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# The impact of commodity price risk management on the profits of a company

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## ABSTRACT

It is well recognized that for the producing companies hedging the commodity price using financial products like forwards or futures has become an important part of the company's production process. But apart from the direct impacts of hedging on the production and hedging costs the use of financial products affects the financing of the company: hedging the volatile commodity prices leads to a reduction of the risk premium the company has to pay for its debt capital, since hedging contributes to more confidence of the investors in the redemption of the debt. In this paper we therefore analyze this dependency of hedging and financing and derive optimal hedging extents for companies in different market situations based on a long-term model. By hedging the commodity price, companies can realize a surplus in profits. Thereby, the optimal hedging extent for a monopolist is often up to 100%, whereas for companies in a polypolistic market the optimum is always less than 100%. These results are illustrated by examples for a producing company.

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## Introduction

### Motivation

Undergoing a financial crisis to an extent, which had never even been imagined, crude oil prices were one of the first commodity prices to be strongly affected in 2008 leading to a high volatility. In the beginning of May 2008 Goldman & Sachs Corp. had predicted a crude oil price increase up to \$200 for the time period of the following six month to two years as growth in supply apparently failed to keep pace with the increased demand from the developing nations (Subrahmaniyan, 2010). Still according to this prediction the West Texas Intermediate hit an all-time high of \$145.31 per barrel on July, 3 2008. However, not even six month later on December, 23 2008 it had fallen to only \$30.28 per barrel (U.S. Energy Information Administration, 2010).

On the other hand, companies such as airlines depending on commodities like oil are being endangered by these volatile prices. For instance, the Lufthansa Group, Germany's biggest airline, states according to its annual report in 2008 that 21% of the group's operating expenses was owed to its fuel consumption. It is especially industries like the aircraft industry that strongly depend

on commodities and their price evolution. But the occurrence of extreme volatile price evolutions are not only restricted to crude oil prices. To name just a few among many, prices of wheat, steel and copper have not been lagging behind regarding their price volatility in the last years (see e.g. Chen, 2010).

Inevitably, companies competing in these and similar industries have to hedge their commodity demand since this provides a basic degree of security in the ever more competitive and volatile commodity markets of today. But hedging also influences the financing of a company: hedging the volatile commodity prices leads to a reduction of the risk premium a company has to pay for its debt capital, since hedging contributes to more confidence of the investors in the redemption of the debt. To reduce the risk of volatile commodity prices, only few companies decide to hedge their idiosyncratic commodity risk by backward vertical integration, the majority prefers to use financial products like future or forward contracts for this purpose.

The importance that economies and companies attach to commodities, their exploitation, and along with that their prices and hedging against them can be found widely. Hedging not only reduces risks for the company buying the commodity e.g. the Lufthansa Group, as hedging is done with counterparties: either directly with the provider of the commodity or indirectly with an intermediary or speculator who then hedge themselves with the providers. In both the cases, the market risk for all market participants taken together, intermediaries, speculators, buyers and sellers of the commodity may be reduced if allocated properly

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(see e.g. Rafiq et al., 2009). Then, the long-term commodity price may become more stable and predictable for the companies depending on the resources, both as producers and consumers. This eventually contributes to lower volatilities in markets and economies, and in the end to a world that is less risky, and hence more desirable for all market participants in the long run. Consequently, the probability of a possible resource price crisis can be reduced, or – on a microeconomic level – industries and companies can predict their commodity expenses more accurately.

#### Literature overview

While many have dealt with the various reasons for hedging (e.g. Smith and Stulz, 1985), first studies were conducted into deriving the optimal hedging extent as far back as 1960, starting off with Johnson (1960) who was the first to derive the number of future or forward contracts necessary to hedge a certain spot position based on the attempt to minimize the variance of a hedged portfolio followed by Cecchetti et al. (1988). Since then many others have analyzed similar aspects varying the techniques and assumptions of previous studies, and for instance examined the history of future markets and forward pricing of commodities (e.g. Goss, 1981) or the role and significance of futures trading of commodities (e.g. Weston and Silverii, 1985). However, many of them thereby focused on the risk reduction of the commodity prices as a result of hedging (e.g. Lien and Tse, 2002; Chen et al., 2003) neglecting further impacts of hedging on the company.

But since hedging also influences for example the company's financing, other authors turned their attention towards this field: Froot et al. (1993) developed a model for corporate risk management in which they linked the activity of hedging to a company's overall financial situation. Another approach was introduced by Rogers (2002) who scrutinized the dependency between the hedging extent of a certain company and its CEO's risk taking incentives while others analyzed the impact of hedging on tax payments (see Smith and Stulz, 1985; Leland, 1998). Furthermore, Franke (2003) showed how the hedging policy of a company depends on the characteristics of the exchange rate process, the real investment option and the costs of financial distress, whereas Broll et al. (1999) show that to hedge the exchange rate risk in forward markets, it does not imply standard full hedging. But neither of the above mentioned developed their model with the main focus on commodity price risks and in dependence of the market structure in which the analyzed company interacts.

In the last few years, research concentrated mainly on analyzing the various and different time series data of commodities (see e.g. Chen, 2010; Cortazar and Eterovic, 2010 among many others). These studies try to predict the future development of the commodity prices or the prices of commodity futures and forwards. Due to the findings of these extensive data analysis that, however, often neglects the impact of commodity prices on the commodity buying or selling company, and due to the lessons learnt from the recent financial and economic crisis, we refocus on the methodological aspects between commodity hedging and the company's financial situation, particularly with respect to debt financing. Thus, in this paper we develop a model that derives optimal hedging extents for companies subject to its financial costs in different market situations based on a long-term model. It additionally makes a contribution to help establish a more sustainable environment.

To begin with we present the basic model and its key players in Section "The model". Based on this model we derive the long term optimal hedging extents for risk-neutral companies in different types of markets: first we analyze the model within a monopolistic sales market in Section "Monopoly", and then we continue within a polypolistic one in Section "Polpoly". Section "Conclusion and outlook" concludes.

#### The model

As already mentioned, hedging the commodity price has an overall positive effect: on commodity producing and selling companies, on commodity processing and buying companies, on intermediaries at the financial markets and thus on all market participants including the commodity industries and the whole economy (see e.g. Rafiq et al., 2009). In the following we focus on commodity buying companies e.g. the Lufthansa Group, and analyze the situation of a company exposed to commodity price risk, i.e. the risk that commodity prices underlie a certain fluctuation over time. We assume that a company and its direct competitors<sup>1</sup> within a certain industry demand an unstable amount of resources to be able to produce their products and to sell those to their clients. Since commodity prices are volatile, the company will be interested in hedging its demand of the commodity by placing forward contracts. These forward contracts allow the producing company to purchase a certain amount of commodity at a fixed price at a predestined point of time in the future (Hull, 2008). Companies tend to use these forward contracts among other reasons<sup>2</sup> mainly because of the following two.

First of all hedging has impacts on the financial costs of the company, namely on the risk premium the company has to pay to its investor.<sup>3</sup> To give an example, an airline that has to rely on kerosene for its core business is highly dependent on the price a barrel of oil is sold at. If this company chooses not to hedge at all, it will face major problems in times of high oil prices to pay all its outstanding fix costs as for example debt payments. The risk of illiquidity can lead to insolvency, which implies insolvency costs. Since the capital lenders would therefore lose invested money to third parties, the risk of insolvency eventually leads to higher risk premiums for the company's issued capital.<sup>4</sup>

Secondly, hedging allows a company to obtain a more sophisticated planning horizon (Grinblatt and Titman, 2002). Based on a fixed commodity price, a company can plan its expenditures and decide on eventual investments. Especially divisions like accounting and risk management can take advantage out of a deeper knowledge regarding the future buying and expenditure plans.

Whether a company hedges or not is therefore not only a factor that influences the costs for commodities, but also the costs of financing and strategic investment decisions. Nevertheless it is evident that the savings due to a better planning horizon are very difficult to quantify since they underlie subjective estimates. We will therefore stick to the costs of commodities and financing when considering the quantifiable advantages of hedging.

#### Monopoly

To begin with we analyze a company trading its products in a monopolistic market. A monopolist does not have to face any direct competitors within its industry and is therefore able to set the price of its products and predict the corresponding demand of its clients. In

<sup>1</sup> We restrict this model to the analysis of direct competitors mainly because we want to analyze the impact of hedging of a certain commodity. Since indirect competitors rarely use the same components and therefore commodities to produce their products we will ignore their existence in this paper.

<sup>2</sup> Other reasons are for example the smoothing of taxable income in countries with progressive tax systems, economies of scale regarding transaction costs for hedging, and agency problems between managers and investors or equity and debt holders.

<sup>3</sup> Concerning debt it is exemplarily stated in Chew and Watters (2009) that credit ratings depend on the management style of a company, in particular the styles that affect the company's default risk. Managing the commodity price risk of input factors is considered one of these styles, since this risk highly influences the margins of a company.

<sup>4</sup> Concerning debt this affects already issued loans only if restrictions stated in the loan covenants demand it.

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