculation reasoning behind the attacks was described around that time by Cowing (1895,p.5):

The seemingly orthodox futures contract, occasionally used before the Civil War and an outgrowth of earlier “to arrive”, and “forward delivery” agreements, began to receive unprecedented attention from speculators. Persons not previously connected with the commodities business had been attracted, and were buying and selling futures contracts in the central markets, especially in Chicago and New York. The number of bushels and bales traded on the exchanges exceeded the annual production from 1872 on and in several years toward the end of the century amounted to sevenfold the annual crop. Prices had moved widely before the war because of weather, economic instability, and imperfect crop information, but it appeared that the new volatility was due to maneuvers by speculators with large purses. Thus “speculator” became more than ever a term of opprobrium; the physiocratic bias against those who produced no primary products was more bitterly asserted as the agrarian population shifted consciously to the defensive. The mysterious and remote commodity speculator seemed more of a parasite to the farmers than the local physician who was holding land for appreciation. Farmers identified the commodity speculator as the villain responsible for erratic price changes in Chicago, Minneapolis, and New York, especially around harvest time. The stage was set; the national crusade against the exchange speculator was about to begin.

Various efforts were made by the exchanges, as well as state and federal legislatures, to control the perceived market manipulations. At the federal level, between 1880 and 1920, there were some 200 bills introduced in the US Congress aimed at regulating derivative security trading, though few bills made it out of committee (Markham 1987, p.6-9). State legislatures that did pass bills, e.g., an 1874 Illinois statute prohibiting ‘corners’, were unsuccessful in curbing such activities. Various states passed laws prohibiting futures trading for which there was no intent to take delivery. Such laws were voided by the courts on grounds that “pro forma assertions of interest with respect to delivery were sufficient to preclude application of the statutes” (Markham 1987, p.6; Lurie 1972).

The decline in agrarian conditions following the post-1886 droughts generated sufficient political will to produce the Hatch-Washburn bill of 1892, the most concerted effort at legislation prior to passage of the Grain Futures Act in 1921. Instead of outlawing futures trading, this bill aimed to impose a prohibitive tax on speculative dealings in futures. The Congressional debate on the issue surrounding the Hatch-Washburn bill is an essential primary source on 19th century views on derivative securities. The committee meetings leading up to votes on the bill included testimony from important agrarians, such as J.H. Brigham, Master of the National Grange and C.W. Macune of the Farmers' Alliance and Industrial Union. Not only farmers were in favor of the bill, the testimony also included statements from millers, such as Charles Pillsbury, as well as grain and hog merchants. Pillsbury held that “neither grower nor miller had as much influence over prices as a few men around the wheat pit in Chicago. Short selling by these few made prices erratic and unstable; opinions based upon supply and demand were worthless in the face of this manipulation” (Cowing 1965, p.7). Pillsbury also maintained that the use of futures to hedge would not be necessary if price volatility due to speculation was eliminated.

In 1893, the Hatch-Washburn bill successfully passed the House, 167 to 40, and passed the Senate, 40 to 29, though there were some amendments which had to be returned to the House for approval.<sup>31</sup> However, this placed the bill too far down the calendar to be dealt with before the end of the session. A suspension of House rules was required for the bill to become law. However, suspension of rules requires a two-thirds majority and the vote, 172 to 124, fell short by 26 votes. The gradual return of prosperity dampened, but did not eliminate, the drive of the anti-speculator forces. However, it was not until after WWI that sufficient legislation, such as the Grain Futures Act (1922), was in place to curb the alleged abuses of the middlemen and speculators using the exchanges. By this time, the extreme anti-speculator position of the agrarians had faded. Though the Act did contain provisions against manipulation these were largely ineffective. The Act was successful in bringing the futures exchanges under federal supervision and in providing for “continuous fact-finding and supply of continuous trading information” (Hieronymous 1977, p.314). However, the failure to recognize and exploit the fundamental role of exchange self regulation in identifying and penalizing market manipulation still survives to the present.

The history of options trading in the US reflects the general confusion surrounding exchange trading of derivative securities. In considering this history, a distinction between stock and commodity options is needed. Though there were instances of earlier trading, initial US trade in *commodity* options is usually associated with the beginnings of the CBT, where options were known as “privileges”. Bid and offer privileges roughly corresponded to modern day puts and calls. The similarity of privileges to gambling, as well as the prominent use of options in a number of market manipulations, led to numerous unsuccessful attempts by the CBT, various state and federal legislatures and the courts to halt commodity options trading. As early as 1865, the CBT introduced a rule which denied the protection of the exchange to privilege traders. This rule was found to be both unpopular and ineffective and was withdrawn in 1869, illustrating the ineffectiveness of self-regulation when the governance of the exchange is controlled by the members being regulated. Various legal challenges were launched to privilege trading, including an Illinois Supreme Court ruling which found privileges to be illegal. In 1890, the US Congress attempted to ban commodity options but was unsuccessful in getting the legislation passed. The trade in commodity options continued under different guises, e.g., calling the contracts “indemnity of sale or purchase” (Markham 1987, p.9), until the trade was banned by the Commodity Exchange Act (CEA) (1936).

The social resistance to commodity option trading during this period was propelled by farm based “populist” political movements which associated erratic price behavior with excessive speculation. These views were not without foundation. The limited amount of regulation of commodity markets in the pre-WWI period permitted numerous corners and other market manipulations. Charles Taylor (1917) relates the role of privileges in one of the more “outstanding of these (corners that) had to do with oats, and was operated by Mr. Chandler, a prominent merchant. He peddled ‘puts’ about the city, inducing speculation on the part of a large number of people not ordinarily in the market. Chandler and his friends did not count on a large inrush of oats attracted to Chicago by the high prices and the corner failed. Many people lost money and there was much public indignation.” (Hieronymus, p.85) There was a prevailing belief among populists that brokers were using the exchange process to extract money from farmers. This view was carried forward into the Grain Futures Act (1922) which contained a section maintaining derivative security “prices are extremely sensitive to speculation and manipulation” (Markham 1987, p.14). The social importance of many

of the underlying commodities meant that commodity options received substantially more scrutiny than stock options.

For a variety of reasons, including a history of speculative abuses, option trading was held in low esteem by the bulk of commodity market participants in the US. Absence of exchange sanction prevented the exchange trading of such derivative securities. As a consequence, the trade was generally conducted by a specialized group of OTC traders catering to a relatively small clientele. Circa the end of the 19<sup>th</sup> century, trading in privileges was only conducted in the after market and on ‘the curb’ as such trading was prohibited on all US commodity exchanges. By the end of the 19<sup>th</sup> century, all US produce exchanges had banned option trading, though some OTC trade did take place in other venues and other various guises. Evidence for such trade in stock options is provided by Kairys and Valerio (1997, p.1709) where an 1873-5 sample of over-the-counter US option contracts is examined. This sample was obtained from advertisements in the Commercial and Financial Chronicle. The prices were only ask quotes, exclusive of bids, and were aimed at generating business from buyers of options. The option prices were found to favor the option writer. Following the European practice, these contracts determined prices by keeping the premium constant and adjusting the exercise price:

Whereas current option prices are quoted after fixing the strike price, the cost of a privilege was fixed at \$1.00 per share for all contracts and the strike price was adjusted to reflect current market conditions. Furthermore, the strike price was expressed as a spread from the current spot price of the underlying stock with the understanding that the spread was then the “price” that was quoted for the privilege contract.

Based on Emery (1896), this method of pricing options was also customary in the Chicago grain markets where contract maturities varied from one day to a week. This indicates the prevalence of European practices in the US option market at this time.

### **Hedgers vs. Speculators: The Cargill Corn Case**

The traditional approach to commodity risk management divides derivative market participants, particularly those operating in forward and futures markets, into the two general groups of *hedgers* and *speculators*, e.g., Hieronymous . This distinction has both economic and legal implications. A number of the legal implications can be found in the Commodity Exchange Act, where a legal separation of traders in futures markets is identified and differential reporting requirements and position limits are specified. Commissions and margin requirements can and do vary between the two types of traders. The basic textbook distinction between hedgers and speculators has hedgers trading to reduce the risk associated with a cash market position while speculators are trading solely on the basis of expected price changes. While useful analytically, there is much more to this dichotomy which needs to be explained.

Historically, some legal distinction between the two types of traders was essential. The anti-speculative sentiment surrounding the passage of the CEA (1934) had to be tempered to accommodate commercial interests with a real need to trade derivative securities in order to manage risk. Initial definitions of hedgers were quite restrictive. By the 1970s, the easing of anti-speculative

sentiment spurred on by the increasing needs of commercial enterprise was sufficient to produce a rethinking of the legal treatment of hedging and speculation. Of particular interest, as part of the process surrounding the revisions to the Commodity Exchange Act (1974), the CFTC was required to provide a definition of hedging in order to determine which traders would be subject to position limits on speculative trade, and which traders would be considered as hedgers, and not subjected to limits on trading positions. This definition for a hedger was released in 1977. Instead of attempting a precise legal definition, the CFTC opted for a long and involved definition, derived from the economic motivations for hedging.

Though there is considerable scope in the CFTC definition for consideration on a case-by-case basis, the CFTC definition generally requires (Leuthold et al. 1989, p.71):

(a) it must be economically appropriate to reduce risks; (b) risk must arise from operating the commercial enterprise; (c) the futures positions normally represent a substitute for transactions to be made later in the physical market; and (d) price fluctuations in futures markets must closely relate to fluctuations in the cash market value of assets, liabilities or services hedged. Thus, hedging is more than just enumeration of specific transactions and positions -- it is a process of risk reduction. Prior to this definition, several legitimate hedging operations, especially cross and anticipatory hedges, were not recognized as hedges because futures positions did not meet the approximate equal and opposite requirement to the cash position.

While this explicit attempt to incorporate economic motivations into the definition of hedging is definitely an improvement over a strict legal approach, the underlying issues may be unresolvable.

The Cargill corn case (Falloon 1998, ch.8) provides a classic instance of the difficulties, and associated implications, of distinguishing hedging from speculation. The case originated from actions of Cargill, Inc., a grain marketing company, primarily in the trading of corn futures contracts on the CBT during 1936 and 1937. Cargill was a major player in the grain industry, at that time handling approximately 12% of American grain being marketed (Broehl 1992, p.467), arguably the largest single private grain distributor. Also at the time, Cargill was the largest user of grain futures contracts on the CBT. Despite being a major player in the markets, Cargill was something of an outsider in the CBT hierarchy, having only grudgingly been admitted as a clearinghouse member in 1935. Cargill did not have a seat on any of the primary CBT governing committees. As a result, Cargill reacted negatively to a series of adverse decisions from the CBT which were implemented to prevent what was perceived as blatant market manipulation by Cargill. The resulting court cases which originated were the first major test of the market manipulation provisions of the CEA.

As a major player in the corn market, Cargill was able to forecast tight conditions in US corn supplies in 1936 and again in 1937. In response, during July 1936 Cargill bought corn offshore, in Argentina, for import and placed a large long position in Sept 1936 corn futures on the CBT. Such activities are consistent with the role of Cargill as a grain distributor seeking to match orders with purchases. What was questioned by both the CBT and the regulators was whether the size of the position was fully consistent with hedging activity. Did the position contain a significant speculative component? The size of Cargill's corn futures position constituted about 1/4 of open interest and can be compared with the 22.5 million bushels, which was the four year historical average for the

“visible supply of corn in the US” at that time (Falloon 1998, p.190). As the end of the delivery month approached, the size of this position attracted the attention of the business conduct committee of the CBT, which held meetings on the matter involving, on Sept 25, the president of Cargill. Despite assurances from Cargill that the position would be unwound in an orderly fashion and no evidence to the contrary, the CBT board of directors took action on Sept. 29 allowing an extension of the deadline for notice of physical delivery. This action precipitated a substantial price drop in the cash corn price, adversely impacting Cargill.

Not surprisingly, the Cargill management was incensed. The atmosphere was again poisoned on December 7, 1936 when the business conduct committee took action regarding Cargill’s position in the Dec 1936 corn contract, which was deemed to be too large to be justified by legitimate hedging activity. The committee took the unprecedented action of ordering Cargill to reduce positions. Even though Cargill complied, at an estimated cost of 15¢ per bushel per contract, positions were only further hardened setting the stage for the events of Sept. 1937. Again confronted with supply shortages, during the summer of 1937 Cargill placed large long positions in CBT corn futures, first in the July contract and then for the Sept contract. The Sept position was about double that of the previous year, being as large as 9.4 million bushels, about one half of the contract open interest. Based on past experience, Cargill surmised that the size of this position would come under intense scrutiny by the CBT. To counteract such scrutiny Cargill entered into temporary futures-for-cash exchange contracts with the Continental Grain and Uhlmann Grain companies. The result was a reduction in Cargill’s reported position to 2.2 million bushels.

The grain business being a closely knit community, it was not possible for Cargill to disguise the actual activities from the CBT business conduct committee which was only too aware of Cargill’s controlling position in the Sept contract open interest. As the delivery month progressed, Cargill did little to reduce the size of its position, resulting in Cargill having an increasingly larger share of open interest in the contract. By Sept. 22, the pressure on the price of deliverable stocks was evident. Despite apparent assurances to liquidate in an orderly fashion, Cargill did not move promptly to reduce its position. In response, on Sept. 23 a cease and desist order was sent to Cargill and on Sept. 24 a trading halt was ordered and a settlement price for all outstanding contracts was set at \$1.10½, 2 cents below the close of Sept. 22. The impact on the cash market was predictable, the cash price fell resulting in significant losses for Cargill on the cash grain it held in company stocks, as well as on the cash corn it had acquired in the cash-for-futures swap it had done with Continental and Uhlmann. Cargill was incredulous and a long series of CBT committees as well as two court actions under the CEA were initiated. Hearings of the CBT board of directors in March 1938 resulted in the expulsion of Cargill from the CBT. The resolution of the CEA cases also went against Cargill, though only specific managers at Cargill were sanctioned. In the end, Cargill, Inc. was still able to use the futures markets to facilitate grain marketing.

Was Cargill engaged in legitimate hedging activities? Surely, there was a significant hedging element behind some of Cargill’s futures activities. Cargill maintained that insiders at the CBT acted to undermine the legitimate activities of a grain distributor, with the members of the CBT business conduct committee directly benefitting from the negative decisions made against Cargill. This accusation that the futures exchanges act as monopolies seeking to further the interests of the members has been replayed in other cases. For example, a similar comment applies to the Hunt silver manipulation. The apparent evidence of manipulative activities on the part of Cargill was

confirmed in various forums, from CBT hearings to court actions under the CEA. Yet, somehow, the arguments are not clear cut. The boundary between legitimate hedging, speculation and speculation supported by manipulative intent is not clear cut. The hedging decision involves a speculative component. Combined with sufficient impact in the cash market, it is possible to rig the game. Precisely when rigging the game is happening is not as easy to discern as might appear.

### ***C. Speculation and Manipulation***<sup>32</sup>

#### **The Hunt Silver Manipulation (1979-80)**<sup>33</sup>

The impact of the activities of the Hunt brothers, Bunker and Herbert, on the silver market during June 1979 to March 1980 has been the subject of much legal wrangling and academic debate, e.g., Williams (1995). At the centre of the debate is the issue of market manipulation. Precisely what constitutes manipulation is not an easy concept to legally define. What constitutes legal activity in one situation may be illegal in other situations. These events in the silver market during 1979-80 also provide useful insight into the workings of futures markets. Playing fundamental roles in the incident were: the exchange oversight function; the crucial role of variation margin; and, the details of the delivery process. The incident is also interesting because of the considerable economic analysis which was done on the event, arising from the lawsuits which were generated by specific events.

The central characters in the story are the Hunt brothers. Though the Hunts were not the only players in the ring, the social importance their family has led attention to focus on their role.<sup>34</sup> The Hunts started dabbling in the silver market in 1973, beginning with trading in silver futures. Being men of substantial wealth, it was not surprising that they soon expanded their silver activities to include the taking of delivery on futures contracts. From that point, until 1979, the Hunts became involved in an expanding attempt to dominate the global silver market. These activities included an attempt to gain control of the Sunshine Mine, the largest silver mine in the US, from Sunshine Mining Company. As of 1 Jan. 1979, the Hunt's had accumulated approximately 37 million troy ounces of bullion, with an additional 25 million in futures positions, an amount equal to around \$375 million at early 1979 prices (Williams 1995, p.20).

While interesting reading, the motives for the Hunts getting involved in the silver market have been told elsewhere, e.g., Fay (1982). What is relevant here is that, as speculators, the Hunts were in a situation where business profitability depended almost exclusively on the movement in the level of silver prices. Their business risk was almost exclusively a market risk. Given this large exposure to a specific commodity price, it is not surprising that the Hunt's were involved in activities designed to control the price of silver. In the process of accumulating their large silver positions, the Hunt's had also developed an intricate network of silver market players. Included in this network were two Saudis who, starting in the summer of 1979, combined with the Hunts to form the International Metals Investment Company (IMIC). This company was formed to engage in further trading in silver, especially silver futures. The Hunts also informally enlisted the participation of another group, which traded primarily through ContiCommodity Services (Conti). Despite being an American company, Conti seems to have been fronting for offshore, primarily Middle Eastern, clients, e.g., Fay (1982).



The relationship between the price of silver and the activities of the Hunts, IMIC and the Conti group has been intensely examined in a 1988 civil court case, *Minpeco v. Hunt* (Williams 1995). The plaintiff in the case, Minpeco, is a Peruvian government-owned metals marketing firm. The case against the Hunt's was successful and \$192 million in damages were awarded. The six month trial produced what can only be characterized as remarkable evidence. "All the legal professionals involved with the Hunt silver litigation have remarked on its exceptional complexity in regard to both laws and facts. In addition to manipulation law, the Hunt case involved antitrust law, racketeering law and fraud-on-the-market doctrine" (Williams 1995, p.xii). That the case went to trial is unusual, illustrating the complicated issues involved.<sup>35</sup> As the trial progressed, the various participants revealed information in detail which is not typically available.

#### INSERT Figure 2.C.a Daily Silver Prices, May '79-April '80

The Hunt case illustrates the inherent vagueries determining what constitutes *illegal* manipulative activities. The timeline is important. Shortly after IMIC was formed, the price of silver began what is best described as a bubble (see Figure 2.C.a). At debate in the court case was the role of the Hunt's in any market manipulation that took place. The evidence is clear that during the summer of 1979, the Conti group, in combination with IMIC, took large positions in Comex silver futures, with the Conti group targeting the Dec '79 contracts with the Hunt's focus being Feb. '80 and Mar. '80. On Aug. 31, 1979, the combined positions of the Hunt's, IMIC and the Conti group totalled 25% of Dec. '79 open interest on the Comex and CBT, with 32%, 47% and 38% in the Feb, Mar and May '80 deliveries.

Williams (1995, p.32) describes the extent of the Hunt's silver commitment:

Manipulative schemers or not, Bunker and Herbert Hunt, in the summer of 1979, had doubled their already colossal bet on the price of silver. In just their personal accounts, including their half of IMIC and their existing holdings of bullion, they had positions approaching 140 million troy ounces (a level they kept more or less until the following March). At prevailing prices, the value of the silver they controlled exceeded \$1.3 billion, a large fraction of their net worth. With every \$1 movement in the price of silver, they gained or lost \$140 million, an amount substantial even to them.

Given the size of these positions, the Hunts made considerable gains from the runup in prices that started around Aug.22 and continued to Sept. 18, a rise from \$9.537 to \$15.90.

Not unlike the Cargill grain case over four decades previously, this abrupt price change surrounding a contract delivery triggered the oversight bodies within the futures exchanges. On Sept 4, the first of a number of initial margin increases was announced. In early October, the Comex set up the Special Silver Committee to monitor the market and set rules as needed. Pressure was exerted on the visible longs, primarily Conti, to facilitate an orderly liquidation of the Dec. contracts. However, until the Dec '80 contract deliveries started to weigh on the market during the delivery month, the principal shorts were not having difficulty locating bullion for delivery. What did start occurring was a substantial decrease in market liquidity. The principal commercial shorts were exiting the market, many using an *exchange for physicals* (EFP) transaction.

An EFP is an off-exchange transaction in which the futures contract is settled by delivery of a non-standard grade of the underlying commodity. An EFP is usually motivated by a commercial transaction, e.g., a scrap copper producer can do an EFP with a scrap supplier, where both are hedging using copper futures contracts. The futures contract offset is bundled with the commercial transaction. During October there were a number of large EFPs where major silver dealers (Mocatta Metals; Sharps, Pixley; J. Aron) seemed to be delivering a large portion of physical silver inventories to IMIC and others in exchange for cancellation of futures contracts with maturities covering Dec. '79 through Apr. '80:

IMIC's EFPs which supplanted most of its futures contracts, were perfectly consistent with its avowed business purpose of acquiring physical silver. Coupled with the deliveries already taken in September and October, IMIC had acquired 35.3 million troy ounces by mid-December, 27.8 million of that as bullion. Bunker and Herbert Hunt themselves took delivery of 6.425 million troy ounces during the fall of 1979. For the two Hunts, taking delivery afforded sizable tax advantages, given the increase in price since the summer. According to US tax laws then applicable, a liquidation of a futures position, including a rollover into a later month, triggered a taxable event, upon which any gain would be taxed. In contrast, deliveries taken were not a taxable event; the gain, if it existed, would be taxed only when the silver was ultimately sold.

By November, the principal longs had accumulated a sufficiently large enough position in deliverable physical supply that the stage had been set for a squeeze on the shorts.

The price increases for spot silver during December and January were dramatic. From \$20 on Dec. 1 to \$38.85 on Jan. 1 the price increase was more than worrisome to Comex officials. The December delivery had finished without failed deliveries but only with considerable exchange oversight. What transpired over the next three weeks was a remarkable series of Comex decisions aimed at stabilizing the market. On Jan 7, position limits of 2000 contracts were imposed, with the proviso that those with current aggregate positions in excess of 2000 contracts be given a year to comply providing for at least a 10% reduction in position size per month. Deliveries were also limited to 500 contracts per month. Commercial firms making hedging decisions with transparent connection to physical stocks were exempted from the limits. The impact of this on the principal longs can be seen by recognizing that Bunker Hunt alone had long 13,055 contracts for Mar '80 delivery. The restrictions combined with the intense variation margin pressure being imposed on the commercial shorts, triggered another round of EFPs with Engelhard Mineral and Chemical (Philipp Bros.), Bunker Hill Co., Swiss Bank Co. and others.

Faced with the bankruptcy of major commercial shorts, the end of the silver bubble came on Mon. Jan 21, 1980 when the Comex announced that all trading in silver futures would be limited to liquidation only. This unprecedented step effectively closed the silver futures market. (The much smaller silver futures market on the CBT followed suit the next day.) This action precipitated a drastic fall in the spot price of silver. Having traded briefly above \$50/oz. in the week prior, the close on Tues. Jan. 22 was \$34, a level which was maintained until mid-March when prices again fell precipitously to the \$17 level. In the interim, the Comex deemed that the pressure on the market had eased sufficiently, that the liquidation only restriction on silver futures trading was lifted. The

price behavior had reversed the pressures on the commercial shorts placing the burden of variation margin squarely on the longs. The underlying strategy of taking profits in bullion, through EFPs and standing for deliveries, turned on the longs with a vengeance. The bullion, which could be used to secure financing, is declining in value and can only be partially leveraged. Considerable cash on hand has been expended to settle the EFPs.

Variation margin rules at the Comex and on most exchanges provide for daily limits on the payments that have to be made to the account. This caps the daily cash flow pressures, leaving a longer period of time for payment and the possibility that prices will recover. Nonetheless, given a long enough time frame, the payments will eventually be made. Englehard Mineral, an important commercial short, was reported to have paid \$1.3 billion in variation margin on silver futures up to mid-January. Though the notional variation margin was over \$1 billion in mid-March, the actual payments required from personal sources was some \$60 million per day for the Hunt's. The cash flow pressure was such that on Mar. 13 the Hunt's and IMIC defaulted on variation margin payments to their brokers. After a brief period during which the brokerage houses covered unpaid variation margin balances, on March 27, 1980 the final phase of the bubble took place with brokers liquidating various cash and futures positions.

#### INSERT Fig. 2.C.b Variation Margin Payments for Hunt's

Under the selling pressure of the brokerage house liquidations, the price of silver reached \$10.40/oz. The bubble had completely burst and new longs were entering the market. The Hunts were forced to mortgage key assets in the family portfolio, particularly Placid Oil which secured a loan of \$1.1 billion. By the end of April, the outstanding balances for the Hunts at various brokerage houses had been paid. Though the court cases dragged on for years, the immediate crisis was over. The usual array of House and Senate subcommittees, regulators reports and academic studies followed. One key finding of the regulators was that the key brokerage houses acting for the longs, Bache and Merrill Lynch, both acted imprudently by making large loans backed by bullion. The solvency of the firms could have been put in jeopardy. Yet, like the Cargill case, there is a strong case to be made regarding the lack of fairness in the exchange's treatment of the Hunts.

### **Derivative Debacles and Manipulation**

By definition, a debacle is an unusual event. The large losses and disruption of the price discovery process associated with such events often attracts considerable public attention. The result is often a public misperception about the actual riskiness of markets where risk management products are traded. Closer inspection of specific debacles reveals a decidedly murkier picture. Some events such as the reported \$1.33 billion loss reported by Metallgesellschaft in 1993 originate with poor internal risk management planning by large commercial companies. Other debacles, such the approximately \$6 billion loss by Amaranth Advisors in 2006, are driven by the leveraged speculation of inadequately monitored employees. Still others, such as reported \$2.6 billion loss reported by Sumitomo in 1996, are the result of misguided employees using a firm's market power to manipulate pricing for a particular commodity. In addition to staggering losses at the firms involved, the disruption to the price discovery process can have a far reaching impact that affects all firms that

produce and consume the underlying commodity.

Traditionally, most participants in the commodity derivatives markets – both ‘hedgers’ and ‘speculators’ -- had some connection to the underlying cash markets. What is manipulation? The answer to this question is important, if only because manipulation is an activity which is considered illegal under a number of US statutes. For example, the Commodity Exchange Act (1936) makes it a felony "to manipulate or attempt to manipulate the price of any commodity in interstate commerce". The CFTC licences futures exchanges with guidelines requiring rules be in place that prevent manipulation. Various other statutes dealing with price fixing and monopoly also make manipulation a criminal activity. As illustrated in a large number of civil cases, e.g., *Minpeco vs. Hunt*, there are also severe civil sanctions associated with attempts to manipulate markets. Yet, despite all this legal foundation: "The law governing manipulations has become an embarrassment -- confusing, contradictory, complex, and unsophisticated" (McDermott 1979, p.205).

The difficulties in the law surrounding manipulation speak to the difficulty in defining manipulation. Following Gray (1981), it is useful to make a distinction between *manipulation*, which is an economic concept, and *illegal manipulation* which is a legal notion. There are two essential elements required for an illegal manipulation: intent and "the creation of an artificial price by planned action".<sup>36</sup> The issue of intent is primarily a legal concept which is difficult to capture in a legal sense. It often speaks to the specifics of the case at hand. Similarly, price artificiality is an economic concept, which is also difficult to capture. Presumably, an artificial price is not a market clearing price. The underlying forces of supply and demand have been circumvented for personal or corporate gain. But this puts too much pressure on economic theory, a science which can usually provide only a vague estimate of what the ‘true’ market price ought to be in a given situation. Various measures of artificiality have been proposed, e.g., Leuthold et al. (1989, p.383), with some of these measure being adopted in specific legal cases.

In approaching manipulation, the courts have chosen to proceed piecemeal. The Congress has stated quite clearly that manipulation is not a desirable economic activity. Yet, a precise definition of manipulation is not available in the relevant statutes. The number of legal cases dealing with manipulation in the US is small, probably not more than thirty such cases have gone to trial since the 1950s, e.g., Johnson (1981), Gray (1981). Most of these cases have originated from trading on futures exchanges. From these cases, certain actions have been identified which are essential features of a manipulation: a controlling position in the appropriate derivative contracts; a dominant position in the deliverable commodity; and the undertaking of specific actions which would produce an artificial price. The first activity is associated with a squeeze. The first two activities together constitute a corner. The last activity encompasses what Williams (1995, p.6) refers to as:

A “rumor” manipulation, in which someone with a previously established position in the physical commodity or in futures convinces other traders through false reports that a shortage in that commodity will occur, for example, through a rumor of a freeze. The rumor must be believed by others only long enough for the manipulator to close out his position at top prices ... (or) ... An “investor-interest” manipulation, in which a series of trades and statements made by the manipulator convinces others of a broadly based desire to hold the commodity, thereby increasing its price. Until others realize that the underlying interest is merely temporary, the manipulator can sell her holdings at a high price.

The resulting confusion associated with applying all these standards in a specific legal situations is understandable.

The confusion surrounding manipulation extends to the jargon used to describe the possible strategies. Some sources, e.g., Williams (1995, p.6), use the terms squeeze and corner interchangeably. Others, e.g., Leuthold et al. (1989), require a controlling position in both the derivative market and the cash market for there to be a corner. For a squeeze, the trader only takes advantage of cash market shortages (oversupply) by establishing long (short) positions in derivative contracts. Corners and squeezes can occur from both the short and long side of the market, though most attempts in practice are from the long side. For a long corner, the trader establishes long derivative positions, typically well in excess of available deliverable supplies. At the same time, the trader has attempted to obtain a controlling position in the available supply. The process of standing for delivery on the contracts forces the short side to pay high prices to bring available supplies onto the market. Yet, those available supplies are controlled by the holder of the long derivative positions. The shorts are forced to go “hat in hand” to the longs to cover their positions.

The textbook description of a long side corner is usually more involved in practice. The Hunt silver operations leading up to the silver price peak in 1980 had elements of a corner, but there are real questions about the presence of whether the Hunts and their confederates had controlling positions in both the spot and futures markets. The Sumitomo copper operations which ended in 1995 is a much better example of a corner. This particular operation was spread over a long period of time, with the position in the deliverable spot commodity growing gradually, starting around 1986 when Yasuo Hamanaka assumed control of Sumitomo’s team of copper futures traders. In the Sumitomo case, a plausible explanation was given for the buildup in stocks: even before Hamanaka began his trading activities for Sumitomo, the firm was an important player in the international copper market.

The Hunt silver operation had many of the earmarks of a traditional corner. Swashbuckling entrepreneurs making big bets on rigged games. The evolution of the Sumitomo copper corner has a decidedly more modern flavour. Hamanaka was a career man at Sumitomo, with a 20 year history in the company division. Whether more senior Sumitomo executives were aware of his activities is not clear. However, in any event, Hamanaka was legitimately able to assume huge positions in cash and futures on Sumitomo’s behalf. He also had signing authority over various corporate bank accounts and access to corporate lines of credit. Hamanaka also was able to geographically disperse his positions around the globe and to exploit the laxness of regulators in specific jurisdictions. For example, Hamanaka did a considerable amount of trading on the London Metal Exchange which, together with the Comex are the most important markets for forward and futures trading of copper. Despite being vigorously warned about possible wrong doing by Hamanaka as early as November 1991, the LME did not get actively involved in serious investigations of Hamanaka until the CFTC became involved in October 1995.<sup>37</sup>

Due to filing requirements and other regulatory oversight, cornering activities in modern markets require considerable effort to avoid detection. The elaborate networks of traders involved in the Hunt silver operations was needed to avoid the appearance that large positions were being accumulated on one side of the market by one group of traders. Despite the laxness of the LME, Hamanaka had to enter into arrangements to hide the total size of Sumitomo’s position in deliverable supplies of copper. A combination of LME regulatory laxness and careful planning permitted

Hamanaka to successfully deny involvement in a market manipulation. This despite a number of instances of market turbulence, such as that in the extreme cash-futures price backwardation of September of 1993, where evidence of a cornering operation was difficult to deny. Eventually, it was the vigilance of the CFTC which in April 1996 announced that it had uncovered sufficient irregularities in the Sumitomo accounts to proceed with regulatory actions.

Both the Hunt and Sumitomo operations were manipulations aimed at forcing up prices, to the detriment of the short side of the market. Operations aimed at driving down prices, to the detriment of the long side of the market, are much less common. Take the case of a corner aimed at squeezing the longs. The trader aims to acquire a controlling position in the cash commodity without significant impact on cash prices. Once this is done, the trader establishes a controlling short derivative position across a range of delivery dates and aims to deliver a large amount of the commodity against the nearby contracts. The trader may simultaneously engage in cash market sales in order to further depress the price. The combination of selling pressure from the short derivative positions and the weakness in the cash market permits the trader to profit from the excess short future positions which are being held. The initial investment in the cash commodity which had been accumulated has now been recouped through deliveries on the futures contracts.

Manipulation is legally difficult to prove. When prosecuted, those involved in activities aimed at manipulating are often convicted of crimes associated with covering up the manipulation, e.g., forging documents, lying to regulators, and not for violation of statutes directly concerned with manipulation. The lines between manipulation and legitimate speculation are difficult to define. Consider the case where an astute trader identifies a trading opportunity associated with the lack of deliverable supplies for a nearby contract delivery. The possibility of a squeeze causes the trader to take much larger nearby long positions than would be customary. Is this trader involved in manipulating markets? Say this trader was also a major player in the cash market and had what would be reasonably considered a potentially controlling position in the cash market. Would an unusually large long, nearby speculative position be manipulative in this case? Preventing the trader from taking positions aimed at profiting from the potential squeeze would be unreasonable, as other smaller traders without cash market influence would not be similarly restricted.

## **1.3 Recent Commodity Risk Management Debacles**

### ***A. Copper Market Manipulations***

#### **Yasuo Hamanaka and the Sumitomo Copper Manipulation**

The Sumitomo copper manipulation is noteworthy both for the size of the losses and for the length of time the manipulations went undetected. The centerpiece of the manipulation was Yasuo Hamanaka, the assistant general manager of the nonferrous metals division at Sumitomo, the fourth largest trading company in Japan during the period of the manipulation. Prior to the manipulation being uncovered, Hamanaka was apparently well respected within the company. Between 1985 and 1996, Hamanaka worked as a head of a team trading on copper cash and futures markets, obtaining market recognition with the nickname of ‘Mr. Five Percent’, the approximate size of Sumitomo demand within the global copper market. In June 1996, Hamanaka confessed to unauthorized

trading for a decade resulting in a loss to Sumitomo of US\$2.6 billion. Though Hamanaka's suspicious activity was reported to LME as early as 1991, with further complaints about Sumitomo's trading activity throughout the years until the disclosure, no action was conducted until 1995 when the U.S. CFTC and Britain's Securities and Investment Board launched an investigation into possible price manipulation, and discovered that manipulation by Sumitomo was the source of suspicious market price movements. Ultimately, it was determined that Hamanaka's unauthorized trading activity was done without the awareness of superiors at Sumitomo.

The strange tale of Yasuo Hamanaka and the Sumitomo Copper Scandal begins in 1985 when Hamanaka incurred an unreported loss of \$30 million in the physical trading of copper and tried to cover up the loss with more unreported deals. Civil and criminal court testimony by Saburo Shimizu, Hamanaka's boss in 1985, indicates that Shimizu told Hamanaka the appropriate way to recoup the loss was through speculating on the London Metal Exchange (LME) (Furukawa, 1997). In 1986 Hamanaka was chosen by Sumitomo to lead a copper futures trading team with authority to accumulate large spot inventory positions and signing authority over several bank accounts (Dwyer 1996). In July 1987 Shimizu resigned from Sumitomo because he did not want to accept reassignment to its Manila office. From this point, Hamanaka assumed complete control of the firm's copper trading activities, greatly facilitating a decade long pattern of rouge trading. The ability of Hamanaka to avoid detection for such a long period speaks to the difficulties of regulating corporate commodity trading in the modern era.

Perhaps the most troubling aspect of this debacle was the failure of regulators to react to reports of manipulative trading that appeared well before 1995. As early as 1991, the effects of Hamanaka's speculative trading appeared to impact price discovery in the copper market. In particular, during 1991 copper prices on the LME rose to levels considered too high by market observers to be justified by pricing fundamentals. At the time, this distortion in prices was attributed to a technical supply squeeze that resulted in a backwardation between the spot and future prices. Because copper for immediate delivery was in short supply late in the year, the LME became suspicious that Hamanaka was purchasing high volumes of copper to manipulate the market. Hamanaka denied this, arguing that Sumitomo always maintained large volumes to satisfy its customers' needs. In response, the exchange imposed somewhat arbitrary limits on how far the backwardation could range (Jenkins 1996). It was later revealed that, in November, 1991, David Threlkeld, an American copper trader based in London, notified the LME about a request he had received from Hamanaka asking him to backdate confirmations for a deal worth more than \$400 million. The LME contacted Sumitomo, but the corporation denied any wrongdoing, so the investigation went no further (Fennell, 1996).

Just two years later, in 1993, another technical squeeze on the LME occurred, and member traders complained that Sumitomo controlled much of the copper supplies in LME warehouses and refused to release it (Gooding 1996). Once again, the LME intervened by putting limits on prices and pressuring Hamanaka to release significant holdings of copper back into the market. The LME justified these actions by claiming that market fundamentals had been unnaturally thrown out of balance (Jenkins 1996). Thelkeld, who alerted the LME to Hamanaka's trading methods in late 1991, identified essential operating assumptions of a free market economy when he told the Metals Weeks Copper Conference in 1992: "Markets run on trust, that they are fair and equitable, that they protect the participants by protecting the market first, that they maintain its financial and ethical credibility." Ironically, it was because Hamanaka was given so much trust by Sumitomo that he

could control the copper market as much as he did from 1986-1995.

Apparent price irregularities in the copper market continued for the next two years. Spot prices were typically higher than forward prices. Such backwardation was historically unusual in copper because of the storage and transaction fees necessary for forward purchasing of copper in combination with typically plentiful supplies (Glasser and Barbash 1996). Various traders observed that Hamanaka's trading practices were the cause of the backwardation, some accusing Sumitomo of trying to corner the market by holding large supplies and driving up the prices. In October 1995, the New York Mercantile Exchange notified the CFTC that copper supplies in the LME Long Beach warehouse in California were growing significantly, indicating a technical squeeze on the market. (Dwyer 1996). Though there was little doubt who the principal suspect was, Hamanaka insisted that his trading was influenced by "nothing more than fundamentals" (Furukawa 1995). The CFTC contacted the LME and, by late November 1995, the British Securities Investment Board joined the investigation. Sumitomo agreed, in early April 1996, to make Hamanaka available for questioning (Dwyer 1996). In early May 1996, the investigators notified Sumitomo that its copper trading practices exhibited apparent abnormalities (Glasser and Barbash 1996). On May 17, after discovering unaccounted for bank transactions, Sumitomo removed Hamanaka from his position as the company's chief copper trader (Burgert and Furukawa 1995). During this period copper prices fluctuated wildly as traders first heard rumors that Hamanaka was buying all the copper he could, and then heard rumors that Sumitomo had fired him.

On June 5, 1996 Sumitomo learned of copper trading losses of \$1.8 billion at the current copper price, though it was predicted that the final figure might reach \$2.5 billion if the price of copper fell. On the same day Hamanaka confessed to ten years of rouge trading in the commodity futures market (Burgert and Furukawa 1996). On June 6, owing to rumours about Hamanaka's fate, the LME price for copper fell an unprecedented 15% in two hours. Someone on the exchange said, "Our copper dealer was having to quote a price every second, I thought he was going to have a heart attack." The price had dropped 25% in only six trading days. (Gooding 1996: June 15) On June 7, however, copper prices rebounded, but they remained under pressure throughout this period, pushing the backwardation spread to \$330 a ton on the LME. The biggest losers were apparently those involved in delta-hedging with long-term put positions. On June 13, Sumitomo made its 51.8 billion yen loss public, and the same day the firm fired Hamanaka. Because traders feared Sumitomo would dump much of its massive inventory of deliverable copper, despite assurances from the firm that it would honor all its obligations and would not unload large amounts of copper, by June 25, 1996 prices dropped to a two-and-a-half year low on the LME and a new low on the Comex.

Against this market backdrop, the CFTC and the British Serious Fraud Office vowed to investigate all the companies involved in Sumitomo's copper activities (Fennell 1996). Winchester Commodities in London and Global Minerals and Metals in New York were investigated, but both denied any responsibility for Sumitomo's losses. Throughout the crisis phase of the debacle Sumitomo officials repeatedly insisted that they had no knowledge whatsoever of Hamanaka's trading activities (Fennell 1996). The rest of the story involves the legal consequences of Hamanaka's rouge trading. On October 22, 1996 the Tokyo police arrested Hamanaka (Taylor 1996). On November 13, he was formally indicted for fraud and forgery (Furukawa 1996). Hamanaka's trial began in the spring of 1997, and on March 26, 1998, he was sentenced to eight years in prison. Throughout all this time Hamanaka never revealed exactly how he had traded, whether or not he had



attempted to control the global copper market, and whether or not Sumitomo had been aware of his activities (Shirouzu 1998).

In all the accounts of Yasou Hamanaka, there appears to be a substantial discrepancy between the man as a person and the man as a trader. As one observer put it: "Hamanaka is a quiet family man, who wears conservative suits and glasses, drives a modest car, and lives in a medium-sized suburban house. But give him a telephone and vast sums of money to invest, a suddenly he's stomping through world metals markets like Godzilla in downtown Tokyo" (Moffett 1996). At the time of the scandal came to light, the 48-year-old Hamanaka had developed a number of popular titles in addition to "Mr. Five Percent", including "Mr. Copper", "The Hammer" – even "The Mad Jap" – because of his famous influence in the world of copper trading (Jenkins, 1996). As another observer put it, Hamanaka was "the puppet-master who pulled the string of traders in the 'copper ring' at the London Metal Exchange ...and bent a \$1.45 trillion market to his will" (Dwyer 1996, p.28). And yet outside the world of Sumitomo and the copper market Hamanaka was anything but remarkable.

Hamanaka was a graduate of the Seikei University law school, initially joining Sumitomo in 1970 and working his way up to the position of chief copper trader in 1986. This was a highly trusted and respected position. Known as a cheerful, hard-working employee, the head of a family with a wife and two children, Hamanaka seemed to be the average salaried Japanese man dedicated to the conservative firm for which he worked (Dawkins 1996). Being a notorious chain smoker was perhaps the only outward sign of the inner tensions that Hamanaka must have felt (Dwyer 1996). At Hamanaka's trial his former boss, Saburo Shimizu, confirmed Hamanaka's claim that his motive for engaging in speculation in the commodities and futures market was simply the desire to recoup losses that he had already incurred (Furukawa 1997). Presumably, Hamanaka was ashamed of these losses, so he did not report them. He did not appear to have any intention to defraud Sumitomo for personal gain. His only intention seems to have been recouping losses in the interest of the firm.

At trial, Hamanaka stated that his boss Shimizu first suggested that they engage in speculation on the LME (Furukawa, 1997a). In defence of his action, Hamanaka claimed he was only following orders -- like an ordinary salaried man. However, once Hamanaka set out to recoup the initial losses a transformation took place. To understand Hamanaka's action it is possible to reference the psychology of speculating in the commodity and financial futures market. Speaking generally about speculation in derivatives Chiu and Foerster (1997, p.58) observe:

In many instances where derivatives have been misused, egos overtook rationality. Rather than using derivatives objectively, users became addicted to a transaction's profit aspect. Instead of attributing the transaction's performance to market conditions, they believed they had developed an innate skill to outperform the market consistently ... the moment fortune turns, panic often ensues.

Though Hamanaka did not show signs of panic, no matter how much money was lost, he did display a gambler's irrational drive to keep on betting. As Dawkins (1996, p.8) observes: "Rouge traders are, by definition, hard to stop in any company of any nationality."

The scope of the Sumitomo copper scandal raises questions as to how Hamanaka could have amassed such great losses over a ten-year period without anyone in the company knowing what he was doing. Various market observers maintained that Sumitomo, in spite of its typical Japanese

corporate culture of trust, must have been involved.. Whether or not, Sumitomo knew what Hamanaka was doing, the firm was quick to dissociate itself from Hamanaka, publicly denouncing him as a criminal (Furukawa 1996). If this caused Hamanaka any grief, perhaps a greater cause for sorrow was his ultimate downfall in the market itself. "One lesson to be learned from the Sumitomo affair is that it is clearly impossible for any player to defy market forces for very long" (Dwyer 1996, p.29). Ten years is a long time. "No one really knows -- at least publicly -- how a trader losses that much money over a decade as Sumitomo officials claim the deviant trader did. Because the answer lies with Hamanaka and Sumitomo officials, who have not divulged the losing strategy nor the company's current positions, it is difficult even for those trading copper every day to determine what went wrong" (Kharouf 1996, p. 66).

Even after Hamanaka's trial and subsequent imprisonment many questions remain that can only be partially addressed with available facts and some educated guesses. Hamanaka traded on the LME, and "around" the LME. Sumitomo was not a ring member of the LME. Normally trading is done with brokers or ring members and trades are reported on the exchange. However, it is also possible to trade "on the LME curb" (Furukawa, 1996). The bulk of Hamanaka's trading involved such over-the-counter transactions and third-party business not reported on the exchange (Taylor 1996). That Sumitomo used the derivatives market in copper to compensate for its relatively limited control of physical copper supplies (Dawkins 1996) was unusual among Japanese firms. Hedging copper market dealings by trading derivatives to supplement buying copper on the spot market was not common practice (Gooding 1996). In hindsight, it is surprising the amount of trading Hamanaka did that was not reported on the LME.

Hamanaka seems to have been drawn to the LME rather than Comex in New York and Tokom in Tokyo because the LME is basically a forward market, whereas the other two are futures markets (Furukawa 1996). Many analysts believe that Hamanaka's main interest was in forward trading because this allowed him to take three-month positions without putting up margins and to defer settlement with brokers without losses being reported. Essentially, a forward trader, unlike a futures trader, operates with a credit line, but once the credit line is reached, the player cannot go on. (Burgert and Furukawa 1996). Hamanaka's ability to keep the trading scheme going for ten years not only demonstrates ingenuity, but also the extent of Sumitomo's credit in the market. Hamanaka's forward trading was combined with trading in the cash market for physical copper. The purpose of this strategy seems to have been to corner as much copper supplies as possible without being detected. The more certainty Hamanaka had in controlling the price of spot price copper and the forward copper curve, the more certainty of profiting from derivatives trades linked to copper (McGee and Frank 1996).

An on-going complaint that other traders brought against Hamanaka was that he was amassing physical copper in exchange warehouses, leading to a supply squeeze that drove up futures prices. This would also drive up the value of copper stocks, further benefiting Sumitomo (Dwyer 1996). Considering the extent of Hamanaka's trading and the seemingly effective complexity of his apparent strategy, it is surprising that he kept on losing money. One analyst has referred to Hamanaka's "staggering incompetence" in the market, while another referred to his *kamakaze* or suicidal trading practices (Jenkins 1996). No matter what Hamanaka's strategy was, he still had to make good bets, and it seems that he often failed to do this. As the losses continued to mount, it is likely that Hamanaka borrowed to cover them. It seems that his reputation was so esteemed that he was able

to borrow from banks without any higher authorization. It is, however, difficult to say how much Sumitomo executives knew about Hamanaka's borrowing. One of the banks, Merrill Lynch in London, claimed after the scandal came to light that Sumitomo's account was properly authorized.

Like various other rogue trading operations, the inability to settle on-going losses led eventually to the unravelling of the scheme. By 1994 Hamanaka was having difficulty borrowing in London, so he turned to New York, where he borrowed nearly a billion dollars from J.P. Morgan and Chase Manhattan, allegedly by falsifying and forging documents (McGee, Frank, and Shirozu, 1996). By this time Hamanaka appears to have been desperate, for he probably saw the end of his career approaching.

### **Mr. Qibing Liu and the State Reserve Bureau of China**

From September 23, 2005 to March 31, 2006 the near month COMEX copper futures price jumped from US\$1.7985 per pound to US\$2.488 per pound, an increase of almost 40% in a relatively short period of time.<sup>38</sup> In hindsight, it appears that the price appreciation was propelled by a Chinese copper trader, Mr. Qibing Liu, an employee of the Import and Export Department of China's State Regulation Centre for Supply Reserves, the trading agency for the State Reserve Bureau of China (SRB). Mr. Liu built a substantial short position in one to 3 month copper forward contracts traded on the London Metal Exchange (LME), betting on a downward trend for the copper price. The size of the position built up in the first two weeks of September was estimated at 220,000 metric tons of copper with delivery dates mostly due on Dec.21 and others reaching into 2006. Unfortunately for Liu, other copper traders and several international speculative funds took large long positions in copper futures trying to squeeze SRB's short position. At the end of 2005, the rise in copper prices produced a cash loss to the SRB estimated to be US\$150 million needed for SRB to either settle or extend future contracts to later delivery dates, some to March 2006, and some to 2007.

While the story of Yasuo Hamanaka originates with a large Japanese conglomerate, the SRB is not a corporate business entity but an internal department in the National Development and Reform Commission of China (NDRC). As a government agency, the SRB is responsible for managing national strategic material stockpiles that are reserved for national defence purposes, for safeguarding the stability of the society, and for mitigating unexpected disasters or catastrophes. One byproduct of the SRB's operations is the stabilization of market prices for reserved materials such as oil, cotton and copper. Specifically, when the market prices of certain reserved materials, such as copper, are considered 'high', the SRB might increase supply by auctioning part of its stockpile. In turn, when the price is decreasing due to reduced demand, SRB might increase inventories to add some extra support to the market price and build inventory for use in future periods. In other words, the SRB can function, to some extent, as a "pool" that can stabilize prices of some strategic materials.

In order to perform a price stabilization function, the SRB routinely participates in open market operations to adjust reserved material stockpiles. However, as a government agency, the SRB cannot directly participate in market trading, but instead has to adjust stockpiles through another entity: the State Regulation Center for Supply Reserves (SRCSR). This Center, although owned by the NDRC, is an independently registered state-owned entity. It is a non-profit organization performing trading activities based on the SRB's authorization. The SRCSR actively participates in domestic and global market trading, but the underlying commodities, the reserved materials, that the Center trades are

the property of SRB. In other words, the SRB, an internal department of the NDRC, and SRCSR, an independent entity owned by NDRC, do not have a parent-and-subsidary relationship, but are principal and agent. In addition, the SRCSR is a corporate body with registered capital and could be protected by bankruptcy laws if its net liabilities (total liabilities - total assets) are greater than the capital invested by the NDRC.

Contrary to western press reports, Mr. Qibing Liu was not an employee of SRB but a senior officer in SRCSR, e.g., Zwick and Collins (2006). This obscure administrative detail explains why, when Liu ‘mysteriously’ stopped trading in November 2005, officers from the SRB repeatedly rejected any linkage between Mr. Liu and SRB, e.g., Fu Jing (2005). For example, Zwick and Collins (2006, p.14) report: “in November when Liu abruptly stopped trading, and an SRB official was quoted as saying, ‘We do not have such a person working for us,’ which later morphed into, ‘He was acting on his own behalf,’ and eventually became, ‘He is on leave.’” From a legal perspective, it was the SRCSR rather than SRB that was ultimately responsible for the short positions built by Mr. Liu. What is less clear is whether the SRB was aware that an official in the SRCSR was trading on the LME using information obtained from the SRB about possible future sales of spot copper.

Not unlike ‘Mr. Five Percent’, Qibing Liu earned the nickname of “Mr. Mangler” in the Chinese copper market. Liu entered SRCSR following a bachelor's degree in economics. In 1995, he was sent to the LME and was trained there for half a year. In 1999, Liu was promoted to be director of Import and Export Department in SRCSR, and was authorized to place orders on LME and the Shanghai Futures Exchange (SHFE). Upon becoming the chief trader of SRCSR around 2002, Liu started building a reputation among Chinese traders by precisely forecasting a bullish copper market while most other traders were predicting the market would not change significantly. Starting around 2003, Liu started to arbitrage copper prices between the SHFE and LME. Liu was typically long copper futures on the SHFE simultaneously entering an equivalent amount of short positions on the LME. The fundamentals underlying the trades were institutional limitations on the SHFE: foreign investors and international speculative funds are not allowed to access to the SHFE and, as a result, there are often disparities of prices between the Chinese and global copper markets.

Liu was apparently adept at taking advantage of the disparities between SHFE and LME and was successful at generating some arbitrage profits. As the major long position taker in SHFE, SRCSR and its head trader Qibing Liu were a nightmare for short position takers which earned Liu the nickname of “Mr. Mangler” among Chinese copper traders, e.g., Le-Min Lim (2005). Unfortunately, Liu did not keep to a pure inter-market arbitrage strategy. His trading strategy was observed to gradually change at the end of 2004. Success in Shanghai apparently nourished an overconfidence making him willing to take more risks. Liu evolved, little by little, from a market arbitrageur to a speculator. In September 2005, likely based on information about impending spot sales of copper by the SRB, Liu believed that copper price would turn downward in the near term and started increasing short positions on the LME. In the last ten days of September, Liu took up as many as 8000 copper future contracts. For liquidity reasons, these contracts were mostly for Dec. 21 delivery. The average price of those contracts was about US\$3,500 per metric ton.

As the LME copper future contract is for 25 tonnes of copper, the 8000 contracts meant that SRB had agreed to deliver approximately 200,000 tonnes of grade A copper in three months. Such a short position, even on the LME was a huge number. This large exposure was noticed by experienced LME traders who apparently concluded that the SRB did not have enough deliverable copper

stockpiles to execute those contracts. This meant the SRB would have to close these positions by taking enough long contracts to offset the uncovered short positions. In combination with the LME traders, international speculative funds marshalled 'hot money' to buy copper futures and forwards adding to the SRB demand, pushing the copper price to a record high.

On November 14, 2005, news broke that Qibing Liu was missing, bringing the SRB short positions on LME into the global news spotlight. Was Liu another rogue trader in the same vein as Nick Leeson, Yasuo Hamanaka, or Jiulin Chen? While the world was guessing where Liu was, officers from SRB said to the influential China Daily newspaper that "we do not have such a person working for us!" and "investigations show that Mr. Liu's market behaviors are not authorized and the SRB should not be responsible for the short positions" (Fu Jing 2005). Given the administrative relationship between the SRB and SRCSR, such comments were legally correct. This dramatic unofficial announcement worried the LME's clearing house members and brokerage firms with which Liu had opened accounts. A lengthy and costly law suit was inevitable if SRB insisted that Liu was trading for personal, unauthorized reasons. In the event of such fraud, the short position would be non-executable. Shortly thereafter, the SRB took over the positions created by Liu and continued efforts to restrain market price increases.

More precisely, on November 11 the SRB released information about auction sales of copper that apparently benefited short position takers. A senior officer from SRB informed reporters that the SRB copper stockpile was unexpectedly larger than forecasted. At this time, market estimates placed the Chinese government copper reserves at about 250,000 tonnes of copper. However, the SRB officially disclosed a stockpile of 1.3 million tonnes. With such a large stockpile, SRB had the capability to deliver the underlying copper when the futures contracts expired. This was clearly not information the LME traders and speculative funds wanted to see. The market suspected the genuineness of such information; most traders did not believe it was true: "If you believe China has these stocks, then copper is not worth what it's at right now" (Wall Street Journal 2005). A stockpile as large as 1.3 million tons of copper would give SRB great flexibility to cool the heated copper market, but the SRB did not respond until Liu had built such large short positions. Consequently, a reasonable explanation was that SRB did not have that much copper in storage.

On November 16 and 23, the SRB launched two auctions, each time selling 20,000 tonnes of copper reserves. Although the copper price sharply fell as a reaction to the auctions, it soon rebounded and reached an even higher level. On November 30 and December 7, SRB again auctioned more copper to the market. In theory, such extra spot supplies should force the market price to a lower level. However, the copper price quoted by LME moved in an opposite direction: from US\$4,100 before the first auction to US\$4,400 after the fourth. On December 21, the expiry date of SRB's future contracts, the market experienced a smooth day because most of traders on the LME already knew SRB's choice: partial execution and partial extension. The execution was proven by the increase of copper stocks in the LME's warehouse in Korea. After December 21, LME's copper stocks in Korea increased by around 50,000 tons of copper, most of which was transported from China. The consensus among copper traders was that the rest of SRB's short positions were extended till 2006 and 2007. The first round of the battle ended with SRB's realized loss of about US\$45 millions.<sup>39</sup>

The SRB and its authorized trading agency SRCSR, both fell into the trap of participating in unauthorized financial speculation. As the government agency managing strategic reserve materials,

the SRB should have avoided speculating for profit. Unfortunately, Qibing Liu's market activities, both market arbitrage and the more speculative bets on LME, were apparently profit-driven behaviors. On January 24, 2006, the head office of SRB released a public notice to its nationwide branches reiterating that the entities involved in managing reserve materials are not allowed to participate in trading of financial derivatives or to invest in foreign markets. Significantly, the notice was dated as October 25, 2005, a date on which Qibing Liu was already on leave but the whole matter had not been disclosed to the public. Similar to the case of Barings Bank, the SRB's loss can be explained as being due to operational risk. As Nick Leeson wrote in *Rogue Trader*: "It's unbelievable that nobody comes to stop me". Nobody came to stop Liu either, until it was too late. For breaking various Chinese state regulations, Liu Qibing was sentenced to seven years imprisonment in March 2008.

When SRCSR started its operations in the futures and forward market, it had a trading group (the number of traders at that time is unknown). At the beginning of 2004, only Mr. Liu and another trader were left in that trading group. About six months later, the other trader was removed from his position and Liu became the only authorized trader with rights to place orders on both the SHFE and LME. This situation was ongoing for more than one year until the outbreak of the event. Both SRB and SRCSR were apparently lacking sufficient internal control systems, as demonstrated by the short position Liu was able to establish. Both the SRB and Chinese regulators did not play a proper role in stopping the speculative trading of Liu. Though the trading of financial derivatives is supervised by the China Securities Regulatory Commission (CSRC), the CSRC did not supervise the market activities of other government agencies such as SRB. In addition, the CSRC's supervision does not cover trading activities conducted by the Chinese central bank and commercial banks, although these entities are extensively involved in such trading.

To firms outside China, the Liu Qibing affair has produced some unexpected credit risks related to Chinese customers. In the case of SRB, for example, the brokerage firms with which Liu opened accounts were exposed to considerable credit risks. Qibing Liu worked for SRCSR, an agency performing trading under the authorization of SRB. However, the internal control policies and authorization systems taken for granted in conventional commercial operations might not be properly designed or executed by Chinese companies and administrative entities. In addition, Chinese firms apply an accounting system that is different from the International Accounting Standard (IAS) or American General Accepted Accounting Principles (GAAP). As illustrated in the case of China Aviation Oil Corporation Ltd (CAO), for example, the company was bankrupted in 2004 due to a debacle caused by the derivative trading of Jiulin Chen, the CEO of CAO before the losses were noticed by the public. The rapid economic growth of China and global economy means that more and more Chinese firms will present themselves on the global arena. How to manage commercial risks of doing business with Chinese firms has become an important topic in commodity risk management.

## ***B. Operational Risk in Oil Markets***

### **China Aviation Oil**

Unlike the copper trading activities of the Qibing Liu and the SRCSR, the trading activities of

China Aviation Oil (Singapore) Corporation Ltd (CAO) that led to an estimated \$557 million loss in oil derivatives in 2004 have been exposed to the glare of public scrutiny, e.g., PricewaterhouseCoopers (2005), Deloitte (2006). Headquartered in Singapore, CAO was initially a joint venture between three companies: China Aviation Oil Supply Corporation (CAOSC), an important state owned Chinese enterprise; the China Foreign Trade Transport Corporation; and, Neptune Orient Lines Ltd, a Singapore government-linked corporation. CAO was incorporated in 1993 and, in 1995, became a wholly owned subsidiary of CAOSC following the company's acquisition of the shareholdings of the joint venture partners. CAOSC is responsible for the construction of jet fuel infrastructure, the procurement of jet fuel supply equipment, the supply of jet fuel to airports in the People's Republic of China and also the provision of refueling services to airplanes at airports in the People's Republic of China (PricewaterhouseCooper 2005). All Chinese airlines, are mandated by the state regulator, the Civil Aviation Administration of China (CAAC) to buy jet fuel exclusively from the China Aviation Oil Supplies (CAOSC) and other companies controlled by the CAAC.

In 1997, CAO commenced its operations in jet fuel procurement and made rapid progress gaining market share from less than 3 percent in 1997 to control 92 percent of China's jet fuel imports in 2000. CAO also increased total turnover from S\$170.7 million and net profit before tax of approximately S\$7.1 million in 1997 to S\$963.7 million turnover and profit before tax of about S\$16.2 million. This performance permitted CAO, in July 2001, to be listed on the main board of the Singapore Exchange (SGX). Following the IPO, CAOSC's shareholding was reduced to 75%. In 2002, CAOSC's shareholding was transferred to China Aviation Oil Holding Company (CAOHC) due to a state regulation that requires separation between commercial enterprises and the PRC government. Following the restructuring, CAOHC held 75% of CAO shares and became the parent company of CAOSC. In turn, CAOHC is a large state-owned aviation transportation and logistic group which is directly supervised by Central Government of China. (PricewaterhouseCooper, 2005).

Following the IPO, CAO adopted a "Three-pronged Business Model" involving: strategic oil related investment; international oil trading; and, jet fuel procurement. The oil-related investment has a long term goal of acquiring significant possession of foreign oil-related assets. The rationale for such strategic investments is to stabilize and enhance CAO earnings base, sustain growth and provide essential assets that create value for their end-user. By 2005, this strategy had produced acquisition of: South China Bluesky Aviation Holding Company, Ltd; Shuidong Oil Storage Tank Farm; Shanghai Pudong International Airport Aviation Fuel Supply Company Ltd; Compania Logistica de Hidrocarburos, S.A; and, an acquisition agreement with the Emirates National Oil Company for a subsidiary purchase (China Aviation Oil 2005). For the international oil trading component, China Aviation Oil traded a wide variety of products including crude oil, fuel oil, gas oil, gasoline, naphtha, and petrochemical.

It was the jet fuel procurement component of CAO activities that was the source of the large losses. The company's jet fuel procurement business was heavily dependent on the parent group as CAOSC was the sole entity authorized by the People's Republic of China (PRC) government to import jet fuel into the PRC (PricewaterhouseCooper, 2005). Jet fuel procurement still remains an important component of CAO's businesses as CAO supplies nearly 100 percent of the imported jet fuel for China's aviation oil industry. Despite the losses suffered in 2004, CAO continued as a publicly

traded entity on the SGX. Future prospects for CAO are excellent. Jet fuel procurement activities alone promise approximately a 10-15 percent growth in the next 10 years. Though the losses suffered in 2004 by CAO are largely in the past, the story of Jiulin Chen survives in the chronicles of commodity risk management debacles.

Jiulin Chen was born in 1961. Despite a childhood in the turbulence of the Cultural Revolution, Chen managed to get enough schooling to attend Beijing University in 1982, studying Vietnamese in the Department of Orient Languages for 5 years, receiving Bachelor of Arts. This was followed with a postgraduate diploma in law from the Chinese University of Political Science and Law in Beijing. At the time of the losses, Chen was pursuing a PhD in law at Tsinghua University. Before joining China Aviation Oil, Chen acquired management experience with Air China. In 1993, he started working with CAOSC as the chief negotiator and project manager on various projects, later moving to be the managing director and CEO. In 1997, Chen was given the assignment of establishing CAO in Singapore with an initial capital of US\$210,000. Chen successfully combined the strong demand for aviation oil in China with previous business experience to turn the small firm into a company worth US\$ 326 million by 2003. This success had raised his salary to S\$4.9 million, making Chen one of the best-paid executives in Singapore (CRIOOnline, 2004).

Before 2002, CAO only used derivatives for hedging purposes, employing crude oil futures and swap contracts to hedge the price risk exposure associated with the jet fuel and fuel oil cargoes. Starting in 2002, CAO began to use option contracts with the objective of increasing firm profitability. An audit conducted by PricewaterhouseCooper found substantial evidence that CAO did not have enough knowledge and ability to do the option trading which later caused considerable losses. Not only was it not reported that options were used for speculative purposes, the size of the losses was worsened by the inadequate risk management and corporate governance in place at CAO during that time. CAO did not know how to value the option portfolio properly for accounting reporting purposes required of publicly traded companies in Singapore. Finally, CAO management did not provide enough disclosure regarding the speculative derivatives operation. The inadequate loss recognition associated with the derivative transactions resulted in major inaccuracies in the 2003 and 2004 financial statements (PricewaterhouseCooper, 2005).

Initially, CAO involvement in options trading featured back-to-back transactions between the company and certain PRC airline companies. In turn, CAO then resold options with similar terms to non-PRC counter-parties. Because CAO bought options from Republic of China airlines, CAO was not required to pay premiums to the airline companies. By reselling the option and assuming the credit risk of the airline companies, CAO earned premium income from the sale of the option to the other counter-parties (PricewaterhouseCooper 2005). Starting March 28, 2003, CAO commenced 'speculative' trading in options in addition to its trading in futures and swaps. CAO management felt that by executing these options, more profit could be gained than just the premium income from reselling the options (Santini et al. 2004). These trades were at first restricted to only Gerard Rigby, the deputy Head of Trading Division I at CAO and Abdallah Kharmah, head of Trading Division II. However, most of the trades were done by Rigby who had more previous experience in option trading (PricewaterhouseCooper 2005).

The evolution of speculative derivative trading at CAO is described by PricewaterhouseCooper (2005, p.viii)



[B]y 2003, the volume of derivatives traded well exceeded the volume for physical trades. This was accompanied by an increase in the revenue generated from oil derivatives trading from 2001 to 2003, such revenue exceeding the revenue generated from physical oil trading from as early as 2001. In keeping with these trends, by November 2004, the Company had a total of 9 oil traders.

During the first three quarters of 2003, company trading decisions assumed a bullish view on oil prices and pursued a strategy of “structured collars” – buying calls and selling puts – involving approximately 2 million bbl. of oil. This assumption proved to be correct and yielded some profit (PricewaterhouseCooper 2005). As the oil price rose, call options that had been purchased were exercised and profits were registered in the CAO financial statements. On the other side, puts that CAO sold could not be exercised since the oil price had risen allowing CAO to book the premium as a profit.

Starting in the fourth quarter 2004, the CAO view on oil prices changed to bearish. This resulted in a change in the options strategy to selling calls and buying puts. Presumably to increase premium income received, extendible features were attached to the calls being sold. Unfortunately, the assessment of the oil price trend proved to be largely incorrect. A sharp rise in oil prices caused the market-to-market (MTM) value of the CAO position to deteriorate. As the oil price kept rising, the counter-parties exercised the right to extend the term to maturity, generating further profit deterioration. PricewaterhouseCooper (2005) describes the situation:

As prices continued to trend upwards, the options had an increasing negative MTM value. These options were maturing in 1Q 2004. This was probably an early defining moment in the events that were to transpire. Those managing the Company took the view (incorrectly) that unless the losses were realised, there was no requirement to account for them in its financial statements. To avoid realising the losses and in the hope that the situation could be managed, the Company entered into a restructuring of its options portfolio with J. Aron on 26 January 2004. Further, the Company (again incorrectly) did not book the losses that were realised upon the restructuring when closing-out the loss-making near-dated options

This situation led to the defining moment in the CAO debacle. Losing money on the speculations would likely have been manageable if CAO management had employed appropriate risk management and corporate governance practices. For example, imposing a stop-loss strategy would have allowed the company to limit losses to a certain amount. Apparently, CAO already had a stop loss policy for the speculative accounts. However, because of the CEO's ambition to surpass past achievements, there was no a specific control as the CEO hired himself as the CFO as well. As a result, CAO was allowed to trade more in the first quarter of 2004 even though CAO had experienced losses of \$5.5 million on the option trades at that time.

### **Summary of CAO events by PricewaterhouseCooper (2005)**

... the Company in effect traded options speculatively on its own account for just about 10 months from March 2003 to January 2004. From January 2004 when it first embarked on the course of restructuring its options portfolio, no new transactions were entered into other than those transacted as part of the restructuring. It is also noted that in a short span of about 5 years the Company had unwittingly or otherwise, changed its primary business model from one that was rooted in physical trading with some hedging paper trades and some speculative trades to a model that was heavily weighted the other way. Moreover, the nature of its speculative portfolio itself changed within a short time from relatively straightforward transactions in futures and swaps to exotic options. In doing so, the Company was apparently oblivious to the very significantly different risks that applied to a seller of options for whom the downside risk is potentially unlimited as opposed to a buyer of options whose risk is limited to the premium cost. The risks manifested themselves in January 2004 with losses on the options contracts which therefore led to the Company considering and executing the January restructuring. This restructuring proved to be a defining moment. In a misguided attempt to avoid recording and reporting losses, the Company assumed a greater risk exposure by selling options with a very high risk profile and long tenure to raise premiums to cover the cost of closing-out the loss-making options contracts. The Company then exacerbated the situation manifold in the restructurings that followed in June and September 2004 for the same reasons. This was an imprudent course to take and it was ultimately the immediate cause of the Company's predicament

If CAO had been a wholly owned PRC state enterprise, the losses suffered would likely have past unnoticed to public scrutiny. However, CAO was publicly traded on the SGX and, faced with the prospect of reporting significant losses, entered into a sequence of ill-conceived decisions designed to avoid reporting the losses in the financial statements. Instead of closing out the option position and realizing a loss of approximately \$5.8 million from the options maturing in the first quarter of 2004, CAO entered into a restructuring of the options portfolio. In doing the, the company incorrectly assumed that there was no requirement to book the losses. The restructuring was effected by the purchase of option contracts to close out the loss on the short-dated options and financing the cost of this exercise by selling longer call options and buying puts with higher strike prices, with maturity dates stretching from the second quarter of 2004 to the fourth quarter of 2005. The aim of CAO management was to achieve a zero net cash flow by matching the cost of buying out short-dated call options with the premium revenue from that received by selling a higher volume of call options.

As it turns out, the management objective of using premium income from new positions to cover off losses from maturing positions is unacceptable from a public accounting perspective because it overrides the full disclosure and recognition principle. Not only had CAO hidden recognition of the option losses from the financial statement, there was also no information released about the option portfolio restructuring. The person held responsible for this action was Jiulin Chen as he was responsible for signing the manipulated-financial statement results. The inaccuracies in the financial statements being presented were identified by PricewaterhouseCooper (2005) as:

S\$ million	1Q	2Q	YTD June 04	3Q	YTD September 04
Reported PBT	19.0	19.3	38.3	11.3	49.6
Adjusted PBT	(6.4)	(58.0)	(64.4)	(314.6)	(379.0)

where PBT is ‘profit before tax’. As the oil price kept rising in the second quarter of 2004 following the restructuring, the market-to-market value of the CAO option portfolio kept deteriorating. This caused margin calls to the company in May 2004. Yet CAO trading, which was apparently guided mostly by the opinion of Jiulin Chen, still believed that the oil price would eventually fall. Therefore, in the second quarter 2004, CAO did another restructuring to avoid closing out and recording losses of around \$30 million. Once again, Jiulin Chen misrepresented the financial accounts by withholding information about the option restructuring and not recognizing the loss being incurred.

Two critical issues arise in regard to the second restructuring: the risk associated with the CAO option position; and, the MTM value of the positions. The risk associated with the CAO positions was greater than following the first restructuring due to a further round of closing out option losses from the first quarter by issuing an even larger volume of call options with higher strike prices and, significantly, with options that were subject to tighter margin call requirements if there was a substantial oil price change. In September 2004, CAO did a third major restructuring, again aimed at achieving a zero cash flow from the options portfolio in order to avoid recording losses from the second quarter. The same approach was used to reach zero cash flow from the portfolio, which involved closing out short-dated options by the issuing longer-dated call options with substantially larger underlying oil volumes. An important difference with this restructuring was the involvement of 5 counter-parties. For the third time, Jiulin Chen manipulated the quarterly financial statements being released.

By October 2004, CAO was holding trades that involved 52 million bbl. of oil. The options portfolio held by CAO was now subject to margin calls even if the oil price just rose slightly. This presented a serious cash flow problem for CAO, as it had used almost \$26 million of its working capital plus a \$120 million loan and \$68 million from the proceeds of a trade receivable to finance previous margin calls. In Oct. 2004, the oil price reached what was, at that time, an all-time high of \$55.67/bbl on NYMEX. “In the 7-month period from May through November 2004, a total of approximately \$381 million was paid to meet margin calls arising from the mounting MTM losses” (PricewaterhouseCooper 2005, p.xiv). As a consequence, CAO had to close out the option positions as CAO did not have the financial capability to meet margin calls. On Nov. 30, 2004 CAO issued a press release stating the firm was “unable to meet some of the margin calls arising from its speculative derivative trades, resulting in the company’s being forced to close the positions with some of its counterparties” and would have to recognize a \$550 million loss.

The revelation about the hidden losses had frightening repercussions for those involved. The SGX

immediately halted trading on the stock and appointed PricewaterhouseCooper to investigate the losses. Following release of the auditors report in March 2005, on June 7, 2005 five CAO executives, including Chen Jiulin, were charged with various offences. During the trial, further details of the debacle were revealed. In particular, when the only remaining avenue of rescue was for CAO management to tell the parent company, CAOHC, the situation being faced in the hope of financial help to reconcile the losses without publicly disclosing the information in the financial statements, Jiulin Chen, CEO of CAO, told the director of Finance, Peter Lim that CAOHC would help CAO. To this end, Chen presented a document signed by the parent company sufficient to preclude disclosure of the loss. However, Jiulin Chen had forged the CAOHC document and the associated signatures (Sawyer 2005, p.44). While the failure to disclose information in a timely fashion was a potential source of criminal prosecution, it was for the forging of documents that Chen was later to receive the harshest penalties from criminal conviction. On March 21, 2006, the subordinate court of Singapore sentenced Chen Jiulin to four years and three months imprisonment and fined him for S\$335,000.

In addition to a variety of obvious failures, investigation of the events in the debacle revealed that CAO employed improper option valuation methods to determine estimates for the accounts. CAO was unprepared to handle the valuation of the exotic options that came to dominate the portfolio. For accounting purposes, CAO used intrinsic value to determine the value of options being traded. Given the intrinsic value of an option is calculated by differencing between the forward (spot) price and the strike price, this valuation method is not accurate as it ignores the option time value. This failure to recognize the time value was compounded by the relatively long tenure to maturity of the options. This practice was not problematic when CAO was generating premium income by selling back-to-back options between PRC and non-PRC counterparty airlines in 2002. However, the practice of using intrinsic value continued when the company moved to speculative option trading until the announcement of the big loss in 2004.

It is significant that the CAO debacle took place within a publicly traded company that, for all intents and purposes, appeared to have already addressed internal risk management issues. In 2002, CAO with the help of Ernst and Young developed a risk management manual, which was approved by the board on March 2002. In hindsight, it does not seem the board and the audit committee had sufficient time to digest all the contents of the risk management manual. As a consequence, the board decided to approve internal risk management procedures on a 'test run basis'. An additional complication identified by the auditors was that the risk management manual had been developed for swaps and futures only. When CAO began option trading in 2002, it would have been prudent to augment the risk management manual to include option trading when options were introduced as new products. To this end, the risk management manual should have: had a trading limit for options; distinguished between bought and sold options as these carry different risk; and, distinguished between different type of options with varying complexity and degree of risk.

Following the announcement of losses in November 2004, big creditors moved to make claims. The various lawsuits and criminal actions provide some information on the names of market players. In particular, Barclays Capital, Mitsui & Co. Energy Risk Management, J. Aron & Co., Standard Bank (London), Macquarie Bank, Sumitomo Mitsui Banking Corporation, and Fortis Bank were the entities making the largest claims against CAO. Several lawsuits were filed because of the non-performance and mis-management by CAO, e.g., SK Energy Asia Pte. Ltd filed a civil lawsuit

requesting removal of CAO's management. Creditors requested that reorganization or bankruptcy of CAO be handled by judicial oversight to ensure CAO creditors receive full and frank information before a rescue plan could be voted. The court decided to remove old CAO management, with new management to oversee a debt restructuring. The debt restructuring paid 56.1% of the money owing over five years with deferred interest and immediate payment of 45% owing, a total of approximately \$275 million. This debt-restructuring plan was agreed to by most of the creditors on June 8 and the plan was ratified by the Singaporean high court.

Other civil lawsuits that were filed included a claim by Sumitomo Mitsui Banking Corporation that CAOHC, as the parent company, and Jiulin Chen had conspired against the bank in hiding the derivative losses in order to obtain a loan in mid 2004. The court decided that Sumitomo would get equal treatment with the other creditors. Another related lawsuit filed by a group of creditors claimed the parent company, CAOHC, was aware of the problems at CAO. Instead of trying to fix the problem, CAOHC on October 20, 2004 sold 15 percent of its ownership in CAO to Deutsche Bank (DB). At this time CAOHC did not disclose any news to DB or other potential stakeholders. The result of this deception against DB was that CAOHC was guilty of insider trading practices and was required to pay a total fine of S\$8 million to the Monetary Authority of Singapore. The criminal lawsuits charged five executives and directors of CAO with an array of crimes including forgery, insider trading, and false financial statements. The CEO, Jiulin Chen was charged with 15 offences including forgery, filing false financial statements, lack of full disclosure on notifying Singapore Exchange of CAO losses and conspiracy to deceive Deutsche Bank AG on the sale of a block of CAO shares. Jia Changbin, CAO chairman and president of CAOHC was charged with insider trading and two other offenses. Peter Lim, CAO's Singapore finance director was charged with five offenses including issuance of false financial statements, and conspiracy with Mr. Chen to cheat and deceive Deutsche Bank. In addition to the penalties imposed on Chen, Jia Changbin was fined S\$250,000 for trading on insider information and S\$150,000 for failing to disclose information about the losses. The following year Jia Changbin was forced to resign as chairman of CAOHC.

The reasons behind the CAO debacle can be traced to a mis-guided speculative view of the oil price trend. In addition to this view, the auditors also identified the following sources of difficulty:

- a desire not to disclose losses in 2004;
- a failure to value the options portfolio in accordance with industry standards;
- a failure to appropriately recognise the correct value of the options portfolio in the Company's financial statements;
- the absence of proper and stringent risk management procedures specifically for options trading;
- the willingness by the management to override risk management policies that ought to have been obeyed; and
- a failure on the part of the Audit Committee in particular and the Board in general to fulfil their duties in relation to risk management and controls applicable to the Company's speculative derivatives trading.

Ultimately, the person that was held liable for these difficulties was Jiulin Chen, as the CEO of CAO. It was Chen that was the source of the inaccurate prediction regarding the future of oil prices

in the fourth quarter of 2003. Faced with relatively small losses from this incorrect prediction, Chen attempted to cover the losses with option restructuring and not recognizing the losses incurred in the financial statements. Chen was also responsible for ensuring the appropriate option valuation method was used. Valuations done using conventional option valuation software were ignored when the numbers did not conform to the values Chen was wanting. Finally, application of risk management controls was lacking. To address this problem, the restructuring of the risk management at CAO has produced the risk management structure given in Fig. 3.B.a.

INSERT Fig. 3.B.a CAO Risk Management Structure

### **Metallgesellschaft AG and Rolling Stack Hedges (1993)<sup>40</sup>**

Though the Metallgesellschaft AG debacle is now almost two decades past, the debacle has achieved almost mythic status within academic study of commodity risk management practices. Contributions to the analysis of the risk management strategies and practices include many of the leading figures in the field. Many of these contributions are collected in Culp and Miller (1999).

Circa 1994, Metallgesellschaft AG (MG) was the 14th largest corporation in Germany, involved in a range of activities, including mining, engineering and financial services. In December 1993, MG reported immense losses on positions in energy futures and swaps incurred by its US affiliate, MG Refining and Marketing (MGRM). These losses were later determined to be around \$1.3 billion, the largest derivatives losses by any firm up to that time. It took a \$1.9 billion rescue package from 150 German and international banks to maintain the solvency of MG. While initial press reports attributed the losses to speculating in energy derivatives by MGRM, it turned out that MGRM was actually engaged in a sophisticated long term marketing program for gasoline and heating oil. The saga of how a firm engaged in hedging activities could incur such losses has been told and retold, often brilliantly, by Culp and Miller (1994, 1995), Mello and Parsons (1995), Kuprianov (1995), and Edwards (1995).

Mello and Parsons (1995) outline the background to the MGRM saga:

Metallgesellschaft's US subsidiary was reorganized in 1986 with equity capital of \$50 million and net sales of \$1.7 billion from trading in US government bonds, foreign currency, emerging markets instruments, and various commodities. The US subsidiary's oil business, organized under MG Refining and Marketing (MGRM), grew significantly between 1989 and 1993. In 1989 the company obtained a 49% stake in Castle Energy, a US oil exploration company, whose transformation into a refiner MGRM helped finance. MGRM contracted Castle Energy to purchase their output of refined oil products -- approximately 46 million bbl. per year -- at guaranteed margins for up to 10 years, and assembled a large network of infrastructure necessary for the storage and transport of oil products. During 1992 and 1993, MGRM succeeded in signing a large number of long-term contracts for delivery of gasoline, heating oil, and jet fuel oil to independent retailers. By late 1993 MGRM had become an important supplier. In addition MGRM ran large trades in energy-related derivatives. Its portfolio included a wide variety of over-the-counter forwards, swaps, and puts, and it did

large amounts of trading in futures contracts on crude oil, heating oil, and gasoline on a number of exchanges and markets.

MGRM was involved in intermediating the spot market for oil products with the long term forward market. For this business strategy to work, MGRM had to be directly involved in sophisticated commodity risk management. Though some of the risk could be captured with longer dated OTC products, to accurately handle the risk it was assuming for customers, MGRM also had to use oil complex futures contracts. Due to limited contract liquidity for longer delivery dates, MGRM had to implement a rolling stack hedging strategy, involving short dated futures contracts.

As demonstrated in numerous sources, e.g., Culp and Miller (1995), a rolling stack hedge can have a sizable basis risk. For the MGRM story, this basis risk was dramatically compounded by variation margin costs and certain peculiarities of German accounting principles. As a result, a promising business plan was destroyed by inadequate execution. That MGRM had a business plan is apparent. The plan commenced with the recruitment of a management team with a track record in implementing a similar plan at Louis Dreyfus Energy Corporation. The program was featured on the cover of the annual report of the parent corporation, MG AG. Under the forward supply or “flow delivery” contracts MGRM had contracted to deliver approximately 160 million barrels of associated oil products, primarily heating oil and gasoline, at fixed prices under contracts stretching out ten years. These contracts had a sell-back option clause, permitting the counterparty to terminate early if the market price was some threshold greater than the fixed price at which MGRM had contracted to deliver. The counterparties in these contracts were a mix of retail gasoline suppliers, large industrial corporations and a few government bodies.

The fixed price contracts written by MGRM provided for a spread over current spot market prices of from \$3 to \$5 per barrel, with many of the contracts being written in the summer of 1993. This was the profit margin that MGRM had to design a hedging strategy to protect. The unhedged risk to MGRM was that prices would rise and MGRM would be obligated to deliver oil products at lower than market prices. To hedge this spot position, circa late 1993, MGRM had a position of 100 to 110 million in OTC energy swaps and 55 million barrels in heating oil and gasoline futures on NYMEX. It seems that MGRM was pursuing a long one-to-one hedge. An important complication facing MGRM was the lack of liquidity in long dated maturities for both futures and swaps. Instead of implementing a relatively riskless strip hedge which seeks to match the maturity of the futures contract delivery with the date of the future spot transaction, MGRM was obliged to use a rolling stack hedge. Apparently, this was considered to be a benefit to MGRM, due to rollover gains implied by a one to one hedge when futures prices are in backwardation.

Unfortunately for MGRM in the later part of 1993 oil prices fell. While this would be an excellent outcome for an unhedged MGRM, the long hedge positions started requiring significant amounts of variation margin. In addition, futures prices went into contango, dictating rollover losses instead of rollover gains. These negative variation margin cash flows were not matched by offsetting mark to market gains on the long term forward delivery contracts. Such was the business risk that MGRM assumed. Prices fell from the \$19 level to below \$15, combined with the rollover losses, this meant cash flow requirements to the hedge in the hundreds of millions of dollars. As it turns out, German accounting principles, which were applicable to the parent corporation, required the classification of these variation margin payments as losses. In what can only be described as a classic case study

in strategic risk management, on Dec 17, 1993 the supervisory board of Metallgesellschaft fired the management board chairman and brought in new management with a mandate to liquidate both MGRM derivative security positions and its forward supply contracts.

The end result of the supervisory board decision can be estimated at \$640-\$800 million on the derivatives positions alone. The cancellation of the forward supply contracts was done without penalties, thereby releasing the counterparties from what was a positive cash flow situation for MGRM, again losing value. The MGRM saga has several key questions to examine. Among these points, one stands out: what were the members of the supervisory board thinking about when they pulled the plug on the operation? Unfortunately, the deliberations of the board, such as they were, are hidden behind the veil of corporate secrecy. It is apparent that the hedging strategy which was implemented was not well understood *ex ante* by the supervisory board. As such, the Metallgesellschaft failed to follow a tenet of strategic risk management: that the risk management program is enterprise wide. Senior management needs to understand the stress test values for the various cash flows which could result from a particular risk management operation.

### ***C. Commodity Funds and Regulatory Confusion***

#### **Amaranth Advisors LLC**

In September 2006, the hedge fund industry was rocked by the news that Amaranth Advisors LLC, a \$9 billion hedge fund based in Greenwich, Connecticut, reported to investors the fund had lost 65% of its net asset value, about \$6 billion, within one week. This surprising news startled not only Amaranth investors; the media, the industrial professionals, academics and regulators also became immediately attracted to the debacle. The Senate Permanent Subcommittee on investigations held meetings and prepared a staff report on excessive speculation in the natural gas market (US Senate 2007). Due to the private, closely-held character of hedge funds, the reasons behind the huge loss were not immediately apparent. Over time, the facts were gradually revealed. For example, Till (2006, 2008) uses reverse-engineering to replicate the trades held by Amaranth in September 2006 finding the loss was due to a large position in spread trades in the natural gas market. More importantly, backed with the authority of congressional investigation, US Senate (2007) provides a wealth of information about the debacle. Yet again, market failure arising from hedge fund activities loomed large.

Hedge funds are a fitting metaphor for the uncertain state of commodity and financial markets early in the 21<sup>st</sup> century. It was a network of feeder hedge funds that Bernard Madoff used to pull off the largest Ponzi scheme in history, lasting from the early 1990's until the collapse in late 2008. It was hedge funds run by Bear Stearns that were implicated in the distribution of the toxic mortgage assets that led to the financial market meltdown of late 2008. In this mix, Amaranth Advisors LLC, losing \$6 billion trying to manipulate the natural gas market in Feb. and April 2006, eventually led to the bankrupt firm being required to pay a \$7 million fine to the CFTC for market manipulation. The first hedge fund distributed to Canadian retail investors in 2004 – Portus Alternative Asset Management – was soon discovered to be an intricately designed legal structure aimed at providing the fund manager with unlimited discretion to move capital offshore into a network of offshore hedge funds. The collapse of the fraud in February 2005 resulted in hundreds of millions in losses



to investors, some of which was ultimately covered by the investment management companies that directed clients to these products. At least since the collapse of LTCM, similar red flags to those appearing in the Madoff, Bear Stearns, Amaranth and Portus cases have been apparent in US hedge fund activities.

The term “hedge fund” is generic, being used to describe a variety of different fund strategies that loosely share some similar characteristics. In the aftermath of the LTCM debacle (Dunbar 2000), the President’s Working Group on Financial Markets (PWGFM) (1999, p.40) defined the term “to refer to a variety of pooled investment vehicles that are not registered under the federal securities laws as investment companies, broker-dealers, or public corporations”. A similar definition appears in an SEC staff report on hedge funds appearing in 2003 (SEC 2003), with the clarification that a hedge fund “is not registered as an investment company under the Investment Company Act”. This recognizes ongoing efforts by the SEC to regulate hedge funds under the Investment Advisors Act (1940), e.g., Pekarek (2007). The continuing lack of regulatory oversight is not due to vigilance by US regulators. Substantive changes have been implemented in July 2011 as part of Dodd-Frank initiatives. New rules – the Private Fund Investment Advisers Registration Act of 2010 – have tightened registration, reporting and record keeping requirements of the IAA to include hedge funds.

SEC (2011) marks a considerable advance from PWGFM (1999, p.40) where it is observed that: “The term ‘hedge fund’ is not defined or used in federal securities laws”. Under Dodd-Frank initiatives, hedge funds are now loosely defined in SEC (2011, p.22-3) where Form PF filing requirements for ‘private funds’ are detailed. More precisely:

Form PF defines “hedge fund” generally to include any private fund having any one of three common characteristics of a hedge fund: (a) a performance fee that takes into account market value (instead of only realized gains); (b) high leverage; or (c) short selling ... [A] commodity pool that is reported or required to be reported on Form PF is treated as a hedge fund.

Hedge funds are now identified as a type of ‘private fund’:

Altogether, the seven types of private fund defined in Form PF are: (1) hedge fund; (2) liquidity fund; (3) private equity fund; (4) real estate fund; (5) securitized asset fund; (6) venture capital fund; and (7) other private fund.

By significantly increasing the variety of funds that would qualify as hedge funds, the introduction of this legal definition of a hedge fund changes the landscape somewhat.

Despite repeated recommendations and attempts to regulate hedge funds dating to the 1960's, the defining characteristic of hedge funds was until recently: “pooled investment vehicles that are not registered under federal securities laws”. To achieve this combination of pooling and avoidance of registration, hedge funds organized as limited partnerships or, in some jurisdictions, limit liability companies with shares not publicly traded (van Berkel 2008). This approach emphasizes that hedge funds are designed to avoid registration restrictions and reporting requirements imposed on tradeable securities. Over time, the growth of the hedge fund sector has made this definition too narrow. In order to access public capital markets, some hedge funds have undergone registration directly, or indirectly as part of a fund of hedge funds. By loosely classifying hedge funds as a type of ‘private

fund', the SEC and CFTC are aiming to cast a wide net in order to facilitate reporting needed to identify possible systemic risks such funds may pose. The objective is not to provide a precise analytical description of 'hedge fund' characteristics.

Much is made in academic studies of the different hedge fund categories and that "hedge fund investment strategies provide greater diversification opportunities and may result in higher risk-adjusted returns for investors" (Edwards 2006, p.46). Some even claim: "the hedge fund industry may have played more of a role in creating liquidity and making markets efficient than the mutual fund industry" (Stulz 2007, p.193). On balance, Stulz (2007) captures the 'bullish' stance of academics on hedge funds: "regulation should leave alone financial innovators who dream of new strategies and find savvy well-funded investors to bet on them." Prior to the market downturn of 2008-9, there was even considerable progress toward retailization of 'alternative asset classes' such as hedge funds and private equity funds because such funds "can pursue investment and speculative strategies that are not open to other institutional fund managers, ... avoid the costs associated with regulatory oversight, and ... use whatever fee structure they believe to be optimal" (Edwards 1999, p.191).

Viewed as a type of managed fund, the characteristics of classical hedge funds are: actively managed; leveraged; regulatory free rider; and, *de facto* investment companies disguised as limited partnerships. Though a hedge fund does not directly issue securities, because fund size changes with redemptions and additional investments, hedge funds can also be classified as open ended funds with restrictions on redemptions. In any case, hedge funds possess essential characteristics of the types of managed funds that the ICA and IAA were designed to stamp out. There are sound historically based rationales for restricting highly leveraged speculative trading activities by unregulated entities. The costs associated with regulatory oversight are important to maintaining the stability and integrity of financial markets. Free rider funds that are able to avoid such regulatory costs are at an advantage to funds that do pay such costs. From an historical perspective, permitting unregulated and possibly highly leveraged financial entities that operate in securities and commodity markets with the sole objective of making speculative profits is ill conceived and reckless and results in increased potential for severe market disruption that outweigh the potential benefits of increased market liquidity.

## **Regulation of Hedge Funds**

In order to avoid the registration requirements specified under US federal securities laws for securities companies, hedge funds have to satisfy a number of specific conditions. Exemption from the Securities Act (1933) is achieved by having no public offering. This is an issue with using the 'funds of hedge funds' approach as a strategy to retailize hedge fund investing. Whether it is possible to issue a tradeable equity security holding assets that would not otherwise be considered to be tradeable depends on the jurisdiction. Similar regulatory quandaries arise with the exemption from the ICA achieved by being a 'private investment company'. Hedge funds have two possible avenues to qualify as private investment companies, either the '100 person exemption' (Sec. 3(c)(1)), or the 'qualified purchaser exemption' (Sec.3(c)(7)) that permits up to 500 qualified investors. While there is often the perception that hedge funds are privately structured and closely held entities qualifying because the primary investors are high net worth individuals, in practice the 100 person exemption is not used because the institutional investors in hedge funds satisfy the test for 'qualified

purchaser'. Each institution, such as a pension fund or investment bank, is counted as a separate investor. Because such institutions could contain investments from thousands of investors, the actual 'size' of the hedge fund would be much larger than the small number of institutions investing in the fund.

Hedge funds have been an ongoing headache for regulators. Since the collapse of LTCM, there has been a parade of hedge fund related problems. On recently has a loose legal definition of a hedge fund been provided. One of the attractive features of hedge funds has been the avoidance of certain legalities associated with registration, information filing, taxes and so on; though some US hedge funds did register under the IAA even before the Dodd-Frank reforms. To achieve exemption from federal securities regulations, a hedge fund is typically structured as a pooled investment vehicle, that is privately organized, closely held among a small number of partners and run by professional investment managers, typically on an incentive fee basis. The master-feeder organizational structure of such funds often involves a corporation domiciled outside the US in tax havens such as the British Virgin Islands or Bermuda, e.g., Greene et al. (2007). It remains to be seen whether various characteristics of a hedge fund will still permit such funds to fall through any remaining cracks in the US securities laws.

The avenue chosen for dealing with hedge funds is enhanced regulation to bring such funds within the scope of regulatory oversight. To date, under ongoing Dodd-Frank initiatives, hedge funds now fall within the scope of the IAA. This will hopefully end efforts have by hedge fund advisors to seek relief in federal court proceedings, especially the earlier Bulldog Investors case upholding the exemption of hedge funds advisors from the IAA, e.g., Pearson and Pearson (2007); Pekarek (2007); Mann (2008). In addition to this direct regulation, indirect regulation of hedge funds occurs through the array of financial institutions which hedge funds need to conduct business. For example, the SEC imposes capital, margin and reporting requirements on broker-dealers, which are essential counter-parties or clearing members for hedge funds. Included among these requirements are risk assessment rules specified in the SEC Act to "establish record keeping and reporting requirements for subject broker-dealers and their affiliates whose business activities are reasonably likely to have a material impact on the financial and operational conditions of the broker-dealer" (PWGFM, p.42).

## **Hedge Fund Strategies**

The situation surrounding regulation of hedge funds is complicated because hedge funds are not the only managed funds which seek such specific exemptions from US securities laws. For example, venture capital pools, private equity funds, venture capital investment funds, asset securitization vehicles, family estate planning vehicles and investment clubs can receive such treatment. As a consequence, another defining feature of hedge funds is the types of strategies which the funds pursue. Given the restricted scope of other types of funds seeking exemptions, hedge funds can exhibit considerable variation in strategies. "There is no single market strategy or approach pursued by hedge funds as a group. Rather, hedge funds exhibit a wide variety of investment types, some of which use highly quantitative techniques while others employ more subjective factors" (PWGFM 1999).

### The MARhedge hedge fund categories

MARhedge was an important source of information and news about the hedge fund industry until it was absorbed by Institutional Investor where MARhedge still conducts hedge fund conferences. Data available through MARhedge has been examined in Ackermann et al. (1999). In order to provide some degree of organization to the variety of hedge fund strategies, MARhedge classified hedge funds into eight broad descriptive categories:

*Global Macro funds*: take positions on changes in global economic conditions in equity, FX and debt markets. Use derivatives, including index derivatives, and leverage.

*Global funds*: similar to macro funds but targetted at specific regions, often involving stock picking.

*Long-only (US Opportunistic) funds*: are like traditional equity funds but with the hedge fund characteristics of leveraging and incentive fees for managers. Strategies for these funds include Value, Growth and Short-term trading.

*Market-neutral funds*: the basic objective of these funds is to be long in one group of securities and short in another group, such that market risk is controlled or neutralized. This can be done in a number of ways: by going long one group of stocks and short another group, seeking to benefit from superior stock picking skills; conversion arbitrages, which are long in underpriced convertibles and short in the underlying stocks; stock index arbitrages; and, fixed income arbitrages, which are long, say, off-the-run Treasuries, and short on-the-run Treasuries.

*Sectoral hedge funds*: have an industry focus; short-sale funds, which short sale over-valued securities, investing the balance in indexes or fixed income securities

*Event-driven funds*: target special situations, specifically distressed securities of firms in reorganization or bankruptcy as well risk trading in takeovers, e.g., buying the target and selling the acquirer.

*Short Sales funds*: the fund is positioned to benefit from market declines. These funds can be index driven or can be based on stock picking.

*Funds of hedge funds*: funds of hedge funds, sometimes leveraged.

Within each of these general group, a variety of different strategies could be pursued. Similarly, some funds may be involved in activities covering more than one fund category.

The diversity of hedge fund strategies extends to the types of securities traded (PWGFM, p.9):

Many hedge funds trade equity or fixed income securities, taking either long or short positions, or sometimes both simultaneously. A large number of funds also use exchange-traded futures contracts or over-the-counter derivatives, to hedge their portfolios, to exploit market inefficiencies, or to take outright positions. Still others are active participants in foreign exchange markets. In general, hedge funds are more active users of derivatives and of short positions than are mutual funds and many other classes of asset managers.

However, behind all the confusion about hedge fund typology, some basic intuition is relatively clear: *hedge* funds often combine long positions in certain securities with short positions in other securities. Such ‘hedging’ strategies can be relatively low risk where the securities being traded are highly correlated and short and long positions are balanced, e.g., the ‘on-the-run’ ‘off-the-run’ Treasury security arbitrage run by John Merriweather, first at Salomon Brothers and subsequently at LTCM. Because the price differences involved in achieving a profit are small, substantial leverage is required and warranted. Such hedge fund strategies will, directly or indirectly, involve leveraging. However, many other hedge fund strategies do not have sufficient correspondence between the short and long positions to warrant the degree of leverage that is being partially hidden from public view by the managed funds operating under exemptions from securities laws designed to deter such excessive leveraging.

Hedge funds are not conventional investment vehicles. Investor liquidity is often compromised with “lock-up periods of one year for initial investors and subsequent restrictions on withdrawals to quarterly intervals” (Ackermann et al. 1999, p.834). The regulatory exemptions that hedge funds work under severely restricts the ability of hedge funds to advertise though the barrier to the public markets is increasingly porous.<sup>41</sup> Another atypical feature of hedge funds concern the management (Ackermann et al. 1999):

Hedge funds are ... characterized by strong performance incentives. On average, hedge fund managers receive a 1 percent annual management fee and 14 percent of the annual profits. For most funds this bonus incentive fee is paid only if the returns surpass some hurdle rate or "high-water mark" -- meaning there is no incentive fee until the fund has recovered from past losses. Although incentive fees and high-water marks could lead to excess risk taking under some conditions, there are countervailing forces that may dampen risk. Hedge fund managers often invest a substantial amount of their own money in the fund. Furthermore, the managers of US hedge funds are general partners, so they may incur substantial liability if the fund goes bankrupt.

In contrast to mutual funds which have a much longer history that has been intensively studied, hedge funds only started to receive academic attention in the mid 1990's, though work on managed futures funds and commodity pools, which started somewhat earlier, is also applicable, e.g., Irwin and Brorsen (1985); Elton, Gruber and Rentzler (1987); Edwards and Ma (1988); Cornew (1988); Irwin et al. (1993); Edwards and Park (1996). As data has accumulated on hedge fund activities, a voluminous number of studies has appeared on various aspects of hedge funds. Among the useful studies directly on hedge funds are: Klein and Lederman (1995); Fung and Hsieh (2000, 2002); Brown et al. (1999, 2001); Schneeweiss and Spurgin (1998); Ackermann et al. (1999); Liang (2000); Gregoriou (2002); Goetzmann et al. (2003); Patton (2009); and, Griffen and Xu (2009).

### **Amaranth Advisors Trading Activities**

Amaranth Advisors LLC was a hedge fund founded in 2000 by Nicholas Maounis, a former portfolio manager who had specialized in convertible bonds at Paloma Partners. Amaranth employed a multi-strategy approach to investing that allowed fund managers to seize opportunities

in whatever markets seemed to be most promising at the time, e.g., Chincarini (2008). Prior to the debacle, the fund had been involved in merger arbitrage, long/short equity trading, leveraged loans, blank check companies, and energy trading. As of June 30, 2006, energy trades accounted for about half of fund capital and generated about 75% of profits {Burton and Leising 2006}. Though the head office of Amaranth was in Greenwich, the energy trading division was in Calgary, Alberta where from 2005 Brian Hunter was co-head with Matthew Donohoe of the firm's energy desk with authority to make trades without immediate oversight. With a mathematics degree from the University of Alberta, Hunter had joined Deutsche Bank (New York) in May 2001. Following some initial trading success, Hunter was promoted to head the bank's natural gas desk in 2003. As an omen of future events, in December 2003 Hunter's trading group lost \$400 million in a single week in an excessively risky trade and he was eventually let go by Deutsche Bank.

Davis (2006, p.A1) describes the evolution of the energy book of the Amaranth fund over 2006:

[Amaranth's energy book] was up for the year roughly \$2 billion by April, scoring a return of 11 % to 13% that month alone, say investors in the Amaranth fund. Then ... [the energy strategies] had a loss of nearly \$1 billion in May when prices of gas for delivery far in the future suddenly collapsed, investors added. [The energy traders then] won back the \$1 billion over the summer.

As it turns out, Amaranth's energy book was primarily concentrated in natural gas and had benefited substantially from natural gas price movements associated with Hurricane Katrina in the latter part of 2005: "the double-whammy of Hurricanes Katrina and Rita made Mr. Hunter a hero at Amaranth and a minor legend on Wall Street, as he made \$1 billion for Amaranth"(A. Davis, 2006). The extent of the trading is revealed in US Senate (2007) and Till (2008). At times during 2006, Amaranth controlled as much as 40% of all the open interest on NYMEX for the winter month contracts delivering in October 2006 through March 2007 (US Senate 2007, p.51-52). In late July 2006, Amaranth held a total of more than 80,000 NYMEX and ICE contracts for January 2007, representing a volume of natural gas that equalled the entire amount of natural gas eventually used in that month by U.S. residential consumers nationwide (US Senate 2007, p.52). On July 31st, 2006, Amaranth's trading in the March and April 2007 contracts represented almost 70% of the total NYMEX trading volume in each of these contracts on that date. Amaranth held large positions in winter and summer months spanning the entire five-year period from 2006-2010, e.g., Amaranth held 60% of the outstanding contracts (open interest) in all NYMEX natural gas futures contracts for 2010 (p.52). On 7/4/06, Amaranth's futures position as a percentage of NYMEX futures open interest in the December 2007 contract was 81 %. On 8/28/06, Amaranth accounted for over 40% of the total volume on the ICE and over 25% of the entire volume of exchange-traded futures and swaps on NYMEX and on ICE on that date.

#### INSERT Figure 3.C.a Amaranth's Forward Curve

Even in the aftermath of the debacle, it is not possible to precisely determine the trading strategies employed. However, evidence on Amaranth's positions provided in US Senate (2007) is sufficient to determine the general picture (see Figure 3.C.a). In addition, the size and timing of the losses is

also known. When margin calls on the position crossed US\$3 billion, around September 2006, the fund offloaded some of these positions, ultimately selling much of the book to JP Morgan and Citadel for US\$ 2.5 billion, with this amount to be credited against the losses. The fund ultimately took a \$6.6 billion dollar loss and had to be dissolved entirely. Oddly enough, Maounis said in an interview in August 2006: “What Brian is really, really good at is taking controlled and measured risk” (A. Davis, 2006). Judging from the size and type of positions, those involved in overseeing the various strategies employed by the fund were not employing sufficient risk management tools to accurately manage the risks that were being taken up. In addition, subsequent prosecution of Amaranth by both FERC and the CFTC revealed illegality by the principals. Once the position began to ‘blow up’, Amaranth sought to cover NYMEX losses by substantially increasing position size in the OTC market on ICE, knowingly violating reporting requirements for speculators.

Combining the information in Till (2008) with US Senate (2007), it is apparent that Amaranth was short shoulder season contract deliveries -- mainly April and October 2006 -- and long winter deliveries -- November, January and March 2006. There also appears to be spreading across years as well with a short position in Dec. 2006 approximately balanced by a Dec. 2007 long position. Till (2008) used the movements of natural gas spreads in September to confirm that these two spread trades could produce the losses reported. September 2006 was an unusual month historically for the term structure of futures prices with a contango from summer to winter, and a backwardation from March to April.<sup>42</sup> According to publicly available information, the fund lost \$560 million on September 14, shrinking the size of the fund about 35% for the week, about \$3.2 billion based on a \$9.2 billion net asset value. At the same time, the March/April spread on September 14 fell by \$6000 per spread, and in the whole week the spread dropped by \$30,650 per spread combination. On the other hand, the spread of the Short Summer/Long Winter combination decreased by \$3720 on September 14 and by down by \$48,950 per spread for the whole week.

Evidence of the sophistication of the trading strategy employed by Hunter is provided by Till (2006) which demonstrates that from June to August 2006 the same type of trades generated \$1.2 billion profits, close to the \$1.3 billion reported by Amaranth. Even though the position sizes throughout the months from May to September were not the same, the derived position sizes were similar to what Amaranth's energy portfolio was holding in summer 2006. In effect, Amaranth was taking the same intrinsic view about the seasonal calendar spread in natural gas, profiting from events such as exceptionally cold winters or summers with big hurricanes. Collins (2006) quotes Erk Hinrichsen, senior managing director of Energy Arbitrage Management: “It looks like they put the same position on over and over.” The short Dec. 06-long Dec. 07 spread seems particularly misguided due to supply considerations that were readily apparent in the natural gas market at that time. However, speculative traders often do take incorrect views and the key risk management failure was to identified by Till (2006), “These strategies were and are economically defensible, but the scale of their position-sizing relative to their capital base clearly was not.”

Till (2006, p.97) makes a useful observation:

it is likely that physical natural gas market participants were the ultimate risk takers on the other side of Amaranth's trades, and so benefited from the temporary dislocations that ensued from the fund's distress. In other words, it does not appear that the commercial natural gas industry was damaged by this financial crisis; in fact, commercial suppliers of natural gas

likely benefited. Natural gas commercial hedgers would have earned substantial profits had they elected to realize their hedging windfall during the three months that followed the Amaranth debacle.

The large position size established by Amaranth was unsound relative to the relatively illiquid market for natural gas futures. Unlike liquid financial futures contracts for the S&P 500 index or Eurodollar deposits, activity in natural gas futures relies on commercial participants initiating trades for hedging purposes. Commodity futures traders in relatively illiquid markets recognize a major part of a trading strategy is how to exit positions when necessary. The size of Amaranth's trades were so large there was no counter-parties capable of providing sufficient liquidity for Amaranth to exit positions in a week or two. The counter-parties to many of Amaranth's trades were physical-market participants that had locked in attractive value for production and storage. There was little economic incentive to provide the liquidity for Amaranth to unwind trades.

#### INSERT Figure 3.C.b CME Natural Gas Futures Settlement Prices 13/12/2011

The final aspect of the Amaranth debacle concerns the disposition of the main players, Hunter and Donohoe. Actions were initiated by both the CFTC, for attempted manipulation of NYMEX contracts, and FERC, for actual manipulation of the natural gas market. The enforcement action in July 2007 was the first major initiative by FERC under the expanded powers granted by the Energy Policy Act (2005). In particular, Till (2008, 95):

The CFTC's regulatory authority mainly covers the exchange-traded futures markets, so their investigation narrowly focused on the fund's documented activities on the NYMEX. Correspondingly, the FERC is responsible for overseeing the wholesale natural gas and electricity markets in the U.S. The FERC was granted anti-manipulation authority in the physical natural gas markets by the Congress in 2005, and the Amaranth case is the first such exercise of this authority.

In Aug. 2009, in an action coordinated with the CFTC, FERC imposed a \$7.5 million fine on Amaranth and Donohoe. In addition to stifling attempts by Hunter to relaunch as a commodity hedge fund manager, in April 2010 a FERC administrative judge handed down a \$30 million civil fine against Hunter for violating anti-manipulation rules. As for the scary prospect of Hunter continuing as a hedge fund manager, Christopher Holt, founder of hedge fund consultant Holt Capital Advisors Ltd observed: "As long as you can explain what happened, why it happened, and why it won't happen again, there's no reason that a top trader couldn't attract new backers" (Willis, 2007).

## NOTES



1. The Kolwezi mining project was sold to a shell company controlled by Israeli businessman Dan Gertler in a highly irregular transaction. A close associate of Congo President Joseph Kabila, Gertler then sold most of his stake to London-based ENRC. First Quantum sued in international court and was able to obtain a \$1.25 billion payment to settle a claim that the courts awarded at \$2 billion.
2. Recently, important actuarial organizations, such as the Society of Actuaries ([www.soa.org](http://www.soa.org)) have introduced certification in ‘enterprise risk management’, e.g., the Chartered Enterprise Risk Analyst (CERA) credential issued by the Society of Actuaries. Obtaining this certification requires competence in financial economics and operational risk. By design, enterprise risk management aims to extend the frontier of actuarial science to include both positive and negative risks.
3. There are numerous other similar sources, e.g., Geman and Ohanen (2008), Kat and Oonen (2007), Lewis (2009), Till and Eagleeye (2005), McCormack et al. (2003). For a contrary view see Goldstein and Taleb (2007).
4. Confusion in the *Investopedia* explanation of ‘speculation’ is reflected in the final explanatory comment provided on speculation: “More sophisticated investors will also use a hedging strategy in combination with their speculative investment in order to limit potential losses.” In this view, speculators can be hedgers which is in direct contrast to the conventional legal distinction between hedgers and speculators.
5. Some commodities have unusual characteristics that warrant specific attention. Truly non-storable commodities would be one example. Few commodities do not have some shelf life, so non-storability relates to trading for future delivery involving dates beyond the shelf life. But this is the case with all physical commodities to some extent. As a commodity, electricity has special physical characteristics due to: flexibility and controllability in production and transmission; and, methods of pricing and consumption, e.g., Conejo et al. (2010), Doege et al. (2009), Fong and Gray (2006), Tao and Shahidelphour.(2007), Nakamura et al. (2006).
6. The delivery specifications of the NYMEX crude oil contract permit deliver of specific domestic crude oils with not more than 0.42% sulphur by weight and API gravity between 37° and 42°. Though the contract is usually referred to as the WTI contract, a range of other crudes are deliverable including New Mexican Sweet, Oklahoma Sweet, North Texas Sweet and South Texas Sweet. It is also possible to deliver a range of other crudes, such as UK Brent, at a discount. The common view that the NYMEX contract is for WTI is due to the contract delivery point being any pipeline or storage facility at Cushing, Oklahoma, a delivery site that tends to favor delivery of WTI. Gray (2002) discusses the calculation of API gravity.
7. The following discussion is derived from information provided on the Syncrude website [www.syncrude.com](http://www.syncrude.com). Chastko (2004) is a helpful source on the history of the Alberta oil sands.
8. Shares in the Syncrude project do change hands infrequently and companies merge and change names. Nexen was formerly called Canadian Occidental and Mocal was formerly called Mitsubishi Oil (fully owned by Nippon). Canadian Oil Sands increased ownership share in 2003 by buying out

the share of Encana which, in 2002, was formed from the merger of Pan-Canadian Energy Corp and Alberta Energy Company Ltd.. Prior to this merger, the EnCana share was held by Alberta Energy Company Oil Sands Partnership.

9. This section draws liberally from Poitras (2009).

10. Aristotle also relates a story about a Sicilian iron merchant that was able to acquire sufficient stock of metal to create a monopoly, profiting from the ability to control prices.

11. In the following quote, the old English spelling used in the original text has been modernized, e.g., “booke” to ‘book’, “necessarie” to ‘necessary’. No alternations have been made to grammar.

12. “In 16<sup>th</sup> century England, the bulk of the export trade was in the hands of the Merchant Adventurers, but the import trade was largely controlled by the merchant strangers, especially Italians, Spaniards and Flemings” (de Roover 1949, p.110).

13. Kellenbenz (1957, p.134) gives more precise information on the evolution of the Amsterdam Exchange: “The institution began as an open-air market in Warmoesstreet, later moved for a while to New Bridge, which crosses the Damrak, then flourished in the ‘church square’ near the Oude Kerk until the Amsterdam merchants built their own exchange building in 1611”. The Amsterdam bourse was fully open for business in 1613.

14. Max Weber (1924, 2000, p.339) provides an example of such a definition: “A stock or commodity exchange is a *market* in which the purchase and sale of large quantities of goods and money, of stocks and commercial bills of exchange, take place between professional businessmen”. Weber (1894, 2000) aims to defend the exchange process from the view that “one is dealing with an wholly dispensable organization – one that must be judged by its very nature to be a sort of ‘conspirators club’ aimed at lying and deception at the expense of honest laboring people.”

15. The term ‘bill of exchange’ is being used loosely. The subtle differences in the features of the bill of exchange contract, e.g., transferability, that evolved over time are being ignored. Munro (2000) and de Roover (1949) discuss these differences in some detail. Until the latter part of the 16th century, the bill of exchange was the dominant means of settlement in southern Europe, while the bill obligatory (letter obligatory, writings obligatory) was prevalent in the north: “The bill of exchange was definitely not unknown in the north; on the contrary. But before 1550 the bill of exchange was certainly not yet the characteristic, dominant instrument of foreign trade. Within the Hanseatic League the bill of exchange remained marginal. From the second third of the sixteenth century...use of the bill of exchange quickly became general in the north... The letter (or bill) obligatory, based on extension of payment, had from the late Middle Ages been the characteristic, dominant security in the foreign trade of the north. It continued to hold this position in the fifteenth and sixteenth centuries” (van der Wee 1977, p.324-5).

16. De Roover (1954, p.205) traces the progression of the banking practices from the fairs to fixed metropolitan locations: “By 1325...the role of the fairs of Champagne was played out, both as trading and financial centres. In the fourteenth and fifteenth centuries, the banking places of Europe were:

Bologna, Florence, Genoa, Lucca, Milan, Naples, Palermo, Pisa, Siena, Venice and the court of Rome in Italy; Avignon, Montpellier, and Paris in France; Barcelona, Valencia, and Palma de Mallorca in Spain; Bruges in Flanders; and London in England... Paris declined shortly after 1400... and its place was taken by the fairs of Geneva and, after 1465, by those of Lyons. There were no banking places east of the Rhine, although the fairs of Frankfort-on-the-Main began to emerge as a clearing centre toward the end of the fifteenth century.”

17. Relevant English legislation on enforce ability of interest payments is detailed in de Roover (1949, p.110, n.31). Henry VIII made the first substantive effort in 1545.

18. A similar description can be found in van der Wee (1977, p.318-9).

19. Buckley (1924, p.590) makes the following observation about the treatment of the English merchants of the Staple in Bruges: “It was, apparently, an important concession which the city Bruges made to the English merchants of the Staple in 1559, when it was agreed that the latter should be free of brokers when buying. It was asserted in 1562 that in most foreign countries no ‘stranger’ bought or sold except through a sworn broker, and the English Statute Book contains a number of regulations of similar import. Such arrangements were general, being due to the universal prejudice against foreigners”. Buckley (p.591) also makes another observation which is indicative of the pervasiveness of brokers at Gresham's time: ‘Dealings in Bills of exchange without the intervention of a broker were exceptional’.

20. The identification of this early trade as ‘futures’ contracting is found in Gelderblom and Jonker (2005). This approach is at variance with the conventional view that futures trading began in Chicago in the 19<sup>th</sup> century or the less conventional view that such trading began in the 17<sup>th</sup> century Japanese rice market (West 2000; Schaede 1987).

21. Emery (1896, p.51-3) provides a number of references to late 19<sup>th</sup> century German and French sources on options trading. The connection between German and English terminology is also discussed (p.91). Courtadon (1982) examines option trading practices on the Paris bourse.

22. The acronym VOC is a reference to the English to Dutch translation of the Dutch East India Company, as the *Verenigde Oostindische Compagnie*.

23. The primary documentation associated with the Dutch Edict of 1610, which removed legal protection for ‘windhandel’ contracts, contains an important *memoir*, probably written by Isaac le Maire, which outlines arguments in favour of retaining short sales (van Dillen 1930; De Marchi and Harrison 1994; van Dillen et al. 2007). A number of arguments draw on the similarity of the trade in shares to the trade in goods: “the authors proceed from free trade in goods (perfectly conventional from a common weal point of view), move on to the freedom to make forward purchases of commodities (accepted practice for at least several decades), and end with the freedom to trade in shares. This bundling, as well as the progression itself, may have been intended to persuade the reader that (all) share trading practices should unquestionably be regarded as no different in principle from trade in goods” (De Marchi and Harrison 1994, p.55).

24. This section is based on Poitras (2000, ch.10). Early sources on the tulipmania, such as Francis (1850) and Mackay (1841), refer to the "tulipomania".

25. The source of this anecdote is Mackay. Garber (1989, p.540, n.12) casts considerable doubt on the validity of Mackay's account.

26. Waermond and Gaergoedt translate loosely as True-Mouth and Greedy-Goods. The dialogue format was popular in the 16th and 17th centuries. This approach was used in a number of other important financial works of this period, such as de la Vega (1688) and Wilson (1572). As for the primary literature, Posthumus (1929, p.436) reports that: "At least fifty booklets written by defenders and opponents were published, as well as a great number of prints and caricatures." Posthumus states that the best source of information is the GW dialogues.

27. The *aas* or *ace* (plural *azen*) is a Dutch unit of weight which equals about 1/20 of a gram.

28. The basic mechanics of tulip production argue against widespread option trading for those directly involved in the tulip trade. Tulip growers wanted to sell bulbs for future delivery. Due to potential and actual limitations in the supply of bulbs, other potential market participants were not in a position to quote call option prices from created hedged positions.

29.. There is little support for Malkiel's point about the devastating economic consequences of the mania. Though there were a few traders who lost large downpayments which had been made, most of the contracts resulting from the crash were either cancelled or settled with nominal payments. Posthumus (1929, p.448) concludes that "socially the losses had been very small. The growers had been affected most of all by the crisis, having grown and sold their bulbs, without getting any money in return."

30. Of the various recent exchange mergers, in 1999, the NYMEX merged with the COMEX to form the New York Board of Trade which subsequently merged with the CME. In another important development, the CBT merged with the CME in 2007. Markham and Harty (2008) have a detailed discussion of more recent mergers and developments.

31. The Senate debate included a vote on the George amendment which aimed to ban futures trading altogether. This amendment was prompted by the concern of Southern members about the use of tax-to-destroy as a method of dealing with the anti-speculation arguments of the agrarians and Populists. This amendment was defeated by 51 to 19. However, as it turns out, the Southern supporters of the George amendment held the balance in the House vote to suspend rules which led to the defeat of the Hatch-Washburn bill.

32 Williams (1995) is a helpful source for more in depth discussion of the issues surrounding the definition and legal application of manipulation. The following discussion draws liberally from that source.

33. Fay (1982) and Williams (1995) are excellent sources on this topic. The Sumitomo copper corner is similar in many ways to the Hunt silver dealings, though there were some significant

differences, e.g., the Sumitomo losses were the result of a trading operation within a larger corporate entity.

34. The Hunt family fortune was founded by the eccentric H.L. Hunt, who left three sets of children (Hurt 1981). Bunker and Herbert were from the first of H.L. Hunt's families. This first family also includes Lamar Hunt, owner of the Kansas City Chiefs. Circa 1980, the centrepieces of the Hunt family fortune were Penrod Drilling, an oil drilling company, and Placid Oil, the holder of large oil reserves and leases. The two companies, together with the family's other assets, were controlled through an elaborate network of over 200 companies and trust funds (Williams 1995, p.20).

35. Johnson (1981, p.97) reports: "In fact, its quite rare for their to be manipulation cases. There are, perhaps, not more than a half dozen manipulation cases of any true significance that have been reported in the courts."

36 *General Foods vs. Brannan*, 170 F.2d 220 (7<sup>th</sup> Circuit, 1948), p.231, quoted in Williams (1995, p.5).

37 In November 1991, David Threlkeld, a US copper broker operating on the LME, received a letter requesting him to backdate trade confirmation dates for a fake deal worth \$425 million. This letter was apparently from Hamanaka. Recognizing the illegality of the request, Threlkeld passed the letter along to the head of the LME. The LME's view on the letter was, more or less, that Threlkeld was well advised to keep quiet over the matter to avoid getting sued. At this point, it is not clear whether the LME did anything to follow up on the Threlkeld complaint.

38. At this time, the three major exchanges for copper derivatives were: the London Metal Exchange (LME) with about 80% of world copper trading volume with the COMEX division of the New York Mercantile Exchange (NYMEX) and the Shanghai Future Exchange (SHFE), respectively, with about a 10% share.

39. On December 12, Mingkang Liu, the chairman of China Banking Regulatory Commission (CBRC) used the SRB case as an example in a presentation regarding risk management of financial derivatives. This was reportedly the first time a senior officer from Chinese government acknowledged publicly the substantial losses caused by Liu Qibing.

40. The following subsection on Metallgesellschaft borrows from Poitras (2002, p.58-60). The problems associated with the need to use rolling stack hedges is not confined to the energy sector. For example, Gardner and Schmitt (1996) discuss 'rollover' hedging in agricultural markets.

41. The extent of hedge fund penetration into the public retail market place can be ascertained from websites such as <http://www.hedgeco.net> and <http://www.institutionalinvestor.com/Hedge-Funds-and-Alternatives-Hedge-Funds.html>.

42. As illustrated in Figure 3.C.b, anomalies in the term structure of natural gas futures prices are often observed. For example, due to a surplus of spot gas for delivery, settlement prices for the near-to-delivery 2012 winter contracts are priced below the 2012 summer months. The typical lower in

summer, higher in winter price relationship does not appear until 2013.