International Journal of Industrial Organization 37 (2014) 153–169

Contents lists available at ScienceDirect

International Journal of Industrial Organization

journal homepage: www.elsevier.com/locate/ijio

On the strategic value of risk management ☆

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ARTICLE INFO

Article history:
Received 27 September 2013
Received in revised form 6 July 2014
Accepted 21 July 2014
Available online 16 August 2014

JEL classification:
L13
G32

Keywords:
Risk management
Price and quantity competition

ABSTRACT

This article examines how firms facing volatile input prices and holding some degree of market power in their product market link their risk management and their production or pricing strategies. This issue is relevant in many industries ranging from manufacturing to energy retailing, where firms that are rendered "risk averse" by financial frictions decide on and commit to their hedging strategies *before* their product market strategies. We find that commitment to hedging modifies the pricing and production strategies of firms. This strategic effect is channeled through the risk-adjusted expected cost, i.e., the expected marginal cost under the probability measure induced by shareholders' "risk aversion". It has opposite effects depending on the nature of product market competition: commitment to hedging toughens quantity competition while it softens price competition. Finally, not committing to the hedging position can never be an equilibrium outcome: committing is always a best response to non-committing. In the Hotelling model, committing is a dominant strategy for all firms.

1. Introduction

Most formal analyses of corporate risk management decisions consider price-taking firms facing volatile cash flows. For example, firms producing commodities or raw materials (e.g., metals and minerals, oil and gas, electric power) and facing output price volatility often use derivative contracts to hedge against output prices fluctuations. This standard, "non-strategic" risk management logic also applies to firms facing input price volatility, provided they do not exert market power in either their input or product markets (for example Aid et al., 2011).

However, when firms facing input price volatility have some degree of market power in their product market, their strategies become more elaborate. A firm's hedging modifies its realized input cost, hence its product market strategy. Thus, the firm alters the competitive dynamics in its industry, and must take into account the behavior of its competitors.

This situation occurs in many industries. For example, electricity retailers purchase power on wholesale markets and resell it to their retail customers. In Britain, the electricity and gas regulatory agency (Ofgem, 2008, page 10) indicates that: "there is evidence that the (6 largest suppliers) seek to benchmark their hedging strategies against each other in order to minimize the risk of their wholesale costs diverging materially from the competition". Suppliers thus appear to monitor their competitors' hedging strategy and incorporate it in their own hedging strategy, and ultimately their product market strategy.

Airlines also constitute a relevant example. Carter et al. (2006) report that, over the period 1992–2003, fuel price represented more than 13% of airlines operating costs, and exhibited annualized volatility of 27%, and document the strategic importance of fuel hedging. Airlines do not exert market power in the fuel market, yet they are an oligopoly on specific routes (see for example Gerardi and Shapiro (2009)).

The food processing industry provides another example. Food processing firms are exposed to volatile feedstock prices (e.g., grains, tobacco). They may not exert market power in the feedstock markets, however most empirical studies document market power in their product markets (see the survey by Sheldon and Sperling (2003)).

As the above examples suggest, the interaction between input hedging and product market strategies is relevant for multiple industries. As discussed in Section 2, while there exists a rich literature on the strategic impact of forward output sales, few articles examine the strategic aspects of forward input purchases. In most cases, a separation (or dichotomy) property exists: input hedging is found to have no impact on product market strategy (see the references in Dionne and Santugini (2013)). This article is among the few that explicitly links

☆ We benefited from the useful comments from the Editor, Yongmin Chen, the two anonymous referees, the participants in many Finance and Economics seminars, in particular at HEC Montréal, Paris-Dauphine University, and the IDEI/Northwestern 2010 annual conference. We also received insightful comments from Patrick Rey, Bill Rogerson and Jean Tirole. We are grateful to a grant from Europlace Finance Institute. Rochet acknowledges the financial support from the European Research Council (European Community's Seventh Framework Programme, grant agreement 249415-RMAC) and from NCCR FinRisk (project Banking and Regulation).

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http://dx.doi.org/10.1016/j.ijindorg.2014.07.006
0167-7187/

input hedging and product market strategy when firms compete in quantity (Cournot) and in price (differentiated Bertrand).

We focus the analysis on endogenously “risk-averse” firms[1] that hedge and commit to their hedging position before deciding their product market strategies. The empirical relevance of this choice is justified in Section 3. Formally, we model two-stage games: firms first determine their hedging strategy, then determine their product market strategy (quantity or price), conditional on their first-stage choice.

The main result of this article is that hedging input cost impacts a firm's product market strategy through a reduction in its expected risk-adjusted cost. The intuition is as follows. Due to financial frictions, risk-neutral investors value marginal profits differently in different states of the world. They evaluate any decision using the probability measure induced by this marginal value of profits in each state of the world, and not the physical probability measure. Hedging protects firms against high input prices, when, ceteris paribus, profits are low and investors place high value on marginal profits. Therefore, cost reduction in these states of the world is worth more to investors, and hedging reduces expected risk-adjusted input cost. This risk-adjusted expected marginal cost is determined in equilibrium, and is decreasing in own hedging. Thus, a firm that increases its hedging reduces its expected risk-adjusted cost.

This result is new to the literature, and constitutes the main contribution of this work. Ours is the first article that articulates the impact of committing to hedging input costs on product market strategies when financial frictions are present.

Our main result holds whether firms compete in quantity or in price. However, as discussed below, it has diametrically opposed strategic implications.

Consider first quantity competition. We prove that an equilibrium of the production game always exists. If firms' absolute risk aversion is constant (or does not vary too much), this equilibrium is unique. Furthermore, the standard Cournot logic applies: an increase in own hedging, which decreases own (expected risk-adjusted) cost, increases the rival's equilibrium output (Proposition 1).

If a symmetric equilibrium of the (first-stage) hedging game exists, commitment to hedging *toughens* quantity competition: firms hedge more than their (anticipated) equilibrium production, thus commit to produce more than if their costs were constant and equal to the expected cost under the physical probability measure (Proposition 2).

We establish similar results for differentiated price competition, although we reach the opposite conclusion: commitment to hedging *softens* price competition.

As with quantity competition, an equilibrium of the pricing game always exists. If absolute risk aversion is constant, the equilibrium is unique. An increase in own hedging reduces own (expected risk-adjusted) cost, hence reduces the rival's equilibrium price. This effect is standard with differentiated Bertrand games.

The crucial difference with quantity competition is that commitment to hedging *softens* price competition: in equilibrium firms hedge less than their (anticipated) equilibrium production, thus committing to a price higher than if their cost was constant and equal to the expected cost under the physical probability measure (Proposition 3).

For ease of exposition, the unicity and comparative statics results are derived under the strong condition that risk aversion is constant, and we assume that there is no expected gain (or loss) from forward purchase. Both assumptions can be relaxed. We prove that the unicity and comparative statics results hold under the weaker sufficient condition that the variation of firms' absolute risk aversion remains small (Proposition 4). If an expected gain (or loss) from forward purchase is included, we prove that the strategic effect remains, while a speculative term is added to the forward purchase (Proposition 5).

Finally, we relax the assumption that commitment to hedging is exogenous. We show that, whether firms compete in quantity or in price, committing is a firm's best response to the other not committing. Thus, universal non-commitment never arises as an equilibrium. Furthermore, in the particular case of the Hotelling model (where firms compete in price and total demand is inelastic) commitment is a dominant strategy for all firms (Proposition 6).

Propositions 4, 5, and 6 prove that the strategic effect we identify is robust to changes in the key assumptions.

This article is structured as follows: Section 2 discusses the related academic literature. Section 3 presents the model. Section 4 analyzes quantity competition. Section 5 analyzes price competition. Section 6 proves that the results hold when key assumptions are relaxed. Technical proofs are presented in Appendix A.

2. Relation to the literature

Various articles have examined the interplay between risk management and product market strategies.

First, a rich literature has examined how the possibility to sell output in the forward markets modifies firms' production strategies. For example, Allaz (1992) and Allaz and Vila (1993) look at firms exerting market power on both the spot and the forward markets for their output. Allaz (1992) examines the interplay between the risk management and the strategic motives. Allaz and Vila (1993) assume no uncertainty and focus on the strategic motive. In the spot market (stage 2), a firm that has already sold a share of its output faces lower incentives to withhold output. In the forward market (stage 1), firms face a prisoner dilemma, and cannot resist selling output forward. Thus the existence of forward contracts reduces firms' market power. This result is very similar to our Proposition 6, even though the setting is different: firms in Allaz and Villa sell output in spot and forward markets where they exert market power, while in ours, firms exert no market power in the spot and forward markets for input.

Hugues and Kao (1997) extend Allaz (1992) analysis by considering the impact of observability of forward sales (or purchases) on firms' incentives to hedge. They compare the equilibria for risk-neutral and risk-averse firms, when forward positions are observable and when they are not. They develop a model of forward sales, and discuss a model of forward purchases. As will be discussed later, this analysis complements Hugues and Kao (1997) results. Hughes et al. (2002) consider strategic incentives to publicly report forward sales position if one firm has a first-mover and informational advantage.

These articles focus on the strategic impact of forward output sales. As mentioned in Section 1, few articles examine the strategic aspects of forward input purchases, for in most cases, input hedging is found to have no impact on product market strategy.[2]

A recent exception is Dionne and Santugini (2013), who examine a two-stage game related to ours. In the first stage, firms decide to enter the market (or not). In the second stage, risk averse firms facing a volatile input price compete à la Cournot in their output market, and simultaneously determine their hedging strategy. Dionne and Santugini (2013) find that both hedging and product market strategies depend on the number of firms in the market. The latter is then determined in equilibrium, and is a function of the volatility of input price, expected gain (or loss) from forward contracts, and firms' risk aversion.

There are two main differences with this article: we consider a mature market where the number of active firms is fixed and firms commit ex ante to their hedging strategies (more on this in the next section), while Dionne and Santugini (2013) look at markets where new firms can enter, and hedging and quantities are jointly determined.

[1] As pointed out by one referee, firms owned by diversified shareholders are not risk-averse, rather they sometimes behave AS IF they are risk-averse, due to important financial frictions. These effects are discussed in Sections 2 and 3. To keep the exposition simple, we use in this article the term “risk-averse”, with a slight abuse.

[2] See for example the references in Dionne and Santugini (2013).