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Dynamic corporate risk management: Motivations and real implications

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ABSTRACT

We investigate the dynamics of corporate hedging programs used by US oil producers and examine the effects of hedging maturity choice on firm value. We find evidence of a concave relationship between hedging maturity and the likelihood of financial distress and oil spot prices. We further investigate the motivations of the early termination of outstanding hedging contracts. Using the essential heterogeneity approach, we evaluate the causal effects of hedging maturity on firm value. Marginal firm value increases with short-term hedging maturity. The causal effects vary across oil producers with different hidden attributes.

1. Introduction

We explore the dynamics of corporate risk management through which firms could create value by considering the following questions: How far ahead do firms hedge? What are the determinants of the maturity structure of firms' hedging programs? What are the motivations for the early termination of hedging contracts? What are the real effects of hedging maturities on firm value? These questions related to the dynamics of corporate hedging are largely unexplored because of the lack of empirical analysis due to limitations of appropriate data. Using an extensive and new hand-collected dataset on the risk management activities of 150 US oil producers with quarterly observations over the period 1998–2010, we fill this gap in the literature and answer the above questions. It is important to understand why firms within the same industry and with the same oil price risk exposure differ in terms of their hedging maturity structure.

We contribute to the literature on corporate hedging in several ways. Previous studies, with the exception of Fehle and Tsyplakov (2005), discuss the maturity structure of hedging but do not investigate its determinants.[1] Our first contribution is to provide empirical evidence of the determinants of the maturity structure of hedging contracts. We are also the first researchers to empiri-

[1] Dolde (1993) surveys the hedging practices of 244 Fortune 500 companies and finds that the common practice is to hedge cash flow exposures within a horizon of two to four quarters. In line with Dolde (1993), Tufano (1996) provides statistics about the percentage of the production hedged for North American gold mining firms for 1991–1993, and finds that they hedge 61.2% of their gold production for the current year (1991) and 10% and 11% for the subsequent two years. In a Wharton survey of the financial risk management practices and derivatives of 399 US nonfinancial firms, Bodnar et al. (1998) report that 82% of the questioned firms use foreign currency derivatives with an initial maturity of 91 days or less and only 12% use foreign currency derivatives with maturities exceeding three years. They also find that hedging ratios at longer maturities decreased dramatically during 1998. Adam and Fernando (2006, 2008) study the cash flow gains from selective hedging for a sample of 92 North American gold producers from 1989 to 1999 and report the descriptive statistics of hedging ratios up to five years. They find that gold producers use hedging programs with one-year maturities in 90% of firm–quarters with nonzero hedging with a mean hedging ratio of 54% of the expected gold production, hedging programs with three-year maturities in 51% of hedging quarters with an average hedging ratio of 25%, and programs with five-year maturities in 18% of hedging quarters with an average hedging ratio of 28%. The authors also affirm that near-term hedging ratios are more volatile than those with longer horizons. Carter et al. (2006) investigate the jet fuel hedging activities of US airline firms during 1992–2003 and find that hedging maturities vary significantly between firms (e.g., from one year to six years ahead) and that the hedging ratios of the next year's fuel consumption are very disparate (e.g., from 1% to 43%).

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cally study the rationales for the early termination of outstanding hedging contracts. We then apply the *essential heterogeneity* model of Heckman et al. (2006) to evaluate the causal effects of hedging maturity structure on oil producers' values. The essential heterogeneity model lets us differentiate either short- or long-term maturities effects on marginal firm value. To our knowledge, our study is among the first empirical works in the corporate finance literature that uses this methodology. Our data, collected from publicly disclosed information, provide detailed information about hedging activities. This detailed information allows us to study maturity structure by hedging instrument, namely, swap contracts, put options, and costless collars, which provides deeper insight into the hedging behavior of oil producers.

Some of our findings corroborate the predictions and results drawn from the theoretical model developed by Fehle and Tsyplakov (2005) based on simulations of the gold price paths and calibrated for firms in the gold mining industry. In their model, risk management contracts are modeled as a portfolio of forward contracts on the firm's product price. They further estimate some relationships with real data. In line with their prediction and empirical results in the gold mining industry, we obtain strong evidence of a non-monotonic (concave) relationship between the hedging maturity and likelihood of financial distress measured by the leverage ratio. This non-monotonic relation means that hedging maturities increase and then decrease with the likelihood of financial distress and this is more evident for swap contracts. Results further show that the higher the distress costs, the longer the maturity of put options. There are at least two plausible explanations for this situation. First, distressed oil producers (i.e., those with insufficient cash inflows and higher leverage ratios) do this as a risk-shifting strategy. Costly put options with long maturities decrease assets available for debtholders. Second, distressed oil producers are undesirable hedging counterparties because of their high credit risk, thus put options are the only derivatives they can access for which their counterparties face no credit risk.

In line with the theoretical contribution of Fehle and Tsyplakov (2005), we observe strong evidence of the impact of oil spot prices on the oil hedging maturity structure. In particular, the maturities of swaps contracts and costless collars increase and then decrease with oil spot prices. Results further show that larger oil producers tend to use put options with longer maturity, suggesting the presence of economies of scale in the hedging behavior of oil producers. There is also evidence of maturity matching between the expected life of oil reserves and the maturity of put options. Additional results show that hedging contract features (i.e., moneyness indicator and oil spot price at initiation of the hedging contract) have a significant impact on hedging maturity dynamics. Oil producers keep in-the-money hedging contracts until they mature. The results further imply that a hedging contract initiated when oil spot prices are sufficiently high is more likely to be kept for longer periods. Control variables related to gas production and hedging appear to have significant impacts on oil hedging maturity structure. Particularly, the gas hedging ratio for expected gas production is positively and significantly related to oil hedging maturity. Interestingly, the hedges of oil and gas market risks seem to be complementary.

We provide the first direct evidence of the motivations for the early termination of hedging contracts and find that the likelihood of financial distress has a convex relationship with the early termination of swap contracts in particular, indicating that oil producers with significantly higher leverage ratios terminate their swap positions prematurely. Moreover, oil spot prices have a convex relation with the early termination of costless collars, indicating that costless collars are terminated prematurely when oil prices are significantly high. This is probably done to stop losses due to the selling of a covered call option to form the costless collar. Larger oil producers, with longer debt maturity and longer expected oil reserve life, are reluctant to terminate their put options early.

To gain insight into the causal effects of the hedging maturity on firm value, we estimate the marginal treatment effects (MTEs) of using short-term versus long-term hedging contracts. We identify a credible instrument arising from the economic literature studying the macroeconomic responses to crude oil price shocks, namely the Kilian (2009) index which gives a measure of the demand for industrial commodities driven by economic perspectives. In our application an MTE is the value effect on the marginal firm entering long-term oil hedging contracts (treatment). After controlling for unobserved heterogeneity using the instrumental model of Heckman et al. (2006, 2006b), we show that the marginal firm value related to the use of long-term hedging contracts is lower than that related to the use of shorter contracts. This newly developed methodology allows us to better gauge the effects of hedging maturity choice on oil producers' values because it controls for bias arising from selection on unobservables (i.e., omitted variables) and selection on gain into treatment (i.e., self-selection) due to firms' hidden background attributes.

The rest of the paper is organized as follows. Section 2 states our hypotheses. Section 3 describes our data and variables. Section 4 reports univariate results and Section 5 investigates the empirical evidence of the maturity structure of corporate risk management. Section 6 studies the early termination of hedging contracts. Section 7 examines the real implication of hedging maturity on firm value and Section 8 concludes the paper.

2. Hypotheses

The lack of testable theoretical predictions of hedging maturity structure is compensated for by Fehle and Tsyplakov (2005), who present an infinite-horizon continuous time model of a firm that can dynamically adjust the hedge ratio and maturity of its hedging instruments in response to fluctuations in firm output price. Their model is calibrated to replicate empirical observations for a gold mining firm and produces a number of new theoretical predictions pertaining to the optimal timing, adjustment, and rollover of hedging contracts and their maturities, which we will describe in depth to develop our hypotheses in this section and test empirically later. It is worth mentioning that Fehle and Tsyplakov's model is based on forward contracts but these contracts are not often used during our period of analysis. We will however test empirically their theoretical predictions for hedging instruments with linear payoffs (i.e., swap contracts) and other hedging tools with nonlinear payoffs (i.e., put options and costless collars).

2.1. Financial distress

A large body of the empirical literature has analyzed the positive relationship between financial constraints and firms' hedging activities (e.g., Nance et al., 1993; Géczy et al., 1997; Tufano, 1996; Gay and Nam, 1998; Adam, 2002, 2009). In line with this literature, Fehle and Tsyplakov (2005) analyze the implications of financial distress on risk management adjustments. Based on simulations of gold spot prices, they find, in the presence of transaction costs, a non-monotonic relationship between hedging maturity and measures of financial distress probability. This non-monotonicity means that hedging maturity first increases and then decreases with the probability of financial distress. Thus, firms near distress are often observed with short-run hedging contracts and could terminate longer contracts at a high cost due to risk-shifting behavior. Firms far from distress do not hedge or opt for short-term contracts because of the low marginal benefits of hedging (e.g., Stulz, 1996).