



## Measuring overconfidence in inventory management decisions



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### ABSTRACT

Overconfidence has emerged as a significant explanation of behaviour in diverse managerial settings. In this paper, we explore the relevance of overconfidence for supply chain management by running a series of human experiments within the framework of the classic Beer Game. Unlike previous experimental studies, participants were knowledgeable about supply chain management, either being graduate students in Operations Management or purchasing professionals. Results of the study support the view that overconfidence may lead supply chain professionals to be less careful in the management of inventories and thus incur more costs. A first implication for organizations is that purchasing professionals should be trained to discount their expectations of success by removing this optimistic bias. A second is the importance of providing managers and employees with benchmarks that allow them to assess correctly their performance in relative terms. The study also underlines the effect of environmental uncertainty as an important contextual factor influencing overconfident behaviour.

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### 1. Introduction

Today's purchasing professionals have to handle complex environments and turbulent markets and often are asked to take decisions under conditions of increasing uncertainty (Harland et al., 2003; Wagner and Neshat, 2010). Recent literature has shown that – under these conditions, individual cognition and personality attributes of the decision maker may become crucial in determining outcomes (Ancarani and Di Mauro, 2011; Bendoly et al., 2010, 2006; Gino and Pisano, 2008; Loch and Wu, 2008; Lu et al., 2015).

Findings gathered from diverse disciplines, such as economics, finance and management have emphasised the relevance of one particular individual bias, namely overconfidence, as a determinant of individual decisions in complex and uncertain environments (Camerer and Lovo, 1999; Hayward et al., 2006; Li and Tang, 2010; Malmendier and Tate, 2005; Shipman and Mumford, 2011). Overconfident individuals tend to believe that their information or their estimates are more accurate than they actually are, or that they hold superior skills and abilities than average (Moore and Healy, 2008). Uncertainty may encourage overconfidence because decision makers misunderstand the hazards they face (Kahneman and Lovo, 1993; Park and Santos-Pinto, 2010), or because it provides more room for discretion (Li and Tang, 2010).

Overconfidence has been shown to result in poor performance

in different decision contexts. In particular, empirical evidence suggests that overconfidence negatively affects judgment and decision making of managers (Aspinwall et al., 2005; Åstebro et al., 2007; Shipman and Mumford, 2011), leading to over-trading behaviour in the stock market (Odean, 1998), use of more long-term, as opposed to short-term, debt (Ben-David et al., 2007), imprecision of forecast (Hribar and Yang, 2011), and excessive risk taking (Li and Tang, 2010; Simon and Houghton, 2003).

In supply management, overconfidence may bring about negative consequences for risk management, by leading to risk underestimation, to build a limited supply-base, or to forego the use of appropriate procedures in the selection, evaluation and monitoring of external sources. Overconfidence may lead purchasing managers to under-estimate the variance of demand or of lead times, thus inducing them to hold too little safety stock in inventory (Ren and Croson, 2013).

Notwithstanding the potential relevance of investigating overconfidence in supply management, there is a surprising paucity of empirical analysis. Further, we are not aware of any empirical study investigating the interplay between uncertainty and overconfidence in affecting supply chain performance.

In this paper, we address this literature gap by focusing on inventory decisions within a serial supply chain. Specifically, we address the following research questions:

1. Do buyers along a supply chain exhibit overconfidence?
2. Is overconfidence enhanced under conditions of greater environmental uncertainty?
3. What is the impact of overconfidence on inventory

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management?

In order to address the three research questions, we run a series of controlled human experiments using the framework of the “Beer Game” (Forrester, 1958), a business game that is a paradigmatic representation of a serial supply chain (Croson and Donohue, 2002; Nienhaus et al., 2006; Sterman, 1989). Controlled human experiments have recently been acknowledged as a useful methodology to study the impact of behavioural characteristics (including heuristics and biases such as overconfidence) in operations management (Boyer and Swink, 2008; Tokar, 2010), due to the high internal validity of findings and their replicability. Human experiments can supplement supply management research by providing insight into how the human factor influences supply decisions and by exploring how human characteristics interact with operational and organizational aspects (Boyer and Swink, 2008; Croson and Donohue, 2002; Knemeyer and Naylor, 2011).

Our experiments compare buyers’ behaviour and performance under two different supply chain scenarios: the first characterised by demand uncertainty, the second featuring both demand and supply uncertainty. Results suggest that – contrary to intuitive reasoning, when uncertainty increases buyers overrate their ability to control for uncertainty, thus holding insufficient inventory and incurring costs of stock outs. This makes it important for organizations to design appropriate monitoring systems and risk plans that apply in cases of higher turbulence and disruption risk, in order to counterbalance any potential optimistic bias of the decision maker. Our experiments also provide evidence that overconfident buyers exhibit a worse performance in terms of costs, size of backlogs, and variance of orders.

The rest of the paper is organised as follows: Sections 2 and 3 review the relevant literature and present the hypotheses tested, Section 4 describes the experimental design and the measures of overconfidence used in this paper, while Section 5 reports the results of the experiments. Section 6 discusses implications for research and for management. Section 7 concludes with limitations and an agenda for future research.

## 2. Facets of overconfidence

The concept of overconfidence is an umbrella under which three main psychological effects have been gathered, namely overprecision (or miscalibration), overplacement, and overestimation (Moore and Healy, 2008).

Overconfidence as overprecision refers to the systematic underestimation of the variance of a relevant measure affecting performance (demand, costs, etc.) (Soll and Klayman, 2004; Glaser and Weber, 2007). Conversely, the term overplacement, or better-than-average effect, applies when the decision maker considers herself to be better than others (Alicke and Govorun, 2005; Larrick et al., 2007; Moore and Healy, 2008). Overestimation holds when the decision maker expresses unreasonable optimism about her performance or chances of success (Griffin and Tversky, 1992), and ability to control (Presson and Benassi, 1996; Thompson et al., 1998).

Over-precise managers underrate the volatility of future cash flows (Shefrin, 2001), exhibit higher trading volumes (Odean, 1998), overweight private signals (Gervais and Goldstein, 2007), and choose a longer-term debt structure (Ben-David et al., 2007). These results entail that mis-calibrated managers estimate future unknowns with probability distributions that are too narrow, either because they overrate their ability to predict the future or because they underrate the volatility of random events (Ben-David et al., 2010). Overconfidence as overplacement of one’s capabilities

has been investigated by Malmendier and Tate (2008), who find that overconfident CEOs engage more frequently in unsuccessful mergers and acquisitions. Hribar and Yang (2011) show that overconfident CEOs tend to issue earnings forecasts in the form of point estimates rather than in intervals. Glaser and Weber (2007) find that financial analysts who consider themselves better than average place more orders. Overestimation of one’s chances of success influences entry into competitive markets (Camerer and Lovo, 1999). With reference to entrepreneurial venture performance, Lowe and Ziedonis (2006) find that, consistently with the overestimation bias, start-ups continue unsuccessful development efforts for longer periods than do established firms.

While overprecision has been the focus of many studies, including one in the supply and purchasing management discipline (Ren and Croson, 2013), there is a relative paucity of research addressing overestimation and overplacement in business studies, and no study in the area of supply and purchasing. Therefore, this study focuses on the overestimation and overplacement of buyers within a supply chain. In competitive environments, where decision makers need to assess their performance not only in absolute terms but also in relation to other competitors, these two dimensions are of particular interest.

There is no agreement among scientists on the factors that activate the three facets of overconfidence described above. The presence of overconfidence and its strength has been associated with psychological, social and contextual factors. Hayward et al. (2006) argue that antecedents of entrepreneurs’ overestimation of the wealth they can generate from their ventures can be found in overconfidence in their knowledge, in their ability to predict, and in their personal skills. Radzevick and Moore (2011) show that the drivers of overconfidence are not only psychological but also social, by showing that competitive pressures in a market exacerbate overprecision.

Among contextual factors, building on upper echelon theory (Hambrick, 2007; Hambrick and Mason, 1984), Li and Tang (2010) argue that managerial discretion is the channel through which overconfidence may be transmitted to organizational performance. In addition, there is evidence that an uncertain environment leads decision makers to believe they hold more information than they actually have (Kahneman and Lovo, 1993; Lichtenstein and Fischhoff, 1977; March and Shapira, 1987; Park and Santos-Pinto, 2010), thus resulting in overconfidence. In the same vein, Hayward et al. (2006) suggest that overconfidence in own ability to predict is strongest in uncertain environments, while Kumar (2009) finds that investors make larger investment mistakes and systematically overestimate their investment ability when stocks are more difficult to evaluate.

## 3. Overconfidence in supply management decisions

### 3.1. Environmental uncertainty and overconfidence

Research has emphasised that more and more often purchasing professionals are called to manage unforeseen adverse events (Kleindorfer and Saad, 2005), or they have to take decisions in the face of complex environments and uncertainty (Harland et al., 2003; Wagner and Neshat, 2010). At the same time, there is evidence that often even large corporations disregard uncertainties, and therefore fail to devise appropriate plans against disruptions or accurately build their supply network. Hence, there are grounds for positing that increased uncertainty in governing supply may exacerbate the detrimental effects of managerial overconfidence.

In the supply management field, Carter et al. (2007) posit that overconfidence (interpreted as overestimation) will lead a buyer to place too much confidence in the process of supplier evaluation

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