Sixth International Conference on Construction in the 21st Century (CITC-VI)
"Construction Challenges in the New Decade"
July 5-7 2011, Kuala Lumpur, Malaysia

Derivatives Trading Strategy for Managing Material Price Risks

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Abstract

As global sourcing of strategic materials for construction projects becomes more complex, new tools and/or strategies are needed. This paper investigates some existing tools that have helped other industries mitigate price risk. These tools, or financial instruments, have yet to be broadly adopted for use in the construction arena. A proactive strategy is proposed by employing derivatives trading, specifically for steel pricing control. Various steel markets are identified with pertinent details provided. Additionally, the basic types and functions of hedging are explained. This strategy has broad impact and meaningful application to construction firms working in an increasingly global competitive marketplace.

Keywords

Costs, Estimating, Risk Management, Construction Strategies, Materials

1. Introduction

In today's global construction engineering environment, projects are too commonly over budget, failing to meet the client's financial or market expectations. One of the contributing factors to the construction industry's current difficulty with project delivery is the undeniable complexity associated with global sourcing of strategic materials. Construction organizations are often faced with significant competition for material resources and must contend with extreme fluctuations with regard to availability and price. A resolution to the challenge of managing material pricing on large, multifaceted industrial or infrastructure projects, while complex, is strategically necessary for project success. The engineer, procure, and construct (EPC) industry continues to struggle with effective cost control techniques and is in need of new tools and/or strategies to successfully address these mounting issues. Financial solutions to mitigate price risk are not new but have been underutilized in the construction industry due to costs, complexity, or unknown.

2. Literature Review

Risk may be defined as the probability of an adverse or unfavorable project outcome that has the potential to diminish the likelihood of satisfying the project objectives or success criterion of the project. Since some measure of risk always exists in engineering and construction projects, often leading to cost overruns and related impacts, the overall effectiveness of risk management programs must become an important concern in all project related endeavors (Wang and Chou, 2003). Chua and Li (2000) find that due to uncontrollable risk elements, the actual construction cost will never be exactly equal to the estimated construction costs. Cost overruns create a significant financial risk to both contractors and owners (Akinci and Fischer, 1998; Baloi and Price, 2003). These studies along with numerous others, aid project planners by providing techniques for the identification and measurement of risk, but successful, real world strategies for risk mitigation are much more difficult to find in the literature.

A focus on project risk resulting from materials availability and associated pricing structures is of particular interest to this study. Tseng et al. (2009) discuss uncertainties faced by construction companies such as uncertainty in cost, more specifically how material cost are market driven and subject to volatility. Chua and Li (2000) found adequacy of resource market price information and resource price fluctuation to be significant construction risk elements. Ling (2005) finds that the reliability of company pricing is a global risk factor with significant fiscal impact. Similarly, Oberlender (2001) identified cost information applicability and completeness as major factors in estimate quality. Recognition of the significant impacts that market condition awareness and volatile material pricing can have on project successfulness is an insight that the entire engineering and construction industry must have in today's global economy.

Some important work on this subject has been completed. Williams (1980) noted the grave impacts of cost inflation on project estimating during the unprecedented escalation in material costs during the period of 1973-76. Mochtar and Arditi (2001) propose pricing strategies based on a market-based approach for the US construction industry after confirming that current strategy is predominantly cost-based. Taking a historical perspective, the industry has frequently experienced periods of considerable price escalation or high levels of volatility. The sensitivity to market conditions is obvious. Such trends, or specifically the industry's susceptibility to economic influences, will not abate in the future and may in fact become more impactful than ever before. However, new tools and innovative financial strategies for dealing with such risk are now available and have successfully been employed by other industries. The engineering and construction industry would be well served to adopt these new strategies and use them to diminish their exposure to the negative consequences of material price risks.

An important, rather new and innovative financial strategy that has proven effectiveness in other industries is referred to as "hedging" or the use derivative instruments. The use of this strategy to mitigate risk is well established and has been successfully implemented in a variety of applications. Bartram et al. (2009) shows the use of commodity price derivatives is globally concentrated in the utilities, oil, mining, steel, chemicals food, and transportation industries. According to Clubley (1999) airlines adopted fuel price risk management techniques around 1989. The use of derivative instruments allowed the airlines to hedge their fuel cost risk.

An abundance of financial literature, provides a basis of understanding for non-financial firms uses of hedges, yet does not focus on whether hedging achieves reasonable economic objectives. (Allayannis and Ofek 2001; Berkman and Bradbury 1996; Dolde 1995; Gay and Nam 1998; Géczy, et al. 1997; Graham and Rogers 2002; Haushalter 2000; Mian 1996; Nance et al. 1993; Rogers 2002; Schrand and Unal 1998; and Tufano 1996). The objective of construction companies is to mitigate price risk in real dollars on a project basis. A proactive strategy is proposed in this paper describing how organizations can employ derivatives trading as a risk mitigation technique for steel pricing control.

3. Methodology

In order to implement a successful risk mitigation plan for material or commodity pricing, quantity requirements and availability of materials must be established and managed during project execution. Once critical material information is captured such as estimated quantities and need dates, possible markets can be identified and financial instruments implemented. Since steel is almost always utilized on major projects and is often considered a major influence or driver to cost and schedule performance, steel will be the focus of this study. Furthermore, strategies that mitigate risk associated with steel pricing will have significant and immediate benefit to the engineering and construction industry.

Steel can be considered the most important industrial raw material in construction industries. Global production of steel is approximately 20 times higher than that of all non-ferrous metals combined. China, Japan, and the United States are the leading producers and consumers of steel in the world. Demand for steel has accelerated globally due to demand from China, India and other developing nations and the share these countries partake will increase significantly in the future. Steel products are broadly divided into flat, a hot or cold plate product with varying dimensions of 100mm to 200mm as well as 1mm to 10mm, and long, bars or rods of varying sizes.

A derivative is a financial instrument whose value derives from the value of other, more basic, underlying variables. The variables underlying derivatives are often the prices of traded assets, such as steel products. Markets have different forms of risk, and while some participants wish to avoid risk, others deliberately want to acquire it. The risks depend in part on the market. Over-the-counter (OTC) market consists of traders who are usually representatives of financial institutions, corporations, and fund managers that deal over the phone. Exchange-traded markets have been around since 1848 and exist all over the world. This market consists of individual participants trading standardized contracts that are defined by the exchange.

Steel derivatives are relatively new with China attempting to establish a market as early as the 1990s before abandoning the market entirely. Starting in the early 2000s, Koch Metals Trading Ltd. and Multi Commodity Exchange have offered steel derivatives in an OTC market. More recently even with the active OTC markets, exchange-traded markets on three major global commodity exchanges have emerged for steel contracts. These three exchanges are the New York Mercantile Exchange (NYMEX), Dubai Gold and Commodities Exchange (DGCX), and London Metal Exchange (LME). Each exchange was originally designed to serve a slightly different section of the steel supply chain and is structured differently as a result. NYMEX targeted US hot-rolled coil based steel product for 20 short-ton lots forward for 24 months. The price used to settle the contract is based on an index compiled by surveying opinions held by a cross-section of the steel industry in conjunction with 20 other product and regional price indices. DGCX offers 10 ton deliverable lots of reinforcement bar per contract monthly up to 4 months forward. The LME launched trading of two physically deliverable billet contracts, Mediterranean and Far East. Both contracts are 65 ton lots with spot, 3 month, and 15 month forward. (Visit www.nymex.com, www.dgcx.ae, www.lme.com for more information.) The variety of contracts offered in the above mentioned markets should allow the construction industry to properly align each project's steel requirements as close as possible.

Basis risk describes the risk that the value of the commodity being hedged may not change in tandem with the value of the derivative contract used to hedge the price risk. While the derivative may be highly correlated, significant basis risk can emerge if the relationship between the commodities breaks down. In an ideal hedge, the hedge would match the underlying position in every aspect, eliminating any chance of basis risk. In actuality, even if the derivatives contract is for the exact hedged commodity, basis risk remains a concern. Basis also represents the differential between a given commodity's cash price and its nearest futures contract price.

The following three basis risks occur frequently in hedging: product basis risk, time basis risk, and locational basis risk. Product basis risk occurs when there is a mismatch in the quality, consistency, weight, or underlying product. For example, airlines frequently use crude oil contracts to hedge jet fuel, but obviously crude oil and jet fuel are two different commodities and hence have large product basis risk. Even within the same commodity category, such as crude oil, product basis risk occurs because there are many types of crude oil varying in viscosity (such as heavy versus light crude) and sulfur content (sweet versus sour crude). Time basis risk occurs when there is a mismatch in the time of the hedge. For example, if a hedger wishes to hedge long-term but only has short dated contracts available, time basis risk is very significant. Locational basis risk occurs when there is a mismatch in the price of the product from one location to another or a mismatch in the delivery point for the derivatives contract.

By considering the usage of different derivative contracts that have steel as the underlying commodity, the use of financial hedges should effectively reduce exposure to price escalation of steel. A hedge is simply a trade designed to reduce risk. Hedging is offsetting possible risk in one market through the deliberate assumption of an equal and opposite risk in another market. Since the construction industry is in the business of providing a service and has no particular expertise in predicting commodity prices yet is greatly influenced by them, it is favorable to hedge. A properly utilized hedge strategy will protect them from upside exposure in prices and will limit them to downside windfall, however if this is tied to his estimate it will meet the budget line item. Some strategies will allow for downside windfall capture as well.

The hedges that will be discussed are:

- standard deal (plain vanilla swaps)
- forwards
- futures
- and options

The plain vanilla swap is simple and basic agreement whereby a floating price is exchanged for a fixed price over a certain period of time or vice versa. The swap contract will specify the volume, the duration, and the fixed and floating prices for the commodity. The differences between fixed and floating prices are settled in cash for specific predetermined periods. It is an off-balance-sheet financial arrangement, which involves no transfer of the physical item. Both parties settle their contractual obligations by means of a transfer of cash.

A forward contract is an agreement to buy or sell an asset at a certain time in the future for a certain price. These contracts are traded in OTC markets. The buyer has a long position, agreeing to make delivery of the commodity, while the seller has a short position, agreeing to make delivery of the commodity. Similarly futures contracts are another financial risk management tool that enable companies to hedge their price risk exposure by agreeing to buy or sell a particular volume of product for delivery on a fixed future date at a price agreed today. Futures contracts are traded on an exchange, which specifies standard terms for the contracts and guarantees their performance, thereby removing counter-party risk. Generally positions are closed out before the contract delivery date by entering into the opposite postion. In reality only a small percentage result in actual delivery of the commodity. Instead, it is a financial transaction.

An option is the right to buy or sell an asset. More specifically a call option is the right to buy a particular asset at a predetermined fixed price (the strike) at a time up until the maturity date. A call option protects your business from an increase in market movement. The buyer pays a premium for the right to collect monies if the excess occurs. The other side is a put option which pays the buyer in the event of a downward market movement. Lastly a collar is a combination of a put option and a call option. For a hedger planning to purchase a commodity, a collar is created by selling a put option with a strike price below the current commodity price and purchasing a call option with a strike price above the current commodity price. The purchase of a call option provides protection during the life of the option against upward commodity price movements above the call strike price. The premium received from selling the put option helps offset the cost of the call option. By establishing a collar strategy, a minimum and maximum commodity price is created around a hedger's position until the expiration of the options. A collar can be structured so that the premium received from the sale of the put option completely offsets the purchase price of the call option. This type of collar is called a "zero cost collar." If additional protection against upward price movements is warranted or vise versa, a premium collar is used. With a premium collar, the cost of the call option is only partially offset by the premium received from selling a put option.

The use of hedges come with associated costs whether it be mandated margins, premiums, or fees. Companies need to also be aware of the strict accounting measures and how it may impact income statement and balance sheet. For the purposes of this study these issues are ignored.

4. Results and Discussion

A construction company needs to understand its risks through proper indices, data, and analysis. When the analysis shows that the risk can be effectively hedged, then the next step is to transfer the identified risk in a cost effective manner through the implementation of a financial contract.

In a swap, the construction participant would pay a fixed price and receive a floating price, both indexed to expected steel product use during each settlement period. The volume of steel hedged is negotiable because this is a customized contract. During the life of the swap contract, the participant buys steel in the cash market, as usual, but the swap contract makes up the difference when prices increase and removes the difference when prices fall. The result for the airline is a fixed price for the contracted duration. The fixed rate payment is set based on market conditions when the swap contract is initiated. The floating price of steel could be based on LME cash and calculated monthly using daily prices for the month. The net monthly payment to the construction participant is the floating rate minus the fixed rate. For example, if the floating rate for a month averages $600 per ton and the fixed rate is $595 per ton, then the construction participant collects payment of $5 per ton that month. If the size of the contract is 1000 tons, a payment of $5,000 is received by the construction participant. If the price reverses and averages to $590 per ton then the construction participant pays but at the pre determined $595 per ton rate. This continues for the duration of the contract. By being the fixed-price payer, he has hedged his steel price risk at a fixed amount. Ideally this price is near his estimated amount for the project. Forward contracts act similarly to swaps.

A contruction participant can use the DGCX rebar futures contract to hedge project steel price risk. Since the construction industry would take the long position in the futures market because you are short the physical commodity. The hedger purchases a futures contract at $590 per ton, with a lot size of 10 tons in January. On the same day, the spot price is $595 per ton. If the hedger closes out this futures contract for 10 tons in August at $610 per ton, he gets a profit of $200. The spot price of rebar on the settlement date in August is $620 per ton which would have required an unhedged participant to pay $25 per ton more for the same product. Yet, by using the futures contract and purchasing rebar in the spot market, the gain of $200 on the futures offsets the $25 increase in rebar prices. In essence, the hedger's net cost of rebar is $605 per ton.

The construction industry might find value in the flexibility that options provide, but it comes with a price in the form of a premium. The premium price is greatly affected by the volatility of the underlying commodity; as volatility increases so does the premium. For this reason, collars are often used. Using a collar may be a reasonable hedging strategy for the construction industry since it involves little to no upfront cost and involves no speculative return. This is implemented by the premium paid for the call option portion is reduced by the amount of the premium collected by the put option portion. In essence, sharing the potential profit windfall of low prices reduces the premium for high price protection. However, if steel prices dramatically decrease, the hedger may pay more for steel and miss out on possible additional profits but if properly tied to a project budget will meet his estimate. Figure 1 provides a conceptual illustration for hedging gains or losses using swaps, futures, call options, and premium collar when locking into a $600 per ton price of steel.

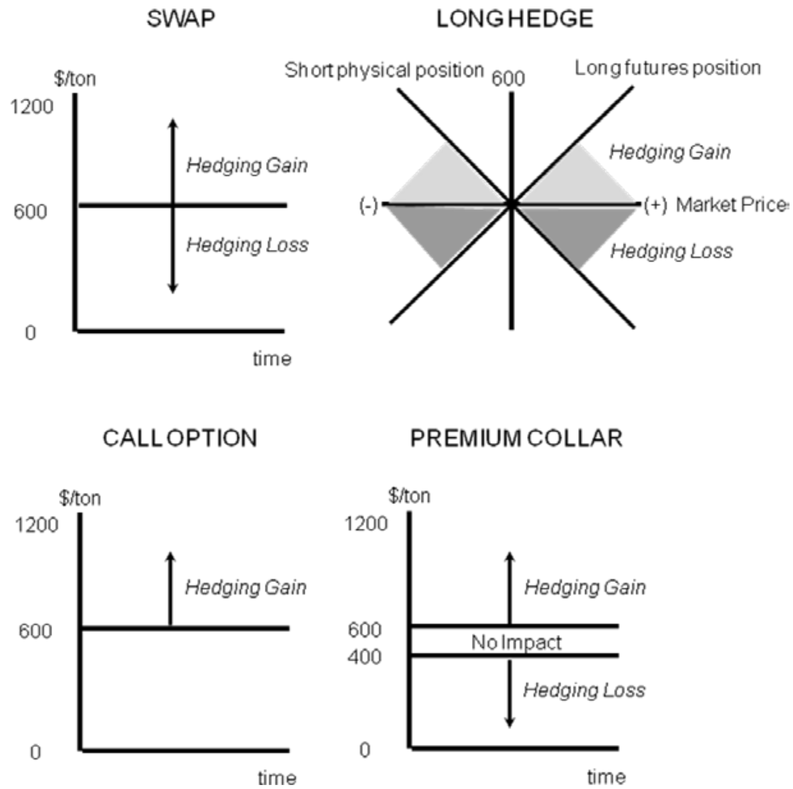

Figure 1: Depiction of four common hedge strategies of steel applicable for the construction industry.

The benefits of implementing a price risk mitigation plan around commodity markets are vast. One such benefit is that price risk exposure can be managed and controlled according to project and contract type. The exchange-traded markets allow for transparency in price, facilitating possible negotiations with other market influencers. Experience in other commodity markets has shown that there is a high correlation between spot prices of different related products. Therefore in the case of steel products this could mean that a futures contract for one product could serve as a basis for other products, accounting for the possible basis risk. This would allow the construction industry to hedge all the required project steel products in one forward contract or option. Decision making on capital investment can be more objective and budgets can be realized from properly executed estimates. The enhanced ability to plan and more certain cash flows should also reduce the fluctuations in project controls in general.

It is also important to point out the possible risks within the market if it is not properly maintained.
The divergence of the physical and futures prices is possible if speculation is not monitored correctly or there is too little liquidity. A cornering the market would lift the futures price, and leave the spot market behind. However with the established structures in the above mentioned markets, numerous steps have been taken to prevent this from occurring such as physical delivery of products. Additionally rules were established and the markets are constantly monitored providing proper oversight.

5. Conclusions

While the steel exchanges might still be in their infancy it offers a great opportunity for the construction industry to start to understand its function and adopting its use. The magnitude of exposure to steel price risk will affect construction participants' hedging decisions and in turn hedging decisions affect exposure to price fluctuations.

This study investigates the use of financial hedges on steel price exposure in the construction industry. It is known how other industries have been employing this strategy and how it could be implemented by the construction industry. In identifying a strategy for price risk management of steel, the importance of market structures, available contracts, and types of hedges are all clearly stated. The exchange-traded venues mentioned are NYMEX, LME, DGCX. These markets have clearly defined structures and contract types as well as different steel products. The hedges most likely to be executed were discussed and examples provided for swaps, futures, options, and collars.

Since every participant in the construction industry cycle has a degree of exposure the proper contractual arrangement will help identify who bears the actual price risk and therefore should use the various financial instruments. The goal of a proper hedge strategy is not to make profits but to protect against escalating losses. When implemented correctly the bid estimate can be held true. Further work in this area can help identify the necessary hedge strategy per project type, owner or construction company perspective, and commodity. Similarly other financial instruments and markets should be investigated for applicable benefit to the construction industry.

6. Acknowledgement

This study was made possible in part by support from the National Science Foundation GK-12 Program Grant # 0742504.

7. References

Akinci, B. & Fischer, M. (1998). "Factors affecting contractors' risk of cost overburden", *Journal of Management in Engineering,* vol. 14, no. 1, pp. 67-76.

Allayannis, George, and Eli Ofek, (2001). “Exchange rate exposure, hedging, and the use of foreign currency derivatives”, *Journal of International Money and Finance* 20, 273-296.

Baloi, D. & Price, A.D.F. (2003). "Modelling global risk factors affecting construction cost performance", *International Journal of Project Management,* vol. 21, no. 4, pp. 261-269.

Bartram, S.M., Brown, G.W. & Fehle, F.R. (2009). "International Evidence on Financial Derivatives Usage", *Financial Management,* vol. 38, no. 1, pp. 185-206.

Berkman, Henk, and Bradbury, Michael E. (1996). “Empirical evidence on the corporate use of derivatives”, *Financial Management* 25 (2), 5-13.

Clubley, Sally, 1999, “An Early Take Off”, *Risk* (May).

Chua, D.K.H. & Li, D. (2000). "Key factors in bid reasoning model", *Journal of Construction Engineering and Management,* vol. 126, no. 5, pp. 349-357.

Dolde, Walter, (1995). “Hedging, leverage, and primitive risk”, *Journal of Financial Engineering* 4, 187-216.

Hull, John C., *Options, Futures, and Other Derivatives*, 7th edition, Pearson Prentice Hall, Upper Saddle River, NJ, 2009.

Ling, F.Y.Y. (2005). "Global factors affecting margin-size of construction projects", *Journal of Construction Research,* vol. 6, no. 1, pp. 91-106.

Gay, Gerald D., and Nam, Jouahn. (1998). “The underinvestment problem and corporate derivatives use”, *Financial Management* 27 (4), 53-69.

Géczy, Christopher, Minton, Bernadette A. and Schrand, Catherine. (1997). “Why firms use currency derivatives”, *Journal of Finance* 52, 1323-1354.

Graham, John R., and Rogers, Daniel A. (2002). “Do firms hedge in response to tax incentives?”, *Journal of Finance* 57, 815-839.

Mian, Shezad L. (1996). “Evidence on corporate hedging policy”, *Journal of Financial and Quantitative Analysis* 31, 419-439.

Mochtar, K. & Arditi, D. (2001). "Pricing strategy in the US construction industry", *Construction Management and Economics,* vol. 19, no. 4, pp. 405-415.
Nance, Deanna R., Smith, Jr., Clifford W. and Smithson, Charles W. (1993). “On the determinants of corporate hedging”, *Journal of Finance* 48, 267-284.
Oberlender, G.D. & Trost, S.M. (2001). "Predicting accuracy of early cost estimates based on estimate quality", *Journal of Construction Engineering and Management,* vol. 127, no. 3, pp. 173-182.
Rogers, Daniel A. (2001). “Does executive portfolio structure affect risk management? CEO risk- taking incentives and corporate derivatives usage”, *Journal of Banking and Finance* 26, 271-295.
Schrand, Catherine, and Unal, Haluk. (1998). “Hedging and coordinated risk management: Evidence from thrift conversions”, *Journal of Finance* 53, 979-1013.
Tseng, C., Zhao, T. & Fu, C.C. (2009). "Contingency estimation using a real options approach", *Construction Management and Economics,* vol. 27, no. 11, pp. 1073-1087.
Tufano, Peter. (1996). “Who manages risk? An empirical examination of risk management practices in the gold mining industry”, *Journal of Finance* 51, 1097-1137.
Wang, M. & Chou, H. (2003). "Risk allocation and risk handling of highway projects in Taiwan", *Journal of Management in Engineering*, vol. 19, no. 2, pp. 60-68.
Williams, L.F. (1980). "Watching inflation in project cost estimating", *Engineering Costs and Production Economics,* vol. 5, no. 1, pp. 7-19.