THE IMPACT OF COMPETITION AND UNCERTAINTY ON THE ADOPTION OF TARGET COSTING

Christian Ax
School of Business, Economics and Law at University of Gothenburg
P O Box 610
SE-405 30 Gothenburg
Sweden
christian.ax@handels.gu.se

Jan Greve
Swedish Business School at Örebro University
SE-701 82 Örebro
Sweden
jan.greve@esi.oru.se

Ulf Nilsson
Faculty of Management
Sabanci University
Orhanli Tuzla
349 56 Istanbul
Turkey
nilsson@sabanciuniv.edu

International Journal of Production Economics 115 (2008), 92-103

ABSTRACT

In recent years factors which may influence firms´ decisions to adopt target costing have been presented in the literature. These studies generally argue that target costing adoption rates positively correlate with the intensity of competition and perceived environmental uncertainty. However, empirical support for this view is limited. This study argues that the adoption of target costing positively correlates with the intensity of competition, but negatively correlates with perceived environmental uncertainty. In addition, perceived environmental uncertainty moderates the adoption of target costing when the intensity of competition intensifies. Hypotheses are generated and tested using data provided by a web-based survey of Swedish manufacturing firms. The findings indicate that the adoption of target costing and the intensity of competition positively relate, although the effect reduces with an increase in perceived environmental uncertainty. There is no evidence of a direct relationship between perceived environmental uncertainty and the adoption of target costing. As a result, the findings partly conflict with the outcomes of earlier work. The article also discusses the implications for research and firm managers considering the adoption of target costing.

Keywords: target costing, adoption, perceived environmental uncertainty, intensity of competition

1. Introduction[1]

In the late 1980s, Johnson and Kaplan (1987) among others argued that the cost and management control systems (CMCS) used in practice had lost relevance. The principal concern of these critics was that these systems had failed to keep up with changes in the business environment. As a result, the information base was frequently inaccurate and misleading (e.g., Lamminmaki and Drury, 2001). In order to restore the relevance of cost and management control practices, several new techniques, including activity-based costing, strategic costing, attribute costing, and target costing (TC), have been presented. This development has generated an immense amount of research focusing on different aspects of these techniques.

Starting in the 1990s, researchers have attempted to identify factors that may influence a firm's decisions to adopt modern cost and management control techniques. However, Drury and Tayles' (2005) literature review of the past two decades shows that almost all of this research has concentrated on studying the antecedents of the adoption and non-adoption of activity-based costing systems, with the other techniques receiving less attention. The research presented in this paper contributes to this stream of research by examining the influence of contingency factors on the adoption of TC.

Dekker and Smidt (2003) reviewed the literature and found that Japanese researchers focusing primarily on TC in a Japanese context have conducted the great majority of empirical research, and that most Western-based research has concerned the rate of mapping usage from TC in different countries. Surveys on the adoption of TC in Western firms have re-

[1] The authors gratefully acknowledge helpful comments and suggestions received from two anonymous referees and participants at the 5th conference on New Directions in Management Accounting Research, Brussels, Belgium, December 14-16, 2006.

ported high usage rates. In the U.S., Ernst & Young and The Institute of Management Accountants (IMA) (2003) found that 26% of IMA member firms employed TC. Likewise, Chenhall and Langfield-Smith (1998) reported that 38% of Australia's largest manufacturing firms have adopted TC. Israelsen *et al.* (1996) found that 50% of Danish firms had adopted TC. Dekker and Smidt (2003) presented an even higher adoption rate from a study of Dutch firms listed on the Amsterdam Stock Exchange, with 59.4% of firms found to be using TC.

Unfortunately, while many firms use TC, there is little evidence about the factors influencing a firm's decision to adopt or reject TC. Factors mentioned in the literature as influencing the adoption of TC include: industry grouping, the intensity of competition, perceived environmental uncertainty and strategy (e.g., Tani, 1995; Ansari and Bell, 1997; Dekker and Smidt, 2003; Hibbets *et al.*, 2003). However, empirical research on factors that influence the decisions on the adoption of TC is scarce. Indeed, a review of the literature identified only a single Western study that actually empirically examined the influence of contingency factors on the adoption of TC. In a study of Dutch firms, Dekker and Smidt (2003) found that the adoption of TC is positively correlated with the intensity of competition and the level of perceived environmental uncertainty.[2]

The current study uses contingency theory arguments in an attempt to add to our knowledge about how these factors are related to the adoption of TC. First, following Dekker and Smidt (2003), we propose that the adoption of TC is positively correlated with the intensity of competition. Second, and in contrast with Dekker and Smidt (2003), we also suggest

[2] In another Western study, Hibbets *et al.* (2003) investigate the relationship between the competitive environment and strategy for nine U.S. and three German firms identified as TC adopters. However, their sample did not include a control group of non-TC adopters with which to compare their findings.

that perceived environmental uncertainty is negatively correlated with the adoption of TC. The argument is that TC is considered when reliable (predictable) information about customer requirements and competitor behavior is available. Our rationale is that the efficient use of TC should be based on rigid targets founded in predictions about customer requirements and competitor behavior. Thus, we suggest that TC is less appropriate when there is a high degree of uncertainty about customer requirements and the future behavior of competitors. Third, we also suggest that perceived environmental uncertainty has a negative moderating effect on TC adoption. The argument is that the intensified competition triggers firms to reflect on TC as a tool for maintaining competitiveness. However, if it is not possible to obtain necessarily reliable (predictable) information about customer requirements and competitor behavior (i.e., perceived environmental uncertainty is high), TC will not be regarded as an option. The three propositions are elaborated upon in Section 3 of the paper.

The remainder of the paper is organized as follows. Section 2 presents the definition and characteristics of TC. In Section 3, the theory is outlined and the three hypotheses are developed. Section 4 describes the research method, including the data collection procedure and the measurement of the constructs used in the analysis. Section 5 presents the results. Finally, Section 6 discusses the findings, the limitations of the study, and some implications from the findings.

2. Definition and characteristics of target costing

TC is a systematic process of planning new product offerings, establishing market sales prices and target profit margins for new products, and reducing the overall cost of new products over their lifecycles (while still meeting customer requirements), by examining all ideas for cost reduction in the product planning, research, and development process (e.g., Cooper and Slagmulder, 1997). TC is based on the idea that a product's quality, functionality, and cost are largely determined during the design stage of the product lifecycle, and that little can be done to improve these elements once product design has been set. This requires management to use systematic market and profit planning, and proactive cost management activities during the product development phase.

Despite the fact that TC has been discussed in the English language literature for more than two decades, there is no consensus on its key characteristics. The presentation of TC characteristics below is based on a recent literature review (Everaert *et al*., 2006) and on work by Ansari and Bell (1997), Cooper and Slagmulder (1997), Ellram (2002, 2006) and Ibusuki and Kaminski (2007). The characteristics that emerge as fundamental in these studies are as follows.

1. *Identifying the desired product and service attributes*. TC is a market-driven approach. The earliest phase of TC focuses on identifying customer needs and the product and service attributes that will meet these needs. This information is vital since it is used continuously throughout the TC process. A number of external sources are typically used to collect this information, including market assessments, customer surveys, focus groups, product prototype tests, and organized interviews with key customers.
2. *Establishing the target price*. On the basis of the information gathered, the product's target selling price to customers is established. A number of factors are typically considered in this phase, including: the firm's long-term sales and profit objectives; the position of the product in the firm's product matrix; the perceived value of the product to the customers; the product's lifecycle; the desired market share of the product; the product's ex-

pected sales volume; the price of existing products; the product's quality and functionality compared to competitive offerings; and the characteristics of the customers anticipated. Thus, the established target-selling price reflects the firm's strategy, competitors' strategies, and customer demand.

3. *Determining the target profit*. The target profit for the future product is typically derived from the firm's long-term profit plan in its business strategy. The literature also suggests that the target profit margin may be determined on the basis of profit levels for similar products, the actual profit of the predecessor product (adjusted for changes in market conditions), the target profit of a grouping of products (raising or lowering the margin for individual products depends on the realities of the marketplace), and the relative strength of competitive offerings.

4. *Determining the target cost*. The difference between target price and target profit equals allowable cost. This represents the cost that has to be met in order to earn the determined target profit. The target cost is determined by adjusting the allowable cost for already identified cost reduction opportunities (e.g., from current products), and for cost-increasing and cost-decreasing factors. A new product development (NPD) project has several, possibly conflicting, objectives such as cost, quality, and functionality issues. Dekker and Smidt (2003) emphasize that TC plays an important role as a disciplining mechanism in realizing these conflicting objectives by having designers and others make tradeoffs between them. Thus, before the target cost is finalized, conflicting objectives need to be balanced. This step requires careful attention to 'the voice of the customer'. Several tools can be used to help make these tradeoffs, e.g., quality function deployment (QFD).

5. *Decomposing the target cost*. In the next step, the target cost is decomposed in order to assign cost targets internally and to suppliers. The literature describes different approaches for this process, of which the function-oriented method and the component-allocation method are most common (Everaert *et al.*, 2006). Employing the function-oriented method, the target cost is first allocated to functional categories of the product. In a second step, the target costs are then assigned to their respective components and parts. The values of product functions as perceived by customers are the main criteria used when deciding which functions are focused on. With the component-allocation method, the target cost is initially allocated to blocks of product components and then to their respective subassemblies, components, and parts. This method is typically used when the new product is similar in design to existing products, since it is primarily based on cost data from existing products. In addition to the methods described above, other methods for decomposing the target cost at the product level are also presented in the literature. These include allocations to cost items, departments, teams, and individual designers. However, studies show that the functional-oriented method is generally preferred in practice (ibid).
6. *Closing the cost gap*. Efforts are then made to close the cost gap. The overall objective is to develop a product that achieves the target cost while still meeting customer requirements. This includes optimizing the relationships between material, parts, and the production process; focusing design efforts on market-driven variables for quality and the cost of ownership; balancing quality, functionality, and cost; and identifying ways of improving existing methods and processes. This requires cross-functional teams with representatives of the different firm functions (e.g., design, production, marketing, and accounting)

and external parties (e.g., suppliers, distributors, customers, and recyclers). The teams have a number of tools and methods available in order to achieve their objectives. These are of different types and focus on different aspects of the TC process. Frequently, the tools and methods used include value engineering, functional analysis, concurrent engineering, QFD, and design for manufacture and assembly (DFMA) (e.g. Cooper and Yoshikawa, 1994; Yoshikawa *et al*., 1994; Cavalieri *et al*., 2004).

7. *Continuous improvements*. According to Cooper and Slagmulder (1997), there is a cardinal rule of TC that the target cost must never be exceeded. This means that a product should not be introduced into the marketplace until the target cost has been reached. Without this rule, it is argued that TC loses its efficiency. However, some studies (e.g., Ellram, 2006) show that firms may introduce a product, even if the target cost has not been achieved, for competitive, service or other reasons. In any case, once a product has been introduced, efforts aimed at continuous improvement are made throughout the product lifecycle. In the TC literature, these efforts are referred to as 'kaizen costing'.

3. Theory development and formulation of hypotheses

3.1 Intensity of competition

The intensity of competition has been long recognized as an important factor influencing the design and use of CMCS. Several studies have examined the relationship between the intensity of competition and these systems. The results from these studies suggest that intense competition is positively associated with the greater use and sophistication of CMCS (e.g., Khandwalla, 1972; Cagwin and Bouwman, 2002). This holds for both traditional (e.g., standard and incremental costing) and novel (e.g., activity-based costing) system tools. Thus, as competition increases, the expected benefits from CMCS increase. The underlying explanation is that there is a risk that competitors will exploit any costing errors made: accordingly, more reliable costing information is needed under intense competition. It is also suggested that intense competition drives firms to customize their products and services. This creates a need for customer-related information (requiring the production of sophisticated CMCS). Competition also drives a need for tight cost control (e.g., Khandwalla, 1972; Guilding *et al*., 2005).

The intensity of competition has been conceptualized in several different ways. Some researchers have used one-dimensional constructs, such as percentages of sales that are exported, the number of competitors for the firm's major product(s), and access to marketing channels (e.g., Khandwalla, 1972; Bjørnenak, 1997; Dekker and Smidt, 2003). However, the use of one-dimensional constructs in assessing competition has been criticized because it could lead to only a partial and biased picture of actuality (Mia and Clarke, 1999). An alternative is composite constructs. Following Porter (1980), Mia and Clarke (1999, p 139) argue that "…the intensity or degree of competition in an industry depends on the collective strengths of different factors in action within the industry". These factors may include the number of major competitors, the frequency of new product introduction, and the frequency of technological change in the industry. In their study, Mia and Clarke (1999) present evidence supporting the composite nature of competition. For example, one manager interviewed said "…it would be unrealistic to consider market competition to be affected by a particular aspect, such as introduction of new products independently of everything else" (p 139).

For this reason, the current analysis defines and measures the intensity of competition as a multidimensional construct. A multidimensional view of the intensity of competition also appears valid, as this study uses a sample of firms from a distinct industry grouping. Section 4 discusses the measurement of the intensity of competition further.

The TC literature shares the view on the influence of competition on the design and use of CMCS previously discussed. Indeed, there is strong support in the literature for a positive relationship between the intensity of competition and benefits and adoption of TC (e.g., Ansari and Bell, 1997; Ellram, 2002; Dekker and Smidt, 2003). Hibbets *et al*. (2003) draw on Porter's (1980) five-forces model when arguing that intense competition creates a need for TC. Generally, this framework argues that the stronger the competition, the lower the collective profitability of firms competing in an industry. Intense competitive pressures also makes firms look for opportunities to decrease costs and streamline operations in order to earn an acceptable return. This drives firms to pay greater attention to costs before they are committed, i.e., early in the product lifecycle.

Cooper and Slagmulder (1997) use a model referred to as the survival triplet when arguing that as the intensity of competition increases, so does the value of TC. The model, which comprises the three product-related characteristics of product price/cost, quality and functionality, illustrates a three-dimensional space (called the product survival zone) bounded by the maxima and minima of the three characteristics within which a product can succeed. Under conditions of low profit margins, low customer loyalty, low first-mover advantage, and the large failure of products launched outside their survival zones, the benefits of TC are high. These conditions, particularly the low profit margins and low customer loyalty, mean that introducing new products outside their survival zone can be very costly because they typically lead to a situation where the firm's market performance declines. TC increases the probability that the new products launched will be inside their survival zones because the competitive pressure faced by the firm is passed on to designers and suppliers in the TC process. On the basis of these arguments, the following hypothesis is formulated.

H1: *Intensity of competition is positively related to TC adoption.*

3.2 Perceived environmental uncertainty (PEU)

One characteristic of the NPD process is environmental uncertainty. In this context, two main types of uncertainty are discussed—technological uncertainty and market uncertainty. These types of uncertainty are generally regarded as subjective phenomena, rather than physical realities. Thus, it is the perception of the environment to which organizations react (Fisher, 1996). In this study, perceived market uncertainty is the focus of interest as it relates to important aspects of TC. Bstieler (2005) reviewed how market uncertainty has been conceptualized in previous research. He reported that the concept relates to uncertainties about, for example, product demand, determining and understanding customer needs, translating customer needs into product specifications, user needs, and pricing. Firms can take action to reduce some of these uncertainties by collecting and processing market-related information. However, the firm cannot manipulate all market uncertainties, and some remain to be coped with by the NPD process (Yap and Souder, 1994). Some of these relate to information that is essential in the TC process. For the purposes of this study, perceived market uncertainty is referred to as perceived environmental uncertainty (PEU).

A basic requisite for effective TC is that target setting and product attribute and trade-off decisions are founded on reliable competitor and customer information (e.g., Ansari and

Bell, 1997; Cooper and Slagmulder, 1997). Indeed, TC requires formal procedures to determine target prices and assess customer requirements. This forces firms to be specific about what customers want (and value) and the prices they are willing to pay (CIMA, 2005). As pointed out in Section 2, this information plays a crucial role throughout the TC process, particularly in the following phases: identifying the desired product and service attributes, establishing the target price, determining the target cost, and closing the cost gap.

In an environment perceived as uncertain, customer and competitor information can be unpredictable or difficult to predict. Several factors may lead to this situation. For instance, changes taking place in the market environment between product generations or during an NPD project may be so rapid and radical that the firm is unable to develop an understanding of how these changes influence customer requirements (and how these can be translated into product attributes) and competitor behavior (Souder *et al*., 1998; MacCormack *et al*., 2001; Bstieler, 2005). Thus, necessary information is not available in the TC process when needed, i.e., at an early stage of the NPD project where customer needs and requirements are examined and product specifications are usually made, and where competitors' behavior is assessed (Yap and Souder, 1994). Under these circumstances, customer and competitor information emerges as the NPD project proceeds (MacCormack *et al*., 2001). For example, the product's ability to satisfy customer needs may remain largely unknown until customers test the product. The same scenario may occur when a firm is targeting a new customer segment or geographical market with a new product.

Under these conditions, it is unlikely that firms would consider the adoption of TC. Only when the level of PEU is low, and firms can predict necessary market elements, will TC adoption be considered. Therefore, we argue that an increase in PEU lowers the attractiveness of TC, and thus reduces the firm's tendency to adopt TC. Based on these arguments, the following hypothesis is proposed.

H2: *Perceived environmental uncertainty is negatively related to TC adoption.*

3.3 PEU as a moderator of the intensity of competition effect

So far in this study, only direct impacts on TC adoption have been discussed. Implicitly it is assumed that the effects of the intensity of competition and PEU on TC adoption are independent of each other, e.g., a certain increase in the intensity of competition causes the same increase in adoption rate among firms with high or low PEU. Is this a reasonable assumption? Recall, TC is supposed to be disregarded when required information about customers and competitors is not accessible, i.e., when PEU is high. Arguably, PEU should influence firms' decisions when competition intensifies. In the current study, PEU is suggested to have a negative direct effect on TC adoption (H2), but we also suggest that PEU negatively moderates the effect of the intensity of competition on TC adoption. To the best of our knowledge, the moderating effects of PEU on TC adoption have not been examined in previous work. Nevertheless, empirical support for this proposition can be found in seminal work by Khandwalla (1972). He observed a positive correlation between the intensity of competition and the adoption of sophisticated CMCS. However, he also observed that *correlation differs between different forms of competition*. The intensity of product competition (i.e., quality and variety) was more strongly correlated with sophisticated CMCS than was the intensity of price competition. Hence, the findings indicate that a certain increase in the intensity of competition affects the sophistication of CMCS more strongly for product competitors than price competitors.[3] While Khandwalla (1972) presents some tentative explanations, the data available did not permit further testing. Interestingly, he noted that price competitors generally felt more exposed to competitive actions from rival firms than did product competitors. If exposure was combined with uncertainty about the competitors' behavior, this may explain the different behavior of the two groups. Since price competitors are unable to manipulate uncertainties, responding to intensified competition by investing in CMCS that are more sophisticated would still not provide them with more relevant and reliable information. This is why price competitors are reluctant to make these investments.

Product competitors, experiencing less environmental uncertainty, invested in sophisticated CMCS as competition intensified in an attempt to gain competitive strength. As an analogy, we suggest that intensified competition generally has a positive effect on TC adoption (H1). If reliable information about customer behavior and competitors' plans is accessible (PEU is low), the adoption of TC will be viewed as an opportunity to cut costs or increase customer value. However, when information about customers and competitors is not accessible (PEU is high), the opportunity to strengthen competitiveness by adopting TC is nonexistent. Accordingly, the adoption of TC is not considered as an option. These propositions are presented in a third hypothesis.

H3: *The positive effect of competition on TC adoption is moderated in a negative direction by PEU.*

---

[3] Indeed, product correlation measures the *strength* but not the *form* (except for the positive sign). However, the correlation analyses are complemented with regressions (not shown in Khandwalla´s article) and the results are substantially identical.

It should be noted that H3 does not automatically follow from H2. In Figure 1 Table A, a hypothetical situation is portrayed where the TC adoption rate is negatively correlated with PEU, but where no moderation takes place. Nor does a rejection of H2 necessarily rule out H3. This is illustrated in Figure 1 Table B where the TC adoption rate is *positively* correlated with PEU, although the moderating effect of PEU is negative. In the present study, it is argued that a high PEU lowers the TC adoption rate (H2) *and* lowers the proclivity to adopt TC as competition intensifies (H3). The two effects are portrayed in Figure 1 Table C.

- Figure 1 here -

4. Methodology

4.1 Data collection

A web-based survey approach to the collection of data was chosen, mainly with a view to including as large a number of firms as possible, reducing the time spent on data collection, and, more importantly, obtaining a high response rate. Cobanoglu *et al*. (2001) undertook an empirical investigation of the effectiveness of mail, fax, and web survey methods and found that web surveys outperformed mail and fax surveys as regards both the response time and rate.

The sampling frame consists of firms in a distinct industry grouping, namely the manufacturing engineering industry. There are two reasons for this approach. First, previous research suggests that TC is typically a manufacturing phenomenon (e.g., Dekker and Smidt, 2003; Davila and Wouters, 2004). Second, by focusing on a distinct industry grouping, the effects of potentially confounding variables that may arise from differences across industries can be avoided, and external factors can be held constant (Davila, 2000). The firms in the study were randomly selected from the listed member firms of the Association of Swedish Engineering Industries. This is a trade organization for Swedish firms operating in the manufacturing engineering industry to which most firms with 50 or more employees belong. Most firms belong to one of the following subindustries: metal, machinery, transportation (automotive), instruments (precision equipment), electronics, and telecommunications. It should be noted that restricting the sample to a single industry might reduce the variation in the independent variables, making broad attributions about the results problematic. This limits the ability of the findings to be generalized to other industries.

To strengthen the validity and reliability of the measures used, the questionnaire was developed on the basis of previous work, primarily Khandwalla (1977), Gordon and Narayanan (1984) and Dekker and Smidt (2003). It also included a glossary and definitions of the terms used. The questionnaire and the web design were tested at meetings with two management accounting researchers, two practitioners, and three management accounting MBA students. This procedure resulted in improvements in both the questionnaire wording and the web design.

The sample of firms investigated was randomly drawn from a population of 664 firms. The web questionnaire was presented to 250 firms. This represented 37.7% of the population of independent firms (excluding the subsidiaries or legal business units of multi-business corporations). Each firm in the sample was approached by telephone with a view to identifying a respondent well aware of the relevant issues. No particular job position was targeted. The decisive criteria were the respondents' knowledge about the firm's research and development, and CMCS. Two hundred and eleven firms agreed to participate in the study.

The reasons for nonparticipation were firm policy and a lack of time or interest. The respondents who agreed to participate (see Table 1 for their job positions in their firms) received an email with a covering letter and a hyperlink directing them to the questionnaire. The first e-mails were sent in late November and early December 2003. After two reminders, 91 questionnaires had been submitted. It turned out that seven of the responding firms had fewer than 50 employees, but we decided to include them regardless.[4] The data collection process thus yielded a response rate of 36.4%. It appeared that 30 respondents were either unaware of TC or did not know whether TC was actually applied in their firm. These firms were excluded from the sample. Hence, 61 questionnaires were potentially usable. Four questionnaires were incomplete, so 57 questionnaires were used in the final analysis.

- Table 1 here -

4.2 Measures

The model in the study comprises three variables: TC adoption, the intensity of competition, and PEU. Previous research has indicated that firm size may also affect the implementation of sophisticated cost and management control tools. It was therefore included in the study as a control variable.

TC adoption. The instrument used for measuring the adoption of TC was adapted from Dekker and Smidt (2003). TC was described quite comprehensively in the question-

---

[4] The number of employees in the seven firms that did not fit the sampling criteria varied between 5 and 49. Of these firms, two had adopted TC, and five had not. Thus, 28.6% of these seven firms had adopted TC. This is a larger percentage share of TC adopters than identified in the entire sample. Testing for potential size effects (see Section 5) yielded no significant results.

naire (see Appendix 1). The description was based on the generic characteristics of TC (i.e., Target selling price – Target profit margin = Allowable cost) (e.g., Cooper and Slagmulder, 1997). The respondents were asked to indicate whether their firms had adopted TC. If a method similar to TC (but with a different name) had been adopted, the respondent was asked to give a short description of the method. If this agreed with the basic features of TC, the firm was classified as a TC adopter. A binary variable was used to measure the adoption rate—i.e., 1 if the firm had adopted TC; 0 otherwise. Following Bjørnenak (1997), we classified firms that had adopted TC, were presently adopting TC, or had decided to adopt TC, as adopters. Firms that did not want TC, or that had not yet decided to adopt it, were classified as non-adopters. Firms that were unaware of TC, or did not know whether TC was being used, were excluded from the sample.

Using this procedure, we identified 14[5] adopters and 43 non-adopters. Thus, 24.6% (14 from 57) of the firms that had submitted usable questionnaires were classified as TC adopters. This adoption rate is lower than rates identified from studies in other countries (see Section 1). One possible explanation is that this study included small- and medium-sized firms, while other studies have tended to focus on larger-sized firms. Firm size has been found to be an important factor explaining the adoption of more complex CMCS practices. For example, several studies have identified a positive relationship between firm size and the adoption of activity-based costing systems. Cultural, historical, and institutional explanations may help explain the varying rates of adoption across countries. Other possible explanations

[5] These 14 firms are subdivided in the following TC adoption categories: “Target costing is a well-established way of working in our firm” (n=10), “We have recently started working with target costing” (n=3) and “We will start using target costing in the near future” (n=1).

relate to methodological issues, for example, the definition of TC used and the industry group studied.

Intensity of competition and PEU. Various instruments have been suggested in the literature for measuring the intensity of competition. However, no single instrument appears to have gained general acceptance (Mia and Clarke, 1999). Among other things, the intensity of competition has been measured by price competition (Cagwin and Bouwman, 2002; Guilding *et al.*, 2005), sometimes combined with factors such as the number of competitors (Bjørnenak, 1997; Dekker and Smidt, 2003) or other forms of competition, such as market competition or product competition (Khandwalla, 1972). Mia and Clarke (1999) present an appealing instrument where respondents are requested to indicate the perceived intensity of competition after being confronted with seven competitive factors. The factors comprise: (1) the number of major competitors, (2) the frequency of technological change in the industry, (3) the frequency of new product introduction, (4) the extent of price manipulation, (5) the availability of package deals for customers, (6) firm access to marketing channels, and (7) changes in government regulation and policy.

Despite considerable attention to these uncertainties in cost and management control research, the lack of generally accepted measures is evident. The supply of different measures (Kreiser and Marino, 2002; Chenhall, 2003) may be explained by the variety of theoretical conceptualizations of uncertainty (e.g., task uncertainty and environmental uncertainty). PEU refers to uncertainty about future environmental states and can be interpreted as "…an individual's perceived inability to predict something accurately" (Milliken, 1987). In this study, PEU is interpreted as an individual's inability to predict customer preferences and competitors' future behavior.

Gordon and Narayanan (1984) have presented a well-known instrument for measuring PEU. The instrument consists of seven items: (1) competition and bidding (price competition, competition of manpower, and bidding for raw materials), (2) the stability/dynamism of the external (economic and technological) environment, (3) new products or services, (4) new scientific discoveries, (5) legal, political or economic constraints, (6) the predictability of competitors activities, and (7) the predictability of customer preferences. However, this particular instrument has been criticized for mixing PEU dimensions with competition factors (Chenhall, 2003). Items 6 and 7 clearly refer to state uncertainty as defined, while items 1–5 indicate the intensity of competition. When comparing items 1–5 with the seven items presented by Mia and Clarke (1999), they appear to overlap. We decided to decompose the measure originally developed by Gordon and Narayanan (1984) in order to measure both the intensity of competition and PEU. Seven-grade Likert scales measured the seven items. A factor analysis was conducted in order to test for the two underlying factors. It was expected that the predictability of customer preferences and competitors' future actions would crystallize as a single factor (PEU), and the remaining items as another, i.e., the intensity of competition.

Firm size. Previous empirical research has shown that firm size has an impact on the use and design of CMCS (e.g., Chenhall and Langfield-Smith, 1998). For example, the adoption rates for recently developed cost and management control practices are higher in large firms. Firm size was measured as the number of employees and serves as a control variable in the model. Natural logarithms are used in order to capture nonlinearity at large values.

5. Results

5.1 Descriptive statistics

The distribution of adopters and non-adopters among subindustries is displayed in Table 2a, and between firms of different size in Table 2b. Descriptive statistics and correlation coefficients between the measures are shown in Table 2c.

- Table 2a-2c here -

5.2 Intensity of competition and PEU

A factor analysis (principal axis factoring, oblimin rotation) was conducted to test the idea about the underlying factors, i.e., the intensity of competition and PEU, in Gordon and Narayanan's (1984) construct. One variable (regulatory regulations) generally showed low loadings and was excluded. The results of the second attempt are presented in Table 3.

- Table 3 here -

Only two factors have eigenvalues above one, and together they explain 42.9% of the variation. Cronbach's alpha was 0.66 for factor 1 (intensity of competition), and 0.61 for factor 2 (PEU). This is somewhat below the 0.70 normally recommended in the literature (Nunnally, 1972). The low product correlation between the two factors (–0.033) indicates that they represent two different underlying dimensions. Nonetheless, the results must be treated with caution. The small sample size (57 cases) might cause an 'overfit' of the data and thus reduce the generalizability of the results. Factor analysis is generally not recommended with samples comprising less than 50 observations. Hair *et al*. (1998) suggests that, as a general rule, minimum sample sizes should allow for 10 cases for each item. Thus, the current study (with six items) touches the lower limit of a satisfactory sample size.[6]

The factor scores from the analysis were used in the subsequent regression analysis when the intensity of competition and PEU were related to TC adoption.[7] This study hypothesized that: (1) TC adoption rate is positively related with the intensity of competition, (2) TC adoption is negatively related with PEU, and (3) PEU negatively affects the positive effect from intensity of competition on TC adoption. The three hypotheses were tested using a hierarchical logit regression model with an interaction factor:

(1) $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_2X_3 + e$

Y = Probability of TC adoption

X_1 = Firm size

X_2 = Intensity of competition

X_3 = Level of PEU

The results of the statistical analysis are shown in Table 4a-b.

---

6 To test for the stability of the results, a second factor analysis was carried out with the total sample, i.e., all usable questionnaires, including respondents not aware of target costing (n=91). The results were almost identical. Two eigenvalues were above 1.0 (1.95 and 1.47) and the factor loadings were very close to the loadings presented in Table 3.

7 Variables were centered to avoid multicollinearity.

- Table 4a–b here -

The independent variables were entered into the equation in three blocks. The first block consisted of the control variable firm size, the second block comprised the intensity of competition and PEU, and the interaction factor was added in the third block. The test for the goodness of fit of the model is a likelihood ratio chi-square test. The results are presented in Table 4a. The chi-square values were 13.195 with three degrees of freedom and 17.167 with four degrees of freedom. Since the Sig. values were both less than 0.05 we conclude the model fits the data. In the first block, the overall percentage of correctly classified cases is 77.2%, i.e., equal to the portion of non-adopters in the sample. When the two predictor variables were added in block two, the overall percentage of correctly classified cases increased to 82.5%. This percentage remained the same when the interaction factor was added in block three.

Although a test for goodness indicated that the model improves when predictor variables are added, tests of individual variables should be more informative in this study (Table 4b). The test is referred to as a Wald chi-square test. Null hypotheses that the coefficients are smaller than null (PEU and interaction coefficient) or bigger than null (intensity of competition) were tested. Since all predictions only go in one direction, a one-tailed test will suffice. The logit form makes the equation coefficients (beta values) difficult to interpret since they are expressed in log odds. Variables in the right-most column have been converted into odds ratios. They show the change in odds when the variable changes by one unit and the other variables remain fixed. The sign of the coefficient (B) shows the direction, where a minus indicates a decrease and a plus indicates an increase in the odds.

An increase in the intensity of competition changes odds in the predicted (positive) direction (3.117) and is significant (p=0.004). Thus, Hypothesis 1 is confirmed. This result is consistent with previous findings reported in the literature (Dekker and Smidt, 2003). Hypothesis 2 stated that the probability of TC adoption decreases in response to an increase in PEU. The negative sign of the coefficient (–0.587) provides support for this proposition. However, the result would normally be considered as insignificant (p=0.075). Still, it is interesting to note that this result conflicts with prior findings where a significant *positive* relation between PEU and TC adoption has been observed (Dekker and Smidt, 2003). In block 3, the interaction factor was added to the equation. A negative interaction coefficient was recorded (B=–1.126), and the result was statistically significant (p=0.031). A negative sign indicates that an increase in PEU *reduces* the positive impact from the intensity of competition on the probability of TC adoption (i.e., the effect stated in Hypothesis 1). Since the scales lack ratio properties, the values of the other coefficients in block 3 cannot be interpreted in a meaningful way (Southwood, 1978).

With the intent of adding some intuitive appeal to the results, the sample was split at the median of PEU. For each subgroup, a logistic regression analysis was conducted between the intensity of competition and TC adoption. While TC adoption is unaffected by the intensity of competition when PEU is high (the change in odds is 1.022 and p=0.976), a significant positive effect on TC adoption is observed when PEU is low (odds changes with +9.28 and p=0.017). These results are in concordance with Hypothesis 3.

6. Discussion and limitations of the study

The study presented in this paper provides some insight into how the intensity of competition impacts on TC adoption and how the level of PEU influences this relationship. The hypothesis that the intensity of competition is positively correlated with TC adoption (H1) was confirmed. This result agrees with the arguments in the TC literature and the extant empirical evidence.

The relation between PEU and TC adoption has also received some attention in the TC literature, where a positive relation between PEU and TC adoption has been proposed (Tani, 1995) and empirically supported (Dekker and Smidt, 2003). However, the arguments presented in favor of a positive correlation between PEU and TC adoption may be questioned. Dekker and Smidt (2003, p 295), for example, suggest that TC "…supports a firm's information processing requirements, when attempting to manage the increasing variability and specificity of factors to be considered in decision-making." However, if firms really succeed in reducing PEU by adopting TC, this invokes a methodological problem. Portraying causalities would require a cyclically recursive model (Luft and Shields, 2003), where an increase in PEU drives firms to adopt TC, but after TC has been implemented, PEU again declines because of the successful implementation of TC. Since these effects occur at different times, it would be complex to test this model empirically with cross-sectional data. The suggested positive relation between PEU and TC adoption in previous studies may be explained by broad definitions of PEU used, where dimensions of intensity of competition have been included (e.g., Tani, 1995). In the current study, it was argued that the intensity of competition and PEU should be separated because they represent different theoretical meanings and are assumed to have different effects on adoption.

On the basis of key TC characteristics, this study proposed that PEU has a negative effect on TC adoption (H2). However, this hypothesis was not supported. This result may be explained by methodological flaws. The limited sample size reduces the statistical power of the tests performed. However, it should be noted that the regression coefficient had a negative sign (as proposed) at the 7% level of significance. Perhaps, a larger sample with more statistical power would yield different results. Nevertheless, this study did not provide support for the idea that an increase in PEU would affect TC adoption in a *positive* direction.

H3 predicted that the positive effect that competition has on TC adoption is moderated by PEU in a negative direction. The hypothesis was confirmed. This result may appear as a paradox. TC is used in NPD, where uncertainty is usually considered high, yet the result indicates that TC loses attraction when uncertainty increases. However, we would argue that this is an incorrect interpretation of the results. Firstly, PEU may also vary in NPD settings. It is argued that in those situations where firms believe it is possible to gather data that are reasonably reliable about customers' future preferences and competitors' activities; intensified competition will be followed by TC adoption in an attempt to retain competitive strength. However, if it is realized that information about customer preferences and competitors' future activities is inaccessible, TC will not be recognized as an option when competition intensifies.

Secondly, as presented in Section 3.2, NPD processes involve different *forms* of uncertainty. Even if PEU (or market uncertainty) modifies the TC adoption rate in a negative way as competition intensifies, other forms of uncertainty may modify TC adoption positively—or not at all. In an in-depth-study of NPD projects, Davila (2000, p 388) described one project characterized by a high degree of *market uncertainty,* where cost and management controls mainly served the purpose of focusing on customer needs: “[b]ecause of the relevance of customer information, management built flexibility into project goals to incorporate this information during the execution instead of freezing it at the beginning of the project”. Albeit with a high degree of customer orientation, the greater emphasis on flexibility may make this process less appropriate for TC management. Other forms of uncertainty, such as technology-related uncertainty, may be more suitable for TC management.

This study has some potential limitations. Firstly, the sample was drawn from manufacturing engineering firms in Sweden. We have no knowledge about how industry and country affect the findings of the study. Chang *et al*. (2003) have pointed out that the nature of the competitive environment and industry structure are different from industry to industry and from country to country. Therefore, future studies could replicate (or extend) our study for other industries and countries. Secondly, the reliability construct was rather weak for both the intensity of competition and PEU. The measurement instrument (Gordon and Narayanan, 1984) has been used in prior cost and management control research (Chenhall, 2003). However, the decomposition in the current study has not been tested before, and the constructs could be tested with new data and possibly refined with additional items.

Thirdly, this study also employed a broad notion of competition, incorporating several different factors. A composite competition construct, as argued in Sections 3.1 and 4.2, has advantages compared to a one-dimensional construct. The factor analysis performed resulted in the strongest loadings for ‘dynamic environment’ followed by ‘emergence of scientific discoveries’, while ‘competition’ was the weakest. Thus, the construct also tells about environmental change and product development itself. Therefore, care should be taken when interpreting the findings and comparing them to previous research. Perhaps an alternative construct singly (or in combinations) assessing each of the different factors of competition would reveal the relationship more clearly. Future studies could test the validity of different constructs of competition.

Fourthly, the sample size was quite small. While the firms in the sample were randomly selected, and the sample size does not fall below what is generally considered as critical, it limits the external validity of the findings since the small sample size might have created an overfit of the study's data. The small sample size also creates a problem in the regression analysis where the number of events (i.e., the number of the firms that have adopted TC) was rather small compared with the number of independent variables. This may have biased the regression coefficients (Peduzzi *et al*., 1996). Future studies could use a larger sample in order to overcome these limitations. Fifthly, this study examined the impact of just two contextual factors on TC adoption. Future research may examine other potential factors influencing TC adoption including, for example, business strategy and customer profile. Finally, the study did not link the fit between the independent variables and TC adoption to organizational performance, for example, return on investment (ROI) or return on equity (ROE). Future research could consider linking the use of TC under different contingencies to organizational performance in order to shed light on its efficient and inefficient use.

Although the main contribution of this study is a refinement of the accepted wisdom about the relationship between contingency factors and the adoption of TC, it may also have implications for practicing managers considering the adoption of TC. There is an extensive literature focusing on identifying the critical success factors in NPD. A literature review by Ernst (2002) identified a number of such factors. Factors relevant to the focus of this study include: accurate predictions about (and clearly defined) customer needs, wants and preferences; knowledge about market competition and competitor strategies; clearly defined product concept/features; and cross-functional development teams and intensive communication between team members during the course of the development process. TC is one tool that may help the firm bring about NPD success. However, as this study suggests, practicing managers could investigate whether a fit exists between the firm's environment (in terms of the intensity of competition and PEU) and the use of TC. Firms not having access to reliable information about customer requirements and competitor behavior could consider other means of achieving success with NPD. However, these recommendations should be interpreted with caution because we do not have evidence indicating that firms that have a fit between their environment and TC actually achieve a higher degree of NPD success or firm performance. This is an issue for future research to investigate.

References

Ansari, S., Bell, J.E., 1997. Target costing – The next frontier in strategic cost management. Irwin, Chicago, IL.

Bjørnenak, T., 1997. Diffusion and accounting: The case of ABC in Norway. Management Accounting Research 8, 3–17.

Bstieler, L., 2005. The moderating effect of environmental uncertainty on new product development and time efficiency. Journal of Product Innovation Management 22, 267–284.

Cagwin, D., Bouwman, M.J., 2002. The association between activity-based costing and improvement in financial performance. Management Accounting Research 13, 1–39.

Cavalieri, S., Maccarrone, P., Pinto, R., 2004. Parametric vs. neural network models for the estimation of production costs: A case study in the automotive industry. International Journal of Production Economics 91, 165-177.

Chang, S-C., Yang, C-L., Cheng, H-C., Sheu, C., 2003. Manufacturing flexibility and business strategy: An empirical study of small and medium sized firms. International Journal of Production Economics 82, 13–26.

Chenhall, R.H., 2003. Management control systems design within its organizational context: Findings from contingency-based research and directions for the future. Accounting, Organizations & Society 28, 127–168.

Chenhall, R.H., Langfield-Smith, K., 1998, Adoption and benefits of management accounting practices: An Australian study. Management Accounting Research 9, 1–19.

CIMA, 2005. Target costing in the NHS: Reforming the NHS from within. CIMA NHS working group, The Chartered Institute of Management Accountants, London.

Cobanoglu, C., Warde, B., Moreo, P.J., 2001. A comparison of mail, fax and web-based survey methods. International Journal of Market Research 43, 441–452.

Cooper, R., Slagmulder, R., 1997. Target costing and value engineering. Productivity Press, Portland, OR.

Cooper, R., Yoshikawa, T., 1994. Inter-organizational cost management systems: The case of the Tokyo-Yokohama-Kamakura supplier chain. International Journal of Production Economics 34, 51-62.

Davila, T., 2000. An empirical analysis of the drivers of management control systems' design in new product development. Accounting, Organizations & Society 25, 383–409.

Davila, T., Wouters, M., 2004. Designing cost-competitive technology products through cost management. Accounting Horizons 18, 13–26.

Dekker, H., Smidt, P., 2003. A survey on the adoption of use of target costing in Dutch firms. International Journal of Production Economics 84, 293–305.

Drury, C., Tayles, M., 2005. Explicating the design of overhead absorption procedures in UK organizations. The British Accounting Review 37, 47–84.

Ellram, L.M., 2002. Supply management's involvement in the target costing process. European Journal of Purchasing & Supply Management 8, 235–244.

Ellram, L.M., 2006. The implementation of target costing in the United States: Theory versus practice. The Journal of Supply Chain Management, Winter, 13–26.

Ernst, H., 2002. Success factors of new product development: A review of the empirical literature. International Journal of Management Reviews 4, 1–40.

Ernst & Young and The Institute of Management Accountants (IMA), 2003. The Ernst & Young and IMA survey of management accounting, Ernst & Young LLP, New York, NY.

Everaert, P., Loosveld, S., Van Acker, T., Schollier, M., Sarens, G., 2006. Characteristics of target costing: Theoretical and field study perspectives. Qualitative Research in Accounting & Management 3, 236–263.

Fisher, C., 1996. The impact of perceived environmental uncertainty and individual differences on management information requirements: A research note. Accounting, Organizations & Society 21, 361–369.

Gordon, L.A., Narayanan, Y.K., 1984. Management accounting systems, perceived environmental uncertainty and organizational structure: An empirical investigation. Accounting, Organizations & Society 9, 33–47.

Guilding, C., Drury, C., Tayles, M., 2005. An empirical investigation of the importance of cost-plus pricing. Managerial Auditing Journal 20, 125–137.

Hair, J.F., Anderson, R., Tatham, R.L., Black, W.C., 1998. Multivariate data. Prentice Hall International Edition, Upper Saddle River, NJ.

Hibbets, A.R., Albright, T., Funk, W., 2003. The competitive environment and strategy of target costing implementers: Evidence from the field. Journal of Managerial Issues 1, 65–81.

Ibusuki, U., Kaminski, P.C., 2007. Product development process with focus on value engineering and target costing: A case study in an automotive company. International Journal of Production Economics 105, 459-474.

Israelsen, P., Andersen, M., Rohde, C., Sørensen, P.E., 1996. Management accounting in Denmark: Theory and practice. In Bhimani, A. (Ed.), Management accounting: European perspectives. Oxford University Press, Oxford, pp. 31–53.

Johnson, H.T., Kaplan, R.S., 1987. Relevance lost: The rise and fall of management accounting. Harvard Business School Press, Boston, MA.

Khandwalla, P.N., 1972. The effect of different types of competition of the use of management controls. Journal of Accounting Research 10, 275–285.

Khandwalla, P.N., 1977. The design of organizations. Harcourt Brace Jovanovich, New York, NY.

Kreiser, P., Marino, L., 2002. Analyzing the historical development of the environmental uncertainty construct. Management Decision 40/9, 895–905.

Lamminmaki, D., Drury, C., 2001. A comparison of New Zealand and British product-costing practices. European Accounting Review 36, 329–347.

Luft, J., Shields, M.D., 2003. Mapping management accounting: Graphics and guidelines for theory-consistent empirical research. Accounting, Organizations & Society 28, 169–249.

MacCormack, L., Verganti, R., Iansiti, M., 2001. Developing product on 'internet time': The anatomy of flexible development process. Management Science 47, 133–150.

Mia, L., Clarke, B., 1999. Market competition, management accounting systems and business unit performance. Management Accounting Research 10, 137–158.

Milliken, F.J., 1987. Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. Academy of Management Review 12, 133–143.

Nunnally, J.O., 1978. Psychometric theory. McGraw-Hill, New York, NY.

Peduzzi, P., Concato, J., Kemper, E., Holford, T.R., Feinstein, A.R., 1996. A simulation study of the number of events per variable in logistic regression analysis. Journal of Clinical Epidemiology 49, 1373–1379.

Porter, M., 1980. Competitive strategy. The Free Press, New York, NY.

Souder, W.E., Sherman, J.D., Davies-Cooper, R., 1998. Environmental uncertainty, organizational integration, and new product development effectiveness: A test of contingency theory. Journal of Product Innovation Management 15, 520–533.

Southwood, K.E., 1978. Substantive theory and statistical interaction: Five models. American Journal of Sociology 83, 1154–1203.

Tani, T., 1995. Interactive control in target cost management. Management Accounting Research 6, 399-414.

Yap, C.M., Souder, W.E., 1994. Factors influencing new product success and failure in small entrepreneurial high-technology electronics firms. Journal of Product Innovation Management 11, 418–442.

Yoshikawa, T., Innes, J., Mitchell, F., 1994. Applying functional cost analysis in a manufacturing environment. International Journal of Production Economics 36, 53-64.

Appendix 1 Survey questions

<u>Questions on respondent, subindustry and size</u>
What is your (the respondent's) position in the firm?
Please indicate your type of business (subindustry):

- Electronics
- Metal
- Machinery
- Transport (automotive)
- Instruments (precision equipment)
- Radio and TV
- Telecommunications
- Other

How many employees are currently in your firm?

<u>Questions on intensity of competition and perceived environmental uncertainty</u>
The study used the questions developed by Gordon and Narayanan (1984) to measure the intensity of competition and perceived environmental uncertainty.

<u>Question on target costing</u>
Are you currently using Target Costing in your firm? In responding, please consider the following description of target costing:

Target Costing is an approach used during new product development/design or when major changes are being made to existing products. Essential elements of Target Costing include product pricing, profit planning and cost control/management. Target Costing starts by estimating a market-based product selling price and then subtracting a desired profit margin to arrive at a cost (allowable cost/target cost) that must be achieved. Next, all the possibilities for cost reduction in the various product-development phases to achieve the cost are assessed. This should be achieved without altering specified product demands connected with functionality, quality or reliability, for example. In a strict way the following formula applies to Target Costing:

Estimated market-based product selling price (Target Price) – Desired profit margin (Target Profit)
= Allowable Cost/Target Cost

As mentioned above, once the allowable cost/target cost has been determined, further efforts are aimed at making sure that the product is designed to meet that cost. Several tools can be used to accomplish this, such as, value engineering, design for manufacture and assembly, and quality function deployment (QFD).

- Do not know
- We are unaware of Target Costing
- We have never seriously considered Target Costing
- We have considered Target Costing, but rejected it

- We are currently considering using Target Costing, but have not made a decision
- We have tried Target Costing, but rejected it
- We will start using Target Costing in the near future
- We have recently started using Target Costing, but have not fully implemented it yet
- Target Costing is a well-established way of working in our firm
- We use an approach with the same fundamental characteristics as Target Costing, but we refer to it as…………..

  If you are using an approach with the same fundamental characteristics as Target Costing, please briefly describe the differences (if there are any) between your way of working and Target Costing according to the above description.

Figure 1 Direct and moderating effects between intensity of competition and PEU on TC adoption

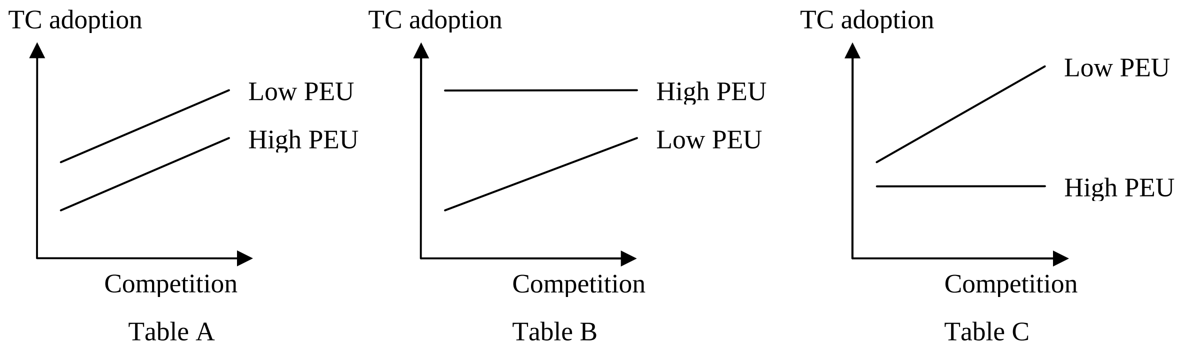

Figure 1. While H2 states that TC is negatively correlated with PEU (Table A) and H3 states that the effect on TC adoption is negatively moderated by PEU (Table B), only the two hypotheses in conjunction state that PEU has a negative direct effect *and* a negative moderating effect on TC adoption (Table C).

Table 1 Job positions held by respondents

	All responding firms		Firms included in the study	
	n	Percent	n	Percent
CFO	23	25.3	13	22.8
R&D/Development manager	18	19.8	11	19.3
CEO	10	11.0	8	14.0
Production manager	9	9.9	7	12.3
Product manager	7	7.7	4	7.0
Engineering manager	6	6.6	3	5.3
Market manager	6	6.6	3	5.3
Controller	4	4.4	4	7.0
Project manager	3	3.3	1	1.8
Product developer	3	3.3	2	3.5
Administrative manager	1	1.1	1	1.8
N/A	1	1.1	--	--
Total	91	100%	57	100%

Table 2a Adopters and non-adopters of TC by subindustry

Industry	Adopters	Non-adopters	Total	Rate of adoption (%)
Electronics	1	2	3	33
Metal	3	22	25	12
Machinery	3	6	9	33
Transportation	0	1	1	0
Instruments	0	3	3	0
Telecommunications	2	0	2	100
Other	5	9	14	36
Total	14	43	57	25

Table 2b Adopters and non-adopters of TC by firm size

No. of employees	Adopters	Non-adopters	Total	Rate of adoption
5–49	2	4	6	33%
50–99	2	22	24	8%
100–249	5	12	17	29%
250–499	4	2	6	67%
>499	1	3	4	25%
Total	14	43	57	25%

Table 2c Descriptive statistics and correlations between variables

Descriptive statistics						Pearson correlation						
	N	Min.	Max.	Mean	Std. Dev.	1	2	3	4	5	6	7
Competition	57	1.667	6.667	4.164	1.049							
New products	57	1.000	7.000	4.912	1.806	0.140						
Dynamism	57	2.000	7.000	4.386	1.086	0.296*	0.487**					
Uncertainty competitors	57	2.000	6.000	4.105	1.145	–0.173	0.082	0.024				
Uncertainty customers	57	2.000	7.000	4.439	1.053	0.031	–0.073	0.162	0.435**			
Scientific breakthroughs	57	1.000	7.000	2.316	1.429	0.366**	0.322*	0.530**	–0.075	–0.046		
Firm size	57	1.609	6.217	4.651	1.091	0.132	0.185	–0.034	0.092	0.054	–0.089	
Use of TC	57	0.000	1.000	0.228	0.423	0.236	0.190	0.349**	-0.198	-0.108	0.322*	0.127

* Correlation is significant at the 0.05 level (two-tailed)

**Correlation is significant at the 0.01 level (two-tailed)

Descriptive statistics						Pearson correlation						
	N	Min.	Max.	Mean	Std. Dev.	1	2	3	4	5	6	7
Competition	57	1.667	6.667	4.164	1.049							
New products	57	1.000	7.000	4.912	1.806	0.140						

Dynamism	57	2.000	7.000	4.386	1.086	0.296*	0.487**					
Uncertainty competitors	57	2.000	6.000	4.105	1.145	–0.173	0.082	0.024				
Uncertainty customers	57	2.000	7.000	4.439	1.053	0.031	–0.073	0.162	0.435**			
Scientific breakthroughs	57	1.000	7.000	2.316	1.429	0.366**	0.322*	0.530**	–0.075	–0.046		
Firm size	57	1.609	6.217	4.651	1.091	0.132	0.185	–0.034	0.092	0.054	–0.089	
Use of TC	57	0.000	1.000	0.228	0.423	0.236	0.190	0.349**	-0.198	-0.108	0.322*	0.127

* Correlation is significant at the 0.05 level (two-tailed)

**Correlation is significant at the 0.01 level (two-tailed)

Table 3 Factor analysis results

	Factor 1 Intensity of competition	Factor 2 PEU
Dynamism	**0.839**	0.145
Scientific breakthroughs	**0.677**	–0.092
New products	**0.504**	0.059
Competition	**0.416**	–0.139
Uncertainty competitors	–0.080	**0.800**
Uncertainty customers	0.022	**0.534**
Eigenvalue	2.10	1.48
Variance explained	26.64%	16.27%

Table 4a Omnibus test of the model

Omnibus test	Chi-square	df	Sig.
Block 1: Model	0.993	1	0.319
Block 2: Model	13.195	3	0.004
Block 3: Model	17.167	4	0.001

Table 4b Variables in the equation

		B	S.E	Wald	df	Sig. one-tailed	Exp (B)
Block 1	Firm size (X_1)	0.319	0.337	0.893	1	0.173	1.375
	Constant	−2.733	1.664	2.697	1	0.055	0.065
Block 2	Firm size (X_1)	0.517	0.381	1.836	1	0.088	1.677
	Intensity of competition (X_2)	1.137	0.421	7.297	1	0.004	3.117
	PEU (X_3)	−0.587	0.408	2.070	1	0.075	0.556
	Constant	−3.991	1.931	4.269	1	0.020	0.018
Block 3	Firm size (X_1)	0.640	0.389	2.709	1	0.050	1.896
	Intensity of competition (X_2)	1.079	0.493	4.782	1	0.015	2.941
	PEU (X_3)	−0.501	0.490	1.047	1	0.306	0.303
	Interaction effect (X_2) * (X_3)	−1.126	0.600	3.523	1	0.031	0.324
	Constant	−4.636	1.997	5.387	1	0.010	0.010