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Accounting for ambiguity and trust in partial outsourcing: A behavioral real options perspective

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ABSTRACT

Concerned with the hidden costs of outsourcing, this paper examines the role of ambiguity and trust in partial outsourcing decisions from the perspective of real options theory. We study pricing and quantity dynamics between an ambiguity averse vendor and a less (more) trusting client in a leader-follower framework with fixed timing. We find that a client's partial outsourcing quantity increases with the vendor's ambiguity if outsourcing is meant for cost-saving purposes. Meanwhile, the effect of trust on outsourcing quantity is jointly moderated by the vendor's ambiguity and quality of shared information forecasts when cost advantages are exaggerated. In terms of pricing effects, the vendor increases (decreases) their threshold with increasing ambiguity for long-term (short-term) contracts. These insights hold under the multiple-priors and worst-case ambiguity specification. When Choquet ambiguity and rank-dependent utility are considered, more complex and subtle dynamics are obtained. Ambiguity has additional non-linear effects on outsourcing quantity due to heterogeneity in ambiguity preferences (seeking versus aversion) and probability weighting. The vendor's price not only increases (decreases) with increasing ambiguity-seeking for long-term (short-term) contracts, but also with ambiguity aversion when specific risk-return conditions are met. Trust effects are qualitatively similar under both ambiguity specifications.

1. Introduction

Partial outsourcing is prevalent in many industries. Most manufacturers outsource their operations to some degree, subject to changes in business and economic conditions. For example, Samsung is known to manufacture its products in-house, but also outsources some of its production processes whenever necessary. Toyota outsources 70% of the components of its vehicles and keeps 30% in-house to improve innovation (Xiao & Gaimon, 2013). According to Capgemini (2014), 72% of 3PL users have increased their reliance on outsourced logistics services either as a whole or in terms of individual activities, while several shippers source most, if not all, of their logistics activities. E-commerce companies, such as Amazon, have their own fleet of trucks, but also use traditional carriers, such as FedEx and UPS, to speed up product delivery and control shipping expenses.

While the above suggests that partial outsourcing has become second nature in manufacturing and services, stories about outsourcing failure are not uncommon (Barthelemy, 2003; Cabral, Quelin, & Maia, 2014).[1] Reasons behind such failures have been attributed to a mismatch in expectations between clients and vendors, unexpected and *hidden* operating costs, poor governance systems, and cultural differences (Cabral et al., 2014; Forbes, 2013; Larsen, Manning, & Pedersen, 2013). Several surveys of executives (Barthelemy, 2003; Benlian & Hess, 2011) particularly highlight how most outsourcing programs fail to meet their cost-saving targets because of unexpected and consistently increasing operating costs, lack of information clarity about outsourcing implementation, and fragile risk mitigation policies. This double-sided form of cost uncertainty together with information incompleteness and suboptimal behavior—as other hidden costs of outsourcing—creates ambiguity in the outsourcing process. Ambiguity also arises from external factors because of the increasingly complex and turbulent business environments that firms (i.e., vendors and clients) find themselves operating in (Sargut & McGrath, 2011). Wages in several outsourcing hubs have more than doubled since 2008. Industrial and agricultural raw material prices have become more volatile (Boute & Van Mieghem, 2015). Exchange rates and shipping costs across the

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[1] Reports in the popular press (e.g., *Forbes*, *IndustryWeek*, *Businessweek*, *CIO magazine*, *Computerworld*) indicate that major companies, such as IBM, JP Morgan Chase, EDS, Royal Bank of Scotland, Boeing, Accenture, and Virgin Airlines have all experienced some type of outsourcing failure in recent years.

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globe are also shifting frequently because of numerous structural economic changes. This renders the task of accurately predicting future costs and effectively managing outsourcing operations extremely challenging and uncertain for vendors. This, in turn, exacerbates the negative effects of cost-related uncertainty on outsourcing performance and increases the hidden costs of outsourcing. Another important source of uncertainty relates to the quality of outsourcing services, the degree of trust between clients and vendors, and the reliability of outsourcing providers (Drauz, 2014; Zuñiga & Martinez, 2016).

In such an ambiguous state of affairs and with the increasing rate of failure surrounding outsourcing, determining the right price and quantity of (partial) outsourcing is becoming a critical and particularly challenging task for vendors (contract-receiving firms) and clients (contract-granting firms). In this paper, we examine the issue of the hidden costs of outsourcing, and its pricing and quantity implications, from an ambiguity perspective using real options theory. We are interested in the cost-saving and volume-based learning effects of partial outsourcing on pricing and quantity dynamics in a dyad consisting of an ambiguity averse vendor and a less (more) trusting client. Owing to her perceived specialization, the vendor (she), while uncertain about her own future operating costs, makes positive forecasts about the cost-saving benefits associated with outsourcing. To clinch a bigger contract, she exaggerates the client's in-house variable costs and communicates this exaggerated information to the client. The client (he), faced with incomplete information, becomes doubtful and less confident about the forecasts and decides whether to and to which extent he should trust the vendor. As such, the client's degree of trust toward the vendor's forecasts and the vendor's uncertainty or degree of ambiguity about the costs of outsourcing are fundamental to the outsourcing arrangement.

This paper proposes a behavioral real option model with trust for quantity and price under ambiguity that enables us to better understand some of the hidden costs of outsourcing, their consequences, and the nature of outsourcing relationships in practice. More specifically, our ambiguity-based modeling provides insights into how unexpected costs, expectations' mismatch, and suboptimal/subjective behavior affect partial outsourcing decisions and their outcomes. The contribution of the paper is twofold. First, we address the problem of the hidden costs of outsourcing by unveiling the joint effects of ambiguity and trust on price and quantity dynamics in outsourcing decision making. Second, we compare and contrast these effects under the multiple-priors and Choquet ambiguity specifications using real options theory, thus introducing notions of cognition and subjective behavior to the real options literature concerned with outsourcing (e.g., Antelo & Bru, 2010; Li & Wang, 2010).

As a real option, outsourcing has the potential to lower costs, increase flexibility, and enhance firm value (Choi, Ju, Kotabe, Trigeorgis, & Zhang, 2018). However, this may be at the expense of innovation, service quality, and tacit know-how (Kenyon, Meixell, & Westfall, 2016). For example, in Xiao and Gaimon (2013), future value is defined as a power learning function of an in-house production quantity that captures the incremental benefits of keeping manufacturing in-house. Simultaneously, the client can also learn from the vendor's tacit knowledge through outsourcing (Aubert, Kishore, & Iriyama, 2015; Gupta & Polonsky, 2014). This learning effect is empirically highlighted by Kroes and Ghosh (2010), but has not received sufficient attention in normative outsourcing decision models. The trade-offs between the future value of in-house operations and that of outsourcing for the client—and their influence on outsourcing pricing and quantity decisions—are also studied in our paper using our ambiguity-based real options approach with trust. This is the first research to examine the partial outsourcing real option problem and the issue of the hidden costs of outsourcing from the perspective of behavioral theory (see e.g., Agliardi, Agliardi, & Spanjers, 2016; Leiblein, Chen, & Posen, 2017 and their behavioral valuation models), while jointly considering ambiguity and trust. Our behavioral real options model of partial outsourcing captures a number of features neglected in the existing literature: vendor's ambiguity, client (dis)trust, and volume-based learning from in-house production and outsourced operations. Allowing for ambiguity in such a setting is important because it enables us to shed light on the role of subjective/suboptimal behavior in outsourcing relationships, account for unexpected cost uncertainty and lack of information clarity in outsourcing provision, and understand some of the antecedents of outsourcing failure.

In our fixed timing setting (for example, see Agliardi and Koussis (2011)), the client acts as a leader in the sense that he controls the outsourcing quantity and timing, while the vendor is a follower who sets her pricing conditions. We model ambiguity using the multiple-priors ambiguity specification or the so-called "worst-case" ambiguity aversion heuristic,[2] addressing the following practical questions: *What is the client's outsourcing quantity with and without trust? How to determine the outsourcing price and quantity of outsourcing under ambiguity when accounting for cost-savings and future learning benefits? How do trust and ambiguity (preferences) affect partial outsourcing outcomes?*

We find that higher ambiguity from the vendor increases the client's outsourcing quantity when the cost-saving index is positive, but does not necessarily increase the vendor's lowest offer price. The vendor's price increases (decreases) with ambiguity for long-term (short-term) contracts. Trust affects the partial outsourcing quantity in a non-monotonic manner as a result of joint moderating effects from ambiguity and information sharing quality. Most of these dynamics are altered under Choquet ambiguity and rank-dependent utility when ambiguity preferences (seeking versus aversion) and probabilistic sophistication come into play. The effects of ambiguity on outsourcing quantity are exacerbated by heterogeneity in ambiguity preferences and the vendor's price is found to not only increase (decrease) with ambiguity-seeking for long-term (short-term) contracts, but also with ambiguity aversion when specific risk-return ratio dynamics are met. Trust effects are maintained under rank-dependent utility. These findings are able to explain over-commitment and short-termism biases in outsourcing, provide guidance on how clients and vendors behave when faced with incomplete and asymmetric information, point to the need to embed flexibility/performance clauses in outsourcing contracts, and sequence commitment into contingent stages as means of dealing with ambiguity and mitigating some of the hidden costs of outsourcing.

The paper is organized as follows. The next section reviews some relevant literature concerned with real options and outsourcing. In Section 3, we investigate the vendor's outsourcing pricing strategy and the client's outsourcing quantity decisions. The effects of ambiguity and trust on outsourcing outcomes are discussed in Section 4. The final section concludes, providing a summary of the findings and research implications. A list of notations and all proofs are covered in the Appendix.

2. Related literature: real options, uncertainty and trust in outsourcing

There is substantial research on how real options affect outsourcing decisions in the presence of irreversibility and uncertainty. Real options theory has been applied to the analysis of clients' outsourcing strategies in a number of economic settings and contractual frameworks (e.g., Nembhard, Shi, & Aktan, 2005; Alvarez & Stenbacka, 2007; Liu and Nagurney, 2013; Benaroch, Webster, & Kazaz, 2012). These studies have provided a deeper understanding of clients' managerial flexibility in outsourcing when faced with international risk and demand and cost uncertainty. Different from this stream of literature, Jiang, Yao, and Feng (2008), Jiang, Talluri, Yao, and Moon (2010), Moon, Yao, and Jiang (2011), and Shi and Feng (2016) have recently emphasized the role of vendors in setting outsourcing contracts and described how real

[2] For comparison, Table 2 revisits our modeling from the perspectives of 1) Choquet ambiguity and 2) risk without ambiguity.