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## An exploration of factors influencing the choice of commodity price risk mitigation strategies

Barbara Gaudenzi<sup>a,\*</sup>, George A. Zsidisin<sup>b</sup>, Janet L. Hartley<sup>c</sup>, Lutz Kaufmann<sup>d</sup>

<sup>a</sup> Department of Business Administration, University of Verona, Italy

<sup>b</sup> Department of Supply Chain Management and Analytics, School of Business, Virginia Commonwealth University, Richmond, VA 23284, USA

<sup>c</sup> Department of Management, College of Business, Bowling Green State University, Bowling Green, OH 43403, USA

<sup>d</sup> SCM Group, WHU – Otto Beisheim School of Management, 56179 Vallendar, Germany

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### ABSTRACT

Most firms are exposed to price volatility associated with commodities, which can significantly affect the price paid for raw materials, energy, packaging, shipping, and component purchases. Commodity price risk represents the financial, operational and informational effects of commodity price volatility (CPV). The purpose of this paper is to contribute to the supply chain risk management literature by providing a taxonomy of commodity price risk mitigation strategies and factors that may influence the adoption of these strategies. A qualitative study was conducted using a grounded theory approach, based on case studies of companies with home operations in Italy, Germany, and the US. The paper provides some initial evidence for theory and practice as to: 1) how firms can mitigate the risk from CPV by implementing various sourcing, contracting, and financing strategies; and 2) the influence of commodity/product factors, buying organization factors, supply chain factors, and external environment factors on strategy capability and choice.

### 1. Introduction

Most organizations, including those in the private sector, non-profit entities, and governmental agencies, are exposed to some level of risk from Commodity Price Volatility (CPV). CPV is the measure for variation of the price of commodities such as energy, metals, refined petroleum products, food and non-food agricultural products (Jacks et al., 2009; Zsidisin et al., 2017; Dobbs et al., 2013). Organizations are exposed to commodity price risk from direct raw materials, indirect purchases such as energy, materials handling and transportation, and from commodities purchased by upstream suppliers that affect purchased parts and components (Kingsman, 2014).

In the mid-2000s, CPV for many commodities increased, creating a significant challenge for firms and increasing the awareness of the importance of managing risk from CPV. For example, the volatility of corn and wheat futures prices, historically averaging 19.7% and 22.2%, respectively, reached record high levels of 30–50% from 2006 to 2011 (Kalari and Power, 2013). Recent crude-oil price movements and frequent cases of supply disruptions confirm that oil price volatility represents a key issue for researchers, organizations and governments (BP Statistical Review of World Energy, 2016).

If not effectively mitigated, CPV can severely affect a firm's ability to

meet customer requirements, make it difficult to decide upon product-pricing, pose significant challenges in budget planning, and ultimately reduce profitability (Matook et al., 2009). For example, U.S. food producer Smucker saw its profits decline in 2015, largely because it could not offset higher green coffee prices by raising prices on its retail coffee products (Smucker, 2015). In 2015, Delta Airlines lost over \$2.3 billion when it failed to alter its financial hedging practices in the face of falling jet fuel prices (Carey, 2016).

The effective management of price-volatile commodities and related risks is recognized as an important, emerging task in supply chain risk management (Zsidisin and Hartley, 2012; Fischl et al., 2014). Although research in supply chain risk management has been growing in areas such as disruptions (Tomlin, 2006; Jüttner and Maklan, 2011; Brandon-Jones et al., 2014), risk assessment (Jüttner, 2005; Neiger et al., 2009; Rao and Goldsby, 2009; Tummala and Schoenherr, 2011; Sodhi et al., 2012; Ho et al., 2015), and risk mitigation (Manuj and Mentzer, 2008a; Tang and Nurmaya Musa, 2011; Kaufmann et al., 2016; Hajmohammad and Vachon, 2016), studies on CPV and risk mitigation strategies are still limited. Researchers in the fields of economics and finance primarily examine financial hedging, using quantitative modeling approaches, for understanding how firms can address price risk (e.g. Smith, 2005; Arezki et al., 2014; Rampini et al.,

\* Corresponding author.

E-mail addresses: [barbara.gaudenzi@univr.it](mailto:barbara.gaudenzi@univr.it) (B. Gaudenzi), [gazsidisin@vcu.edu](mailto:gazsidisin@vcu.edu) (G.A. Zsidisin), [jhartle@bgsu.edu](mailto:jhartle@bgsu.edu) (J.L. Hartley), [kaufmann@whu.edu](mailto:kaufmann@whu.edu) (L. Kaufmann).

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2014). The supply chain management literature (e.g. Finley and Pettit, 2011; Zsidisin et al., 2013; Byrne and Power, 2014; Johnson et al., 2014) likewise describes strategies that companies use to mitigate commodity price risk. Yet a holistic description of mitigation strategies, and the factors that influence the selection and effectiveness of these strategies, are not clear in the literature (Zsidisin et al., 2013; Kaufmann et al., 2016).

The number of theoretical and empirical studies on CPV and related mitigation strategies in a supply chain context is limited. In particular, Fischl et al. (2014) highlighted: “Neither risk sources nor the drivers of price risks have been explicitly examined in the supply chain context” (p. 489), and “Risk mitigation strategies often lack empirical foundation” (p. 491). Our research addresses this gap in the literature by exploring how managers decide upon which strategies to use for managing risk from CPV. Our research also addresses the need for integrating financial and sourcing views of commodity price risk (Finley and Pettit, 2011; Pettit et al., 2013), and extends the analysis of supply chain risk in the context of CPV.

This paper begins with a brief review of the limited existing supply management literature on CPV and commodity price risk mitigation strategies and presents a framework that categorizes commodity risk mitigation strategies. Then, using a grounded theory approach (Strauss, 1987; Strauss and Corbin, 1998; Pinnington et al., 2016) with data gathered in case studies of 12 companies with home operations in Italy, Germany, and the US the framework is validated. This grounded theory study extends existing frameworks about commodity price risk mitigation strategies, and builds new theory about those factors influencing the related decision-making process. The remainder of the manuscript consists of discussion of the findings and overall conclusions and directions for future research.

## 2. Commodity price volatility and risk

### 2.1. Overview of price risk management

International risk management standards classify corporate risks into strategic risks, financial risks, operational risks and hazards (ISO Guide 31000, 2009; AIRMIC-ALARM-IRM, 2010; Hora and Klassen, 2013; Lam, 2014). Researchers have extended the study of risk into the supply chain and primarily have focused on defining and classifying supply chain risk (e.g., Jüttner et al., 2003; Chopra and Sodhi, 2004; Tang, 2006; Christopher and Lee, 2004; Rangel et al., 2015). Jüttner et al. (2003, p. 200) defined supply chain risk as “any risks for the information, material and product flows from original supplier to the delivery of the final product for the end user”. One of the challenges with Supply Chain Risk Management (SCRM) research, as pointed out by Rangel et al. (2015), is that researchers have classified supply chain risk in a number of different ways. For example, Jüttner et al. (2003) divided supply chain risk sources by environmental, network, and organizational. Christopher and Lee (2004) classified supply chain risk into the five categories of process, control, demand, supply and environmental, while Manuj and Mentzer (2008b) distinguished supply, operational, demand, security, macro, policy, competitive, and resource risk. Chopra and Sodhi (2004) identified the category of procurement risk, and Colicchia and Strozzi (2012) highlighted, among key themes for the future SCRM development, the need to investigate mitigation capabilities, particularly from a disruption perspective. More recently, Giannakis and Papadopoulos (2016) classified financial risks as endogenous supply chain risks, distinguished from exogenous ones, and Aqlan and Lam (2015) identified ten different supply chain risk categories.

From the SCRM perspective, CPV is a subcategory of supply chain risk related to operational or resource risk (Harland et al., 2003), and has been placed into the category of supply risk. However, empirical investigations of price risk are still limited (Fischl et al., 2014). When prices significantly increase, there is the potential for an operational

risk from a supply chain disruption if an organization does not have the financial resources to acquire the commodities it needs (Bjornson and Carter, 1997; Lewis, 2003; Tazelaar and Snijders, 2012). Disruptions may also occur when prices significantly decrease because suppliers may not be profitable and experience financial difficulty or exit the business (Bandaly et al., 2013).

From an economics and finance perspective, commodity price risk is considered as financial risk (Allen, 2013), since the purchasing variations can have impacts onto cash flow, profitability, and the ability of a firm to meet its financial obligations (Horcher, 2005; Carter et al., 2011; Symeonidis et al., 2012). Researchers have recently begun to examine some intersections between commodity price risk, finance, and supply chain risk. For example, Poojari et al. (2008) and Guoming et al., (2009, 2011) analyzed the relationships among inventory risk, financial constraints, and supply. In addition, increasing attention has been paid to the impact that supply chain risk may have on long-term operations and financial performance (Hendricks and Singhal, 2001, 2003, 2005; Kleindorfer and Saad, 2005; Hendricks et al., 2009; Chen et al., 2013; Zsidisin et al., 2016). Finley and Pettit (2011) highlighted how the management of commodity price risk should be integrated into sourcing decisions to improve the organization's financial performance.

### 2.2. Commodity price risk mitigating strategies

Although researchers have classified supply chain risk, the literature does not provide a classification framework of strategies used to mitigate the price risk from CPV. The supply chain risk management literature provides some guidelines for understanding how firms implement various strategies for mitigating commodity price volatility and risk. In Table 1 we categorize these into sourcing, contracting, and financing strategies.

#### 2.2.1. Sourcing strategies

Sourcing strategies influence the timing, quantity, sources of supply, and type of material, to minimize the total cost of risk and risk exposure from CPV (see Table 1). These strategies involve applying traditional supply management approaches to mitigate risk and these decisions are typically made by the supply management organization. Changing the *purchase timing* is a common risk management practice (Byrne and Power, 2014) and includes *forward buying* as well as *waiting to buy*. *Forward buying* involves acquiring the commodity for a known forecast (Doering and Suresh, 2016) in advance and holding material in inventory. This strategy works well if prices increase in the future, but also increases inventory cost. When prices decrease or actual demand is less than the forecast this strategy is less effective than waiting to buy (Johnson et al., 2014). When prices are expected to decrease, companies often wait to buy small quantities more frequently, but this increases transportation, handling, and administrative costs. A second strategy firms can employ to mitigate price volatility consists of *supplier switching*. Generally, companies implementing this strategy have long-term agreements with suppliers, assuring a certain level of flexibility within the contract to shift volumes among these suppliers to take advantage of price differentials (Kaynak and Hartley, 2008).

A third sourcing approach consists of *vertical integration*. In this case firms can decide to produce raw materials in-house, or may choose to buy from vertically integrated suppliers (Helman, 2015; Henriques and Sadorsky, 2011) to avoid price volatility from market exposure. This is a strategic decision requiring a commitment of capital and increases the assets of the firm. The reasons for investing in vertical integration go beyond the management of CPV, and thus decisions are made by executives. Nevertheless, vertical integration decisions can be strongly influenced by the need to mitigate commodity price risk. For example, many oil companies such as Exxon Mobile and Royal Dutch Shell are vertically integrated owning upstream exploration and production and downstream refining. However, Marathon Petroleum

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