



A neural network approach to predicting price negotiation outcomes in business-to-business contexts

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ABSTRACT

Price premiums are a key profit driver for long-term business relationships. For sellers in business-to-business (B2B) relationships, it is important to have appropriate strategies to negotiate price increases without trading off the relationships with their buyers. This paper aims to understand the annual price negotiation processes of companies by predicting whether a seller's reservation price, target price, and initial offer positively affect the price negotiation outcome between the sellers and buyers. Data from 284 B2B relationships of a chemicals supplier based in Germany was used to examine our research model. In order to capture the non-linear decisions that are involved in price negotiations and to address collinearity among negotiations' determinants, neural network analysis was used to predict the factors that influence price negotiation outcome. The neural network model was then compared with the results from regression analysis. Compared to regression analysis, the neural network has a lower standard error, and it showed that target price played a more important role in B2B price negotiations. The neural network was also able to measure non-linear, non-compensatory decisions that are involved in price negotiations. The results imply that neural networks should be more widely used by researchers to address the threats that multi-collinearity poses. For companies, the results imply that price targets should be actively managed, e.g. through clear financial aims or through seminars aiming to help sales personnel to establish more challenging negotiation aims.

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1. Introduction

Price negotiations play an important role in business as their outcomes can impact long-term business relationships' profitability and the reputation of businesses (Carbonneau, Kersten, & Vahidov, 2008). B2B price negotiations have various challenges such as the complex business environment which usually involves multiple interactions by at least two – and often many – people (Plank, 1997), and are therefore more complex than consumer price studies (Carbonneau et al., 2008; Holden & Burton, 2008; Kotler & Keller, 2006). Companies understandably also very rarely make their B2B pricing transparent or accessible due to its direct competitive profit relevance and often strategic character. For sales personnel who are preparing for annual price negotiations, it is difficult to know what price to demand (initial offer), what settlement to actually expect (target price), and what minimum price can be accepted before the relationship becomes unprofitable (reservation price). Price references (Mazumdar, Raj, & Sinha, 2005) influence the negotiation behavior of both sellers and buyers and ultimately the price negotiation outcome.

Several conclusions can be drawn from existing studies of pricing negotiations, e.g. by Moosmayer, Schuppar, and Siems (2012) and Van Poucke and Buelens (2002). Firstly, existing studies in price negotiations are overly experimental (Krause, Terpend, & Petersen, 2006), often using student samples, and transactional in nature. However, findings based on experimental designs account neither for context factors such as negotiators' expertise and experience, nor for the fact that the nature of industrial business is predominantly relationship-based, rather than transactional. The validity of experimental, transaction-oriented findings for price negotiations in B2B relationships thus appears questionable. Moreover, studies based on student sampling, although strong in internal validity (Bachrach & Bendoly, 2011; Eckerd & Bendoly, 2011), may suggest inappropriate business decisions due to limited external validity (Ketchen & Hult, 2011; Stevens, 2011). Secondly, linear regression models are often chosen to examine the relationships between the determinants of price negotiations and their outcomes. However, regression models are preference regressions which assume that price negotiation decisions are linear compensatory models (Chong, 2013). Under this assumption, the shortfall in a negotiations decision such as reservation price can be compensated for by other factors such as initial offers or target price. However, given the complexities involved in price negotiations, linear

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regression models may not be able to capture all the non-compensatory decision rules involved in these processes, and as a result such models are deemed unreliable. Studies in other disciplines such as information systems have found that linear models tend to oversimplify the complexities involved in decisions (Chong, 2013; Venkatesh & Goyal, 2010). Thirdly, a limitation of regression models is the assumption of independent determinants; however, the seller's price preferences in negotiations are often interdependent. This may result in high multi-collinearity in the data analysis thus affecting the reliability of the results.

This research has several objectives. Firstly, this study aims to understand the factors that can predict the price negotiation outcomes in B2B relationships. Variables such as a seller's reservation price, target price, and initial offer are examined to see if they predict price negotiation outcome. Secondly, this research aims to examine whether non-linear, non-compensatory decision models such as neural networks provide a better model fit and forecasting than linear regression models for predicting pricing negotiation outcomes. In order to achieve this, the results from the neural network will be compared with regression analysis. Lastly, based on the results, this research will suggest how companies can maintain profitable long term B2B relationships by managing sales personnel's trust in pricing negotiations, and how researchers can use neural networks to help address multi-collinearity issues.

2. Previous research

2.1. Negotiations in a business-to-business context

A defining characteristic of negotiations is that parties with opposing interests make a joint business decision, regularly directed to the purchase of a certain amount of a specific product or service at a specific price. Negotiations may be understood as processes that “bring two or more parties together to try to accomplish mutually beneficial outcomes, while meeting individual goals that may be at odds with the other negotiating parties' goals” (Swaidan, 2007: 163). More competitively, negotiations may be understood as “a process of potentially opportunistic interaction by which two or more parties, with some apparent conflict, seek to do better through jointly decided action than they could otherwise” (Lax & Sebenius, 1986: 11). Prior research has primarily taken economic (Nash, 1950; Nash, 1953; Tversky & Kahneman, 1991) and psychological (Barry & Oliver, 1996; Brenner, Koehler, Liberman, & Tversky, 1996; Oliver, Balakrishnan, & Barry, 1994; Tversky & Kahneman, 1981) perspectives.

The economic perspective on negotiations has been presented by Nash (1950). He assumed distributive bargaining conditions with each party aiming to maximize its own profit (Pruitt, 1983) and both parties knowing the preferences of the negotiation partner. In this context, Nash argued, negotiators who behave rationally would thus share the gains of negotiation equally and agree on the mid-point between the buyer's and seller's reservation prices as a price negotiation outcome; the so-called “Nash equilibrium”. A further focus has thus been the determination of a party's reservation price. Empirically, some studies found support for the Nash equilibrium (White, Valley, Bazerman, Neale, & Peck, 1994), but other research efforts did not (Neale & Bazerman, 1991; Neale & Bazerman, 1992). Furthermore, one might think that more individual aspects like personal ambition are neglected in these economic perspectives. Such aspects have been discussed in the psychological stream.

A particular focus in this context has been on the establishment of cognitive references and their application when evaluating an offer. Cost (Wilken, Cornelissen, Backhaus, & Schmitz, 2010), the best alternative to a negotiated agreement (BATNA) (Fisher &

Ury, 1981) as best sourcing alternative (Wang & Zions, 2008), and market price (Blount White, Thomas-Hunt, & Neale, 1996; Kristensen & Gaerling, 1997b; White et al., 1994) have been discussed as important references in price negotiations. For market price, empirical results are contradictory with some authors describing a significant impact on price negotiation outcome (Blount White et al., 1996) and others showing no influence (White et al., 1994). Moreover, it has been shown that negotiators – although contradicting the assumption of rational behavior – are influenced by past experiences (e.g. prices paid in the past) as a reference (Diekmann, Tenbrunsel, Shah, Schroth, & Bazerman, 1996).

In this paper, we aim to use a seller's references in order to explain B2B price negotiation outcome, i.e. the settlement price reached in price negotiations in continuous B2B relationships. Price negotiation outcome thus describes a percentage price increase compared to the previous year's price level fixed in a framework agreement. As references of the counterparty are usually inaccessible to a negotiator, we focus on only one negotiator's reference points. We focus on the seller side and accordingly we do not consider buyer's references in our model.

A broad range of reference points and their framing have been found to be relevant with regard to price negotiation outcomes (Bazerman, Magliozzi, & Neale, 1985; Nagel & Mills, 1989). We investigate the negotiation of price changes in annual reviews of B2B relationships. In this context, we focus on negotiators' reservation price, target price, and initial offer. We do so because these have been the focus of prior experimental research (Krause et al., 2006; Van Poucke & Buelens, 2002). Moreover, their managerial relevance is high because these “reference points ... are determined before the negotiation” (Krause et al., 2006: 13) and managers could thus manipulate them in order to achieve better negotiation results. Finally, other references that have been discussed in the literature appear not to be relevant or inherent to the context: in the negotiations that were studied, sellers approached buyers with an initial offer; considering the intended initial offer as a distinct determinant as in Miles (2010) is thus not necessary. Similarly, past prices as discussed in Diekmann et al. (1996) are the basis to which negotiated price changes are applied and are thus reflected in each reference.

2.2. References in price research

The reference concept has been established in the psychological domain (Helson, 1964; Tversky & Kahneman, 1992) and has been successfully applied to pricing issues (Mazumdar et al., 2005; Winer, 1986). Reference prices are individual price norms that are applied when judging a price observed in the market (Winer, 1988). Such references may have a predictive and normative function (Rajendran & Tellis, 1994). The application of reference price theory has focused on the explanation of consumer brand choice and on the opportunity to guide consumer price perceptions during and after their purchases. Reference prices are commonly differentiated by their sources being internal (in other words based on memories of prior experiences or derived from the mind) or external (perceived in the decision-making situation, e.g. when shopping in a supermarket) (Mazumdar et al., 2005). The reference price concept has also been applied in B2B marketing (Moosmayer et al., 2012; Wilken et al., 2010) and beyond the marketing domain, such as in human resource management (Siems, Goelzner, & Moosmayer, 2012) and in accounting (Mitter C. & F., 2008). Conceptually, reference prices reflect expectations of acceptable adaptation levels (Monroe, 1973), normative considerations regarding fairness (Bolton, Warlop, & Alba, 2003), aspiration perspectives (Klein & Oglethorpe, 1987), and aspects of social context (Mezias, Chen, & Murphy, 2002).

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