

THE ECONOMICS OF COMMODITY TRADING FIRMS



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INTRODUCTION

The trading of the basic commodities that are transformed into the foods we eat, the energy that fuels our transportation and heats and lights our homes, and the metals that are present in the myriad objects we employ in our daily lives is one of the oldest forms of economic activity. Yet, even though this activity traces its origins into prehistory, commodity trading is often widely misunderstood, and, as a consequence, it is often the subject of controversy. So too are the firms that engage in it.

This whitepaper is intended to help demystify the commodity trading business. It presents a combination of description and analysis: in it, I describe some salient features of the commodity trading business and commodity trading firms, and utilize a variety of economic concepts to analyze and explain them.

SUMMARY CONCLUSIONS

Several fundamental conclusions flow from the analysis:

- Commodity trading firms are all essentially in the business of transforming commodities in space (logistics), in time (storage), and in form (processing). Their basic function is to perform physical “arbitrages” which enhance value through these various transformations.
- Although all commodity traders engage in transformation activities, they are tremendously diverse. They vary in size, the commodities they trade and transform, the types of transformations they undertake, their financing, and their form of ownership.
- In engaging in these transformation activities, commodity traders face a wide array of risks, some of which can be managed by hedging, insurance, or diversification, but face others that must be borne by the firms’ owners.
- Crucially, most commodity trading firms do not speculate on movements in the levels of commodity prices. Instead, as a rule they hedge these “flat price” risks, and bear risks related to price differences and spreads—basis risks.
- Risk management is an integral part of the operations of commodity trading firms. Some major risks are transferred to the financial markets, through hedging in derivatives or the purchase of insurance. Other risks are mitigated by diversification across commodities traded, and across the kinds of transformations that firms undertake. Remaining risks are borne by equity holders, and controlled by policies, procedures, and managerial oversight.
- Commodity trading firms utilize a variety of means to fund their transformation activities. Different commodity traders use different funding strategies involving different mixes of types of debt and debt maturities, and these funding strategies are aligned with the types of transformations firms undertake, and the types of assets they use to undertake them. Short-term assets like inventories are funded with short-term debt, and long-term assets are funded with longer-term debt.
- Commodity trading firms provide various forms of financing and risk management services to their customers. Sometimes commodity marketing, financing, and risk management services are bundled in structured transactions with commodity trading firms’ customers. Offering these services to customers exploits trading firms’ expertise in merchandising and risk management, utilizes the information commodity trading firms have, and provides better incentives to customers.
- Some commodity trading firms are public companies, whereas some are private. The private ownership model is well-adapted to traditional, “asset light” transformation activities, but as economic forces are leading to increasing investments in physical assets by all types of trading firms, the private ownership model is coming under pressure. Some major traders have already gone public; others are considering it; and still others are implementing hybrid strategies that allow them to retain some of the benefits of private ownership while tapping the public capital markets (sometimes including the equity markets) to fund some investments.

- Commodity trading firms exhibit considerable diversity in their investments in physical assets, with some firms being relatively asset intensive, and others being very asset light. These firms also exhibit diverse trends in asset intensity. Within both categories (asset heavy and asset light), some firms are becoming more asset intensive, and others less (or remaining relatively constant).
- What economists refer to as “transactions costs economics” provides considerable insight on what kinds of assets commodity traders own, and why these ownership and investment patterns have changed over time. Most notably, these transactions costs economics considerations imply that commodity traders have strong reasons to own “midstream” assets including storage facilities and terminals. Changes in commodity trading patterns in the last decade have created needs for increased investments in such midstream assets, and commodity trading firms have responded by building them.
- Although it has been suggested that commodity trading firms are potential sources of systemic risk, as are banks, and hence should be regulated in ways similar to banks, they are in fact unlikely to be a source of systemic risk. That is, commodity trading firms are not too big to fail. Not only are they substantially smaller than truly systemically risky financial institutions, they do not engage in the kinds of maturity transformations that make banks vulnerable to runs; nor are they highly leveraged; nor are they major sources of credit; and the assets of a firm that experiences financial distress can be transferred to others.

THE REMAINDER OF THIS PAPER IS ORGANIZED AS FOLLOWS:

Section I discusses the basics of commodity trading, focusing on the three major transformations that commodity traders undertake.

Section II summarizes the various risks that commodity trading firms face.

Section III describes the risk management process at Trafigura.

Section IV examines the financing of commodity trading firms, their ownership structure, and their provision of funding to their customers.

Section V analyzes asset ownership by commodity firms.

Section VI examines the question of whether commodity trading firms pose systemic risks.

The paper concludes with a brief afterword.

I. THE BASICS OF COMMODITY TRADING

SUMMARY

Agricultural, energy and industrial commodities undergo a variety of processes to transform them into things we can consume. These can be categorized as transformations in space, time, and form.

Commodity trading firms (CTFs) add value by identifying and optimizing transformations in commodities that reconcile mismatches between supply and demand:

- in space - using logistics
- in time - through storage
- in form - with processing.

Physical and regulatory bottlenecks may act as constraints on these transformations.

CTFs undertake physical arbitrage activities, which involve the simultaneous purchase and sale of a commodity in different forms.

CTFs do not speculate on outright commodity price risk, but aim to profit on the differential between the untransformed and transformed commodity.

CTFs specialize in the production and analysis of information that identifies optimal transformations. They respond to price signals and invest in physical and human capital to perform these transformations.

There are many different types of CTF. They vary by size and by product specialization. Some are independent entities; others are subsidiaries of oil majors or banks. They may be privately owned or publicly listed.

A. COMMODITY TRANSFORMATIONS

Virtually all agricultural, energy, and industrial commodities must undergo a variety of processes to transform them into things that we can actually consume. These transformations can be roughly grouped into three categories: transformations in space, transformations in time, and transformations in form.

Spatial transformations involve the transportation of commodities from regions where they are produced (supply regions) to the places they are consumed. The resources where commodities can be efficiently produced, such as fertile land or mineral deposits, are almost always located away from, and often far away from, the locations where those who desire to consume them reside. Transportation—transformation in space—is necessary to bring commodities from where they are produced to where they are consumed.

Just as the locations of commodity production and consumption typically do not align, the timing of commodity production and consumption is often disjoint as well. This is most readily seen for agricultural commodities, which are often produced periodically (with a crop being harvested once a year for some commodities) but which are consumed continuously throughout the year. But temporal mismatches in production and consumption are not limited to seasonally produced agricultural products. Many commodities are produced at a relatively constant rate through time, but are subject to random fluctuations in demand due to a variety of factors. For instance, wells produce natural gas at a relatively steady rate over time, but there can be extreme fluctuations in the demand to consume gas due to random changes in the weather, with demand spiking during cold snaps and falling when winter weather turns unseasonably warm. Commodity demand can also fluctuate due to macroeconomic events, such as a financial crisis that causes economic activity to slow. Supply can also experience random changes, due to, for instance, a strike at a copper mine, or a hurricane that disrupts oil and gas production in the Gulf of Mexico.

These mismatches in the timing of production and consumption create a need to engage in temporal transformations, namely, the storage of commodities. Inventories can be accumulated when supply is unusually high or demand is unusually low, and can be drawn down upon when supply is unusually low or demand is unusually high. Storage is a way

of smoothing out the effects of these shocks on prices, consumption, and production. Furthermore, the other transformations (in space and form) require time to complete. Thus, commodity trading inevitably involves a financing element.

Moreover, commodities often must undergo transformations in form to be suitable for final consumption, or for use as an input in a process further down the value chain. Soybeans must be crushed to produce oil and meal that can be consumed, or serves as the input for yet additional transformations, as when the meal is fed to livestock or the oil is used as an ingredient in a snack. Crude oil must be refined into gasoline, diesel, and other products that can be used as fuels. Though often overlooked, blending and mixing are important transformations in form. Consumers of a commodity (e.g., a copper smelter that uses copper concentrates as an input) frequently desire that it possess a particular combination of characteristics that may require the mixing or blending of different streams or lots of the commodity.

Most commodities undergo multiple transformations of all three types between the farm, plantation, mine or well, and the final consumer. Commodity trading firms are vital agents in this transformation process.

B. VALUE CREATION IN COMMODITY TRADING

Commodity trading is, in essence, the process of transforming commodities in space, time, and form. Firms that engage in commodities trading attempt to identify the most valuable transformations, undertake the transactions necessary to make these transformations, and engage in the physical and operational actions necessary to carry them out. The creation of value in commodities trading involves optimizing these transformations.

This is an inherently dynamic process because the values of the myriad possible transformations vary over time due to shocks to supply and demand. For instance, a good harvest of a commodity in one region will typically make it optimal to store additional quantities of that commodity, and to transport the additional output to consumption locations.

Developments in oil markets in North America illustrate how dynamic transformation opportunities can be. Prior to the dramatic increases in oil production in places like the Bakken, the Permian Basin, and the Eagle Ford, the Midcontinent of the United States was a deficit production region where the marginal barrel was imported to the Gulf Coast and transported to the Midcontinent via pipeline to supply refineries in the region. The unprecedented rise in oil output turned this situation on its head. Soon the Midcontinent became an area of supply surplus. This necessitated an increase in storage in the region, and a reversal of transportation patterns. There have also been knock-on effects, including the virtual elimination of light sweet crude imports into the United States and the redirection of Nigerian crude (for instance) to other markets. That is, a supply shock led to a complete change in the optimal pattern of transformation not just in the US, but around the world.

The process of making transformations is constrained by technology and available infrastructure. For instance, transportation technology and resources—ocean freight, rail, barge, truck, pipelines—determine the set of possible spatial transformations. Similarly, storage capacity determines the feasible intertemporal transformations.

Constraints on transformation possibilities can vary in severity over time. Severe constraints represent "bottlenecks". One important function of commodity traders is to identify these bottlenecks, and to find ways to circumvent them. This can be achieved by finding alternative ways to make the transformation, and/or investing in additional infrastructure that alleviates the constraints. Developments in the North American oil market also illustrate these processes. The lack of pipelines capable of transporting oil from the Midcontinent and other regions in which production had spiked to refineries on the Gulf was a bottleneck that severely constrained the ability to move oil from where it was abundant to where it was scarce. In the short run, traders identified and utilized alternative means of transportation, including truck, barge and rail. Over a slightly longer time frame some existing pipelines were reversed and new pipelines were built. Within a period of roughly two years, the bottleneck had largely been eliminated.

Sometimes bottlenecks are not physical, but are instead the consequence of regulatory or legal restrictions. At present, the primary bottleneck that is impeding the movement of newly abundant North American crude to markets where it is scarcer is the US law that largely prohibits the export of crude oil. Even there, traders are finding ways to alleviate the constraint. For instance, market participants are investing in "splitters" ("mini-refineries") that transform crude oil that cannot be exported, into refined products that can be sold abroad.

in form...

...through processing

Commodity traders aim to optimize transformations

They overcome bottlenecks...

Commodities undergo transformations...

in space...

through logistics and transportation...

in time...

through storage...

and incur transportation, storage, and processing costs...

...to realize physical arbitrage

They trade face-to-face with buyers and sellers

They invest in information systems...

...and in human and physical resources

The primary role of commodity trading firms is to identify and optimize those transformations. An important determinant of the optimization process is the cost of making the transformations. These costs include transportation costs (for making spatial transformations), storage costs (including the cost of financing inventory), and processing/refining costs. These costs depend, in part, on constraints/bottlenecks in the transformation processes. All else equal, the tighter the constraints affecting a particular transformation process, the more expensive that transformation is.

Commodity traders characterize their role as finding and exploiting "arbitrages". An arbitrage is said to exist when the value of a transformation, as indicated by the difference between the prices of the transformed and untransformed commodity, exceeds the cost of making the transformation.¹

Consider a spatial transformation in grain. A firm can buy corn in Iowa for \$5.00/bushel (bu) and finds a buyer in Taiwan willing to pay \$6.25/bu. Making this transaction requires a trader to pay for elevations to load the corn on a barge, and from a barge to an oceangoing ship; to pay barge and ocean freight; to finance the cargo during its time in transit; and to insure the cargo against loss. The trader determines that these costs total \$1.15/bu, leaving a margin of \$0.10/bu. If this is sufficient to compensate for the risks and administrative costs incidental to the trade, the trader will make it.

This description of a typical commodity trade illustrates that the commodity traders are primarily concerned with price differentials, rather than the absolute level of commodity prices. Traders buy and sell physical commodities. The profitability of these activities depends on the difference between the prices of the transformed and untransformed commodities, rather than their level. As will be discussed in more detail subsequently, price levels affect the profitability of commodity trading primarily through their effect on the cost of financing transactions, and their association with the volume of transactions that are undertaken.

Although commodity trading firms use centralized auction markets (e.g., futures markets) primarily to manage price risks, their core activities of buying, selling, and transforming physical commodities takes place in what economists call bilateral "search" markets. Commodity trading firms search to identify potential sellers and potential buyers, and engage in bilateral face-to-face transactions with them.

This reflects the facts that auction trading on central markets is an efficient way to transact highly standardized instruments in large quantity, but is not well-adapted to trading things as diverse as physical commodities. Even a particular commodity—say corn, or crude oil—is extraordinarily diverse, in terms of location (of both producers and consumers) and physical characteristics. Moreover, consumers and producers often have highly idiosyncratic preferences. For instance, oil refineries are optimized to process particular types of crude oil, and different refineries are optimized differently. The trade of diverse physical commodities requires matching numerous producers and consumers with heterogeneous preferences. Centralized markets are not suited to this matching process. Instead, since time immemorial, traders have searched both sides of the market to find sellers and buyers, and matched them by buying from the former and selling to the latter in bilateral transactions, and added value by engaging in transformations.

To operate in these markets, commodity trading firms specialize in (1) the production and analysis of information buyers and sellers active in the market, supply and demand patterns, price structures (over space, time, and form), and transformation technologies, and (2) the utilization of this information to optimize transformations. In essence, commodity traders are the visible manifestation of the invisible hand, directing resources to their highest value uses in response to price signals. Given the complexity of the possible transformations, and the ever-changing conditions that affect the efficient set of transformations, this is an inherently dynamic, complex, and highly information-intensive task.

Trading firms also invest in the physical and human capital necessary to transform commodities. Commodity trading therefore involves the combination of the complementary activities of information gathering and analysis and the operational capabilities necessary to respond efficiently to this information by transforming commodities to maximize their value.

¹ This use of the term "arbitrage" is contrary to the strict academic usage in finance, i.e., a transaction that earns a positive profit with positive probability, but entails no risk of loss. Virtually all of the commodity trades referred to as "arbitrages" involve some risk of loss. The use of the term is therefore aspirational. It indicates that traders are attempting to identify and implement very low risk trades, and in particular, trades that are not at risk to changes in the general level of a commodity's price.

Value creation opportunities in commodity trading depend on the economic environment. Volatile economic conditions increase value creation opportunities. Supply and demand shocks can cause geographic imbalances that create spatial arbitrage opportunities for traders. Greater volatility also makes storage more valuable, thereby creating intertemporal arbitrage opportunities. Greater economic volatility is also associated with greater volatility in relative prices, and in particular in temporary mispricings that create trading opportunities.

Moreover, major secular economic shifts can create imbalances that drive trade and increase arbitrage opportunities. The dramatic growth of China in the past 20 years, and particularly in the last decade, is an example of this.

These factors explain why the profitability of commodity trading has tended to be greatest during periods of economic volatility, such as the Iranian Revolution, the Gulf War, and the collapse of the Soviet Union, and during periods of rapid growth concentrated in a particular country or region.

In summary, commodity trading firms are in the business of making transformations. In doing so, they respond to price signals to move commodities to their highest value uses. This improves the efficiency of resource allocation. Indeed, as Adam Smith noted centuries ago, making these transformations more efficiently can be a matter of life and death.²

C. COMMODITY TRADING FIRMS

A large and diverse set of firms engages in commodity trading.³ Indeed, the diversity is so extensive, and occurs along so many dimensions, that it is difficult to make generalizations.

Some commodity trading firms are stand-alone entities that specialize in that activity. For instance, well-known trading firms such as Trafigura and Vitol are independent and engage almost exclusively in commodity transformation activities.

Other commodity traders are subsidiaries or affiliates of other kinds of firms.

For instance, many banks have (or had) commodity trading operations. Prominent examples include J. Aron (part of Goldman Sachs since 1981), Phibro (once part of Citigroup and before that Salomon Brothers, though it is now not affiliated with a bank), and the commodity trading divisions of Morgan Stanley, J. P. Morgan Chase, and Barclays (to name some of the most prominent).

Other commodity trading entities are affiliated with larger industrial enterprises. Most notably, many "supermajor" oil companies (such as Shell, BP, and Total) have large energy trading operations (though some, notably Exxon, do not). Pipeline and storage operators ("midstream" firms such as Kinder Morgan and ETP in the United States) in energy often engage in trading as well.

Commodity trading firms also differ by the breadth of the commodities they trade. Some are relatively specialized, trading one or a few commodities. Others trade a broader set of commodities but within a particular sector. For instance, the traditional "ABCD" firms—ADM, Bunge, Cargill, and Louis Dreyfus—concentrate in agricultural commodities, with lesser or no involvement in the other major commodity segments (although Cargill does have a sizable energy trading operation). As another example, some of the largest trading firms such as Vitol, and Mercuria, and the energy trading-affiliates of the oil supermajors, focus on energy commodities, with smaller or no presence in other commodity segments. One major trading firm, Glencore, participates in all major commodity segments, but has a stronger presence in non-ferrous metals, coal, and oil. Another, Trafigura, is a major energy and non-ferrous metals trader.

Firms with a presence in a particular sector (e.g., agriculture) also vary in the diversity of commodities they trade. For instance, whereas Olam participates in 18 distinct agricultural segments, Bunge focuses on two and other major firms are active in between three and seven different segments.

They are more profitable during periods of upheaval

Commodity trading firms vary by scope and scale...

² Adam Smith, *The Wealth of Nations* (1776). In Chapter V of Book IV, titled "Digression Concerning the Corn Trade and Corn Laws," Smith describes how by engaging in transformations in space and transformations in time grain traders ("corn dealers") were invaluable in preventing local shortages from causing famines. He further noted that even though traders perform their most valuable service precisely when supplies are short and prices high, this is also when they are subject to the heaviest criticism.

³ I will use the term "commodity trading" to mean the process of purchasing, selling, and transforming physical commodities.

*they may own assets
upstream, midstream
or downstream...*

*...they can be
privately owned
or publicly listed*

Furthermore, firms in a particular segment differ in their involvement along the marketing chain. Some firms participate upstream (e.g., mineral production or land/farm ownership), midstream (e.g., transportation and storage), and downstream (e.g., processing into final products or even retailing). Others concentrate on a subset of links in the marketing chain. (This is discussed in more detail in Section V.)

Commodity trading firms also vary substantially in size. There are large numbers of small firms that tend to trade a single commodity and have revenues in the millions of dollars. At the other end of the spectrum, the largest traders participate in many markets and have revenues well over \$100 billion.

Firms that engage in commodity trading also exhibit diverse organizational forms. Some, including many of the most prominent (Cargill, Louis Dreyfus, Koch Industries) are privately owned. Some of these non-public traders are funded by private equity investors: TrailStone (Riverstone Holdings) and Freepoint Commodities (Stone Point Capital) are well-known examples. Others (e.g., ADM and Bunge) are publicly traded corporations. Some are affiliates or subsidiaries of publicly traded firms. Yet others are organized as master limited partnerships with interests traded on stock exchanges: Kinder Morgan, ETP, and Plains All American are examples of this.



II. THE RISKS OF COMMODITY TRADING

SUMMARY

CTFs face several overlapping categories of risk.

They have little exposure to commodity prices (**flat price risk**). They normally hedge physical commodity transactions with derivatives.

Hedging exchanges flat price risk for basis risk. The basis is the differential between the price of a physical commodity and its hedging instrument. **Basis risk** is the risk of a change in this differential.

CTFs accept and manage basis risk in financial markets. They may also take on **spread risk**, which arises out of timing mismatches between a commodity and a hedging instrument.

Margin and volume risk. CTFs have limited exposure to commodity price risk. Their profit is largely based on volumes traded and the margin between purchase and sale prices. Margins and volumes are positively correlated.

CTFs have various kinds of **liquidity risk**:

- Hedging liquidity. CTFs use futures exchanges to hedge commodities. Loss-making hedges incur costs daily before offsetting profits on physical commodities are realized.
- Market liquidity. In some commodities markets it may be difficult to realize value from a trading position at short notice.
- Funding liquidity. With high commodity prices, CTFs need substantial capital to trade effectively.

CTFs are exposed to a wide range of **operational risks**. They manage these through a combination of approaches, including insurance, IT, and health and safety audits.

Other risks include **political risk, legal/reputational risk, contract performance risk, and currency risk**.

CTFs can reduce risk:

- Through **diversification**. There is little correlation between basis risks in different commodity markets. A CTF can reduce its overall exposure by trading in multiple commodity markets. Most large CTFs are widely diversified and are therefore less susceptible to market shocks.
- Through **integration**. Owning assets across the value chain provides opportunities to self-hedge. When there is a market shock, cushioning effects generally occur elsewhere along the value chain.

A. RISK CATEGORIES

Commodity trading involves myriad risks. What follows is a relatively high level overview of these risks. Note that some risks could fall into more than one category. As will be seen, a crucial function of commodity traders is to manage these risks. This risk management essentially involves transferring risks that commodity traders do not have a comparative advantage in bearing to entities that do: this allows them to generate value by concentrating on their core transformation activities.

Flat price risk. Traditional commodity trading involves little exposure to “flat price” risk.¹ In the traditional commodity trading model, a firm purchases (or sells) a commodity to be transformed (e.g., transported or stored), and hedges the resulting commodity position via a derivatives transaction (e.g., the sale of futures contracts to hedge inventory in transit) until the physical position is unwound by the sale (or purchase) of the original position. The hedge

transforms the exposure to the commodity’s flat price into an exposure to the basis between the price of the commodity and the price of the hedging instrument. (I discuss basis risk in more detail below).

Of course, hedging is a discretionary activity, and a firm may choose not to hedge, or hedge incompletely, in order to profit from an anticipated move in the flat price, or because the cost of hedging is prohibitively high. Moreover, particularly as some commodity firms have moved upstream into mining, or into commodities with less developed derivatives markets (e.g., iron ore or coal), they typically must accept higher exposure to flat price risks.

Commodity prices can be very volatile, and indeed, can be subject to bouts of extreme volatility. Therefore, firms with flat price exposure can suffer large losses. This does not mean that flat price exposure is a necessary condition for a firm to suffer large losses: as an example, trading firm Cook Industries was forced to downsize dramatically as a result of large losses incurred on soybean calendar spreads in 1977. Indeed, many (and arguably most) of the instances in which commodity trading firms went into distress were the not the result of flat price risk exposures, but basis or other spread risks: a spread or basis position that is big enough relative to a firm’s capital can create a material risk of financial distress.

Basis Risk. Hedging involves the exchange of flat price risk for basis risk, i.e., the risk of changes in the difference of the price between the commodity being hedged and the hedging instrument. Such price differences exist because the characteristics of the hedging instrument are seldom identical to the characteristics of the physical commodity being hedged. For instance, a firm may hedge a cargo of heavy Middle Eastern crude with a Brent futures contract. Although the prices of these tend to move broadly together, changes in the demand for refined products or outages at refineries or changes in tanker rates or myriad other factors can cause changes in the differential between the two.

Liquidity considerations lead firms to accept basis risk. In theory, it is possible to find a counterparty who would be willing, at some price, to enter into a contract that more closely matches the exposure a firm wants to hedge. However, it can be time consuming and expensive to find such a counterparty: the firm has to accept flat price risk until a counterparty has been found. Moreover, it can be time consuming and expensive to exit such a contract once the hedge is no longer needed (as when a firm hedging a cargo of crude oil finds a buyer for it), in part because the time and expense of finding a new counterparty gives the original counterparty considerable bargaining power. By trading in standardized liquid derivatives contracts (e.g., Brent oil futures, CBOT corn futures), a hedger must accept basis risk (because the standardized contract almost never matches the characteristics of the exposure being hedged), but can enter and exit a position rapidly and at low cost because there are many other traders (other hedgers, speculators, market makers) continuously present in a heavily traded, liquid market. The speed, flexibility, and liquidity of trading in a market for a heavily traded standardized instrument reduce the transactions costs and execution risks of hedging, and for most hedgers the savings in transactions costs and execution risks more than offset the costs associated with basis risk.

Indeed, there is a positive feedback mechanism that creates a virtuous cycle that leads to the dominance of a small number—often just one—of standardized hedging instruments for a commodity, and induces market participants to trade these standardized contracts rather than customized contracts with less basis risk but higher transactions costs. The more firms that trade a particular standardized contract, the cheaper it is to trade that contract. Thus, more trading activity in a standardized contract reduces transactions costs, which attracts more trading activity to that contract. This commonly results in trading activity “tipping” to one contract (or at most two) for a given commodity. For instance, there is only one heavily traded corn futures contract. Oil is exceptional in that two liquid contracts exist side-by-side. Thus, basis risk is ubiquitous because firms prefer to accept such risk in order to achieve the transactions cost savings of trading in liquid markets for standardized instruments.

Although the basis tends to be less variable than the flat price (which is why firms hedge in the first place), the basis can be volatile and subject to large movements, thereby potentially imposing large losses on hedging firms. And as noted above, it is possible to take a position in the basis (or spreads generally) that is sufficiently risky relative to a firm’s capital that an adverse basis (spread) change can threaten the firm with financial distress.

Basis risks generally arise from changes in the economics of transformation during the life of a hedge. Changes in transportation, storage, and processing costs affect relative prices across locations, time, and form. Sometimes these basis changes can be extreme when

...to exchange flat price risk for basis risk

The basis is less volatile than the flat price, but there is still a risk of large losses

Trading firms hedge physical commodities with derivatives...

¹ The “flat price” is the absolute price level of the commodity. For instance, when oil is selling for \$100/barrel, \$100 is the flat price. Flat price is to be distinguished between various price differences (relative prices), such as a “time spread” (e.g., the difference between the price of Brent for delivery in July and the price of Brent for delivery the following December), or a “quality spread” (e.g., the difference between the price of a light and a heavy crude).

Basis risks arise when the economics of transformation change...

...or when traders corner or squeeze a commodity in derivatives markets

Margins and volumes tend to rise and fall together

there are large shocks to the economics of transformation: for example, the explosion of a natural gas pipeline that dramatically reduced transportation capacity into California in late-2000 caused a massive change in the basis between the price of gas at the California border and at the Henry Hub in Louisiana (the delivery point for the most liquid hedging instrument). As another example, in the past three to four years, the basis between West Texas Intermediate crude oil and internationally traded crude oils has become larger, and substantially more variable, due to the dramatic increase in US oil production and to infrastructure constraints.

Basis risk can also vary by commodity. The basis for refined industrial metals tends to be less volatile than the basis for metal concentrates hedged using futures contracts on refined metals.

Local, idiosyncratic demand and supply shocks are ubiquitous in commodity markets. A drought in one region, or an unexpected refinery outage, or a strike at a port affect supply and/or demand, and cause changes in price relationships—changes in the basis—that should induce changes in transformation patterns; commodity trading firms play an essential role in identifying and responding to these shocks.

Basis risks can also arise from the opportunistic behavior of market participants. In particular, the exercise of market power in a derivatives market—a corner or a squeeze—tends to cause distortions in the basis that can inflict harm on hedgers.² For instance, it was reported that Glencore lost approximately \$300 million in the cotton market in May–July, 2011 due to extreme movements in the basis that were likely caused by a corner of the ICE cotton futures contract.³ Basis and calendar spread movements are consistent with another squeeze occurring in cotton in July, 2012. Squeezes and corners have occurred with some regularity in virtually all commodity markets. In the last three years alone, there have been reports (credibly supported by the data) of squeezes/corners in cocoa, coffee, copper, and oil.

Spread risk. From time to time commodity trading firms engage in other kinds of “spread” transactions that expose them to risk of loss. A common trade is a calendar (or time) spread trade in which the same commodity is bought and sold simultaneously, for different delivery dates. Many commodity hedges involve a mismatch in timing that gives rise to spread risk. For instance, a firm may hedge inventory of corn in October using a futures contract that expires in December.

Calendar spreads are volatile, and move in response to changes in fundamental market conditions.⁴ The volatility of spreads also depends on fundamental conditions. For instance, time spreads tend to be more volatile when inventories are low than when they are high. Spreads can also change due to manipulative trading of the type that distorts the basis.

Margin and Volume Risk. The profitability of traditional commodity merchandising depends primarily on margins between purchase and sale prices, and the volume of transactions. These variables tend to be positively correlated: margins tend to be high when volumes are high, because both are increasing in the (derived) demand for the transformation services that commodity merchants provide.

The demand for merchandising is derived from the demand and supply of the underlying commodity. For instance, the derived demand for commodity transportation and logistics services provided by trading firms depends on the demand for the commodity in importing regions and the supply of the commodity in exporting regions.

This derived demand changes in response to changes in the demand and the supply for the commodity. A decline in demand for the commodity in the importing region will reduce the derived demand for logistical services. The magnitude of the derived demand decline depends on the elasticity of supply in the exporting region. The less elastic the supply, the less the

² *The subject of cornering (a form of manipulative conduct) is obviously hugely sensitive and controversial, but it is has been a matter of contention since modern commodity trading began in the mid-19th century. Rigorous economic analysis can be used to distinguish unusual price movements and price relationships resulting from unusual fundamental conditions, and those caused by the exercise of market power. Craig Pirrong, Detecting Manipulation in Futures Markets: The Ferruzzi Soybean Episode, 6 American Law and Economics Review (2004) 72. Stephen Craig Pirrong, Manipulation of the Commodity Futures Market Delivery Process, 66 Journal of Business (1993) 335. Stephen Craig Pirrong, The Economics, Law, and Public Policy of Market Power Manipulation (1996). Craig Pirrong, Energy Market Manipulation: Definition, Diagnosis, and Deterrence, 31 Energy Law Journal (2010) 1. Using the rigorous theoretical and empirical methods set out in these publications it is possible to identify several recent episodes in which it was extremely highly likely that prices and basis relationships were distorted by the exercise of market power. It is important to emphasize that these methods can be used—and have been—to reject allegations of manipulation.*

³ *Jack Farhy, Cotton trading costs Glencore \$330m, Financial Times, 7 February, 2012.*

⁴ *For instance, an unexpected increase in demand or decrease in supply tends to lead to a rise in prices for delivery near in the future, relative to the rise in prices for later delivery dates.*

underlying demand shock reduces the derived demand for logistical services. This occurs because the bulk of the impact of the demand decline is borne by the price in the exporting region rather than the quantity traded, leaving the margin between purchase and sales prices and the quantity of the commodity shipped only slightly affected.

This means that variations in the quantity of commodity shipments, as opposed to variations in commodity flat prices, are better measures of the riskiness of traditional commodity merchandising operations. (Similar analyses apply to the effects of supply shocks, or shocks to different kinds of transformation such as storage or processing.)

The amount of financial risk incurred by a commodity trading firm due to variations in margins and volumes depends on the kinds of transformations it undertakes, and the assets it utilizes in those transformations. Transformations involving large investments in fixed assets (notably many processing and refining activities) entail high fixed costs and operational leverage. The financial performance of a firm with higher operational leverage will vary more due to fluctuations in margins.

It should be noted further that many commodity firms benefit from self-hedges. For instance, a decline in the demand for a commodity (e.g., the decline in the demand for oil and copper during the 2008–2009 financial crisis) reduces the demand for logistical services provided by commodity trading firms, but simultaneously increases the demand for storage services. A firm that supplies logistical services and operates storage facilities therefore benefits from an internal hedge between its storage and logistics businesses; the decline in demand in one is offset by a rise in demand in the other.

These considerations highlight the danger of confusing the riskiness of commodity prices with the riskiness of commodity trading, i.e., the provision of commodity transformation services. Although changes to underlying supply and demand for commodities affect demand for transformation services, the latter tend to be less volatile (especially when underlying demand and supply are highly inelastic), and because there are frequently negative correlations (and hence self-hedges) between the demands for different types of transformations.

Operational Risk. Commodity firms are subject to a variety of risks that are best characterized as “operational”, in the sense that they result from the failure of some operational process, rather than from variations in prices or quantities. The list of potential operational risks is large, but a few examples should suffice to illustrate. A firm that transports a commodity by sea is at risk to a breakdown of a ship or a storm that delays completion of a shipment, which often results in financial penalties.

A particularly serious operational risk is rogue trader risk, in which a trader enters into positions in excess of risk limits, without the knowledge or approval of his firm. The firm can suffer large losses if prices move against these positions. A rogue trader caused the demise of one commodity trading company, Andre & Cie. The copper trading operation of Sumitomo suffered a loss in excess of \$2 billion due to rogue trading that lasted nearly a decade.

Contract Performance Risk. A firm that enters into contracts to purchase or sell a commodity is at risk to the failure of its counterparty to perform. For instance, a firm that has entered into contracts to buy a commodity from suppliers and contracts to sell the commodity to consumers can suffer losses when the sellers default. In particular, sellers have an incentive to default when prices rise subsequent to their contracting for a sales price, leaving the commodity trading firm to obtain the supplies necessary to meet its contractual commitments at the now higher price, even though they are obligated to deliver at the (lower) previously contracted price.

This is a chronic problem in the cotton market, and this problem became particularly acute beginning in late-2010. Initially, many cotton producers reneged on contracts to sell cotton when prices rose dramatically. Subsequently, cotton consumers reneged on contracts when prices fell substantially. As a result, several commodity trading firms suffered large losses in cotton that had materially adverse effects on their overall financial performance. Contract performance has also been an issue in sales of iron ore and coal to Chinese and Indian buyers: this has tended to result in traders dealing with such buyers only on a spot basis.

Market Liquidity Risk. Commodity trading (including specifically hedging) frequently requires firms to enter and exit positions quickly. Trading risks are lower, to the extent that it is possible to enter and exit without having a large, adverse impact on prices. That is, trading is less risky, and cheaper, in liquid markets.

Commodity trading firms are exposed to volumes not prices

Vertically integrated trading firms may benefit from self-hedges

There are liquidity risks for funding, in markets, and when hedging

Liquidity can vary across commodities; e.g., oil derivative markets are substantially more liquid than coal or power derivatives markets. Moreover, liquidity can vary randomly—and substantially—over time. Liquidity can decline precipitously, particularly during stressed market periods. Since market stresses can also necessitate firms to change positions (e.g., to sell off inventory and liquidate the associated hedges), firms can suffer large losses in attempting to implement these changes when markets are illiquid and hence their purchases tend to drive prices up and their sales tend to drive prices down.

As frequent traders, commodity trading firms are highly sensitive to variations in market liquidity. Declines in liquidity are particularly costly to trading firms. Moreover, firms that engage in dynamic trading strategies (such as strategies to hedge financial or real options positions) are especially vulnerable to declines in market liquidity. Furthermore, to the extent that declines in liquidity are associated with (or caused by) market developments that can threaten commodity traders with financial distress, as can occur during financial crises, for instance, liquidity is a form of “wrong way” risk: under these conditions, firms may have to adjust trading positions substantially precisely when the costs of doing so are high.

Funding Liquidity Risk. Traditional commodity merchandising is highly dependent on access to financing. Many transformations (e.g., shipping a cargo of oil on a very large cruise carrier are heavily leveraged (often 100%) against the security of the value of the commodity. A commodity trading firm deprived of the ability to finance the acquisition of commodities to transport, store, or process cannot continue to operate.

Risk management activities can also require access to funding liquidity. A firm that hedges a cargo of oil it has purchased by selling oil futures experiences fluctuating needs for (and availability) of cash due to the margining process in futures. If prices rise, the cargo rises in value but that additional value is not immediately realized in cash.⁵ The short futures position suffers a loss as a result of that price increase, and the firm must immediately cover that loss of value by making a variation margin payment. Thus, even if the mark-to-market values of the hedge and the cargo move together in lockstep, the cash flows on the positions are mismatched. Maintaining the hedge requires the firm to have access to funding to bridge this gap.

Firms can suffer funding liquidity problems due to idiosyncratic factors or market-wide developments. As an example of the first, a firm that suffers an adverse shock to its balance sheet (due to a speculative loss, for instance) may lose access to funding due to fears that it may be insolvent. As an example of the second, a shock to the balance sheets of traditional sources of funding (e.g., a financial crisis that impairs the ability of banks to extend credit) can reduce the financing available to commodity firms.

Funding liquidity is often correlated with market liquidity, and these types of liquidity can interact. Stressed conditions in financial markets typically result in declines of both market liquidity and funding liquidity. Relatedly, stresses in funding markets are often associated with large price movements that lead to greater variation margin payments that increase financing needs. Moreover, declines in market liquidity make it more costly for firms to exit positions, leading them to hold positions longer; this increases funding needs, or requires the termination of other positions (perhaps in more liquid markets) to reduce funding demands.

Currency Risk. Most commodity trading takes place in US dollars, but traders buy and/or sell some commodities in local currency. This exposes them to exchange rate fluctuations.

Political Risk. Commodities are produced, and to some degree consumed, in countries with political and legal systems characterized by a weak rule of law. Commodity trading firms that operate in these jurisdictions are exposed to various risks not present in OECD countries. These include, *inter alia*, the risk of expropriation of assets; the risk of arbitrary changes in contract terms at which the firms have agreed to purchase or sell commodities; and outright bans on exports.

Such risks exist in OECD economies as well, though to a lesser degree. For instance, OECD countries sometimes intervene in commodity markets in attempts to influence prices. Thus, there is a continuum of political risks, and although some countries pose very high levels of such risk, it is not absent in any jurisdiction.

⁵ Inventories financed with traditional transactional bank credit are typically marked to market on a weekly basis. If the price rises over a week, the funding bank increases the amount loaned, whereas if the price falls, the inventory owner/borrower pays down some of the loan.

Legal/Reputational Risk. Various aspects of commodity trading give rise to legal and reputational risks for commodity trading firms. Many commodities are potential environmental hazards, and firms are subject to legal sanctions (including criminal ones) if their mishandling of a commodity leads to environmental damage. These risks can be very large, particularly in oil transportation. Note the 200 million euro fine imposed on Total arising from the *Erika* incident, or Exxon's massive liability in the *Exxon Valdez* spill; although these are not commodity trading firms, firms that engage in oil transportation are exposed to such risks. One commodity trading firm, Trafigura, paid a large monetary settlement and suffered substantial reputational damage when “slops” produced when cleaning a tanker that it had chartered, the *Probo Koala*, were disposed of improperly by an independent contractor, causing some people exposed to the slops to fall ill.

Furthermore, commodity trading firms frequently operate in countries in which corruption is rife, making the firms vulnerable to running afoul of anti-corruption laws in the United States, Europe, and elsewhere.⁶ Moreover, commodities are sometimes the subject of trade sanctions. Since these sanctions create price disparities of the type that commodity firms routinely profit from they create an enticement for trading firms to attempt to evade the sanctions. As a final example, commodity trading firms may have opportunities to exercise market power in commodity markets; indeed, their expertise regarding the economic frictions in transformation processes that make such kinds of activities profitable and their size make them almost uniquely positioned to do so. The exercise of market power in this way is sometimes referred to as manipulation, or cornering: such actions cause prices to diverge from their fundamental values and leads to distortions in commodity flows.

There are recent examples in which commodity traders have been accused of each of the foregoing legal transgressions. This has exposed these firms to legal sanctions and reputational damage. These risks can be substantial. For instance in late-June, 2012 a class action was filed in the United States accusing one major commodity merchant, Louis Dreyfus (and its Allenberg subsidiary), with cornering cotton futures contracts in May and June 2011.⁷ Although the accused firm has vigorously denied the allegation, the potential exposure is large (in the hundreds of million dollars) and is therefore a material risk that illustrates the potential for contingent liabilities arising from manipulation claims.

Given the current environment in which manipulation generally, and commodity manipulation specifically, is the subject of considerable political and regulatory attention, this is a real risk attendant to commodity trading, and likely a growing one.⁸ Note specifically recent allegations of manipulation involving LME metal warehousing and Brent crude oil.⁹ Even though manipulation is difficult to prove in legal proceedings, allegations are increasingly common, costly for the accused to defend, and can result in serious reputational damage even if the allegations are not proven in court.

B. RISK MANAGEMENT

Commodity trading firms universally emphasize their expertise in risk management, and the importance that they place on managing risks (price risks in particular). They utilize a variety of tools to achieve risk control objectives. Most notable among these are hedging using derivatives (e.g., selling crude oil futures or a crude oil swap to hedge a cargo of crude oil) and diversification across commodities and integration of different links in the value chain.

As noted above, hedging transforms the nature of a firm's risk exposure from flat price risk to basis risk. These basis risks can be material, also as noted above.

Diversification across commodities makes firm financial performance less dependent on idiosyncratic events in any particular commodity. Given the nature of commodities, particular markets or submarkets are prone to large shocks that can seriously impair the profitability of operating in those markets. Diversification is a way of reducing the overall riskiness of a commodity trading firm. This is particularly important for privately-held firms that have limited ability to pass idiosyncratic risks onto diversified shareholders.

⁶ For instance, ADM recently agreed to pay a fine of \$54 million to settle charges that it bribed Ukrainian government officials. Gregory Meyer, ADM to pay \$54 million to settle bribery charges, *Financial Times*, 20 December, 2013.

⁷ *In re Term Commodities Cotton Futures Litigation 12-cv-5126 (ALC) (KNF) (SDNY)*. Term Commodities is a subsidiary of Louis Dreyfus. Louis Dreyfus BV and Allenberg Cotton (another Louis Dreyfus subsidiary) are also named defendants.

⁸ There are examples of commodity trading firms paying large sums to settle claims of market manipulation. These include Ferruzzi (in soybeans) and Sumitomo (in copper).

⁹ Morgan Stanley, Phibro, Trafigura and Vitol are also defendants in the Brent lawsuit. Kevin McDonnell et al v. Royal Dutch Shell PLC et al, 1:13-cv-07089-UA (SDNY).

Many commodities pose potential environmental hazards

Legal sanctions and reputational damage can be substantial

Commodity trading firms often operate in territories with a weak rule of law

*Larger firms can
reduce risk by
diversification*

Most large trading firms are widely diversified. Many smaller firms are more specialized, and less diversified. The latter are obviously more vulnerable to adverse developments in a particular market.

To quantify the potential benefits of diversification, I have evaluated data on world trade flows by commodity code. Specifically, I have collected data on world imports and exports of 28 major commodities for the 2001–2011 period from the International Trade Centre UNCTAD/WTO.¹⁰ Using this data, I calculate correlations in annual world imports and exports across these 28 commodities. I calculate two sets of correlations between percentage changes in trade flows across commodities. The first set is based on nominal trade flows, measured in US dollars. The second set is based on deflated trade flows. To calculate deflated traded flows, I divide the nominal trade flow in a given year by the nominal price of the commodity in question, scaled so that the 2001 value is 1.00.¹¹ The deflated trade flow is a measure of the quantity (e.g., barrels of oil or tons of coal) of each commodity traded in a given year.

Correlations of nominal trade flows across commodities are generally positive. The median nominal import and export correlation is close to 50%. However, deflated trade flow percentage changes exhibit much lower correlations. The median correlation for deflated import percentage changes is .065, and the median correlation for deflated export percentage changes is .031. Approximately 40% of the correlations based on the deflated flows are negative.

As noted elsewhere, the derived demand for the services of commodity trading firms, and their profitability, is dependent on the quantities of commodities traded, rather than prices. Therefore, the correlations based on deflated data are more relevant for evaluating the potential benefits to the firms of diversification across commodities. The lack of correlation generally, and the prevalence of negative correlations indicate the potential benefits of diversification across commodities in reducing the variability of trading firm risk.

Diversification can also reduce a trading firm's exposure to basis risk. Dealing in multiple commodities diversifies away basis risk to the extent that basis movements exhibit little correlation across commodities.

Integration in the value chain also tends to reduce risk. As noted earlier, there can be self-hedges in the value chain, as in the case of storage on the one hand and throughput-driven segments on the other. Moreover, shocks at one level of the value chain often have offsetting effects (or at least, cushioning effects) at others. For instance, a supply shock upstream that raises prices of raw materials tends to depress processing margins. Integrating upstream and processing assets can stabilize overall margins, thereby reducing risk. Again, this is particularly useful for privately held firms that cannot readily pass on risks through the equity market, or for firms subject to other financing frictions. Moreover, it is more valuable across segments of the marketing chain where markets are not available to manage price risk at these stages of the chain, or these markets are relatively illiquid (e.g., iron ore, alumina and bauxite, or coal).

Diversification and integration are primarily useful in managing risks idiosyncratic to particular commodities or commodity submarkets, e.g., a drought that affects wheat production and hence prices. They are less effective at mitigating systematic shocks that affect all commodity markets, e.g., a global financial crisis, or a decline in Chinese growth (because China is a major importer of all important commodities).¹²

Although commodity trading firms emphasize their risk management orientation and prowess, they have considerable discretion in their ability to manage—and assume—risks.

Risk measurement is a crucial component of risk management. Most commodity trading firms utilize Value-at-Risk as a risk measurement tool. The limitations of this measure are well known. In particular, commodity trading firms incur model risk (including risks

associated with the estimation of parameter inputs). Such model risks have been implicated in large losses in virtually every market and type of trading firm (e.g., banks, hedge funds), and they must be considered a serious concern for trading firms as well, especially given the fact that these firms have extensive involvement in commodities and markets for which pricing, volatility, and correlation information is particularly scarce (especially in comparison to financial markets).

Given the importance of the subject, I now turn from this more general discussion of risk management to a more detailed analysis that focuses on risk management at Trafigura.

*Integration in the
value chain can
reduce overall risk*

¹⁰ The commodities included are listed in Appendix A. The data was accessed using the ITC's Trade Map system.

¹¹ The nominal price for each commodity is based on data provided in the World Bank Commodity Price Data (Pink Sheet) annual average commodity prices. For commodities (such as oil, coal, or wheat) where there are multiple varieties or grades reported (e.g., Brent and WTI; Australian, Columbian, and South African coal), I utilize the simple average of the 2001=1.00 deflators.

¹² There are some exceptions. As noted previously, some commodity trading activities like storage are profitable when commodity demand is low even though such demand shocks tend to reduce the profitability of other trading company operations.

III. RISK MANAGEMENT BY COMMODITY TRADING FIRMS

SUMMARY

This section examines risk management systems and processes in one company to develop a more granular picture.

Risk management at Trafigura is highly centralized. A Chief Risk Officer has overall responsibility. A Risk Committee and a Derivatives Trading Committee assess risk concentrations and set limits.

Trading desks operate within centrally determined parameters. Outright market price risks are almost always hedged via futures or swaps. Basis risks are managed in financial markets. Hedges are executed through an internal broker and overall risk is consolidated at Group level.

Trafigura has invested \$550 million over the last three years in risk management and measurement systems.

- The company's Value-at-Risk (VaR) model combines 5,000 risk factors to assess net exposure. It uses Monte-Carlo simulations to predict P&L outcomes in multiple scenarios. Its VaR target is 95% confidence that its maximum one-day loss is less than 1% of Group equity.
- Trafigura augments its VaR data with stress tests and analysis that estimate P&L outcomes in extreme scenarios.
- Trafigura's enhanced VaR analysis addresses many, but not all, of VaR's deficiencies. The company therefore supplements this analysis with qualitative assessment.

Trafigura has experienced a low rate of credit losses in its history. A formal process assigns a credit limit for each counterparty. It typically bears less than 20% of trading counterparty credit risk and transfers the remainder to financial institutions.

The company manages liquidity risk by diversifying types of funding and providers of funding.

Trafigura manages freight risk using Forward Freight Agreements and fuel swaps.

It manages operational risks through a combination of liability insurance, best practice procedures, and Group-wide quality controls. It has a comprehensive framework for health, safety, environmental, and community (HSEC) performance.

The company and its subsidiary Galena Asset Management also engage in speculative paper trading. This takes advantage of Trafigura's industry knowledge. Traders deal in calendar and intra-market spreads; they have very little exposure to flat price risk.

A. INTRODUCTION

Trading firms have always been at the forefront of the management of commodity price risk. This fact was recognized by one of the first great scholars of futures markets, Holbrook Working. Working noted that open interest in futures markets (the number of outstanding contracts) varied with the amount of a crop that was in the hands of merchandisers. Open interest was bigger for commodities like wheat that was largely marketed, rather than held by farmers to feed livestock, than it was for corn, which was held by farmers as a feed grain in far larger proportion. Similarly, Working noted that the seasonal patterns in open interest matched crop marketing patterns, with open interest reaching its maximum some time after the harvest, and hence after farmers had sold the crop to merchandisers. From these facts, Working concluded that commodity merchants who transformed wheat, corn, and cotton in space and time were the primary users of futures contracts, and that they used these contracts to hedge their risk.

Commodity trading firms remain major users of futures contracts, and other derivatives contracts, as a centerpiece of their risk management programs. Viewing logistics, storage, and other transformations as their core businesses, they do not have a comparative advantage in bearing flat price risks. As a result, they hedge most price risks using exchange traded ("listed") or over-the-counter derivatives.



Trafigura's risk management is representative of the industry

Risk management is highly centralized

Quantitative data is critical

Qualitative information is also important

Market price risks are always hedged where possible

Although as a general rule commodity trading firms are hedgers, firms have different risk management policies, pursue different risk management strategies, and have different risk management procedures in place. Moreover, although commodity price risk is arguably the largest risk for most trading firms, other risks, notably credit and operational risks, are also material and involve their own company-specific policies, procedures, and strategies. Therefore, it is impractical to characterize in detail risk management by commodity traders generally, and I focus on Trafigura as a representative example of how commodity traders manage risk. A review of the disclosures of some publicly traded commodity trading firms suggests that Trafigura's approach to risk management is broadly representative of major commodity firms generally.

B. THE RISK MANAGEMENT PROCESS

Risk management in Trafigura is highly centralized. The company has a Chief Risk Officer ("CRO") who reports directly to the Chief Operating Officer ("COO") and the Management Board. The CRO is a member of the Risk Committee, which also includes company directors and senior traders. The Committee meets regularly to assess and manage risk exposures, and to adjust strategies in light of prevailing market conditions. The CRO performs functions such as overseeing the refinement of risk models, the review and testing of model performance, and reviewing exposures across businesses. The CRO is independent of the "front office" revenue generating operations of the company.

Trafigura also has a Derivatives Trading Committee that is responsible for implementing the company's risk management policies. It evaluates risk limits and concentrations, and monitors markets to identify emerging risks and opportunities.

This process is highly dependent on the collection, analysis, and distribution of information regarding risks. Some of this information is "hard" data on positions in both physical commodities and derivatives contracts. Other "hard" information includes data on current and historical prices of the commodities that Trafigura trades, and models to analyze this data: I discuss risk measurement and risk modeling in more detail below. Using these data and analytics, the firm produces quantitative measures of overall risk exposure, and the risks of individual trading books. The company establishes limits on these quantitative risk measures, both on a firm-wide basis and for each individual trading team. A team is notified when its measured risk approaches its assigned limit.

Given the number of commodities that Trafigura trades, and the large number of prices (e.g., spot prices of various varieties of oil at various locations, futures prices for different maturities) collecting, storing, distributing, and analyzing this hard information is an extremely computationally and information technology intensive process. Largely as a result of the computational demands of the risk management process, Trafigura has spent \$550 million on information technology hardware and software in the past three years. This is an overhead expense, and from the perspective of the industry overall, expenditures on risk management information technology creates a scale and scope economy that tends to favor consolidation of the industry into a smaller group of large firms, and which makes it more difficult for smaller and more specialized firms to compete. The increasing data and analytical intensity of trading and risk measurement modeling is tending to increase the degree of these scale and scope economies.

Other information is "softer", more qualitative information about market conditions and market dynamics. Trading desks constantly active in the market obtain this information, and provide it to the CRO, the Risk Committee and the Derivatives Trading Committee. The CRO, the Risk Committee, the Derivatives Trading Committee and the Trading Desks collaborate to integrate, interpret, and analyze this information. They then utilize this analysis to assess and manage risks.

C. MANAGING FLAT PRICE RISK AND BASIS RISK

It is standard practice at Trafigura to hedge market price risks where possible. Indeed, hedging is required under the terms of some transactional financing arrangements. In the past (prior to 2007) the bank providing funding for a transaction controlled the hedge through a tripartite agreement (TPA) between it, the brokerage firm, and the client; this arrangement is still utilized for smaller and medium sized-traders. In this arrangement the bank has a security interest in the portfolio of derivatives and the product being hedged (e.g., a cargo of crude oil), and finances the margin calls on the futures.

At present, however, Trafigura (and other larger traders) do not utilize this TPA mechanism, as it is operationally and administratively cumbersome. Instead, although the bank lending against a physical position has a security interest against that inventory, and adjusts the

financing on a weekly basis (or perhaps more frequently under volatile conditions), it has no interest in, or even view of, the futures or swap position used to hedge. Instead, Trafigura and other traders operating in this way endeavor to hedge all the risk via futures or swaps, self-finance the initial margins (mainly out of corporate lines), and also finance any mismatches in variation margin payments: mismatches arise because futures (and some swaps) are marked to market daily, which results in daily variation margin payments, but as just noted normally the bank lending against inventory only marks its value to market on a weekly basis.

In addition to hedging inventories, Trafigura also routinely hedges future physical transactions. For instance, it may enter into an agreement to purchase crude from West Africa for delivery in two months at the Brent price plus/minus a differential, and enter into another contract to sell that cargo to a US refiner at the West Texas Intermediate price plus/minus a differential. This set of transactions exposes the company to fluctuations in the Brent-WTI differential, which it can, and routinely does, hedge by buying Brent futures and selling WTI futures.

This type of transaction receives different accounting treatment than a hedge of a physical inventory. Whereas the derivatives position associated with the physical inventory is accounted for as a hedge, the derivatives used to hedge the forward floating price transactions are put in the trading book. These positions can represent a substantial fraction of Trafigura's total net notional derivatives positions. For instance, as of September 30, 2011, the notional value of derivatives held for trading purposes represented approximately 45% of the total notional amount of Trafigura's derivatives.¹ Although as discussed later some of the derivatives held for trading purposes are fairly characterized as speculative (though mainly involving speculation on price differentials rather than flat prices), most are entered for the purpose of managing price risks.

The hedging process is rather mechanical and centralized. When the price on a physical trade (e.g., the purchase of a physical oil cargo) is fixed, the Deals Desk initiates a hedge. The hedge is executed through a broker by the central execution desk of Trafigura Derivatives Limited (TDL): all hedges are also centrally booked through TDL, which acts as an internal broker for the group. There is thus a separation of the execution of physical trades from the management of the market price risk associated with those trades, and the risk management function is centralized.

Trafigura primarily utilizes futures and swaps to manage its risks. For instance, it typically hedges the purchase of a cargo of crude oil by selling oil futures or an oil swap. Options can be used to manage risk as well, but Trafigura does not use them extensively in its hedging program.²

Due to differences between the characteristics of the commodity being hedged, and the hedging instruments, no hedge is perfect, and Trafigura bears some residual risk. For instance, hedging a cargo of Nigerian crude with Brent crude futures or WTI crude futures involves a mismatch in quality, location, and timing. Since these factors influence price, mismatches cause the prices of the hedge instrument and the commodity being hedged not to move in lockstep. Trafigura is at risk to changes in the difference between the price of the hedged commodity and the hedge instrument. This difference—the basis—is variable, due to this differential movement in prices arising from the mismatches. Thus, a hedger like Trafigura is exposed to basis risk, and hedging involves the substitution of basis risk for flat price risk. Since the prices of hedging instruments and the commodities hedged are correlated, however, basis risk is typically substantially less than flat price risk.

The amount of basis risk differs by commodity. For instance, whereas copper cathodes stored in an LME warehouse can be hedged quite effectively using LME copper futures, copper concentrates can be hedged less effectively. The copper content in the concentrate can be hedged, because many contracts for the sale of concentrates specify that one component of the price will be based on copper content and the LME price: the LME price risk can be hedged. But the other components of the price, notably treatment and refining charges, cannot be hedged, and are a source of basis risk.

Basis risk can also vary over time. For instance, the basis tends to be more volatile when inventories are low. Changes in the severity of constraints can also affect the variability

Future physical transactions are routinely hedged

Hedges are executed centrally through an internal broker

Trafigura mainly uses futures and swaps to manage risk

¹ Base Prospectus, Trafigura Funding S.A. (14 November, 2013) F-31-F-33.

² This illustrates that the firm aims to eliminate flat price exposure, because an option hedge leaves a (one-sided) exposure. For instance, a firm can hedge a cargo of crude against price declines by buying an oil put. This protects the firm against price declines, but allows it to profit from price increases. Thus, an option hedge retains a price exposure, and due to its one-sided nature this hedge is costly: the firm must pay a premium to purchase the put. If the firm's objective is to eliminate price exposure, it can avoid this cost by merely selling futures as a hedge.

It uses its market knowledge to manage basis relationships

Trafigura's overall risk is reduced through diversification

It monitors Value-at-Risk

Its risk analysis examines extreme scenarios

of the basis. For instance, the basis tends to be more variable when transportation capacity is tightly constrained than when it is not. As an extreme example, the basis between WTI at Cushing, Oklahoma and the prices of crude oil at the Gulf of Mexico exhibited relatively little variability when the main flow of oil was from the Gulf to the Midcontinent and there was abundant pipeline transport capacity. When oil went into surplus at Cushing, and there was no pipeline capacity to ship it to the Gulf, the basis became more variable.

Trafigura manages basis risk using its knowledge of the relationships between prices of related but different commodities. Moreover, just as Holbrook Working described in his writing on hedging by commodity traders in the 1950s, the traders use their marketplace knowledge to try to predict future basis movements, and place their hedges to earn a profit from a favorable movements in the basis. Thus, to the extent that Trafigura speculates, most of its speculation is on basis relationships.

The underlying physical transactions and the hedges associated therewith are included in the company's centralized risk measurement system (described below). The basis risk on a trading book's position contributes to the overall risk of the firm. Moreover, the risk measurement system calculates the risk associated with a trading desk's positions, and the trading desk is subject to risk limits: its measured risk cannot exceed the assigned limit. Furthermore, trades are marked to market on a daily basis based on proprietary forward curves produced by the Risk Control Group, and exception reports are generated when a position incurs a change in value in excess of \$50,000. Traders have to explain the reason for the exception to senior management.

Although traders attempt to manage basis risk through judicious design of hedges, this risk cannot be eliminated. However, to the extent that basis movements are uncorrelated across different transactions, this risk can be reduced through diversification. In particular, given that basis movements in different commodities (e.g., oil and copper) are driven by different fundamentals, they are likely to exhibit little correlation, and hence a firm that trades a diversified portfolio of commodities can reduce risk exposure. This provides an advantage to larger firms that participate in a variety of different commodities, engage in a variety of transformations, and trade in many geographic markets.

D. RISK MEASUREMENT

With respect to market price risks, a trading company such as Trafigura can be viewed as a portfolio of positions in a myriad of physical commodities and financial derivatives contracts (including futures contracts and swaps). Given information about the variability of the prices associated with individual positions, and the covariation between these prices, it is possible to compute various measures of the risk of the overall portfolio.

Consistent with standard industry practice for trading generally (not just commodity trading), Trafigura employs Value-at-Risk ("VaR") as its measure of the overall price risk of its portfolio of physical and derivatives trading positions. Value-at-Risk is defined as the amount of money, or more, that can be lost over a given time horizon with a given probability.

Implementation of VaR requires the user to choose a probability level, and a time horizon. Consistent with standard industry practice, Trafigura uses a one-day time horizon, and a 95% probability ("confidence") level. As of 30 September, 2013, Trafigura reported its VaR as \$11.3 million. This means that on 95% of trading days, the company would be expected to suffer losses of less than \$11.3 million. Put differently, on 5% of trading days, the firm could expect to lose more than \$11.3 million.

As noted above, the company has established a VaR target. Specifically, the firm attempts to maintain VaR at less than 1% of group equity. Using equity to set the target reflects the fact that capital represents loss bearing capacity. Thus, the company compares the risk of loss, as measured by VaR, to its risk bearing capacity.

Again consistent with standard industry practice, Trafigura uses a simulation ("Monte Carlo") method to calculate VaR. In particular, it uses a variant on the industry standard historical simulation VaR method. That is, it randomly draws changes in the prices of instruments in its portfolio from historical data. The company's VaR system currently takes into account over 5,000 risk factors. These include the forward prices for the commodities the firm trades, interest rates, foreign exchange rates, and equity prices. Based on these simulated price movements, the profits/losses on each position in the portfolio are calculated and then added to determine the simulated profit/loss on the entire portfolio. It makes many such random draws: there is one portfolio profit per simulation.

The standard approach in the industry is to rank the many simulated profit/loss outcomes, and to set and the 5% VaR equal to the level of loss such that 95% of the simulations have a smaller loss (bigger profit), and 5% of the simulations have a bigger loss: the approach can be applied to other confidence levels.

This is acceptable for calculating VaR, but as will be discussed in more detail below, it is important for trading companies to understand the likelihood of outcomes that are more extreme than the VaR. That is, it is important to understand what happens in the left tail of the probability distribution of possible outcomes. Due to the relative rarity of such extreme outcomes, historical simulations will produce few observations, making it difficult to achieve such an understanding based on historical simulation alone.

Therefore, Trafigura adds another step. It uses the simulated profit-and-loss outcomes to fit "heavy-tailed" probability distributions for portfolio P&L. Heavy-tailed distributions (such as Generalized Hyperbolic Distributions) take into account that extreme outcomes—which are of central importance to determining the risk of a trading operation—occur more frequently than under the Gaussian (Normal) distribution (the standard bell-curve widely used in statistics, and which is the basis of standard derivatives pricing models such as the Black-Scholes equation). Trafigura uses the heavy-tailed distribution fitted to the portfolio profit and loss simulation outcomes to calculate VaR, and to calculate other measures of risk that focus on extreme losses (i.e., losses in excess of VaR): these measures are discussed below.

This historical methodology has decided advantages over alternative methods, most notably "parametric" methods that require the choice of particular probability distributions (like the normal distribution) that may fail to capture salient features of price behavior. If large price moves are more common in the data than the standard probability distributions would imply, the historical method will capture that behavior, especially if the method is augmented by using the simulated outcomes to fit heavy-tailed probability distributions. Moreover, the historical simulation captures dependencies between the changes in different prices (of which there are many: recall that Trafigura's VaR is based on 5,000 different risk factors) that are not well-characterized by standard probability distributions, and which would be daunting to estimate parametrically in any event.³

The company regularly re-calibrates and back-tests its VaR model. Risks that perform poorly in back-tests are subjected to thorough review involving extensive discussions with traders operating that market.

The most problematic feature of historical VaR simulations is that the user is a prisoner of the historical data: current conditions may not be well characterized by past conditions. Moreover, since conditions change over time, not all historical data is equally informative about current risk conditions, and it is a non-trivial problem to determine which data is most representative of current circumstances. This is particularly true inasmuch as Trafigura trades so many markets, and it is likely that current conditions in market A may match time period X well, but conditions in market B may match another period Y better. Trafigura has devoted considerable resources to developing analytic techniques to choose the historical data that is most representative of current conditions, but even the best techniques are imperfect, and what's more, major economic shocks can render current circumstances completely different than anything in the historical record. For example, price movements during the 2007-2008 Financial Crisis were far outside anything experienced in the historical data used by firms to calculate VaR at that time.

In part for this reason, VaR is increasingly being augmented by stress tests that estimate possible losses under extreme scenarios that may not be present in the historical data. Stress tests are useful in identifying vulnerabilities, and stress scenarios can be constructed that match current conditions and current risks. Pursuant to US regulatory requirements, Trafigura does perform stress tests on the funds of its subsidiary, Galena Asset Management. It does not perform stress tests on the entire Trafigura portfolio due to its diversity and complexity, and due to the difficulty of establishing realistic stress scenarios.

Instead, to achieve a better understanding of its downside risk exposure under extreme outcomes, Trafigura and many other companies in commodity and financial trading augment VaR with other methods: in particular, methods that quantify how large might be the losses

³ Parametric methods face two difficult problems. The first is the sheer number of correlations that need to be estimated. For a large portfolio with 5,000 risk factors, it is necessary to estimate almost 12.5 million correlations, or find a way of reducing the dimensionality of the problem, knowing that any such reduction inherently suppresses information. The second is estimating these parameters accurately, especially since they can change dramatically over time.

Historical simulation has advantages over theoretical models...

...but the future may be different from the past

Conditional Value-at-Risk quantifies large losses

The cost of implementing risk measurement gives large trading firms economies of scale

Liquidity risk is not well captured by Value-at-Risk

When multiple firms use similar models it reinforces trends

Quantitative risk modeling has to be supplemented

a firm could incur, if the loss is bigger than its VaR. An increasingly common measure is "Conditional VaR" ("CVaR", also referred to as "excess loss", "expected shortfall", and "tail VaR"). This measure takes the average of losses in excess of VaR. It therefore takes into account all large losses, and presents a more complete measure of downside risks in a trading book. Trafigura estimates CVaR using the heavy-tailed probability distributions fitted to the profits and losses generated by the historical simulations.

Another approach to measuring extreme risks that is employed by Trafigura is Extreme Value Analysis.⁴ This permits the company to estimate the probability of more extreme outcomes with losses substantially greater than VaR.

Although these methods represent a substantial improvement on VaR, they are still dependent on the historical data used to calculate these additional risk measures. Risk relates to the future, but every known measure of risk relies on what happened in the past. As a consequence, any and all risk metrics are themselves a source of risk.⁵

All of these methods are very computationally and data intensive, especially for a large trading firm such as Trafigura that operates in many markets. The cost of implementing a state-of-the-art risk measurement system is another source of scale economies that tend to favor the survival of large firms, and it undermines the economic viability of small-to-medium sized firms.

VaR is by far the most widely employed measure of market price risk, but years of experience and research (much undertaken by academics) have identified various deficiencies in VaR as a risk measure over and above the problem inherent in relying on historical data: some of these deficiencies also plague other measures such as CVaR.

One problem is that the short-time horizon conventionally employed (e.g., the one-day horizon that Trafigura and many others utilize) does not permit the estimation of losses over longer time horizons.

This is especially relevant because of another factor not well captured by VaR: the liquidity of positions in the trading book, where by liquidity I mean the ease and cost of exiting positions, with illiquid positions being more costly and time-consuming to offset. The fact that a firm like Trafigura may hold positions in illiquid instruments that may take some time to reduce or eliminate means that such longer time periods are relevant in assessing overall risk, and the adequacy of capital to absorb these risks: simple time scaling rules are typically subject to considerable inaccuracy.

One other issue relating to the use of VaR deserves comment. Specifically, when many firms in a sector utilize VaR and weight recent data more heavily, another problem arises: "Procyclicality."⁶ This is best illustrated by an example. If oil prices become more volatile, firms using VaR to measure risk will calculate that their risk exposures have increased. This is likely to induce some, and perhaps all, of these firms to try to reduce their risk exposures by offsetting positions. The attempt of a large number of firms to do this simultaneously can cause prices to move yet more, increasing measured volatility, increasing VaR, causing further reductions in position, and so on. Such feedback loops can be destabilizing, and are often observed during periods of market turbulence: working through the VaR channel, turbulence begets position changes that beget more turbulence.

In sum, Trafigura uses a heavily augmented version of the Value-at-Risk approach that is the standard way to measure risk in commodity and financial trading. The enhancements implemented by Trafigura address many of the well-known deficiencies of VaR, but some deficiencies remain, and there are no readily available remedies for them, despite concerted efforts in industry and academia to develop them. It will likely never be possible to quantify future risk exactly, especially since risk quantification inherently relies on historical data. Thus, quantitative risk modeling must be supplemented by more qualitative judgments about risk, and model risk should be backed by capital just like price or credit risks.

⁴ See, for instance, Rolf-Dieter Reiss and Michael Thomas, *Statistical Analysis of Extreme Values* (2007).

⁵ Risk measurement is also substantially more complicated for portfolios that include a large number of non-linear exposures, such as those that arise from options. Non-linear exposures are more difficult and computationally expensive to value accurately. Moreover, non-linear exposures depend on risk factors such as volatilities, so the number of risk factors in portfolios with options is substantially greater than is the case with portfolios that do not have options. Since Trafigura trades relatively few options, this is not a major consideration for the firm.

⁶ Tobias Adrian and Hyun Song Shin, *Procyclical Leverage and Value-at-Risk*, 27 *Review of Financial Studies* (2014) 373. Jon Danielsson and Hyun Song Shin, *Endogenous Risk*, Working Paper (2002).

E. MANAGING CREDIT RISK

Trafigura is at risk of loss resulting from the failure of a trading counterparty (either in a physical trade or a trade in a financial contract) to perform on its contract with the firm. Counterparties include those to whom Trafigura sells physical commodities, and firms from which it buys them. Counterparties also include hedge counterparties, which are typically prime financial institutions or large physical participants (e.g., a multinational oil company). Finally, counterparties include those providing payment guarantees or other credit risk mitigants that are used to manage counterparty risks.

Trafigura uses a variety of methods to manage the credit risk that arises from transacting with these diverse counterparties.

Specifically, it implements a formal credit process. Based on financial information, it establishes credit limits for each counterparty. This information includes historic payment performance information and creditor financial statements, as well as "soft" information about the creditor's business. Trafigura also uses a system (based on the well-known Moody's KMV methodology) that creates a credit risk rating for its counterparties. This system takes into account country and industry factors as well as counterparty-specific financial information.

Credit evaluations are made by teams that specialize based on commodity and geographic region. The firm has credit officers located in crucial markets throughout the world; these individuals can utilize local knowledge and contacts to make more accurate evaluations of counterparty credit risk.

Trafigura historically has experienced a very low rate of credit losses. The firm has suffered ten final credit losses since its inception in 1993.

If a transaction or transactions with a counterparty would result in a credit exposure to that counterparty in excess of the credit limit assigned to it, Trafigura purchases payment guarantees or insurance from prime financial institutions (or declines to make the trade). The purchase of a guarantee transfers the credit risk associated with the counterparty to the financial institution that provides the guarantee. Trafigura typically bears between 10 and 20% of the credit risk associated with its trade counterparties, and transfers the remainder to financial institutions. Moreover, the company purchases political risk cover for any transaction in a country with a Dunn & Bradstreet rating below DB3d, and purchases such cover on a discretionary basis for exposures in countries rated between DB3a and DB3d.

This transfer creates another counterparty risk: the risk that the provider of the guarantee will not perform. Trafigura manages this risk exposure through a credit review process employing a variety of types of information about the guarantee counterparties, and the establishment of exposure limits with them based on this review process.

Trafigura is also concerned about credit risk concentration by individual counterparty, industry, and geographic region. It monitors these concentrations on a continuous basis.

With respect to derivatives counterparties, approximately 70% of the company's trading is in "listed" exchange-traded products that are centrally cleared. Another 15% are centrally cleared over-the-counter transactions: these deals are cleared through the CME Group's Clearport system.

Central clearing dramatically reduces counterparty credit risk. Therefore, hedge counterparty credit risk primarily arises from the 15% of its transactions that are uncleared OTC trades. These trades are executed with a large number of counterparties, consisting primarily of prime financial institutions and large physical market participants. Based on a credit review process, Trafigura assigns credit limits to each counterparty, and requires the counterparty to post collateral when the limit is exceeded. Credit limits and collateral control credit exposure to an individual counterparty, and by trading with a large number of counterparties Trafigura can obtain the hedge transactions it needs without taking on a large exposure to any counterparty, or counterparties from any region. The use of standardized contracts (ISDA Master Agreements or long-form Confirmation Agreements) with derivatives counterparties also facilitates the management of credit risk, most importantly by establishing procedures to address a credit event (such as a default or downgrade) suffered by a counterparty.

The use of cleared instruments requires Trafigura to post initial margins: margins (a form of collateral) mitigate credit risk, and just as the use of cleared transactions reduces the credit risk faces from derivatives counterparties, clearing also reduces the losses that its counterparties would suffer in the event of a Trafigura default. The use of margins—which

Trafigura has a formal credit process

It insures itself by buying payment guarantees

It monitors credit risk concentrations centrally

Commodity trading firms have significant cashflow requirements

must be posted in cash or liquid securities—to control credit risk means that achieving this objective creates demands on the liquidity of the company, and creates liquidity risk. In an important sense, margining substitutes liquidity risk for credit risk.

The company's initial margins routinely total in the \$700 million-\$1 billion range. Trafigura funds these out of its corporate lines. Moreover, cleared derivatives positions (and some uncleared positions) are marked to market regularly (usually on a daily basis), and Trafigura must make variation margin payments on positions that suffer a mark-to-market loss. These derivatives trades are often hedges of inventory positions that are also marked to market under financing arrangements, but on a weekly (rather than daily) frequency. This mismatch in timing of marks and associated cash flows can create an additional funding need: a hedge position may suffer a loss that requires an immediate posting of margin, and although the inventory has likely realized a gain, the firm will not receive the cash payment from the bank for a period as long as a week. The firm uses its corporate lines to manage these mismatches in cash flows.

F. MANAGING LIQUIDITY RISK

A trading company like Trafigura is acutely dependent on access to liquidity to fund its activities. Loss of funding, or even a substantial contraction thereof, would seriously constrain the ability of the company to implement the arbitrage activities through which it generates value and earns a profit. The primary means of managing this risk include: (a) a substantial cash balance, with the cash balance varying directly with market volatility; (b) bilateral credit lines with a large number of banks to fund commodity purchases, with the volume of lines comfortably in excess of anticipated needs, to ensure that the company can finance its trading activities in the event that prices move sharply higher; (c) committed, unsecured credit lines that can be tapped to meet liquidity needs; (d) a securitization program that accelerates the receipt of cash upon delivery of commodities to buyers, thereby reducing reliance on credit lines; and (e) significant retention of earnings and subordination of equity repurchased from employees. In essence, the company manages liquidity risk by diversifying the types of funding, and diversifying the providers of each type of funding.

Liquidity risks tend to be positively related to the prices of the commodities that Trafigura trades. (This is true generally for commodity trading firms.) In low price environments, funding needs are reduced. Moreover, since commodity prices often drop precipitously during financial crises (e.g., the Asian Financial Crisis of 1997-1998, or the recent 2008-2009 Financial Crisis), the secured, low-risk, and self-liquidating nature of transactional financing means that banks are willing to enter into bilateral financing arrangements even when they are sharply reducing their supply of other forms of credit.

Conversely, in high-price environments, credit lines can be insufficient to fund potentially profitable trades. This is a reason to maintain credit facilities substantially in excess of current or anticipated needs.

G. MANAGING FREIGHT RISK

As a major charterer of ships to perform its logistical functions, Trafigura is subject to freight charter rate risks, and to fuel price risks. Once a ship is chartered and the rate fixed, the firm sells a Forward Freight Agreement to hedge against declines in charter rates. It also purchases fuel swaps to manage the risk of fuel price changes.

H. MANAGING OTHER RISKS

As noted earlier in Section II, commodity traders are subject to many other risks other than price and credit risks. These include operational, logistic, environmental, and volumetric risks.

The financial consequences of some risks can be transferred via insurance. The company purchases marine cargo open cover, charterers' legal liability oil, charterers' legal liability metals, and general liability insurance policies. These policies insure against product liability, bodily injury, and pollution.

Other risks cannot be insured. Some of these must be controlled through the establishment of policies and procedures, training employees in these policies and procedures, and the close monitoring of compliance with them. Trafigura has such procedures for, *inter alia*, contracts, charterparties and clauses, environmental policies and legislation, insurance declarations, claims, and demurrage handling.

Since environmental risks associated with transportation and storage are a particularly acute concern (due to the potentially large liability costs that a spill or other accident can cause)

the firm mitigates risks by restricting its chartering of ships, railcars, trucks, and barges based on the conveyance age and design (e.g., using only double-hull tankers). Similarly, the firm inspects all storage locations. To control the risk of theft and contamination, the company routinely inspects the stocks of commodities it holds.

In 2012, the company implemented a Group-wide initiative to manage health, safety, environment, and community ("HSEC") risks. This creates a set of policies regarding these issues. Managers are accountable for implementing these policies, by, *inter alia*, providing resources, training employees, and measuring and reporting HSEC performance. Moreover, even prior to the formal launch of the framework, Trafigura's Management Board established an HSEC Steering Group with a mandate to: oversee HSEC compliance; revise the HSEC policies and principles based on changes in the company's operations and the market environment; analyze and measure HSEC performance; develop and oversee reporting and assurance processes; report to the Management Board on HSEC performance; and coordinate external reporting of the company's HSEC performance. The Steering Group meets bi-monthly.

I. PAPER TRADING

Although Trafigura primarily uses derivatives contracts to hedge the price risks, it also engages in limited speculative trading using these instruments. For instance, the crude oil team has 21 traders, four of whom engage in proprietary "paper" trading. This trading is subject to risk limits established by the Risk Committee.

Moreover, this trading exploits the information advantages that Trafigura has as the result of its physical trading. That is, rather than taking positions that expose the firm to flat price risk, the paper trading focuses on calendar spreads (e.g., buying January Brent crude and selling March Brent crude) and inter-market spreads (e.g., Brent vs. WTI). Spreads are driven by the economics of transformations that commodity trading firms specialize in understanding and implementing. Knowledge of the economics of transformation can be employed to trade spreads profitably.

Trafigura also engages in speculative paper trading through its Galena Asset Management arm. Galena traders have access to Trafigura's physical traders, and their information, which they can use to devise trading strategies. The information flow is one way: information flows from Trafigura traders to Galena, but Trafigura traders do not obtain information on Galena trades and positions. Nor do Galena traders know Trafigura trades and positions. Galena uses this information primarily to trade calendar and inter-market spreads, and for the same reason that Trafigura's proprietary traders do: this information is most relevant to the economics of transformations that drive spreads.

There is a Group-wide framework for HSEC

Trafigura sometimes speculates on intra-market and calendar spreads

Operational risks are managed through insurance, best practice, and compliance

IV. COMMODITY FIRM FINANCING, CAPITAL STRUCTURE, AND OWNERSHIP

SUMMARY

A CTF's capital structure depends on the scale of its operations and the size of its asset base.

Leverage for the largest, most asset-heavy CTFs is similar to non-financial US corporations. Other CTFs are more highly leveraged but much less leveraged than banks.

CTFs' balance sheets are structured differently from banks. In general, short-term assets are funded with short-term debt and long-term assets with long-term funding.

Historically, banks have been major suppliers of credit to CTFs. Fears that reduced bank funding would destabilize markets appear unfounded so far. However, bank funding may be more restricted in future. This may increase concentration in commodity trading, but the impact on trading volumes will be limited.

Smaller firms are all privately owned. Private ownership aligns incentives between managers and equity owners.

Some larger, more asset-heavy CTFs are publicly listed. They may require large-scale equity investments that exceed the capacity of a small group of owner-managers. Public listing allows firms to transfer risks to diversified investors.

Broader market developments, including the wider availability of information, are causing some firms to become more asset-intensive. This will put increasing pressure on the private ownership model.

CTFs also act as financial intermediaries for their customers through complex transactions that bundle financing, risk management and marketing services. Common structures include trade credit agreements, prefinancing, commodity prepays and tolling arrangements. Banks and other financial institutions remain, overwhelmingly, the ultimate source of credit. CTFs act as conduits between these financial institutions and their customers.

A. THE FINANCING OF COMMODITY TRADING FIRMS

Like all firms, commodity traders need to finance their operations. Their choices of funding strategies—their capital structures—influence the efficiency of their operations, and are crucial determinants of their ability to withstand economic shocks. Moreover, since the debt and equity issued by commodity trading firms connects them to the broader financial system, capital structure also determines the vulnerability of trading firms to financial market conditions—including financial crises—and the influence of commodity trading firms (and hence commodity market conditions) on the stability of the broader financial markets.

An examination of the available information on the financing of commodity trading firms indicates that the diversity of commodity trading firm business strategies is mirrored in the diversity of their financing strategies. Firms differ in their gearing/leverage; the forms of leverage that they employ; and their ownership of their equity. Moreover, these differences in financing strategies co-vary with the kinds of transformations that firms undertake: firms that are more physical asset intensive finance themselves differently than firms that are engaged in more traditional pure trading activities. Relatedly, as the business strategies of trading firms are evolving, their financing strategies are evolving as well.

Financial statement information available for some of the largest trading firms illustrates these points. I start by looking at the leverage of trading firms.

One measure of total leverage is total assets divided by book value of equity. Table 1 presents this measure for 2012 for 18 trading firms for which data are available. This ratio ranges from 2.38 (ADM) to 111 (E.On Global). The average (which is somewhat misleading, due to the presence of the outlier E.On) is 18, and the median is 4.

This measure of overall leverage of commodity trading firms is somewhat higher than non-financial corporations in the United States. As of the end of the third quarter, 2013,

Asset intensive firms' financing strategies differ from pure trading operations



the ratio of assets to equity for such corporations was 2.06.¹ The more asset-heavy firms (e.g., Cargill, ADM, Bunge) have leverage ratios that are similar to those for the US non-financial corporations as a whole: the more asset-light firms are more heavily leveraged. Moreover, as will be discussed in more detail below, the heavier leverage of the more traditional trading firms is somewhat misleading. Much of this debt is short-term and associated with liquid, short-term assets. The net debt of these firms (total debt minus current assets, which is a better measure of their true leverage) is quite low.

TABLE 1

TOTAL ASSETS/EQUITY (2012)

Arcadia Energy Pte	17.51	Louis Dreyfus B.V.	3.74
Archer Daniels Midland	2.39	Mercuria Energy Trading	5.06
BP International Ltd	5.32	Noble Group	3.80
Bunge Ltd	2.51	Olam	4.02
Cargill	2.37	Shell Trading International	12.09
E.On Global	111.07	Trafigura	7.94
EDF Trading	4.56	Vitol	4.00
Eni Trading & Shipping	35.09	Wilmar	2.76
Glencore	3.08		

Data from Bureau van Dijk

Notably, trading firms are much less highly leveraged than banks, to which they are sometimes compared: some have argued that commodity trading firms should be subject to regulations similar to banks. Specifically, for US banks that have been designated Systemically Important Financial Institutions ("SIFIs"), the mean leverage is 10.4 and the median is 10. For European SIFI banks, the mean is 20.6 and the median is 22.5.

There is a relationship between the leverage of commodity trading firms and characteristics of the asset side of their balance sheets. In particular, there is a strong correlation between the fixed asset intensity of commodity trading firms, and their leverage: more fixed asset (long term asset) heavy firms tend to be less leveraged. For 2012, the correlation between the ratio of fixed assets to total assets and the ratio of total assets to book value of equity (leverage) is -.55. Thus, trading firms that are asset heavy tend to be less heavily leveraged than those that are asset light. Put differently, pure trading firms that own relatively few fixed assets tend to be more highly leveraged than firms that also engage in processing or refining transformations that require investments in fixed assets.

The structure of the liabilities of commodity trading firms is somewhat distinctive, and also co-varies with the structure of the asset side of their balance sheets. Specifically, short-term liabilities dominate the balance sheets of trading firms. For the 17 firms in the sample, the average of the ratio of current liabilities to total liabilities is .75: the median is .70. There is considerable variation in this ratio across firms: the minimum is .36 and the maximum is 1.00. Furthermore, there is a strong correlation between this ratio and firms' fixed asset intensity. Specifically, the correlation between the ratio of current to total liabilities and the ratio of fixed (or long term) assets to total assets is -.51. Thus, firms engaged in more fixed asset intensive transformations (such as processing) have a greater proportion of long-term liabilities. There is therefore an alignment between the asset and liability structures of commodity trading firms' balance sheets.

Available balance sheet information also indicates that commodity trading firms do not engage in maturity transformation as do banks. Indeed, to the extent that commodity trading firms engage in maturity transformation, it is the reverse of the borrow short-lend long transformation that makes bank balance sheets fragile, and which makes banks (and other financial intermediaries) subject to runs and rollover risk. Specifically, for all 17 of the commodity trading firms studied, current assets exceed current liabilities. The median ratio of current assets to current liabilities is 1.26. Consequently, one measure of net debt (total liabilities minus current assets) is negative for 8 of the 17 firms. Furthermore, the median

¹ Board of Governors, Federal Reserve Board, *Financial Accounts of the United States*, Table B.102. 9 December, 2013. This calculation is based on historical cost data, which makes it more comparable to the accounting data used to determine leverage for trading firms. Based on market values/replacement costs of non-financial assets, the ratio is somewhat smaller: 1.75. Since market values or replacement costs of trading firm assets are not available, I cannot calculate an analogous figure for them.

ratio of net debt to shareholder equity is very small, taking the value of .014. Since commodity trading firm current assets (primarily hedged inventories and trade receivables) tend to be highly liquid and/or of high credit quality (as is documented below) these figures strongly suggest that as a whole, commodity trading firms run far less liquidity risk than do financial intermediaries like banks or shadow banks.

In sum, the data show an alignment between the nature of the transformation activities firms engage in, and their funding strategies. Short-term assets are funded with short-term debt, and long-term assets are funded with long-term debt. The data also show that commodity trading firms are not heavily leveraged overall, and that their balance sheets are not fragile (i.e., subject to liquidity or rollover risk).

B. THE LIABILITY STRUCTURES OF COMMODITY TRADING FIRMS

The foregoing conclusions are reinforced when one evaluates the specifics of commodity trading firm financing. In particular, there is a close connection between the nature of transformation activities, and how they are financed.

Consider, for instance, the financing of most short-term arbitrages involving spatial transformation, storage, and blending. Firms rely extensively on bank borrowings to finance these transformation activities. In particular, they engage in large amounts of relatively short-term borrowings, including borrowings through unsecured credit lines arranged with banks, frequently through syndication arrangements. Moreover, they typically maintain bilateral credit lines with banks that can be drawn upon to fund the purchase of commodities and the issuance of credit instruments, such as letters of credit, utilized in the merchandising of commodities. These are generally used to finance each transaction at 100% of collateral values, and are marked to market periodically (e.g., weekly, or more often during periods of large price movements). They are referred to as "self-liquidating" because they are repaid upon the receipt of payments from the purchasers of the commodity. Given that these borrowings are secured by commodities that are often saleable in liquid markets, marked to market, and hedged, and that these exposures have relatively short maturities, they present less credit risk to the lending banks than unsecured credit, or credit secured by less liquid collateral.

In the past decade, some commodity trading firms have also arranged non-traditional short-term financings that could be characterized as "shadow bank" transactions.² These include the securitization of inventories and receivables, and inventory repurchase transactions. Borrowings secured by inventories pose limited credit risk to the lender, especially to the extent that these inventories are in relatively liquid commodities (e.g., deliverable aluminum held in an LME warehouse) and are located in jurisdictions where there is little risk of perfecting legal title; borrowings secured by less liquid commodities, and in some jurisdictions, pose greater risks. Commodity receivables that back some securitization structures historically have exhibited very low rates of default, and rates of default did not rise appreciably even during the 2008-2009 crisis period.³ Moreover, these structures do not generally exhibit the maturity mismatches that contributed to runs on the liabilities of some securitization vehicles during the financial crisis. Indeed, in some of these structures, the liabilities have longer maturities than the underlying assets, meaning that the challenge they face is replenishing the assets, rather than rolling over the liabilities.

These non-bank financing vehicles may become increasingly important because broader financial trends may constrain the availability of, and raise the cost of, traditional sources of transactional financing. Historically, banks, and especially French banks, have been major suppliers of credit to commodity trading firms; five banks, three of them French, are reported to provide 75% of the commodity trade finance for Swiss-based trading firms. Deleveraging post-crisis and dollar funding constraints on European/French banks have led to a reduction in bank extensions of commodity credit. This has led to increases in funding costs and reductions in the flexibility of credit arrangements. The impending Basel III rules impose greater capital charges on commodity lending and trade finance generally, which could further reduce bank supply of commodity credit.

² The earliest such transactions that I am aware of is a securitization of base metals inventories undertaken by Glencore and a securitization of receivables by Vitol in 2003. The term "shadow banking" is used in many different ways. Here is used to mean financial intermediation through the issuance of debt outside the insured banking system.

³ An International Chamber of Commerce study of data from 2005-2009 found that for trade credit generally (which includes not just commodity trade finance), default rates averaged .02%, and that the rate of defaults did not rise appreciably during the period of the crisis. The Offering Circular from a securitization of Trafigura receivables from 2012 reports default rates on the trading firm receivables from November, 2004-February, 2012. Default rates are less than 0.1%, and delinquency rates never exceed 2.4% and are typically less than 0.1%.

*Asset heavy firms
are usually less
highly leveraged*

*Commodity trading
firms have less
liquidity risk than
financial
intermediaries*

*Non-bank financing
is becoming more
important*

Reductions in traditional sources of finance will have a bigger impact on smaller firms

Fears of a large reduction in financing available from traditional sources were particularly acute in early-2012, but have abated somewhat. Moreover, according to statements by industry participants, the impact has been minimal for larger, more creditworthy trading firms.⁴ Nonetheless, the seismic changes in bank regulation, and the potential for further changes going forward, mean that the traditional commodity trading funding models may not be sustainable. Thus, it is advisable to consider how commodity firms could replace reduced transactional bank funding.

A scaling back of lending by traditional suppliers of commodity finance would create opportunities for new suppliers less severely constrained (e.g., US banks with that can obtain dollar financing more readily, and non-European regional banks looking to invest export-driven dollar flows), but given the relationship-specific nature of bank lending these new suppliers would likely be less efficient than the incumbents. Moreover, global rules like Basel III will impact banks internationally. The reduction in traditional sources of credit would also encourage greater reliance on shadow bank-type funding arrangements.

Any future reductions in traditional forms and sources of commodity finance would be likely to have greater impacts on smaller commodity trading firms than on the larger ones. This would tend to increase concentration in commodity trading activities. Moreover, it should be noted that some of the higher funding costs would be shifted to commodity suppliers (in the form of lower prices) and commodity consumers (in the form of higher prices): that is, higher costs will be associated with higher margins. Given the relative inelasticity of commodity supply and demand, a large fraction of these higher costs will be shifted via prices in this fashion, and the impact on commodity trading volumes will be modest.

One area that deserves further study is the possibility that the reduction in traditional sources of funding for commodity trading could lead to funding squeezes during times of market stress. Traditional commodity finance has been quite flexible and responsive to market conditions. Sharp reductions in the supply of commodity financing from traditional sources would likely result in a decline in the responsiveness of the funding of commodity trading activities to extraordinary conditions in the commodity or financial markets. This could lead to funding squeezes during periods of such conditions that could lead to disruptions in commodity trading; that is, the contraction of traditional sources of commodity finance will likely increase future funding liquidity risk.

C. THE OWNERSHIP OF COMMODITY TRADING FIRMS: PUBLIC VS. PRIVATE

One important aspect of the capital structure of commodity trading firms is the ownership of equity. As noted before, some commodity trading firms are listed firms with publicly traded equity, but others are private firms. Although all small commodity trading firms are private, the relationship between size and equity ownership is complex. Some very large commodity trading firms are private, while other firms that are similar in terms of size and market participation are listed, public firms.

The ABCD firms provide an interesting illustration. Although these firms are broadly comparable in terms of size and breadth and depth of market segment participation, ADM and Bunge are publicly traded, but Cargill and Louis Dreyfus are private. There is thus evidently an element of indeterminacy in the choice of public or private ownership.

This indeterminacy reflects fundamental trade-offs that are particularly challenging for commodity trading firms. A primary advantage of private ownership is the superior alignment of incentives between managers and equity owners. Managers who own small (or no) stake in an enterprise have an incentive to act in ways that benefit themselves, but are harmful to equity holders. For instance, they may consume excessive perquisites, invest in low-returning prestige or empire-building projects, or run ill-advised risks: the managers enjoy the benefits of these activities, but the outside investors bear the costs. In contrast, manager-owners have lower (and perhaps no) incentive to engage in these wasteful behaviors. Moreover, owner-managers have a stronger incentive to monitor their peers, and do so more effectively, than do diffuse outside-equity owners. More generally, since owner-managers more completely internalize the costs and benefits of their decisions than do the managers of public firms, they have a stronger incentive to exert effort, control costs, manage risks, and make value-enhancing investments.

⁴ See, for instance, *Mercuria CFO Interview: "We Have Seen a Flight to Quality"*, *Euromoney*, 29 October 2013. *Mercuria CFO Guillaume Vermersch said, "We have seen a flight to quality. Basically, the good and strong tier 1 credits, such as Mercuria, have had the benefit of additional support and credit lines brought by the same banks that reduced their balance sheets during the crisis. My only explanation for that is that banks have probably ended tier 2 and 3 credit relationships to refocus on tier 1 companies like us." In interviews with me, Trafigura financial executives expressed similar views.*

These benefits do not come for free, however. The main cost of private ownership is inefficient risk bearing. Whereas shareholders of a listed firm can diversify away the idiosyncratic (i.e., firm specific) risks of commodity trading, the owner-managers of a private firm hold a large fraction of their wealth in their enterprise, and hence cannot diversify away these idiosyncratic risks. Thus, idiosyncratic risks are more costly to bear with private ownership than public ownership.

The scale and scope of a commodity trading firm's operations, and the availability of markets to transfer risk, influence the optimal trade-off between public and private ownership. Private ownership is more viable for a commodity firm that engages in activities where many of the risks outside of management control can be transferred to others via financial contracts. For instance, a firm that engages in activities that primarily involve flat price risks that can be hedged in derivatives markets (e.g., an oil trading firm) or credit risks that can be assumed by banks or insurers or casualty risks that can be insured can transfer these primary risks through financial contracts, leaving the managers to bear only risks that they can more readily control (e.g., operational risks that can be mitigated through close management oversight). Private ownership offers substantial advantages under these circumstances, because the risk bearing benefits of public equity are modest and the incentive alignment benefits of private ownership are large.

In contrast, if a firm is engaged in an activity that involves risks that cannot be transferred by (non-equity) financial contracts, the benefits of public ownership are larger. For instance, the risks of investing in and operating a large mining or energy production project (e.g., the risks of increases in labor costs or construction costs, variability in well depletion rates) cannot be transferred (or are extremely expensive to transfer) using non-equity financial contracts.

Private equity can bear these risks at modest cost if the scale of the activity is sufficiently small. However, large-scale investments (e.g., in a mine or energy exploration and production) require equity investments that are beyond the capacity of a small group of managers to finance. Thus, despite its superior incentive effects, private ownership is incompatible with the operation of large-scale assets with large exposures to risks that cannot be transferred to others by non-equity financial contracts.

This suggests that more traditional "asset light" pure trading activities are efficiently undertaken by private firms, but that more "asset heavy" transformation activities (e.g., mining, crude oil production, refining and processing) must be financed in large part with public equity. This is broadly consistent with observed patterns. For instance, most small, specialized commodity trading firms are privately owned. Even the far larger, but asset light, trading firms, such as Trafigura and Vitol, are privately owned. This reflects the fact that many of the largest risks incidental to these businesses can be hedged in derivatives, credit, or insurance markets. A company that was, in many ways, similar to Trafigura and Vitol, but which integrated into more asset-intensive transformation activities (notably mining)—Glencore—shifted from private to public ownership in parallel with this increasing asset intensity.

Notable potential exceptions include large, relatively asset-heavy firms such as Cargill and Louis Dreyfus.⁵ Their choice to remain private is likely a consequence of path-dependence. These companies are old (both dating from the mid-19th century), and have accumulated substantial retained earnings during their long history. This historical success has made internal equity finance viable: the companies can finance large projects internally, and diversify risks internally by participating in a wide variety of market segments, thereby reducing the benefits of selling equity to diversified investors.

The increasing asset intensity of commodity trading firms—a trend discussed in Section V—is forcing some of them to evaluate their ownership structure. Trafigura is a case in point. It is transitioning from a pure trading model to a more fixed asset intensive model, and this is forcing it to adjust its financing accordingly. Heretofore it has decided to remain private, and explicitly invokes the incentive benefits of private ownership to explain its choice. The Trafigura Annual Report states: "We believe [an employee owned private company] is the best ownership model for our core trading business." Other firms—most notably Louis Dreyfus—are actively considering going public.

Creative financing methods (e.g., the issuance of perpetual debt) that offer some of the advantages of outside equity (e.g., no rollover risk) but which do not require the firm to go public permit can permit a firm to continue to realize the incentive benefits of private

⁵ I provide data on the asset-heaviness of some important commodity trading firms in Section V below.

...and makes most sense when risks can be transferred

Public ownership works better for large, asset-heavy firms

Increasing asset intensity may change ownership structures

There are alternatives to public listings

EU-registered private companies have greater disclosure requirements

Commodity trading firms extend trade credit...

ownership: Trafigura and Louis Dreyfus have issued perpetual bonds.⁶ Moreover, Trafigura is using hybrid strategies that tap equity financing, but allow it to retain the benefits of private ownership for its core activities. Specifically, the firm has sold off equity in its Puma Energy affiliate, and may pursue a similar strategy with its Impala subsidiary in the future.

Private equity stakes sold to outside groups is another way of transferring risks to non-managers while maintaining the incentive benefits of private ownership. As noted earlier, in recent years a variety of private equity firms have invested in commodity trading ventures.

However, these alternative financing methods are inherently limited (because firm debt capacities are inherently limited due to what economists refer to as “agency problems”).⁷ Thus, private ownership for companies not blessed with more than a century of good fortune constrains their future strategic choices. Retention of private ownership necessarily limits the fixed asset intensity of a firm’s transformation activities, and the types of risks it can run.

This further implies that broader market developments that undermine the viability of the pure trading model (such as the greater availability of public information about prices) and that are causing some firms to become more asset intensive will put pressure on the traditional private ownership model.⁸ Ownership structure and the nature of firm activities are complementary, and determined jointly. These things cannot be chosen independently.⁹

The form of organization (public vs. private ownership) also has implications for public disclosure, and the amount of information that firms must reveal. In all jurisdictions, private firms like Cargill, Louis Dreyfus, and Trafigura are obligated to keep accounts and records, which must be kept according to accepted accounting principles and standards. Laws regarding what information must be disclosed vary by jurisdiction. In the United States, private companies are not obligated to disclose publicly accounts or other financial information. In the European Union, in contrast, every limited liability company (even private ones) must disclose its balance sheet, income statement, notes to its financial statements, an annual report, and an auditor’s opinion: this information is available from the central register of the country where the firm is incorporated.¹⁰ Therefore, standard financial information about companies registered in EU countries (e.g., Louis Dreyfus, Trafigura) is available, whereas the same is not true for firms incorporated in the US. Thus, although the ability to limit disclosure of financial information may influence the choice between private and public ownership in the United States, it is likely a far less important consideration in Europe.

One final point on disclosure and transparency is warranted. Even privately owned firms in the United States have to provide financial information to their lenders and derivatives counterparties, and private firms anywhere can at their discretion distribute their financial information in ways similar to those used by public companies: Trafigura’s recent publication of an annual report, available on its website, is an example of this. With respect to disclosures to government regulators, trading firm positions in listed derivatives are available to exchange staff and government regulators. Moreover, with new reporting regulations under Dodd-Frank in the United States and EMIR in Europe, regulators also have, or will have, access to commodity traders’ positions in OTC derivatives.

D. COMMODITY TRADING FIRMS AS FINANCIAL INTERMEDIARIES

Not only is the funding of commodity firms an important aspect of the trading business: so is the fact that trading firms also play a role in financing the commodity trade. Specifically, firms involved in commodity trading often provide various forms of funding to their customers. Thus, these firms supply financial intermediation services to their customers. This intermediation takes the forms of traditional trade credit, and more complex structured transactions that bundle financing, risk management, and marketing services.

The practice of commodity trading firms extending trade credit to those they sell to is a venerable one. These receivables (along with inventories) represent the bulk of the current assets on the balance sheets of trading firms.

An established economics literature provides an explanation for the prevalence of such

⁶ Javier Blas, *Louis Dreyfus taps bond markets for \$350m*, *Financial Times*, 6 September, 2012. Javier Blas and Jack Farhy, *Trafigura raises \$500m with perpetual bond*, *Financial Times*, 10 April, 2013.

⁷ Jean Tirole, *The Theory of Corporate Finance* (2005).

⁸ Trends in asset intensity, and the reasons for it, are discussed in Section V.

⁹ Paul Milgrom and John Roberts, *Economic Organization and Management* (1990).

¹⁰ Jones Day, *Public Disclosure Requirements for Private Companies: U.S. vs. Europe* (2012).

trade financing.¹¹ A firm selling a commodity to a customer frequently has better information on this buyer than would a bank, due to the trading firm’s intimate knowledge of the buyer’s operations, how it will employ the commodity, market conditions in the buyer’s region, etc. This permits the trading firm to evaluate creditworthiness better than the bank, and to monitor the creditor more effectively than the bank.

Furthermore, trade credit is often less subject to opportunistic behavior by the borrower. One concern about any credit transaction is that the funds lent are diverted for other than their intended purpose. Cash is more fungible, and hence more easily diverted, than a commodity used as an input: converting the input to cash would require the buyer to incur transactions costs, transportation costs, and other expenses. Moreover, such activity is subject to risk of detection by the commodity trading firm that sold the input on credit, due to its information on commodity transactions and movements in the markets it serves. The lower susceptibility to diversion means that trade credit expands the borrowing capacity of commodity buyers.¹² Commodities are cheaper, and credit to obtain them more abundant, when commodity trading firms provide trade credit to their customers.

In addition to traditional trade credit, firms involved in commodity trading (including, notably, some banks that have physical commodity trading operations) increasingly provide structured financing to their suppliers and their buyers. A common element of these structures is an off-take agreement, whereby a trading firm agrees to purchase a contractually specified quantity of a commodity (e.g., copper concentrate or gasoline) from a producer (e.g., a miner or refiner) usually at a floating price (benchmarked to some market price, plus or minus a differential). These contracts can vary in duration (e.g., a year, or multiple years) and quantity (e.g., the fraction of a mine’s output, or its entire production).

One common structure that utilizes an off-take is a prefinancing. Three parties are involved: a borrower (a producer), a trading company, and a bank. The producer and the trading company enter into a prepay agreement, and the bank lends money to the producer. Upon delivery of the commodity from the producer to the trading firm, the trading firm pays (some or all of) the amounts it owes under the off-take agreement to the bank to repay the loan. In this arrangement, the bank has no recourse to the trading firm (as long as it performs under the off-take agreement), and bears all the credit risk associated with the loan to the producer.

Another structure is a commodity prepay. There are two major variants of this structure, but under each the trading firm and a commodity seller enter into an off-take agreement, funding is provided to the producer (the prepayment), and the terms of the off-take arrangement are set to repay the prepaid amount.

In the first variant, the bank provides limited recourse financing to the trading firm, and the trader assigns the rights under the off-take agreement to the bank as a security. The trading firm provides funds to the producer, but the bank absorbs the credit risk on the loan, although in some instances the trading firm may keep a risk participation (e.g., 10%).

In the second variant, the bank provides full recourse financing to the trading firm, which makes a loan to the producer. In this variant, the trading firm, rather than the bank, bears the risk that the producer will not repay the prepaid amount. It is common for the trading firm to offload all or some of this credit risk by entering into an insurance policy. Depending on the terms of the financing provided by the bank to the trading firm, the bank may be the loss payee on this insurance policy.

Another common structure offered by commodity trading firms is a tolling arrangement, whereby a firm supplies a commodity processor (e.g., an oil refiner) with an input (e.g., oil) and takes ownership of the processed commodity (e.g., heating oil, jet fuel, and gasoline). The trading firm pays a fixed fee to the processor, pays the market price to acquire the input, and receives the market price for the refined products.

These structures bundle together multiple goods and services. For instance, in a simple off-take agreement, the trading firm provides marketing services and hedging (because the seller is guaranteed a price, and the commodity firm is at risk to price changes over the life of the contract). A prepay incorporates these elements and a financing element as well. The seller receives cash upfront, in exchange for a lower stream of payments in the future: the discount on the sales price is effectively the interest on the prepay amount.

¹¹ See, for instance, Bruno Biais and Christian Gollier, *Trade Credit and Trade Rationing*, 10 *Review of Financial Studies* (1997) 903, and Mitchell Petersen and Raghuram Rajan, *Trade Credit: Theory and Evidence*, 10 *Review of Financial Studies* (1997).

¹² Mike Burkart and Tore Ellingsen, *In Kind Finance: A Theory of Trade Credit*, *American Economic Review* (2004) 569.

and provide structured financing...

...that bundles financial, logistical, and marketing activities

*Bundling services
can reduce
transaction costs...*

A tolling agreement bundles input sourcing, output marketing, price risk management, and working capital financing. The working capital element exists because the commodity trading firm has to finance the input from the time it is purchased until it can realize revenue from the sale of the refined good after processing is complete.

The various elements of these bundles could be provided separately. Instead of entering a tolling arrangement, for instance, a refinery could source its own input and market its own output, hedge its input purchases and product sales in the futures markets, and finance its working capital needs by borrowing from a bank. Instead of engaging in a prepay, a miner could market its own output, hedge its price risk on the derivatives markets, and borrow from a financial institution or the capital markets.

However, there are frequently efficiencies that can be captured by bundling these transactional elements into a single structure. By exploiting these efficiencies, firms trading commodities (which, notably, can include banks as well as non-bank trading firms) reduce transactions costs and allocate risks more efficiently, thereby benefiting commodity producers and consumers.

To understand these benefits consider a tolling transaction (which is the structure with the largest number of elements in the bundle). Refineries, power plants, and the like typically need to pay for the inputs they process before they receive payment for their outputs. This creates a need for working capital to finance the timing gap between cash outflows and inflows.

Providing funding for working capital is clearly a traditional banking activity. One way to do this is for a lender to provide a loan or credit facility, and leave the refiner or power plant to acquire inputs and market outputs, and bear and perhaps manage the price and operational risks associated with those activities.

This exposes the lender of the funds to risk: adverse movements in prices could put the refiner or generator into financial distress, and perhaps cause a default. The lender could require the borrower to hedge, but there is a moral hazard: if it does not hedge, or does not do it effectively, the lender bears risk. This undermines the incentive of the borrower to hedge, and hedge well. The lender can monitor, but this is costly, and often imperfect.

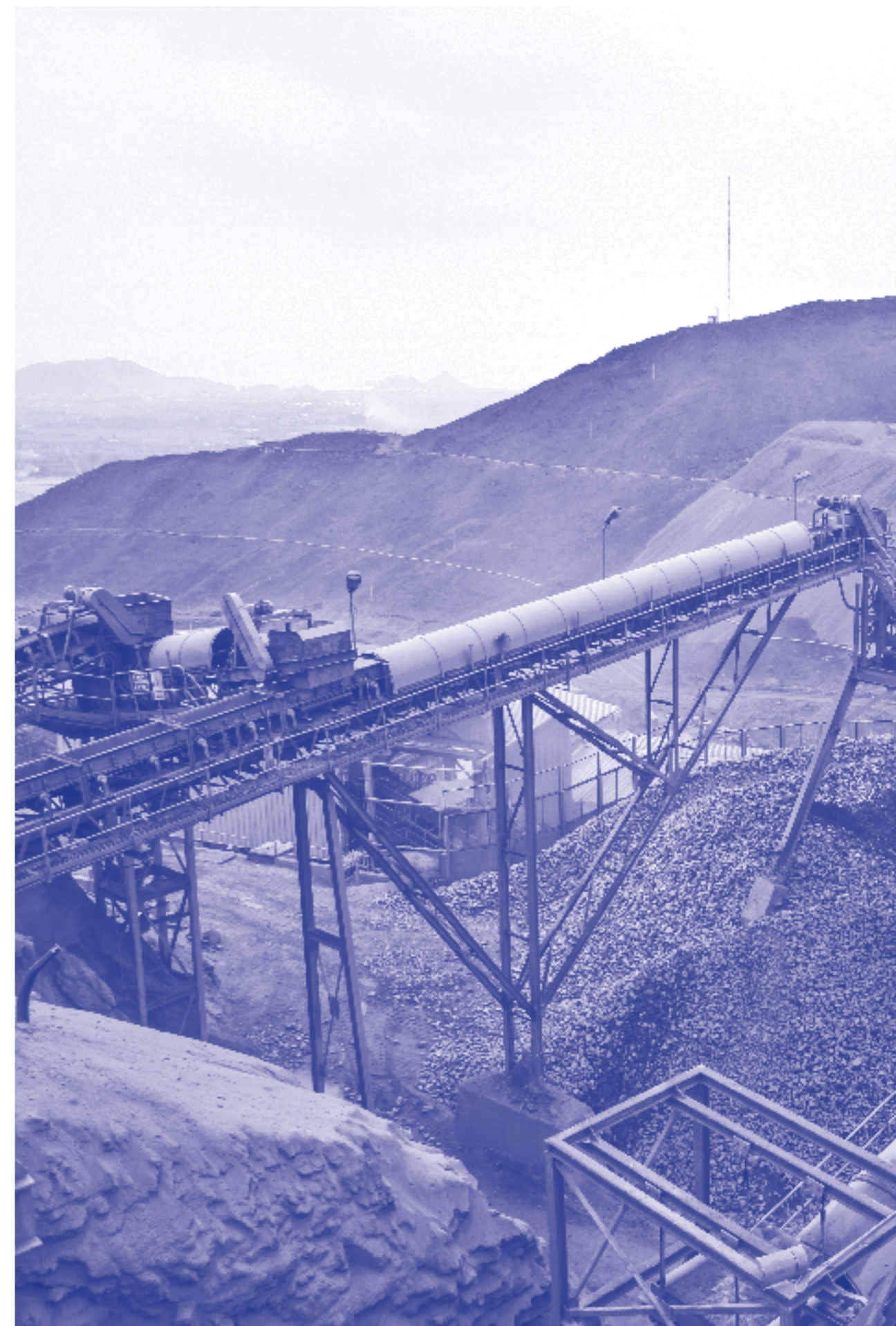
The moral hazard problem can be eliminated by passing the risk on to the lender. A prepay agreement or tolling deal does this. These types of deal implicitly provide funding to bridge the outflow-inflow gap, and pass the price risks back to the lender. The lender can manage these risks, and the agency cost in this arrangement is lower: because the lender bears the price risk, there is no moral hazard; it has the incentive to manage the risk; and there is thus no need to monitor. Therefore, bundling price risk management and funding can reduce the cost of funding working capital needs. This is presumably more valuable for lower credit quality refiners and generators.

*...and improve
economies of scale*

There are other potential benefits. The lender may have a comparative advantage in managing risk due to specialization and expertise in this function: commodity trading firms and banks have a comparative advantage in risk management. Moreover, they may be able to manage risk more cheaply because they run large books: there are economies of scope in risk management. For instance, a lender doing an off-take deal with a refinery is short crude and long products, but it might have a long crude position based on a trade it executed with producer, and might have a short products position as the result of a swap with an airline or heating oil dealer. These natural hedges reduce the amount of trading necessary to manage the risks.

Moreover, trading firms specialize in marketing and logistics, and there are scale economies and scope economies in these activities. It may be cheaper for a big trading firm to provide marketing and logistical services, thereby eliminating the need for the refiner or the power plant to pay the overhead associated with such activities. Smaller, or less sophisticated firms (e.g., a refiner in an emerging market) are likely to benefit most from delegating marketing, logistics, and risk management services to specialist firms that can exploit scale and scope economies.

Thus, there are strong complementarities that make it beneficial to bundle financing, logistical, and marketing activities for some firms that process commodities.



V. COMMODITY FIRM ASSET OWNERSHIP AND VERTICAL INTEGRATION

SUMMARY

Many CTFs are investing more heavily in physical assets as the profitability of pure physical arbitrage comes under pressure.

The complexity and diversity of CTFs makes it difficult to generalize.

The data suggest that:

- There are two categories of firm: asset-intensive and asset-light.
- There is a trend towards increased vertical integration for some firms, but this is not uniform.

Midstream

All major CTFs own midstream assets such as storage and terminals. There are strong economic arguments for this. CTFs that control their own storage and processing are not subject to the risk of a third party creating an artificial bottleneck to extract excess profit.

As arbitrage opportunities become more fleeting there is a greater incentive to integrate. In oil trading, increased price transparency has restricted arbitrage opportunities and made access to storage and logistics more valuable.

Recent acquisitions of physical assets by Trafigura highlight the economic factors propelling midstream investment.

Downstream

Downstream activities are mainly concentrated in emerging markets or developing regions of advanced economies. These are usually small markets requiring investment. Sometimes governance is poor. These conditions favor vertical integration. Integrated midstream and downstream operations are replacing retreating oil majors in emerging markets.

Upstream

Owning production has transactions cost benefits, but these can be achieved in other ways, for instance with off-take agreements. There are cases of upstream integration in agricultural products, but the trend is more common in energy and industrial metals.

Vertical Disintegration

Commodity trading firms have also contributed to vertical disintegration by developing liquid, competitive markets that reduce transactions costs and increase sector efficiencies.

A. THE PHYSICAL ASSET INTENSITY OF COMMODITY TRADING FIRMS

In the past few years, there have been numerous stories and consulting reports claiming that commodity trading firms are evolving from pure intermediaries that own very few physical assets, to more vertically integrated firms that invest more heavily in physical assets, in order to profit from the real optionality inherent in these assets.¹ There is a kernel of truth in this characterization, but reality is more complicated. Many well-known firms commonly identified as commodity traders (notably the ABCD firms) have always been vertically integrated to some degree, and have substantial investments in durable physical assets including refining/processing plants. Other trading firms are affiliates of asset-heavy firms including most notably vertically integrated oil and gas producers. It is the case that some energy and metals trading firms that historically have been very asset light are becoming more fixed asset intensive through the strategically targeted purchase of or investment in physical assets at various stages of the value chain. But the patterns of asset ownership among commodity traders are extremely diverse, complex, and dynamic, making generalizations impossible.

Given this complexity and diversity, a detailed analysis of the integration and structure of commodity trading firms is well outside the scope of this study. I therefore set my sights on more modest objectives. First, I will present data that quantifies asset intensity and

¹ Deloitte, *Trading up: A look at some current issues facing energy and commodity traders* (2013). Jan Ascher, Paul Laszlo, Guillaume Quiviger, *Commodity trading at a strategic crossroad*, McKinsey Working Papers on Risk (2012). Steven Meersman, Roland Rechtsteiner, Graham Sharp, *The Dawn of a New Order in Commodity Trading*, Oliver Wyman Risk Journal (2012).

integration by some commodity trading firms. This data shows the diversity of commodity trading firm integration strategies. This data also illustrates some trends. Second, I will draw on the economics literature relating to vertical integration and asset ownership to identify some of the factors that influence the integration of some commodity transformation activities. Third, I will focus on the evolution of integration patterns among oil and energy trading firms, focusing on the experience of Trafigura.

The information on individual companies, and integration within particular sectors, is useful in conveying the diversity of commodity trading firms, and in illustrating the fact that commodity firm presence in multiple stages of the commodity value chain is and has been quite common. This information is less useful in illustrating broad patterns. For commodity trading firms for which financial data is available, however, it is possible to construct measures of asset intensity that proxy for integration along the value chain.

Specifically, the assets held on the balance sheets of traditional pure intermediary trading firms tend to be predominately current assets, consisting of commodity inventories and receivables (trade credit granted to customers). A traditional trading firm can operate with an office, phones and computers, and rent, lease, or charter the physical assets needed to transform goods in space or time. Thus, current assets tend to represent a large fraction of the total assets of pure trading firms, and fixed (or long-term) assets tend to represent a small portion. Conversely, firms engaged in other commodity transformations, notably processing, invest in and own long-term fixed physical assets, such as refineries. Similarly, firms engaged in primary commodity production (e.g., mining or oil production) own assets like mines and wells.

I therefore use fixed assets (or long term assets) as a fraction of total assets as a measure of whether a firm is primarily a pure trader, or is instead more extensively integrated into asset-intensive transformation activities.² This data is available for 17 firms for years going back as far as 2007. Table 2 presents this information in tabular form: Figure 1 presents it graphically.

TABLE 2

FIXED ASSETS DIVIDED BY TOTAL ASSETS AT COMMODITY TRADING FIRMS

	2007	2008	2009	2010	2011	2012
Archer Daniels Midland	0.31	0.39	0.42	0.35	0.35	0.34
BP International Ltd	0.20	0.14	0.16	0.29	0.33	0.31
Bunge	0.34	0.35	0.45	0.39	0.44	0.37
Cargill	0.45	0.44	0.43	0.43	0.29	0.35
E.On Global	0.02	0.12	0.06	0.02	0.02	0.02
EDF Trading	0.02	0.02	0.02	0.03	0.02	0.08
Eni Trading & Shipping	0.00	0.01	0.02	0.04	0.06	0.03
Glencore	0.39	0.40	0.42	0.44	0.47	0.49
Louis Dreyfus B.V.	0.18	0.26	0.33	0.29	0.29	0.33
Mercuria Energy Trading	0.00	0.00	0.00	0.03	0.03	0.04
Noble Group	0.19	0.20	0.20	0.29	0.23	0.29
Olam	0.10	0.21	0.27	0.24	0.32	0.36
Shell Trading International	0.00	0.00	0.00	0.06	0.06	0.07
Trafigura	0.06	0.07	0.08	0.08	0.10	0.13
Vitol	0.05	0.05	0.08	0.07	0.08	0.05
Wilmar	0.54	0.54	0.45	0.41	0.40	0.43

Two things stand out. First, firms fall into two basic categories. One set of firms, consisting of companies including the ABCD firms, is relatively asset intensive. The other set, consisting primarily of oil traders (and oil and metals traders) are much less asset intensive. The disparities can be extreme, with some trading firms having virtually no fixed or long-term assets, and some other firms commonly categorized as traders having nearly 50% long-term physical assets.

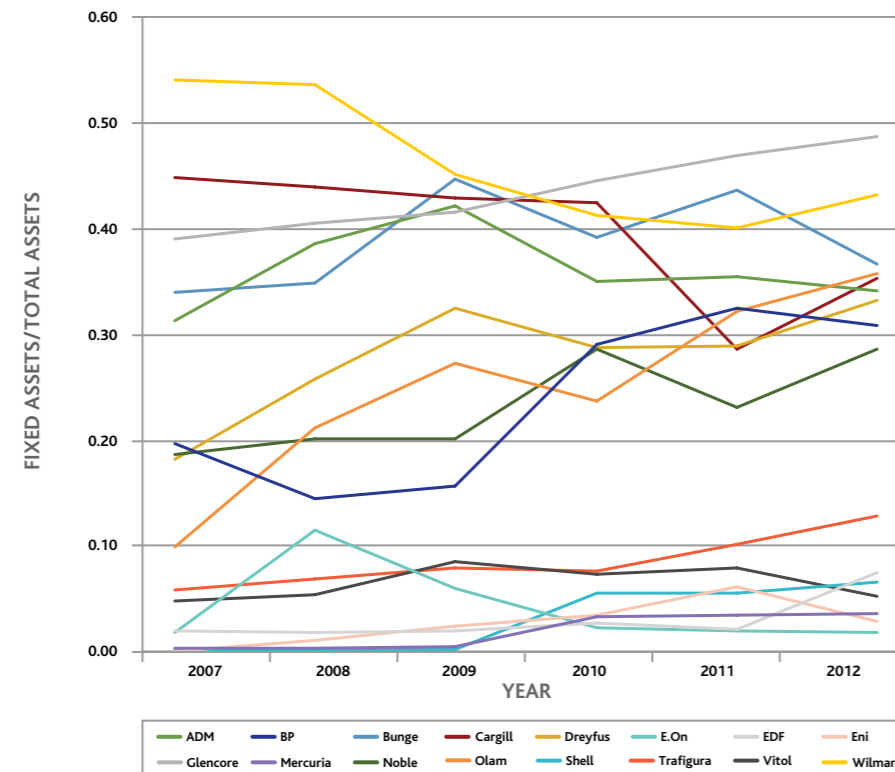
Second, there is an upward trend for some firms, but not uniformly across all the firms in the sample. Among the ABCD firms, ADM and Bunge have exhibited relatively stable ratios, Cargill's ratio has actually fallen, but Louis Dreyfus's has increased. For Asia-based firms,

² Fixed assets divided by revenues is another measure of asset intensity. Traditional trading firms tend to have large revenues, because their business consists of continuous buying and selling of commodity inventories, but involves little investment in fixed assets. The data on this measure exhibit similar patterns to those for fixed assets relative to total assets, so I do not separately report them.

Patterns of asset ownership are very diverse

Fixed assets/total assets measures asset intensity

FIGURE 1
FIXED ASSETS DIVIDED BY TOTAL ASSETS AT COMMODITY TRADING FIRMS



Wilmar has become less asset-intensive, but Olam and Noble have become more asset-intensive. Glencore was becoming more asset intensive even before its acquisition of Xstrata.

There is a similar diversity in trends among the traditional traders who are less asset-intensive. Mercuria has increased its intensity somewhat, though that level remains relatively small, while Vitol's intensity increased, then in 2012 decreased back to its 2007 level.³ In contrast, Trafigura's asset intensity more than doubled between 2007 and 2012 (and has more than tripled since 2006).

Thus, it is incorrect to say that commodity trading firms have uniformly become more asset-intensive. Some have, but some have not. In this, as in so many other things examined herein, there is considerable diversity among trading firms.

B. ASSET OWNERSHIP BY COMMODITY TRADING FIRMS

As the data on fixed assets suggests, there is substantial variation in asset ownership across commodity trading firms. This is further demonstrated by a more detailed examination of specific trading firms. Some firms own assets at all stages of the value chain—upstream, midstream, and downstream. Some have investments at all stages for some of the commodities they trade, but in only one or two of the stages for others.

This finding is documented in graphical form in Appendix B for a selection of major companies. There is a chart for each company that indicates its activities in 13 major commodities. Four types of activity are considered: pure trading (with no asset ownership); upstream (which includes ownership of mines, oil wells, and agricultural land); midstream (which includes storage and terminals); and downstream (which includes processing and refining). A solid dark blue box for a particular commodity and activity indicates that the company owns physical assets for that commodity-activity pair.⁴

One generalization is that all major commodity trading firms own midstream assets, such as storage facilities and terminals, although some firms participate in some commodity markets purely as traders, with no asset ownership. Moreover, some of the increased asset

intensity documented above is driven by increasing investments in midstream assets. As will be discussed in more detail below, there are strong economic reasons for trading firms to invest in such assets: by doing so, they reduce transactions costs. Moreover, the increasing availability of information about prices and flows has increased the transaction cost reduction-related benefits of midstream asset ownership. Generalizations are more difficult to make about upstream and downstream assets. Hence, the analysis is inherently more case-by-case. Given the complexity of the markets, I will focus on a few representative cases to illustrate some of the factors at work.

Another generalization is that trading firm asset ownership cannot be viewed in isolation. Especially in energy, commodity firms are acquiring assets that other firms are divesting for strategic reasons. Thus, understanding patterns and trends in commodity trading firms requires an understanding of patterns and trends in other companies, such as large oil companies.

I now consider trading firm investments in midstream, downstream, and upstream assets.

Midstream Investments. Commodity merchandisers have long invested in midstream assets such as storage facilities and terminals. Historical data and systematic statistics are lacking, but some documentation dating back to the early-20th century illustrates this point. The Federal Trade Commission's (FTC) Report on the Grain Trade analyzed terminal and country grain marketing around 1920. With some alarm, the FTC documented that merchandisers tended to control terminal grain elevators, country elevators, and grain export facilities. It noted that 80% of terminal elevator capacity was owned by "private dealers in grain."⁵ Even ostensibly "public" elevators that stored grain for third-parties were largely owned by grain dealers, and they utilized this capacity in their merchandising activities. With respect to country elevators and warehouses, the FTC found that 35% were "line elevators" owned and operated by large grain merchants.⁶

As noted above, this continues to be the case in the grain and cotton trades today. The major agricultural trading firms own storage and logistical facilities.

Transactions costs economics sheds considerable light on the need for trading firms to control storage facilities and terminals. Specifically, the concept of "temporal specificity" is of particular relevance for midstream assets.⁷ A temporal specificity exists when even a short delay in obtaining (or selling) a good imposes a large loss on the buyer (or seller). Under these circumstances, the seller (or buyer) has considerable bargaining power that he can exploit. Moreover, the wide bargaining range induces wasteful haggling, that sometimes results in a failure to complete what would have been a mutually beneficial transaction.

This is perhaps best illustrated by a commodity trading example, namely, storage. One of the main functions of commodity storage is to smooth out supply and demand shocks: the amount of a commodity in store should go down (or up) when demand is unexpectedly high (or low), or supply is unexpectedly low (or high).⁸ These shocks occur continuously, and particular in volatile market conditions can be large in magnitude. Optimal utilization of storage capacity requires timely response to these shocks.

Consider a firm that has put a commodity in store in a facility that it does not own, or control under some contract or lease. There is an increase in demand, making it optimal for the firm to take the commodity from storage and sell it (or consume it itself). The operator of the storage facility realizes that the value of the commodity to the customer is maximized if the customer can access it quickly to respond to the demand shock, and is worth less if access is delayed. This gives the storage facility operator the ability to extract some of this value by threatening to delay performance. Although the terms of the storage contract may attempt to preclude such conduct, contracts are incomplete (i.e., all contingencies cannot be set out in the contract, leaving room to attempt to evade performance by taking advantage of one of these contractual gaps), and are costly to enforce (meaning that the storer might prefer to capitulate to the storage operator's demand rather than go to court). Moreover, since timely access to the stored good is essential and getting the contract

All major firms own midstream assets

Trading firm asset ownership cannot be seen in isolation

Trading firms want to control delivery and reduce transactions costs

⁵ Federal Trade Commission, *Report on the Grain Trade, Volume III: Terminal Grain Marketing (1921)* at 7.

⁶ Federal Trade Commission, *Report on the Grain Trade, Volume I: Country Grain Marketing (1921)* at 41.

⁷ For a discussion of temporal specificity, and an application of the concept to the study of a particular market, see Stephen Craig Pirrong, *Contracting Practices in Bulk Shipping Markets: A Transactions Cost Explanation*, 36 *Journal of Law and Economics* (2003) 937.

⁸ Craig Pirrong, *Commodity Price Dynamics: A Structural Approach* (2011).

³ Data on Vitol is available going back to 2003. Its asset intensity decreased by almost 60% (from .11 to 0.5) from 2003 to 2007, before increasing in 2008-2011 and then turning down.

⁴ I made determinations as to whether a company owned assets in a particular activity-commodity pair based on an examination of the websites of private companies (e.g., Cargill, Louis Dreyfus, Vitol) and an examination of annual reports and websites for public companies (e.g., ADM, Glencore).

Some (but not all) firms are getting more asset intensive

There are strong economic reasons for traders to own midstream infrastructure

enforced is likely to be time consuming, capitulation becomes a more reasonable alternative.⁹

These problems can be avoided if the firm that stores the commodity controls the storage facility, either by owning it, or obtaining control via a long-term contract or lease arrangement that is not subject to opportunistic conduct by the asset owner or user. This logic can explain the phenomenon noted by the FTC almost a century ago: the decline in “public” warehousing and merchandiser ownership (or control) of storage facilities. It can also explain the ownership (or control by lease/contract) of storage facilities across major commodities by trading firms.¹⁰

Similar arguments obtain for other fixed logistic assets, such as terminals. Executing an arbitrage transaction frequently requires unpredictable, rapid and timely access to such an asset, and this creates a temporal specificity that the asset operator can exploit to extract a supercompetitive price from the firm attempting to execute the arbitrage. If the firm executing the arbitrages owns the asset, however, such a “holdup” cannot occur.

It should be noted further that the possibility for such holdups reduces the incentive to seek out arbitrage opportunities, because the operator of the logistics facility can extract some of the value that the arbitrageur’s efforts create. If the arbitrageur owns the asset, however, it can capture fully the value of the arbitrage, and therefore has a stronger incentive to seek out and exploit such value-enhancing transactions.

Not all logistic assets are equally susceptible to temporal specificity-related holdups. Standardized bulk ships (or tankers) operating on heavily-trafficked routes are relatively immune, for instance. If a carrier attempts to hold up a shipper, the shipper can readily find another carrier: competition sharply mitigates the potential for a holdup.¹¹ However, fixed logistic assets for which there are few alternatives are more susceptible to this problem. Thus, one expects that commodity traders need not own standardized bulk carriers or tankers, but have a far stronger incentive to own terminals or storage facilities. This prediction is largely borne out in practice.

The analysis also has implications for the factors that cause changes in the incentive for trading firms to integrate into ownership of logistic assets. The more fleeting are arbitrage opportunities, the more acute are temporal specificities and the greater incentive to integrate. Recent developments in some commodity markets, notably the oil market, are consistent with this prediction. Due to information technology, greater ability to monitor the activities of competing traders (e.g., by tracking vessel movements in real time), and the substantial increase in price transparency in the energy markets,¹² the duration of arbitrage opportunities has declined substantially. Immediate access to logistic assets and storage facilities is therefore more valuable for firms that are primarily engaged in executing arbitrages. This helps explain increased investment of traditional trading houses in midstream logistic assets and storage facilities, which is a major driver of the increased asset intensity of some of these firms.

Supply and demand shocks in the commodity markets can increase the demand for midstream infrastructure that is needed to facilitate commodity flows. Moreover, the needed new infrastructure often exhibits characteristics that makes it economical for those that are going to utilize it, build it and own it, at least for some period. In particular, the infrastructure often exhibits substantial scale economies at efficient scale, and due to these scale economies infrastructure assets may be geographically dispersed, with only a small number of facilities serving a particular tributary territory. Moreover, it is often specialized to optimize its efficiency. Furthermore, it is fixed to a specific location: in the language of transactions cost economics, it is “site specific.” Finally, some traders control flows of the commodity sufficient to utilize a large fraction of the asset’s capacity.

All of these factors create the potential for serious opportunism problems if the major users of the new assets (traders controlling commodity flows) do not own them.¹³ Specialization of the asset, site specificity and scale economies that make it efficient for a single piece of infrastructure to serve a substantial portion of the commodity flows for a large region, and the fact that large traders control flows of the commodity that can utilize a substantial fraction of the asset’s capacity mean that bargaining and contracting hazards arise if the

⁹ *The ongoing controversies about long load-out times and alleged opportunistic behavior by industrial metals, coffee, and cocoa warehouse operators that offer public storage (usually as warehouses regular for delivery under futures contracts) illustrates the potential for conflicts between those who store commodities in warehouses they do not own and the owners of these facilities.*

¹⁰ *It also sheds light on current controversies in LME warehousing.*

¹¹ *My article on contracting practices in bulk shipping markets goes through this argument in detail.*

¹² *Jan Ascher, Paul Laszlo, Guillaume Quiviger, Commodity trading at a strategic crossroad, McKinsey Working Papers on Risk, No. 39 (2012).*

¹³ *For a detailed analysis of these issues, see Oliver Williamson, The Economic Institutions of Capitalism (1985).*

trader that controls the commodity flows does not control the asset. If the parties attempted to deal through a long term contract, the asset owner could attempt to evade performance under the contract to extract a better deal from the trader: the trader may find it better to agree because alternative ways of moving the commodity are substantially more costly (because they are out of position relative to the trader’s commodity flows, or not optimized to meet the trader’s needs). Similarly, the trader could threaten to evade performance by diverting its flows elsewhere, unless the asset owner makes concessions. If the trader controls a substantial fraction of the flows that use the asset, if it carries through on the threat the asset will operate well below capacity, meaning that the asset owner may feel compelled to make concessions in order to avoid idling the bulk of the facility. Thus, the combination of traders that control large commodity flows, with assets that are specialized to facilitate those flows and which must operate at scale, creates the conditions for ongoing and wasteful disputes between the trader and the asset owner. This problem can be eliminated if the trader owns the asset.

These considerations are an important driver of the increased asset intensity of some trading firms that was documented above. Trafigura provides several examples. Consider the Burnside Terminal on the Mississippi River in Louisiana. The shale gas boom in the United States, and the resulting decline in natural gas prices, has substantially reduced the demand for coal for electricity generation in the United States. This freed substantial quantities of coal for export, but there is inadequate infrastructure to accommodate an increase in export flows. Trafigura determined that the Burnside Terminal is ideally placed to alleviate this bottleneck, but that this required a substantial investment to upgrade the facility and optimize it for use as a coal (and also alumina and bauxite) terminal. The asset is specialized, of large scale, site specific, and there are few nearby facilities capable of handling its volumes. Moreover, Trafigura, as a major trading firm, efficiently markets coal internationally in sufficient quantity to utilize a substantial fraction of the capacity of the facility. The transactions cost economics considerations discussed above make it efficient for Trafigura to own the asset.

Similar considerations pertain in Corpus Christi, where the shale oil boom in Texas created the need for substantial amounts of new, specialized terminal capacity; in Colombia, where existing infrastructure is inadequate to handle increased oil and coal output, and the needed infrastructure exhibits scale economies and is site specific, and where Trafigura controls large flows of coal and oil; and Peru, where large-scale, specialized storage, blending and terminal facilities are required to handle large flows of concentrates marketed by Trafigura.

Thus, Trafigura’s increased physical asset intensity is concentrated in logistics assets needed to handle large volumes of new commodity flows caused by large changes in supply and demand patterns. Transaction costs considerations make it efficient for the firm, which handles large flows of the commodities, to own the infrastructure assets scaled and specialized to handle these flows.

Although Trafigura provides an excellent illustration of the economic factors that can drive increased investment in midstream assets by trading firms, it is by no means the only one. Another example is Brazil, where existing infrastructure on the Amazon is insufficient to handle the increased production of soybeans in tributary regions that can be exported to China. Trading firms, including all of the ABCD firms, are making large investments in handling and storage facilities on the river, and will own and operate these assets (in some cases in joint ventures with Brazilian firms).

In sum, commodity trading firms have always owned and operated midstream assets, like terminals, blending facilities, and storage facilities. The nature of these assets makes it efficient for firms merchandising large commodity flows to own them: this reduces transactions costs. Moreover, major changes in supply and demand patterns have led to the need for new infrastructure, which large commodity trading firms have accommodated through investment and ownership, thus increasing their fixed asset intensity.

This increased intensity is sometimes explained as the result of commodity trading firms investing in assets that offer “optionality.” This explanation is incomplete. Optionality (defined as adjusting the use of the asset in response to unexpected supply and demand shocks and the associated relative price changes) is a necessary condition for ownership of an asset, but not a sufficient one. Bulk cargo ships and tankers offer substantial optionality (in terms of routes and sometimes cargoes), but a trading company does not need to own a bulk carrier or tanker to exploit that optionality because ships are mobile, and because there are competitive charter markets with large numbers of buyers and sellers: a trader can exploit a ship’s flexibility and optionality by chartering it when needed. Many infrastructure assets, in contrast, are sufficiently unique (in terms of location, configuration, size, etc.) that

Owning midstream assets creates transactions cost efficiencies for Trafigura

Trading firms invest downstream in emerging economies and developing markets

something analogous to a ship chartering market is not feasible. For these assets, ownership is necessary to exploit their optionality efficiently.

Downstream Assets. One of the notable developments in energy markets in recent years is the integration of some large trading firms into the fuel and lubricants retail, distribution, and downstream distribution businesses. Puma Energy, originally a wholly-owned subsidiary of Trafigura, owns and operates fuel storage and marketing businesses (involving distribution, retailing and wholesaling) in 40 countries in Africa, Latin-America, North-East Europe, the Middle East, Australia, and Asia. As another example, Vitol's Vivo joint venture (with Helios Investment Partners and Shell) distributes and markets fuel in Africa.

The downstream activities of trading firms are primarily concentrated in emerging markets, or rapidly developing regions of advanced countries.¹⁴ These markets tend to be relatively small, and have underdeveloped infrastructures and therefore require additional investment. Moreover, local capital markets are relatively undeveloped. The market sizes are insufficient to support a large number of efficiently-scaled retailers, wholesalers, and distributors (as is the case in far larger markets, such as the United States). If these businesses were operated separately, it is likely that firms at each segment of the marketing chain would have market power, leading to potential for multiple monopoly markups and the potential for opportunistic behavior if firms in the different segments attempted to use long term contracts to mitigate the markup problem. These factors tend to make vertical integration more efficient than separate ownership of retail, wholesale, and distribution segments.

Further, markets in these countries tend to be highly regulated, and often adopt price controls. In some, the quality of governance is poor. It is well known that such conditions tend to favor vertical integration.¹⁵

Economic considerations therefore strongly favor the integration of midstream and downstream functions in fuel markets in emerging economies, and these activities have historically been integrated in these markets. The previous owners were the oil majors, and the integration of trading firms into this sector is the flip side of the exit of the majors. Majors have been becoming less integrated generally because returns in downstream businesses do not compare favorably with those that can be earned in the very capital-intensive upstream exploration and production activities. Trading firms that can efficiently supply inputs into the downstream markets in emerging economies are the natural buyers for these businesses. So the tale of vertical integration by commodity traders is also very much a story of disintegration by oil majors.

Recently some traditional trading houses (including Gunvor and Vitol) have acquired oil refineries. These acquisitions are again to a considerable degree a reflection of developments in the broader oil industry, in particular the serious erosion in refining economics in Europe. One major refiner, Petroplus, went bankrupt, and the financial performance of European refineries generally has led refiners to shed capacity. Some of this capacity has been idled: from 2006 to 2013, European refining capacity (crude distillation units) declined 7.5%. Trading firms have found it economical to purchase and operate some of the capacity that was no longer sufficiently profitable for traditional refiners to retain.

The major agricultural trading firms that merchandise grains and oilseeds also process these commodities. For instance, Cargill and ADM process wheat, corn, and soybeans. Bunge processes soybeans.

Processed agricultural products are typically marketed to a large, diverse, and geographically dispersed group of customers. Efficient performance of this marketing function requires the same skills and resources required to merchandise unprocessed agricultural products, including most notably expertise in logistics. Further, expertise in sourcing, storing, and transporting unprocessed agricultural products can be utilized to acquire efficiently inputs for processing operations. Thus, there are complementarities between merchandising of unprocessed and processed agricultural products, providing an incentive for trading firms to engage in processing. Moreover, there can be benefits of centralizing risk management across processing and merchandising activities (for both processed and unprocessed products). This provides an additional reason for firms to engage in both marketing and processing.

Upstream investments. There are some instances of upstream integration in agricultural products. Olam and Wilmar own palm oil plantations, and Cargill recently announced an investment in a major Ukrainian agricultural producer, UkrLandFarming. Again, transactions

costs economics explains how these decisions can increase value. The plantations are large (due to scale economies), and obviously site-specific, and Olam and Wilmar market large quantities of oil: ownership avoids the inefficiencies that arise from bilateral monopoly.¹⁶ It should also be noted that the companies own and operate processing facilities on the plantations. Again, this makes sense from a transactions costs economics perspective. Similar considerations obtain in the case of Cargill and UkrLandFarming. The inefficiencies of having a large buyer and a large seller dealing at arms length can be mitigated if the buyer has an ownership stake in the seller (or vice versa).

Integration upstream has been more common in energy and industrial metals. For instance, Glencore (especially with its merger with Xstrata) has become in effect an integrated mining company. Mercuria has upstream oil and coal assets, and Vitol owns upstream oil assets as well. Trafigura owns mines in Spain and Peru, and recently sold off another in Peru that it had owned since 1997.

Transactions costs considerations again explain some of the benefits of integrating processing and marketing operations. Repeated negotiation of short term agreements between the operator of a mine, say, and a trading firm that is capable of marketing all (or a large fraction) of its output is likely to be costly because of the small numbers bargaining problem inherent in this situation. Integration can avoid that problem.

That said, there are means other than ownership to achieve similar economies. For instance, a trading firm can enter into a long-term off-take agreement that avoids the costs associated with repeated negotiations between a mine owner and a trading firm. Although such long-term contracts are potentially vulnerable to opportunistic behavior by both the producer and the trading firm/buyer, the ubiquity of these off-take arrangements demonstrates that these contractual hazards can be surmounted economically. Indeed, off-take agreements are a more common way than ownership for commodity firms to acquire commodity flows on a long-term basis from producers.

The case of Trafigura provides some insight into factors that can make ownership of an upstream asset like a mine efficient. Trafigura has acquired considerable technical expertise in mining and extraction industries. By purchasing a mine in need of additional investment, Trafigura can utilize that expertise: the well-known difficulties of selling information or expertise often make it more efficient for the party with the expertise to make the investment, rather than provide that information at arms length to a mining company.

Trafigura's investment in the Aguas Teñidas Mine (MATSA) in southern Spain is an illustration of this. Further, its purchase of, investment in, and subsequent sale of Compania Minera Condestable SA in Peru suggests that it is the transfer of expertise, rather than synergies between operation and marketing that can be decisive in making ownership of an upstream asset optimal for a trading firm. Trafigura purchased the firm in 1997, and utilized its expertise to improve its efficiency and extend its life. After 16 years of ownership, the mine had achieved such a level of efficiency that Trafigura's expertise was no longer as necessary, so the company sold its 99% stake to a private mine operator. Importantly, as part of the sale, Trafigura entered into a life-of-mine off-take agreement for 100% of the mine's production. This strongly suggests that the reason for ownership was that this was the efficient way to transfer technical expertise and management investment in capacity expansion, and that ownership was not necessary to secure and market the mine's output efficiently.

Commodity Trading Firms and Vertical Disintegration in Commodity Markets.

Although much public discussion of commodity trading firms focuses on their increasing integration, it is important to note that commodity trading has also contributed to vertical disintegration. As pointed out by Coase long ago, markets and firms are different ways of carrying out transactions.¹⁷ When markets become cheaper to use, some transactions that used to take place within vertically integrated firms (e.g., the supply of crude oil to a refinery) can be undertaken in markets instead, and the upstream and downstream parts of the firm can be separated. By facilitating liquid, competitive markets in crude oil and refined products, commodity trading firms made it more economical to carry out many transactions that had taken place within integrated firms on markets instead. The rise of refining independents and the retreat of oil majors from refining reflects in large part the efficiencies created by commodity trading firms.

¹⁶ Note that upstream integration into agricultural production is most common in crops that are produced at scale on large plantations (e.g., palm oil), and virtually unknown in crops (e.g., corn) that are grown by large numbers of relatively small producers.

¹⁷ Ronald Coase, *The Nature of the Firm*, 4 *Economica* (1937) 386.

Energy and metals traders integrate upstream

Commodity trading generates market efficiencies

¹⁴ For a detailed analysis of these issues, see Oliver Williamson, *The Economic Institutions of Capitalism* (1985).

¹⁵ George Stigler, *The Organization of Industry* (1968).

VI. SYSTEMIC RISK AND COMMODITY TRADING: ARE COMMODITY TRADING FIRMS TOO BIG TO FAIL?

SUMMARY

For CTFs to pose a systemic risk three factors must be present:

1. There must be a risk of a large triggering shock.
2. There must be a risk that the shock propagates through the financial system via contagion or chain reaction.
3. The financial disruption must affect the broader economy.

CTFs are unlikely to be a source of systemic risk for several reasons:

- Even the largest commodity firm is significantly smaller than the major banks.
- Commodity firms' balance sheets are far more robust.
- Commodity firms are not an important source of credit.
- There is relatively low market concentration among commodity firms.
- The assets used in commodity trading can be redeployed relatively easily.
- The economics of commodity trading help to insulate the industry from the effects of a large economic downturn.
- Trading firms provide logistical services. Recent history demonstrates that even large disruptions to logistical networks have limited economic impact.
- There have been numerous recent failures in trading firms, which have had no impact on the broader financial system.

A. INTRODUCTION

After decades of operating in relative obscurity and out of the glare of publicity, in recent years commodity trading firms have received much more public scrutiny. Since the Financial Crisis in particular, some (including some regulators) have questioned whether commodity trading firms pose risks to the financial system analogous to banks, and hence should be regulated similarly to banks.¹ Most notably, in 2013 the Financial Stability Board (FSB) requested national and regional regulators to establish whether commodity trading firms required additional regulation, including initially additional regulatory reporting and financial disclosures.² In 2012, the FSB's Timothy Lane opined that trading firms might be systemically important.³ In public discussion, including many articles in the media, the issue has been framed as "are commodity firms too big to fail?"

An evaluation of this issue first requires a definition of "systemic risk" and an understanding of what kinds of financial institutions are likely to be systemically important ("systemically important financial institutions" or "SIFIs"). These terms are widely used, but not always consistently so. Therefore, it is essential to define the terms. I will use a definition provided by then Federal Reserve Chairman Ben Bernanke in a letter to Senator Bob Corker in 2009: "Systemic risks are developments that threaten the stability of the financial system as a whole and consequently the broader economy, not just that of one or two institutions." Stanford Professor John Taylor advances a three-part test to determine whether systemic risk exists, and the analysis that follows adheres to this test. Taylor says for a risk to be systemic, (1) there must be a risk of a large triggering shock (such as a natural disaster or the failure of a firm or firms,) (2) there must be a risk of the shock propagating through the financial system via contagion or chain reaction, and (3) the financial disruption must affect the broader macroeconomy.⁴

¹ Alexander Osipovich, *Commodity trading firms face questions over systemic risk*, *Energy Risk*, 20 September 2013.

² Emma Farge, *Commodity traders could face regulation for role as lenders*, *Reuters* 1 May 2013.

³ Timothy Lane, *Financing Commodity Markets: Remarks Presented to the CFA Society of Calgary*, 25 September, 2012.

⁴ John B. Taylor, *Defining Systemic Risk Operationally*, in George Schultz, Kenneth Scott, and John B. Taylor (eds.) *Ending Government Bailouts as We Know Them* (2009).



Systemic risks threaten the financial system and the broader economy

Commodity trading firms are not a source of systemic risk

The FSB has a similar definition.⁵ It identifies three crucial criteria for assessing systemic risk: size, substitutability (i.e., the ability of other firms or entities to provide the services previously supplied by a failed firm), and interconnectedness.

B. ANALYSIS OF THE SYSTEMIC RISK OF COMMODITY TRADING FIRMS

Given these definitions, and the broader economic literature on systemic risk (especially the literature that has developed in the aftermath of the recent Crisis), an analysis of commodity trading firms indicates that they are not a potential source of systemic risk, and hence do not warrant being regulated in ways similar to SIFIs. Several considerations support this conclusion.

Commodity firms are not really that big, especially in comparison to major banks.

The assets of Glencore, the largest commodity trading firm, (which has evolved into a very asset heavy mining firm, more comparable to a Rio Tinto or BHP than a Vitol or Trafigura, or even an ADM) total slightly more than \$100 billion, which ranks it approximately 240th of world publicly traded corporations in terms of assets. If Cargill, the second largest trading company in terms of assets, were publicly traded it would rank approximately 450th in terms of assets. Comparing just to major banks, Glencore's assets are approximately equal to the 60th largest bank (by assets) in the world. The banks of similar size include Bank Leumi and Bank Hapoalim, hardly household names outside their home countries. Cargill is comparable in size to the 65th largest bank in the world.

Focusing on SIFIs, the median European SIFI bank has assets of \$1.3 trillion, and the median US SIFI bank has assets of \$1.18 trillion. Thus, most banks that have been designated as SIFIs have assets that are an order of magnitude larger than the largest commodity trading firms, and two orders of magnitude larger than most commodity trading firms. Thus, the financial distress of even the largest commodity trading firm, or even several of them, would be unlikely to have the same disruptive impact on the financial system as the collapse of a middling-size major bank, let alone a behemoth like Deutsche Bank or JP Morgan.⁶

The balance sheets of trading firms are not fragile in the same way that banks' balance sheets are. The analysis of commodity trading firm financing in Section IV demonstrates several salient features that bear on the potential systemic risk arising from the financial distress of a trading firm.

First, in comparison to banks in particular, commodity trading firms are not heavily leveraged. Whereas large bank leverage ratios (measured by book value of assets divided by book value of equity) range between 9 and 14 for US SIFI banks (with a median of 10), and between 9.6 and 37 for European SIFI banks (with a median of 22), the median leverage for commodity trading firms I have examined is 4. Moreover, focusing on net debt, many commodity trading firms are not leveraged at all because current assets exceed total liabilities: since most of these current assets are highly liquid (e.g., hedged commodity inventories) net debt is better indication of leverage because commodity firms can sell the current assets to raise cash to pay off liabilities.

Second, the most important factor contributing to financial crises throughout history is the fact that banks engage in "maturity transformation", but commodity trading firms do not. Maturity transformation occurs when banks (or shadow banks) issue short-term liabilities to fund long-term assets. This requires the banks to rollover debts almost continuously in order to fund their assets. When lenders suspect that a bank, or the banking system in general is financially unsound, they may not agree to rollover the bank's (or banks') short-term debts as they come due. This renders the bank (or banks) unable to fund their operations, and they collapse. Indeed, balance sheet data indicates that major banks do engage in such maturity transformation.

In stark contrast, as noted in Section IV, commodity trading firms do not engage in maturity transformation. Indeed, the short-term assets of all commodity trading firms analyzed (which includes the largest) exceed their short-term liabilities.

Moreover, the character of assets differs substantially between banks and commodity trading firms. Many bank assets that are funded with short-term liabilities are highly illiquid, meaning

that if banks attempt to dispose of assets to de-lever when they face funding stresses, they will have to dispose of these assets at fire sale prices. Moreover, since many banks have similar assets on their balance sheets, fire sales by one bank can reduce the values of similar assets held by other banks, which can put them under financial strain, leading to further fire sales. This vicious cycle is characteristic of financial crises.

In contrast, relatively liquid assets (e.g., hedged inventories, trade receivables) predominate on commodity trading firm balance sheets. As a result, the fire sale problem is mitigated. Indeed, many of the short-term liabilities of commodity trading firms are secured and self-liquidating: for instance, a transactional credit issued to purchase an oil cargo is secured by that cargo, is paid off as soon as the cargo is sold, and is not subject to commodity price risk because the bank requires the commodity trading firm to hedge.

Even the non-traditional forms of financing employed by some commodity firms, which have been considered to be a form of "shadow banking" do not have the problematic features of the liabilities that caused severe systemic problems during the Financial Crisis. The liabilities that proved toxic during the Crisis (e.g., asset backed commercial paper) were used to fund long-term illiquid assets. In contrast, facilities like Trafigura's securitization of trade receivables issue liabilities with maturities that are typically greater than the maturities of the securitized assets. Moreover, these assets tend to be of high quality: as discussed in Section IV, default rates on trade credit tend to be very low.

Commodity trading firms are not even remotely as important as issuers of credit as banks. One reason that bank failures can be systemically catastrophic is the central role of banks in the supply of credit. If banks fail, or become financially distressed in large numbers, they reduce the amount of credit that they supply, which reduces investment and consumption (especially of durable goods) in the economy. As noted above, commodity trading firms do issue credit to commodity consumers and producers (in the form of prepayments, for instance), but ultimately the source of the bulk of this credit is banks. Commodity trading firms commonly purchase payment guarantees from banks when they extend credit to customers: in the case of Trafigura, approximately 80% of the credit it extends is backed by payment guarantees or insurance from banks. Thus, banks bear the bulk of the credit risk, and hence are ultimately the source of credit; the trading firms are basically conduits between banks and customers. To the extent that a particular trading firm has a comparative advantage in serving as a conduit to some customers (because, for instance, its knowledge of the customers' business allows it to monitor them more effectively), the firm's failure would impair the flow of credit to its customers. But there are alternative ways of providing this credit (other trading firms can step in the breach, or the customers can borrow directly from banks), and this mitigates the impact of the failure of the individual firm.

For many commodities, especially the most important ones, there is relatively little concentration among commodity trading firms. To illustrate the contrast, in the crude oil market, two of the largest traders (Vitol and Trafigura) each account for about 6% of freely traded oil. Glencore accounts for approximately 3%, and Mercuria 3%.⁷ Concentrations are somewhat higher in metals Glencore trades about 60% of freely traded zinc (although the termination of its off-take agreement with Nyrstar under terms imposed by the European Commission to secure approval of its purchase of Xstrata will reduce this concentration); 50% of freely traded copper; and 22% of freely traded aluminum.⁸ The company also accounts for a large fraction—approximately 28%—of the global thermal coal trade. Thus, the non-ferrous metals markets are more concentrated and hence more susceptible to a single trading firm's distress, than the oil market.

It is important to note that concentration is small in commodities that represent a relatively large fraction of trade, and that the markets in which concentration is sometimes large represent very small fractions of trade. For instance, depending on the region, oil represents between 3 and 10% of imports. This is an appreciable fraction, but concentration in oil trading is quite low, with the largest firms handling only around 6% of trade.

⁷ These figures are from reports on these companies' websites.

⁸ These figures are derived from Glencore's IPO Prospectus. Glencore utilizes publicly available data and its own estimates to determine the "addressable" quantities "that are available to a third party marketer such as Glencore." For instance, commodities produced and consumed by a vertically integrated firm are excluded from the calculation. Domestic Chinese production is also excluded, as are volumes sold directly from a producer to an end-user without use of an intermediary. As an example, when calculating its share of thermal coal trade, Glencore utilizes seaborne volume of 692 million MT, out of a total world output of 4,556 m MT. The "addressable" market is typically far smaller than total global output. Based on total global output, Glencore calculates its market share to be 13% for zinc, 10% for zinc concentrates, 7% for copper, 4% for copper concentrates, 8% for alumina, 9% for aluminum, and 4% for thermal coal. Glencore considers the total oil market to be accessible to traders.

They're not major credit providers

They mainly operate in fragmented markets

Their balance sheets are much more robust than banks

⁵ Financial Stability Board, Report of G20 Ministers and Governors, Guidance to Assess the Systemic Importance of Financial Institutions, Markets, and Instruments: Initial Considerations.

⁶ In January, 2014 the FSB proposed to use an asset value of \$100 billion as a threshold to determine whether a non-bank financial corporation should be designated as a SIFI. Since such corporations typically have far more fragile capital structures than commodity trading firms, and since most commodity trading firms have assets less than \$100 billion, by the FSB criteria even the largest commodity trading firms are not SIFI.

Assets are redeployable if a firm gets into difficulty

Commodity trading firms are exposed to trading volumes not prices

In contrast, other commodities represent much less than 1% of imports (or exports), meaning that even if one of the dominant firms in a concentrated market were to disappear, the potential effect on overall trade and economic activity would be trivial. This conclusion is reinforced when one examines trade in commodities as a function of GDP: even oil imports are less than 2% of GDP for all regions except Asia, where they are less than 3% of GDP.

This means that the failure of a commodity trading firm is unlikely to disrupt severely the trade in any major commodity. This conclusion is strengthened by the next fact:

The assets used in commodity trading are readily redeployable, meaning that the financial distress of a trading firm has at most a modest impact on the capacity to trade and transform commodities, and then for only a short interval of time.

Much of the physical and human capital deployed in commodity trading is highly re-deployable. In the event of distress of a trading firm, its physical assets and employees can move to other firms. Moreover, insolvency/bankruptcy laws generally facilitate the continued operation of financially distressed firms, so they can continue to provide transformation services even while in financial distress (although perhaps less efficiently, due for instance, to higher costs of funding). These factors limit the duration of the impact of the firm's distress. While redeployment is occurring, or if a firm operates less efficiently while in bankruptcy, customers of the distressed firm will be adversely impacted. This effect will be most acute if the distressed firm has a large share of for a particular commodity or geographic region. However, since such conditions are most likely to occur for smaller-volume commodities and regions (because there is less concentration in the trade of major commodities in major markets), the broader systemic implications of such disruptions will be minor.

The economics of commodity markets and commodity trading means that large economic downturns are unlikely to have a severe impact on the profitability, and financial condition, of commodity trading firms. If commodity trading firms are robust to economic downturns, they cannot be a vector of contagion that communicates the effects of the downturn to its customers and creditors. Economic theory and a variety of data, demonstrate that commodity trading firms are indeed largely robust.

A large economic downturn does lead to a large decline in the demand for most commodities. A decline in demand for a commodity leads to a decline in the demand for some transformations, notably transportation/logistics and processing/refining, but an increase in the demand for others, notably storage. The declines in derived demand tend to result in declines in both volumes and margins, thereby reducing the profitability of the firms that engage in the adversely impacted transformations. To the extent that a commodity trading firm also stores commodities, it benefits from an internal hedge that offsets the losses from supplying transformations in space and time.

The magnitudes of these changes in derived demands depend on the magnitude of the demand shock (and hence the severity of the financial crisis) and the elasticity of supplies of the underlying commodities. Since many commodities are highly inelastically supplied, especially in the short run, the effects on margins and volumes, and hence trading firm profits, can be modest.

Trade data provide some insights onto this source of risk to commodity trading firms. Figures 2 through 5 depict data relating to world exports by commodity. (Data related to world imports by commodity behave similarly, so I only present charts on exports.) Figure 2 graphs nominal exports by commodity reported in the ITC data for 2001-2011. These are indexed to simplify comparative analysis. Note the large downturns in nominal trade volumes in 2009, reflecting the impact of the financial crisis. Due to the large size of oil and steel and iron exports compared to those for other commodities, Figure 3 graphs nominal exports for all commodities except oil and iron and steel. Virtually all commodities exhibit a noticeable dip in 2009.

As noted above, however, although changes in nominal flows reflect changes in both flat prices and quantities, quantities are the major determinants of commodity traders' margins and profits. Figure 4 depicts annual nominal exports for each commodity deflated by its average annual price (scaled so that the 2001 average price equals 1.00) and indexed for comparison purposes. The impact of the 2008-2009 Financial Crisis is much less noticeable in the deflated exports than the nominal exports. Only iron and steel exhibit a pronounced dip. Figure 5 presents the deflated exports for all commodities studied excluding oil and iron and steel. These smaller commodities do not exhibit a pronounced decline in deflated exports (a proxy for quantity) in 2009.

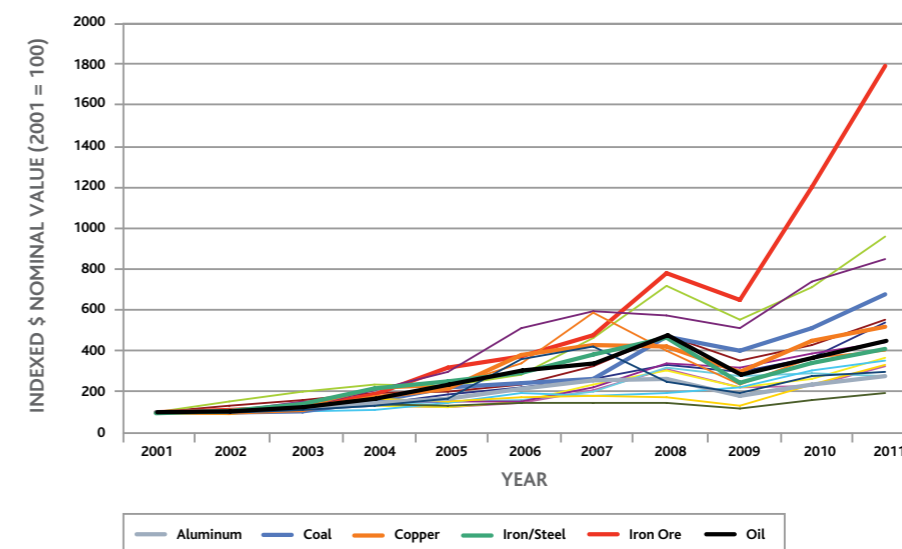
These charts strongly support the conclusion that a large demand shock primarily affects commodity prices, and has a much smaller impact on the quantities of commodities traded. Inasmuch as the profitability of commodity trading firms is primarily driven by quantities (to the extent that these firms hedge price exposures), the risk that a large demand shock (like that experienced in 2008-2009) poses to the viability of commodity trading firms is limited.

Demand shocks arising from a macroeconomic shock such as a financial crisis also affect the funding needs of commodity trading firms. Crucially, adverse shocks of this nature tend to reduce funding needs and liquidity stresses. Adverse demand shocks reduce prices, thereby reducing the amount of capital necessary to carry inventories of commodities as they undergo transformation processes. Moreover, to the extent that commodity trading firms are typically short derivative instruments (which may be marked to market on a daily basis) as hedges of commodity stocks, price declines generate mark-to-market gains on derivatives that result in variation margin inflows. This provides a source of funds to repay credit taken to acquire the inventories. That is, these price declines tend to result in cash inflows prior to obligations to make cash payments, which further ease funding needs of commodity trading firms.

Figures 2-5 illustrate this clearly. The nominal value of virtually all commodities traded declined sharply in 2009, but quantities (as proxied for by deflated exports) did not decline substantially or uniformly across commodities. This decline in nominal trade reflects the pronounced price declines that occurred in late-2008 to mid-2009. Moreover, the sharp decline in the nominal value of a relatively stable quantity of exports means that the financing needed to carry out such exports declined sharply as well.

FIGURE 2

INDEXED NOMINAL EXPORTS BY COMMODITY



The decline in funding needs during periods of sharp demand declines resulting from a shock arising in the financial system is particularly beneficial, inasmuch as financial shocks constrain the availability of credit.

The foregoing analysis implies that trading firms should be relatively robust, even to large shocks emanating from the financial system. This implication is testable, using data from the 2007-2009 financial crisis. I have reviewed data on ADM, Bunge, Cargill, Vitol, Louis Dreyfus, Mercuria Energy Trading, Glencore, Olam, Wilmar, Trafigura, and Noble.

All of these firms remained profitable throughout the 2007-2009 commodity boom-bust cycle. Between 2007 and 2009 (the nadir of the commodity price cycle), net income changes ranged between -57% (Bunge) and 224% (Wilmar) with a median of between 44% (Cargill) and 113% (Noble).

This sample is dominated by firms that are focused on agricultural commodity trading. Glencore is focused on metals and energy, two notably procyclical commodity sectors: its profit declined 24% over the cycle. Trafigura is focused on energy and industrial metals: its earnings rose 85% over the boom-bust cycle. Vitol is another energy-focused trading

Macroeconomic demand shocks reduce trading firms' funding needs...

...which makes them more resilient

FIGURE 3
NOMINAL EXPORTS BY COMMODITY EXCLUDING OIL, IRON & STEEL

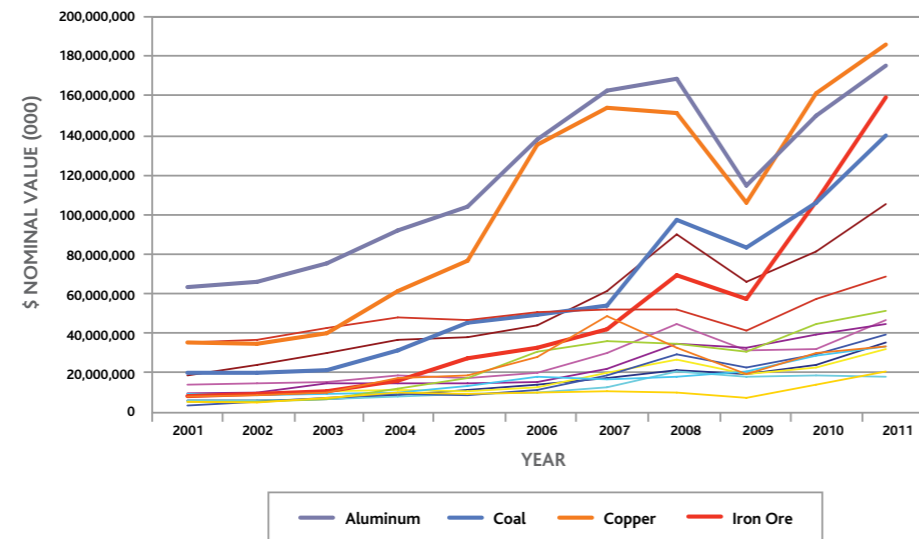


FIGURE 4
INDEXED DEFLATED EXPORTS BY COMMODITY

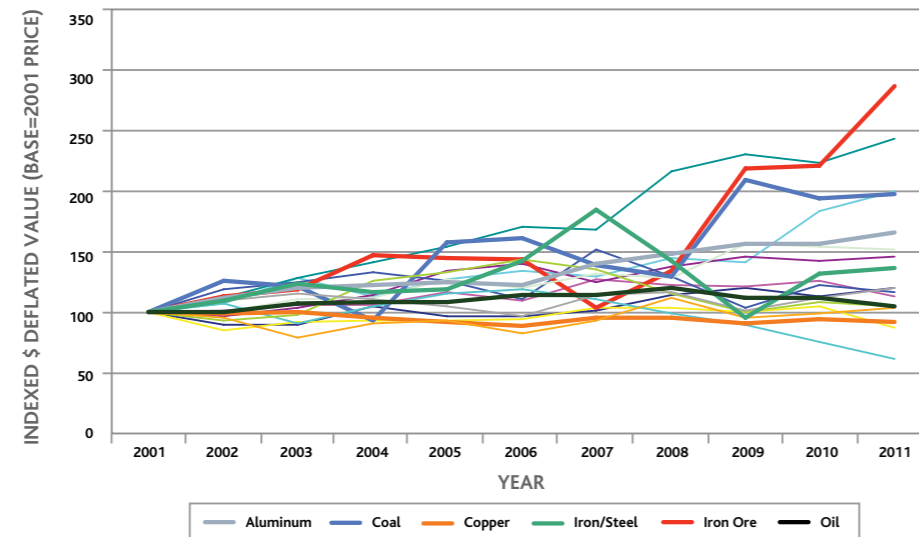
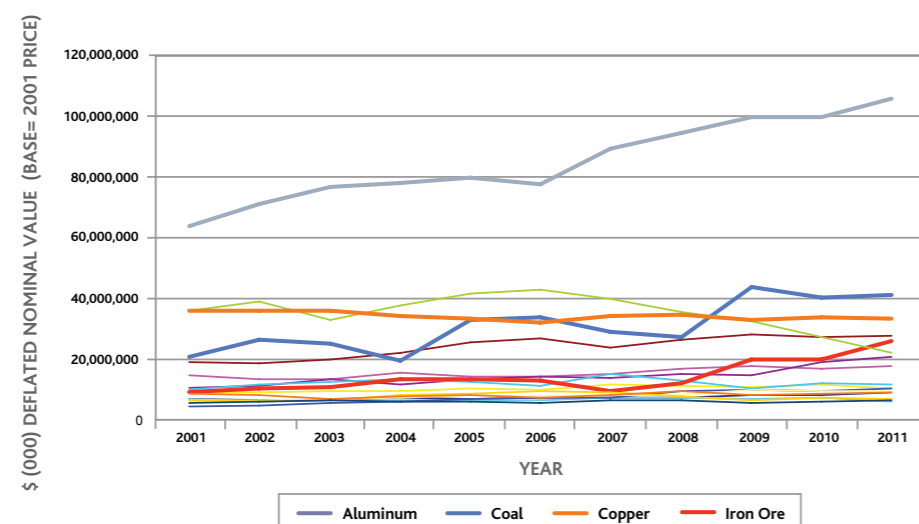


FIGURE 5
DEFLATED EXPORTS BY COMMODITY EXCLUDING OIL & STEEL



firm, and it experienced a 91% increase in income over the cycle. A third energy-focused firm, Mercuria Energy Trading, saw its income rise 122%.

These figures are worth noting, given the substantial rise, decline, and subsequent rise in oil and metals prices over 2007-2009. This performance likely reflects the fact that economic volatility can create arbitrage opportunities, and serious economic downturns can increase the demand for some transformation activities, notably storage.

The variability in performance across the firms for which data is available, with some companies suffering substantial declines in earnings and other substantial rises over the 2007-2009 commodity cycle (and Financial Crisis cycle), is inconsistent with the hypothesis that trading firm financial performance is highly sensitive to global economic conditions. This is in stark contrast to other SIFIs. Trading firms would be more likely to create systemic risk if, like SIFIs, their earnings were highly correlated over the cycle.

This is true of large banks, whose profits collapsed during the Crisis. Total profits for the 8 US SIFI banks plunged from \$58 billion in 2007 to a loss of \$9.8 billion in 2008, and recovered only to \$40 billion the following year. European SIFI banks earned a profit of \$114 billion in 2007, but suffered a loss of \$16.5 billion in 2008, with profits rebounding to \$58 billion in 2009. This performance differs starkly from that of commodity trading firms over this period.

Trading firms provide logistical services, and recent historical experience shows that even large disruptions of the logistical system have very modest effects on the broader economy. As noted throughout, one of the primary functions of commodity trading firms is to make transformations in space and time—logistical transformations. Even if the assets utilized by a distressed trading firm to make these transformations are not redeployed immediately, the impact on the broader economy will almost certainly be minor. Recent experience demonstrates that even a major disruption of the logistical system in a major economic region does not cause an appreciable decline in the world economy. Specifically, the Japanese earthquake and tsunami in 2011 wreaked havoc on the single most important trading region in the world, but this had only very small effects on the world economy. These natural disasters seriously disrupted production at numerous firms that played a central role in global supply chains for high value manufactured output. A report prepared under the authority of the Directorate General of the Treasury of France concluded that:

- *Japan is a key player in global production chains, particularly in high-technology sectors. Japanese firms account for over 70% of global production in at least 30 technological sectors... The triple disaster, which led to a nearly 8% reduction in Japanese products exports in Q2, also caused disruptions to global supply in some sectors, particularly in electronics and the automotive industry.*
- *Japan also plays a key role in Asian trade where production chains are highly integrated. Schematically, Japan supplies sophisticated intermediate goods to and buys final goods from its Asian partners including China, the pivot of the new international division of labor, which performs assembly and transformation of the semi-finished products. Given the network structure of production processes, a shock affecting an upstream producer can cause strong fluctuations in the economy as a whole, through cascade effects from one firm to another.⁹*

Nonetheless, the French Treasury concluded that the effect of the catastrophe on aggregate output was small, even in Asia. It estimates that the effect was 0.1 point of GDP in China and 0.2 percentage points for other "Asian dragons" in Q2 2011. Furthermore, it concluded that "the impact is very low" in Europe and the US. Furthermore, it found that "virtually zero" impact for the full year 2011, because of the "restoration of both Japanese production capacity and global supply chains."

The IMF Japan Spillover Report also found that the effects of the earthquake were modest (outside of the automobile industry) and short lived (even in the auto sector).¹⁰

The Japanese natural disaster caused the destruction of production capacity. The affected capacity was an essential element of a complex supply chain in high value-added industries. Even so, the spillover effects of this destruction were small and fleeting. This demonstrates the resilience of economic activity to the disruption of trade.

⁹ *The impact of Japan's earthquake on the global economy. Tresor-Economics Report No. 100 (2012).*

¹⁰ *International Monetary Fund: Japan Spillover Report for the Article IV Consultation and Selected Issues (2012).*

Their performance is relatively insensitive to global economic conditions

Disruptions to logistics have limited economic impact

When firms have failed it has not caused problems

The financial distress of a trading firm would not result in the destruction of any productive assets (although it could impede the efficiency of their use); the assets would be available to be redeployed, or operated by those who control the distressed firm. No single firm, or even multiple firms, is as critical in the global supply chain for large, high value added industries (such as autos and electronics) as the Japanese companies affected by the earthquake and tsunami. Thus, the effects on the broader economy of the financial distress of a large commodity trading firm, or even multiple firms, would almost certainly be smaller, and shorter lived, than the small effects of these natural disasters.

There have been numerous instances in which commodity trading firms have suffered large losses, or actually failed, without causing problems in the broader financial system.

There have been numerous instances in which large commodity trading firms have suffered large losses, sometimes resulting in the failure of the firms involved, but where there were no pronounced disruptions in the commodity markets in which the firm operated, let alone in the broader economy.

In commodities in particular, large losses at Ferruzzi (\$4 billion), Metallgesellschaft (over \$1 billion), Sumitomo (\$2 billion), Constellation (a \$10 billion loss in market capitalization), or Amaranth (\$6 billion) did not have broader systemic consequences. Enron was the most important trading intermediary in US natural gas and power markets, and its precipitous collapse did not disrupt those markets appreciably, let alone the broader economy.

Some months after Enron's demise, the entire merchant energy sector in the US suffered catastrophic financial losses. From 25 April, 2002 through the end of May of that year, the equity values of a portfolio of large energy merchants declined by approximately 91%. The credit rating of every energy merchant firm was downgraded. Many firms exited the business, and one prominent firm (Mirant) declared bankruptcy.

Merchant energy firms engaged in the same transformational activities as commodity trading firms, and also provided risk management and financing for their customers similar to those provided by commodity trading firms. Despite the acute financial distress of the entire sector, gas and power continued to flow, houses were heated and lights went on. Moreover, there was no impact on the broader economy.

In sum, many commodity trading firms are large, and play a crucial role in facilitating the flow of vital commodities to their highest value uses, but that does not make them systemically important in the same way banks and other major financial institutions are. Commodity trading firms provide very different intermediation services than banks do. What's more, they are not central to the provision of credit in the same way banks are. Furthermore, in comparison to banks, they are not large. They are not, therefore, too big to fail, and should not, therefore, be subject to the same kinds of regulation as banks.

Commodity trading firms play a crucial role, but they are not systemically important



AFTERWORD

Commodity trading firms transform commodities in space, time, and form in order to enhance their value. Their function is to move commodities from low value uses to high value ones. In so doing, they enhance the wealth and welfare of both the producers and consumers of commodities. It may seem paradoxical, but commodity trading raises the prices that producers receive, and lowers the prices that consumers pay. It is not paradoxical, however, because commodity traders are both buyers and sellers, and are in the business of earning a margin between sales and purchase prices: they care little about the level of prices overall. Competition on margins between traders tends to narrow price differentials and encourages traders to improve the process of transforming commodities from what producers produce to what consumers consume.

They do not do this out of altruism. Moreover, their activities are not uniformly beyond reproach. But the profit motive and intense competition combine to create a powerful tendency for these firms to create value, of which they take a relatively small portion.

Nonetheless, commodity trading is controversial, especially in times like the present, and the recent past, in which prices have been high. But this is nothing new. Adam Smith noted the same phenomenon when writing in 1776 about criticisms of commodity trading dating back to the 14th century, criticisms eerily similar to those heard today.

Smith had an answer to these criticisms, and his answer remains true today even though in size, scope, technology, and financing commodity trading today is vastly different than it was in 1776, let alone the time of Edward VI. Smith understood how the transformation of commodities by competing firms benefits producers and consumers.

By highlighting the role of transformations, and analyzing them in detail, I have attempted to provide a conceptual framework for analyzing commodity trading and evaluating the role of commodity trading firms. Hopefully this will contribute to a more informed public discussion of commodity trading, and how it can be improved through good policy.



APPENDIX A

TABLE 1

SOURCE DATA FOR INTERNATIONAL TRADE FLOW IN COMMODITIES

	COMMODITY	UNCTAD/WTO CODE
AGRICULTURAL	Animal or Vegetable Fats or Oils*	15
	Cane or beet sugar*	1701
	Corn*	1005
	Cocoa beans	1801
	Coffee*	901
	Cotton*	52
	Cotton neither carded or combed*	5201
	Palm Oil*	1511
	Rice*	1006
	Soyabbeans*	1201
	Soyabean oil	1507
	Wheat*	1001
	ENERGY	Coal*
Petroleum oils (crude)*		2709
INDUSTRIAL	Iron and steel*	72
	Iron Ore*	2601
	Aluminum*	76
	Aluminum ores and concentrates	2606
	Copper*	74
	Copper ores and concentrates*	2603
	Lead	78
	Lead ores and concentrates	2607
	Nickel*	75
	Nickel ores and concentrates	2604
	Tin	80
	Tin ores and concentrates	2609
	Zinc*	79
Zinc ores and concentrates	2608	

Annual nominal export volumes for 28 commodities between 2001 and 2011 can be found on the International Trade Centre's Trade Map statistical database. These data were used to calculate correlations between commodities.

A subset of these commodities (asterisked) is represented graphically in Figures 2,3,4 and 5.



APPENDIX B

TRADING ACTIVITY AND PHYSICAL ASSET OWNERSHIP FOR LEADING COMMODITY TRADING FIRMS

FIGURE 1

ADM

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading		x	x			x							
Upstream													
Midstream	x		x			x							
Downstream	x		x			x							

FIGURE 2

BUNGE

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x			x							
Upstream													
Midstream	x	x	x			x							
Downstream		x	x			x							

FIGURE 3

CARGILL

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x	x		x	x	x	x	x	x
Upstream	x	x	x										
Midstream	x	x	x	x	x	x							
Downstream	x	x	x			x	x						

FIGURE 4

LOUIS DREYFUS

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x			x	x				
Upstream	x	x	x										
Midstream	x	x	x	x	x			x	x				
Downstream	x	x	x			x		x					

FIGURE 5

GLENCORE

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x			x	x	x	x		
Upstream								x		x	x		
Midstream	x	x	x			x		x		x	x		
Downstream			x			x		x	x				

FIGURE 6

GUNVOR

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading												x	x
Upstream										x	x		
Midstream										x			
Downstream										x			

FIGURE 7

MERCURIA

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x					x	x	x	x	x	x
Upstream										x	x		
Midstream										x	x	x	
Downstream													

FIGURE 8

TRAFIGURA

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading								x	x	x	x	x	
Upstream								x					
Midstream								x	x	x	x		
Downstream										x			

FIGURE 9

VITOL

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading										x	x	x	x
Upstream										x	x		
Midstream										x	x	x	
Downstream										x			

FIGURE 10

OLAM

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading		x	x	x	x	x	x						
Upstream			x	x	x		x						
Midstream		x		x	x	x							
Downstream		x	x	x	x	x							

FIGURE 11


NOBLE

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x	x	x	x	x	x	x		x
Upstream			x				x		x				
Midstream	x	x	x	x	x	x	x	x	x	x			
Downstream			x			x	x						

FIGURE 12

WILMAR

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading			x	x		x							
Upstream				x		x							
Midstream			x	x		x							
Downstream			x	x		x							



Commodity trading is one of the oldest forms of human activity. It is central to the global economy. Yet up to now there has been remarkably little research into this important area.

The Economics of Commodity Trading Firms
demystifies the commodity trading business through a combination of description and analysis.

Professor Pirrong employs a variety of economic concepts to investigate the dynamics of the commodity trading business. His analysis produces valuable insights into the nature of the business, and the economic role and social relevance of commodity trading firms.