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## Journal of Financial Economics

journal homepage: [www.elsevier.com/locate/jfec](http://www.elsevier.com/locate/jfec)Capital expenditures, financial constraints, and the use of options<sup>☆</sup>Tim Adam<sup>a,b,\*</sup><sup>a</sup> Humboldt-Universität zu Berlin, School of Business and Economics, Spandauer Str. 1, 10178 Berlin, Germany<sup>b</sup> Risk Management Institute, National University of Singapore, Singapore

## ARTICLE INFO

## Article history:

Received 22 December 2005

Received in revised form

3 June 2007

Accepted 14 April 2008

Available online 22 January 2009

## JEL classification:

G32

## Keywords:

Risk management

Hedging

Insurance

Instrument choice

Speculation

## ABSTRACT

This paper analyzes why gold mining firms use options instead of linear strategies to hedge their gold price risk. Consistent with financial constraints based theories, the largest and least financially constrained firms are the most likely to hedge with insurance strategies (put options), while more constrained firms finance the purchase of puts by selling calls (collars). The most financially constrained firms use strategies that involve selling calls. Firms with large investment programs are also more likely to use insurance rather than linear strategies. Firms' hedging instrument choices are also correlated with current market conditions, suggesting that managers' market views partially drive hedging instrument choices.

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## 1. Introduction

Options positions are an important part of the risk management strategies of many firms. For example, [Bodnar, Hayt, and Marston \(1998\)](#) report that among derivatives users 68% of firms use options. However, our understanding as to why and how non-financial firms use

options rather than linear strategies (e.g., forwards) is limited. Hedging instrument choice is clearly an important question for any firm that hedges, and understanding how firms hedge can provide indirect evidence as to why firms hedge. To shed light on this area, this paper comprehensively evaluates options strategies in the North American gold mining industry.

Several theoretical models predict when firms should use options to hedge their risk exposures. For example, [Froot, Scharfstein, and Stein \(1993\)](#) show that if a firm is financially constrained and if its future capital expenditures are a nonlinear function of some risk exposure, then options can be necessary to achieve the value-maximizing hedge. [Adam \(2002\)](#) extends the [Froot, Scharfstein, and Stein \(1993\)](#) model to an inter-temporal setting and shows that financially less constrained firms buy options, while financially more constrained firms sell options. [Adler and Detemple \(1988\)](#) show that borrowing and short-selling constraints can cause exposures to be nonlinear and hence create a demand for options.

In addition to these financial constraints-based theories, a few authors have examined the impact of non-hedgeable

<sup>☆</sup> I would like to thank Simon Benninga, Sugato Bhattacharyya, Greg Brown, Kalok Chan, Eitan Goldman, Gunter Dufey, Joseph Fan, Chitru Fernando, Charles Hadlock, David Haushalter, Dirk Jenter, Alberto Moel, Tim Opler, John Parsons, Peter Tufano, and seminar participants at the annual meeting of the Western Finance Association, Boston University, Erasmus University, the University of Michigan, the University of Oklahoma, the Hong Kong University of Science and Technology, Nanyang Technological University, and the National University of Singapore for valuable comments and suggestions. I am especially grateful to an anonymous referee, who helped to significantly improve the paper. Thanks also go to Ted Reeve for providing me with his derivatives surveys. Any remaining errors are my own.

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risks and real options on the demand for options. [Adler and Detemple \(1988\)](#) and [Moschini and Lapan \(1995\)](#) show that the optimal hedging portfolio contains options if hedgeable and non-hedgeable risks are correlated. [Brown and Toft \(2002\)](#) show that this result can hold even if hedgeable and non-hedgeable risks are uncorrelated. Finally, in [Moschini and Lapan \(1992\)](#) the optimal hedging strategy requires nonlinear instruments, i.e., options, if a risk-averse firm can choose certain production parameters after product prices are observed. Common to all these theories is the general insight that if the exposure is nonlinear then the optimal hedging strategy is also nonlinear.

To test the empirical relevance of these theories, I examine the use of options strategies in the North American gold mining industry over a 10-year horizon, between 1989 and 1999. The gold mining industry represents an excellent laboratory for studying hedging instrument choices because gold mining firms share a relatively simple risk exposure (the future price of gold), while employing a range of different hedging strategies.<sup>1</sup> Therefore, differences in hedging strategies are more likely the result of differences in certain firm-specific characteristics rather than differences in exposures. Furthermore, to my knowledge no other industry reveals similarly detailed information about its derivatives portfolios that would allow a detailed study of hedging instrument choice.

I find that firms with relatively high investment expenditures are more likely and more extensive users of insurance (put options) instead of linear strategies. This result is consistent with the [Froot, Scharfstein, and Stein \(1993\)](#) model, in which financially constrained firms hedge to match their cash inflows with their cash outflows, i.e., capital expenditures. If capital expenditures are sufficiently large and a nonlinear function of the future gold price, then an options strategy involving puts would provide a better hedge than a linear strategy.

Furthermore, I find that the largest and least financially constrained firms are the most likely to hedge their price risk by buying puts, while more financially constrained firms finance the purchase of puts by selling calls, and thus hedge with collar strategies. The most financially constrained firms use strategies that involve selling calls (without purchasing puts). These results are consistent with the [Adam \(2002\)](#) extension of the [Froot, Scharfstein, and Stein](#) model, which predicts that the least financially constrained firms buy options while the most financially constrained firms sell options. Overall, the use of options strategies in the gold mining industry is consistent with the hypothesis that financial constraints are an important determinant for corporate derivatives usage.

I find no evidence that the uncertainty of the exposure (the presence of production risks) motivates firms to use options strategies. However, I find that firms' hedging instrument choices are correlated with current market conditions. When gold prices decline, firms shift away

from hedging with forwards and buy put options instead. When gold prices increase, firms tend to sell more calls. In the presence of a requirement to hedge, which is independent of a manager's market view, these results could arise from a belief that the gold price is mean-reverting. When gold prices decline, managers prefer not to lock in the relatively low price with a forward contract but hedge the downside risk with a put option to maintain the upside potential.<sup>2</sup> When gold prices rise, managers sell calls possibly in the hope that they will expire worthless.

No comprehensive studies exist on the corporate use of options as hedging instruments. [Tufano \(1996\)](#) describes the different risk management strategies used by gold mining firms. Consistent with the results in this paper he finds that large firms are more likely to use options. A couple of papers examine other types of derivatives used as part of their analyses. For example, [Géczy, Minton, and Schrand \(1997\)](#) find that firms are more likely to use currency swaps if they have more foreign-denominated debt while they are more likely to use other foreign currency derivatives (such as forwards, futures, and options) if they receive more income from foreign sources. In a clinical study of a durable goods manufacturer, [Brown \(2001\)](#) finds that concerns about accounting treatments and the firm's competitive position affect its hedging instrument choices.<sup>3</sup> Consistent with the impact of market conditions on instrument choices, [Chernenko and Faulkender \(2007\)](#) find that the use of swaps is affected by the shape of the yield curve.

In contrast to the lack of studies on hedging instrument choices, several studies examine hedging strategies in the gold mining industry. [Tufano \(1996\)](#) analyzes the determinants of the decision and the extent of hedging. He finds that hedge ratios are higher among firms that keep less liquidity and lower among firms that reward their executives with more stock options but less shares of the company. In a second paper, [Tufano \(1998\)](#) studies the gold price exposures of a cross section of gold mining firms and finds that hedging has only a marginal effect on a firm's stock price sensitivity to gold prices. [Petersen and Thiagarajan \(2000\)](#) argue that differences in operating cost structures can lead some firms to use financial hedges and others to use operational hedges to mitigate gold price risk. [Chidambaran, Fernando, and Spindt \(2001\)](#)

<sup>2</sup> This rationale is also cited by Merck & Co., Inc.: "Given the possibility of exchange rate movements in either direction, we were unwilling to forgo the potential gains if the dollar weakened; so options were strictly preferred" (see [Lewent and Kearney, 1990, pp. 26–27](#)).

<sup>3</sup> Under the new derivatives accounting standards FAS 133 and IAS 39, adopted in 1998, only a portion of option positions qualify for hedge accounting, while forward positions can qualify up to 100%, which should reduce the attractiveness of hedging with options. In the Global Survey of Corporate Financial Policies and Practices, however, [Servaes and Tufano \(2006\)](#) report that 71% of metals and mining firms expect no impact on their commodities derivatives strategies. If an impact is expected, it is more likely to be negative than positive and affects options positions more than linear positions. However, even among firms that use over-the-counter options, only 15% state that they will decrease their reliance on options. The largest impact is expected on exchange-traded derivatives, which mining companies rarely use. Thus, the impact of the new accounting standards is likely to be small in the gold mining industry.

<sup>1</sup> The four primary hedging strategies are selling forwards, buying put options (insurance strategies), buying collars, and selling call options. Further details are given in Section 2.1.

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