

THE ECONOMICS OF COMMODITY TRADING FIRMS

III. RISK MANAGEMENT BY COMMODITY TRADING FIRMS

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INTRODUCTION

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TRAFIGURA

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.

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

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

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.

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.

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

The standard approach in the industry is to rank the many simulated profit/loss outcomes, and to set 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

Historical simulation has advantages over theoretical models...

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

Conditional Value-at-Risk quantifies large 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.

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.

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

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)

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

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

