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From Temporary Competitive Advantage to Sustainable Competitive Advantage

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Both industrial organization theory (IO) and the resource-based view of the firm (RBV) have advanced our understanding of the antecedents of competitive advantage but few have attempted to verify the outcome variables of competitive advantage and the persistence of such outcome variables. Here by integrating both IO and RBV perspectives in the analysis of competitive advantage at the firm level, our study clarifies a conceptual distinction between two types of competitive advantage – temporary competitive advantage and sustainable competitive advantage – and explores how firms transform temporary competitive advantage into sustainable competitive advantage. Testing of the developed hypotheses, based on a survey of 165 firms from Taiwan's information and communication technology industry, suggests that firms with a stronger market position can only attain a better outcome of temporary competitive advantage whereas firms possessing a superior position in technological resources or capabilities can attain a better outcome of sustainable competitive advantage. More importantly, firms can leverage a temporary competitive advantage as an outcome of market position to improving their technological resource and capability position, which in turn can enhance their sustainable competitive advantage.

Introduction

The concept of competitive advantage has been widely discussed by prior researchers. Most of the prior studies have mainly investigated the factors facilitating a firm's sustainable competitive advantage (SCA), such as intellectual capital (Hsu and Wang, 2012), innovation (Barrett and Sexton, 2006) or dynamic capabilities (Bowman and Ambrosini, 2003; Easterby-Smith and Prieto, 2008; Macher and Mowery, 2009; Pandza and Thorpe, 2009). However, these studies rarely attempt to look into the different natures of temporary competitive advantage (TCA) and SCA, with few exceptions. For instance, Bowman and Ambrosini (2000) differentiate value creation from value capture from the perspective of the difference between TCA and SCA while Ambrosini and Bowman (2010) investigate how causal ambiguity affects the sustainability of competitive advantage and rent appropriation. No matter what arguments the prior studies propose, the concept of competitive advantage is particularly discussed by industrial organization (IO) economists as well as proponents of the resource-based view of the firm (RBV). Although one can acknowledge the differing starting point and assumptions of the essentially inward looking RBV and the externally focused gaze of the IO approach, both at heart are concerned with competitive success. The IO proponents assert that competitive advantage (or superior profit) is attained if the firm has a stronger market position in an industry compared to competitors, created for example through economies of scale (Caves and Porter, 1977; Porter, 1980; Rumelt, 1991). Alternatively, RBV researchers suggest that sustained competitive advantage arises from the firm's possession of resources and capabilities with particular characteristics (Barney, 1991). These competitive advantage studies either focus on how independent variables affect firm performance from the RBV perspective or on the sustainability of superior performance for a long period of time from the IO perspective. However, such studies rarely investigate how a firm moves from TCA to SCA based on an integrated view of both the RBV and IO perspectives (with an exception by Nickerson, Hamilton and Wada's (2001) study). In this paper, we integrate the RBV and IO perspectives into one framework to explain how a firm can attain a TCA and then move to an SCA.

Depending upon the underlying theory, a firm's competitive advantage is determined by two major forces, an endogenous force from resources and capabilities and an exogenous force from market position in an industry (the 'industry effect'). A common link between these two streams of studies is the focus on firm performance as the dependent variable although it is considered an imprecise proxy (Crook *et al.*, 2008). There have been considerable studies devoted to testing how various variables affect firm performance but little attention has been paid to the detailed mapping of performance itself (Wiggins and Ruefli, 2002). No specific definition distinguishes TCA from SCA in prior studies except Barney's (1991) and Wiggins and Ruefli's (2005) studies. Barney (1991) suggests that firms can achieve SCA if they possess resources with valuable, rare, inimitable and non-substitutable attributes and just a TCA if they possess resources displaying only valuable and rare attributes. SCA may be made up of a series of temporary advantages over time (D'Aveni, Dagnino and Smith, 2010; Wiggins and Ruefli, 2005). Less clear though is how firms move from TCA into SCA.

The competitive advantage attained from the environmental structure may vanish if environmental factors change. For instance, markets may be punctuated by processes of creative destruction manifested through shocks and technological discontinuities (Schumpeter, 1934), or hypercompetition (D'Aveni, 1994), which may erode the original competitive advantage derived from the original market structure. Therefore, firms need to appropriate value from their TCA and then transform it into resources or capabilities with valuable, rare, inimitable and non-substitutable attributes to attain SCA. A recent research stream, the dynamic capability perspective, has extended the research focus to how firms can sustain competitive advantage for a period of time when facing dynamic and fast-changing environments (Teece, Pisano and Shuen, 1997). However, prior research rarely empirically investigates the relationships between market position, resource and capability position, TCA and SCA. Our research proposes a framework wherein firms will attain a better outcome of TCA via a stronger market position (IO perspective), transform the appropriated value from TCA into resources and capabilities (RBV perspective), and then utilize these resources and capabilities to achieve a better outcome of SCA.

In order to meet the research objectives, a questionnaire survey of 165 of Taiwan's information and communication technology (ICT) firms was conducted and structural equation methods were employed to examine our developed hypotheses. After the introduction, we discuss related literature and develop the research hypotheses. Then we describe the research method and provide the empirical results. Following this we discuss the findings while the final section concludes the paper.

Theoretical background and hypothesis development

Competitive advantage and firm performance

As Powell (2001) notes, prior theories suggest that superior performance arises from different SCAs. Whatever the underlying theory, a firm's competitive advantage is determined by two major forces, an endogenous force from resources and capabilities (the RBV perspective), and an exogenous force from market position (the IO perspective). From the IO perspective, superior performance derives from monopoly rents sustained by protected market positions (Caves and Porter, 1977; Porter, 1980). From the RBV perspective, Ricardian rents take place due to idiosyncratic firm-specific resources (Lippman and Rumelt, 1982; Wernerfelt, 1984), or Schumpeterian rents emerge due to the dynamic capability to renew advantages over time (Teece, Pisano and Shuen, 1997). Thus, a firm achieves a superior performance either from a stronger market position (Porter, 1980) or from possessing valuable, rare, inimitable and non-substitutable resources (Barney, 1991). In other words, a firm's competitive advantage consists of two components, sources of competitive advantage (i.e. market position or resources) and the outcome of competitive advantage (i.e. performance such as profitability).

A common connection in these two streams is the focus on how firms can attain superior firm performance or economic rents. There have been a considerable number of studies concerning how various independent variables affect superior firm performance for a persistent period of time (Powell, 2001). For instance, Mueller's (1986) time series regression of 600 large industrial firms in the USA over the period between 1950 and 1972 finds that profit levels (return on assets, ROA) converge toward the mean of ROA, but the highest-performing firms converge most slowly and some high-performing firms even increase profitability over time. Alternatively, by using return on investment as the measure for firm performance, Jacobsen (1988) finds that profit levels converge over the period between 1970 and 1983 but do not persist. Using a different methodology, Wiggins and Ruefli (2002) also find that only a rare minority of firms exhibit superior economic performance and that the duration of sustainability declines (measured by ROA and Tobin's q) over the period between 1974 and 1997. However, these studies (the Wiggins and Ruefli (2002) study excepted) regarding the persistence of superior economic performance focus on whether firms can sustain their superior profits over a period of time by comparing the variation from the mean profit of the sample industry, but pay less attention to differentiating a firm's TCA and SCA and to which antecedents determine TCA or SCA.

Partly redressing the balance, D'Aveni, Dagnino and Smith (2010) called a special issue to remind strategic management researchers of the distinction between TCA and SCA. The major concern in that issue was: what if sustainable advantages did not exist? (D'Aveni, Dagnino and Smith, 2010). In answering their own question, D'Aveni, Dagnino and Smith suggest that ensuring a string of temporary advantages might then become the focus of strategy. Further research suggests that the temporary component of competitive advantage is rising compared to the long-run component of SCA (Thomas and D'Aveni, 2009). However, the focus on TCA and SCA should not be constrained by their substitution for each other. In fact, there ought to be a causal relationship between these two competitive advantages. As noted by Wiggins and Ruefli (2005), firms with SCA are likely to be companies which achieved a series of TCAs over a period of time. Our study concurs with their proposition and attempts to provoke an integrative view of TCA and SCA.

An integrative view of temporary and sustainable competitive advantage

Before beginning the theoretical induction, there are two assumptions in our framework: (1) the destruction assumption and (2) the mobility assumption.

Destruction assumption. The destruction assumption refers to the unpredictability of sustaining a competitive advantage by a firm. Inherently, our view of the environmental context is that it is uncertain because of increasingly frequent and rapid changes in technology and market demand. The incumbent firm's competitive advantage generated by the environmental structure may vanish if creative destruction processes take place in the market in which markets are punctuated by shocks and technological discontinuities (Schumpeter, 1934). Such violent and hypercompetitive environments may destroy the equilibrium between players in the industry, which in turn erodes the advantageous firm's superior performance (Wiggins and Ruefli, 2005).

Both Porter's five-forces model and the RBV are rooted in a conception of the world that is essentially stable (D'Aveni, Dagnino and Smith, 2010). However, an increasing number of studies suggest that formerly stable environments are becoming uncertain as a result of accelerating technological change, globalization, industry convergence, aggressive competitive behaviour, deregulation and so on. Thus, any status quo generated by competitive advantage would be subject to disruption. For instance, Nokia and Motorola were two of the largest handset makers in the world until early 2000. However, Motorola's leadership in terms of market share was weakened as the market migrated from analogue-based mobile phones (1G) to digital-based mobile phones (2G) (He, Lim and Wong, 2006). Nokia similarly lost leadership and market share to Apple and Samsung as the system transformed from 2G to 3G in the second half of the new millennium's first decade. The strong market position (larger market share) of the incumbents in the mobile phone industry was eroded as the technology base in the handsets shifted. This suggests that the superior firm performance generated by a strong market position (market share) may only be temporary and not sustainable once a destructive environment ensues. This prompts us to argue that the competitive advantage derived from industry structure or market position as suggested by the IO school may be temporary instead of sustainable depending on the frequency and level of destructive events.

Mobility assumption. From the RBV perspective, valuable, rare, inimitable resources or capabilities are the foundation of superior performance or SCA (Barney, 1991; Barney and Clark, 2007). Nevertheless, there are two important assumptions for this statement: (1) firms are heterogeneous and (2) factors are imperfectly mobile among firms (Barney, 1991; Barney and Clark, 2007). Foss and Knudsen (2003) also reflect on Barney's classification of valuable, rare, inimitable and non-substitutable conditions, and propose two necessary conditions for achieving SCA: uncertainty and immobility. In an era of globalization, the first assumption remains valid but the second assumption of immobility becomes increasingly void. Major advances in cross-border communications and transportation have both enabled and spurred rapid internationalization (Beechler and Javidan, 2007; Bloodgood and Sapienza, 1996), making factors such as capital (Stulz, 1999) and highly skilled labour (Parey and Waldinger, 2011) mobile across countries at lower costs. For instance, a number of semiconductor engineers were first lured away from the US Silicon Valley to Taiwan in the 1990s (Hobday, 1995), and now from Taiwan to China (Klaus, 2003). Moreover, interorganizational cooperation or alliances also serve as a means for mobilizing resources that have been considered immobile by conventional RBV theorists. When resources cannot be mobilized, interorganizational cooperation or alliances enable the transfer of benefits associated with such resources and thus weaken the imperfect mobility condition (Lavie, 2006). For instance, an advanced technology or knowledge which has been considered a competitive advantage can be mobilized from one firm to another via licensing, technology alliances or even open innovation (Chesbrough, 2003). Android, a mobile device's operating system developed by Google, has been overwhelmingly adopted since Google opened its standard to hardware and software companies via the Open Handset Alliance. This implies that a privileged resource mobilized among firms may create more value than when it is possessed by a single firm. This example suggests that the assumption of imperfectly mobile factors is increasingly challenged and weakened even though some location-bounded resources or assets, such as land, remain immobile. Therefore, a firm possessing resources or capabilities with the attributes suggested by the RBV may no longer attain a sustainable superior performance. Of course superior rents are less likely to derive from valuable, rare and inimitable resources or capabilities, but rather from the dynamic capability of reconfiguration and rebuilding resources over time (Fiol, 2001; Teece, Pisano and Shuen, 1997).

Taking our assumptions of destruction and mobility into account, neither the IO nor RBV perspectives individually can fully explain SCA on their own. Although both IO and RBV scholars agree that the fundamental objective of the firm is profit maximization or earning above-normal returns (Conner, 1991), they disagree on the antecedents of competitive advantage. Ideally, a view on SCA should take both the IO and RBV perspectives into consideration. The antecedents of competitive advantage raised by both IO and RBV should complement each other to explain the difference between TCA and SCA.

Some scholars argue that hypercompetition is so pervasive that 'all competitive advantage is temporary' (D'Aveni, 1994; Fine, 1998, p. 30). Brown and Eisenhardt (1997) assert that a firm's success can only be achieved from a continuous stream of temporary advantages when the environment is 'relentlessly shifting'. Wiggins and Ruefli (2005) also suggest that a firm's SCA is likely to be achieved via a series of TCAs over a period of time. From the RBV perspective, slack resources are needed to alter current capabilities or to create new ones in response to environmental threats or opportunities (Sirmon, Hitt and Ireland, 2007). Thus, the accumulation of TCAs can also be regarded as the growth of slack resources which facilitate firms to build new capabilities and then sustain competitive advantage. Nevertheless, exploring whether SCA exists or not, although a valuable question, is not the focus of this paper; rather in this paper we examine the causality between TCA and SCA based on the existence of SCA, which is increasingly accepted by theorists. Our research therefore attempts to provide an integrative view of IO and RBV to shed light on competitive advantage over a period of time as well as to explain how a firm accumulates its TCA to achieve SCA.

From temporary competitive advantage to sustainable competitive advantage

Attaining a better outcome of TCA via a stronger market position (IO perspective). The term 'competitive advantage' has been widely studied in economics as well as strategic management, even though the term itself continues to be ill-defined and subject to debate (Leiblein, 2011). Most economic perspectives mainly explore superior economic performance at an equilibrium point, which is compatible with the concept of TCA in the short run. Such superior performance is attained either with the imposition of entry barriers as the mechanism for protecting abnormal profits or from the concentrated nature of the industry structure such as in the cases of monopoly and oligopoly (Schmalensee, 1985). Porter (1980, 1985) goes further in arguing that market structure shapes entry barriers in an industry and further influences a firm's long-term profitability. By analysing five significant structural forces (threats from potential entrants, supplier power, buyer power, substitute products and internal rivalry), Porter (1980) argues that a firm can exploit its competitive advantage by positioning itself in its optimal market and then sustain its competitive advantage by erecting entry barriers for competitors. Entry barriers are key industry structural factors that impact on market shares (Dess, Ireland and Hitt, 1990; Mason, 1939; Porter, 1980) as well as economic returns (Hofer and Schendel, 1978; McDougall, Robinson and DeNisi, 1992; Porter, 1980; Robinson and McDougall, 2001). Firms could establish entry barriers through economies of scale, making large capital investments or producing differentiated products (Bain, 1956, 1959; Hay and Morris, 1991; Hofer and Schendel, 1978; Porter, 1980; Siegfried and Evans, 1994) in order to deter competitors from entering the market.

However, in a fast-changing hypercompetitive environment, imitation by competitors, new entry, or the introduction of substitutes will all erode original competitive advantages (D'Aveni, 1994), which prevents initially superior economic performance from sustaining into the future. Moreover, the competitive advantage resulting from the environmental structure may disappear if these markets are punctuated by shocks and technological discontinuities (Schumpeter, 1934). Carr (1993) finds that firms using a market-power-based strategy significantly underperform their competitors who adopt a resource-based strategy over a longer period of time. This suggests that firms in possession of market positions may gain only a temporary advantage over their rivals. Accordingly, firms with stronger market positions are expected to attain a superior outcome of competitive advantage that is at least temporary in dynamic and hypercompetitive environments. Hypothesis 1 summarizes our argumentation:

> *H1*: A firm's stronger level of market position in an industry is expected to increase the firm's outcome of TCA.

Using the better outcome of TCA to accumulate a technological resource/capability position. RBV theorists (Barney, 1991; Penrose, 1959; Rumelt, 1984, 1991; Wernerfelt, 1984) argue that a firm's SCA emerges from the firm's command over specific resources and superior capabilities. In their empirical study, Hansen and Wernerfelt (1989) find that organizational factors explain about twice as much of the variance in firm profit rates as industry factors. Rumelt (1991) also asserts that the most important determinant of the long-term rate of business returns is not associated with industries but with the unique endowments, positions and strategies of individual businesses.

However, the potential to attain a competitive advantage is not inherent in all resources (Wernerfelt, 1989). Firms can use such 'barriers to imitation' to prevent duplication by other firms in order to sustain a competitive advantage acquired through a valuable and rare resource position (Lippman and Rumelt, 1982; Peteraf, 1993; Rumelt, 1984, 1991; Wernerfelt, 1989). Several such barriers are identified in the literature, including unique historical conditions (Barney, 1991; Dierickx and Cool, 1989; Mata *et al.*, 1995; Reed and DeFillippi, 1990), causal ambiguity (Barney, 1991; Reed and DeFillippi, 1990; Teece, 1987) or uncertain imitability (Lippman and Rumelt, 1982), and social complexity (Barney, 1986, 1991, 1994; Reed and DeFillippi, 1990; Teece, 1987).

From the RBV perspective, TCA stems from resources that are valuable and rare but that are easily imitated by rivals or cheap to reproduce. When resources are valuable, they generate at least a TCA by reducing the organization's costs or raising prices (Crook *et al.*, 2008). However, if these valuable and rare resources serve as a source of competitive advantage and the cost to the organization of imposing inimitability is greater than the benefit derived from such actions, other firms will soon imitate them resulting in competitive parity. Firms with inimitable resources may also struggle to sustain competitive advantage when they face a disruptive environment (D'Aveni, Dagnino and Smith, 2010). Under such conditions, firms may become locked into an ongoing continuous transformation and the innovation processes implied for acquiring and developing valuable and rare resources (Audia, Locke and Smith, 2000) and may exhaust available financial capital for supporting the expensive consumption in innovation or responding to intense competition. Therefore, having access to continuous and sufficient cash inflows to secure attaining valuable and rare resources, such as continuous product innovation (Verona and Ravasi, 2003) for a high-technology firm, becomes important, and a firm's better outcome of TCA will provide the foundation of such cash inflows. For instance, HTC, a Taiwanese smart phone maker, with strong innovation capabilities in mobile technologies, has struggled to establish a SCA in the mobile industry. HTC's global market share in terms of sales had grown to 2.4% by 2011 (Gartner, 2012) but has dropped rapidly since 2012. Thus, the profit and cash inflows might be quickly consumed if it continually competes with rivals Apple and Samsung in innovation and markets without increasing or at least sustaining its market position.

The HTC case implies that, without sufficient capital generated by a better outcome of TCA derived from a strong market position, even a firm possessing value and rare resources or capabilities (innovative mobile technologies in HTC's case) may not sustain its competitive advantage or its superior economic rents. Thus, it is important to recognize the role played by market position in securing a TCA when a firm seeks an SCA. Prior studies also conclude that firms with SCA are likely to have achieved a series of temporary advantages over time (Wiggins and Ruefli, 2005), particularly in the disruption of the status quo (D'Aveni, 1994).

In short, we argue that a better outcome of TCA, a static outcome of market position, can provide sufficient pockets of capital for supporting continuous innovation and competition to acquire value and rare resources or capabilities, particularly technological resources or capabilities for high-technology firms, for the sustainability of competitive advantage (or persistent superior economic returns). Thus, a firm's better outcome of TCA derived from a strong market position can help it to continuously create and rebuild resources and capabilities, which leads to a higher position of technological resources and capabilities for high-technology firms. Hence, we derive the following hypothesis:

> *H2*: A firm's better outcome of TCA is expected to improve the firm's technological resource and capability position.

Retaining a better outcome of SCA by utilizing a technological resource/capability position (RBV perspective). As noted earlier, from the RBV perspective, TCA stems from resources that are valuable and rare whilst SCA arises from resources that are inimitable and non-substitutable (Barney, 1991). In a fast-changing environment, the resources that support a competitive advantage in one or several time periods may become liabilities in a present time period (Leonard-Barton, 1992). Arend (2004) argues that strategic assets, following RBV attributes (e.g. valuable, rare etc.), are capabilities that are costly for the firm to appropriate since they are not equally distributed between firms and cannot be converted to a munificent state with any benefit to the firm because of the high costs involved in doing so. However, Sirmon, Hitt and Arregle (2010) suggest that these core rigidities or strategic liabilities do not have to be absolutely costly but only less valuable than competitors', as well as possessing the potential to be converted from weakness to strength over time with a net benefit to the firm. Firms may need to give up on seeking the once-coveted SCA but use one temporary position of strength to 'hopscotch' into another (Useem, 2000). This implies that a high-technology firm with a superior temporary position of technological resources or capabilities (including dynamic capabilities) is more likely to reconfigure and rebuild its resources in responding to a fast-changing environment and therefore to achieve a better outcome of SCA or superior economic rents for a longer period of time. Thus, we can derive our Hypothesis 3 as follows:

> *H3*: A firm's higher technological resource and capability position is expected to increase the firm's outcome of SCA.

Figure 1 provides a research framework summarizing our three hypotheses.

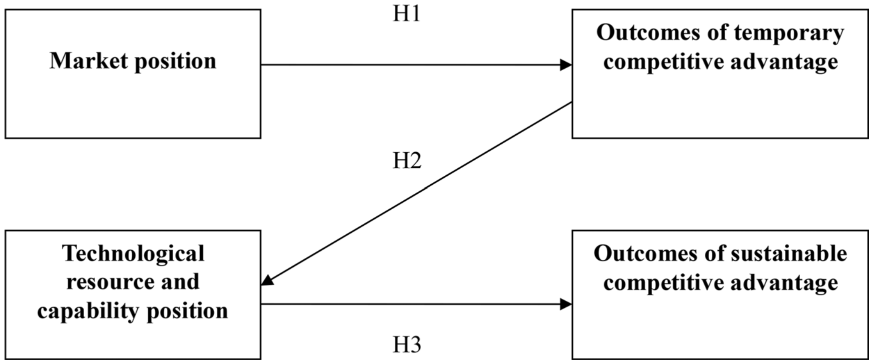

Figure 1. Research framework.

Research method

Theoretically, the RBV focuses on exploring competitiveness at the firm level whereas the IO concentrates on analysing competitiveness at the industry level. However, in order to integrate these two different perspectives, we used the firm level as the analysis unit in our study, which allowed us to investigate both market position and resource and capability position at the same level. A questionnaire survey of 165 Taiwan high-technology firms in the ICT industry was conducted and the structural equation method was employed to examine our hypotheses after data collection.

Sample selection and data collection

The sample firms of this research were Taiwanese manufacturing firms in the ICT industry. Due to dissimilarities between manufacturing and trade-only firms, the trade-only firms were excluded from our samples. Moreover, only firms with seven or more years of financial history were included in the sample for this study. Based on the above selection criteria, 415 publicly listed firms were selected and accounted for approximately 80% of the production value of the entire Taiwan ICT industry in 2002, suggesting that our sample selection was highly representative. The firms were selected on the basis of the stock code compiled by the Taiwan Stock Exchange Corporation (TSEC) and the over-the-counter (OTC) market, starting with 23, 24 and 30 in the TSEC and 53, 54, 61 and 80 in the OTC.

The CEOs or senior managers of the sample firms were targeted. Two mail surveys were conducted together with follow-up telephone and face-to-face interviews. As a result, 169 of 415 CEOs or senior managers returned their replies (40.7% response rate). After excluding four invalid respondents, 165 firms were finally valid. An independent sample t-test tested the two sub-samples (81 firms from the first mail survey and the rest of the firms) in terms of firm size. The result showed that the two sub-samples had no significant difference ($F = 2.564$, $p > 0.1$). This suggests that non-response bias might not be a problem.

Quantitative data in this research were gathered from various sources, including Taiwan's official government publications and corporate financial statements. For instance, ROA was derived from the database of the Securities and Futures Institute (SFI).

Research approach and statistical techniques

Following Huber and Power (1985) and Miller, Cardinal and Glick (1997), we used a retrospective report method to evaluate the independent variables in this research. Respondents were asked to evaluate the items in the questionnaire in 2002. This allowed us to measure market position, which is rarely used in traditional IO studies.

To establish the groundwork for our research and to develop the measures for our constructs, a total of 26 items for a firm's market position were designed in our multi-purpose questionnaire. All items were standardized as five-point Likert scale questions ascending from 1 (strongly disagree) to 5 (strongly agree) in the type of agreement questions. The validity of construct measurement in the questionnaire was checked by Cronbach's alpha. The overall value of Cronbach's alpha in our study is 0.7, which is theoretically acceptable (Henson, 2001).

After data collection, we used path analysis via a structural equation procedure to test our developed hypotheses. The path analysis procedure is becoming common in management studies when a small sample size restricts the use of full structural equation models (Chaudhuri and Holbrook, 2001; Li and Calantone, 1998), allowing us to examine the relationship between multiple independent variables and multiple dependent variables.

Dependent variables

There are two dependent variables in this research: outcomes of TCA and SCA.

Outcomes of TCA. Indicators such as ROA, return on equity or return on sales are normally adopted to measure a firm's profitability or the outcome of competitive advantage in various economic and management studies. Since ROA, in particular, is widely accepted by business practitioners and academic researchers (Corbett and Claridge, 2002; Eriksena and Knudsen, 2003; Scherer and Ross, 1990), ROA was employed as our indicator for measuring the outcome of a firm's competitive advantage. Taking into account the short industry life cycle for the ICT industry (Moore's law suggested that the capacity of semiconductor chips doubles every 18–24 months), a firm's outcome of TCA was measured by a three-year averaged ROA between 2003 and 2005.

Outcomes of SCA. Time spans for sustainable profitability measures vary among different studies. For industrial organization economics studies, the time span for measuring the sustainability of profitability can be more than 20 years (Mueller, 1986; Wiggins and Ruefli, 2002). Alternatively, for general management research, a shorter time span is used, such as the five-year averaged ROA in Eriksena and Knudsen's (2003) study or a six-year averaged ROA in the Said, HassabElnaby and Wier (2003) study. Moreover, the time span for sustainable profitability also varies among different industries due to the nature of the product life cycle. A short product life cycle increases the possibility of competition among firms. It shortens the time span of a new product in the market and imposes on firms the need to continually innovate. To some extent, this implies that the leading firm can only possess its technology advantage over a short time period and often loses the advantage of lower unit costs generated from long-term production (Dedrick and Kraemer, 1998). Thus, the sustainability of competitive advantage varies among different industries due the nature of the product life cycle. In our research, considering the short life cycle of Taiwan's ICT industry, a firm's outcome of SCA in our research was measured by a six-year averaged ROA between 2003 and 2008.

Independent variables

We used the questionnaire survey to assess market position and incorporated secondary data to assess the resource and capability position.

Market position. Traditionally, conventional industrial organization economists use the concentration ratio as a measure for market position, such as the four-firm concentration, the Herfindahl index[1] and the Lerner index[2] (Barla, 2000; Carlton and Perloff, 1994; Feinberg, 1980; Lerner, 1934; Lippman and Rumelt, 1982; Ornstein *et al.*, 1973; Scherer, 1965). Nonetheless, the above measures for market power have some limitations. Lippman and Rumelt (1982) commented that the concentration ratio and the Herfindahl index might not be able to predict the relationship between market position and profitability. Moreover, the conventional instruments are normally employed for analysing market position at the industry level, which may not be appropriate for our analysis at the firm level. Thus, we used the questionnaire to assess a firm's market position based on Porter's (1980) five-force framework, which included threats from new entrants, bargaining power of suppliers, bargaining power of buyers, pressure from substitute products, and the extent of internal rivalry from competitors. In addition to Porter's (1980) five forces, we also included the institutional context such as industrial policies, which are suggested to be associated with a firm's market position (Porter, 1998). We designed a five-point Likert scale questionnaire with 26 items to measure these six important factors determining a

[1]The Herfindahl index refers to the sum of the squared market shares of all firms in an industry (Barla, 2000; Lippman and Rumelt, 1982).

[2]The Lerner index refers to (P − MC)/P where P represents price and MC represents marginal cost. It proposes an index of divergence from optimal resource allocation and is frequently applied as a measure for the effects of concentration, firm size or entry barriers (Feinberg, 1980).

Table 1. Descriptive statistics and correlations

	Mean	Std deviation	(1)	(2)	(3)	(4)
(1) Market position	2.982	0.312	1.00			
(2) Technological resource and capability position	11.725	13.839	0.210*	1.00		
(3) Outcomes of TCA	5.050	9.686	0.232**	0.509**	1.00	
(4) Outcomes of SCA	4.613	8.487	0.234**	0.475**	0.901**	1.00

N = 165; **$p < 0.01$; *$p < 0.05$.

firm's market position (see Appendix 1 for the detailed questions). Market position was calculated by the mean of these 26 items.

Technological resource or capability position. In this study, we measured a firm's resource and capability position with its technological resources and capabilities since they are critical factors to a high-technology firm's performance (Miyazaki, 1995), which was the context for our sample firms (ICT firms). Prior studies have shown that a firm's technological innovative capabilities are significant sources of competitive advantage (Barney, 1991; Kogut and Zander, 1992; Porter, 1985). Moreover, a firm's position in technological resources and capabilities is an outcome of the combination of different resources and capabilities such as organizational learning, organizational structure, employee knowledge, top management strategy, culture, or networks with external resources. Thus, focusing on a firm's position in technological resources and capabilities enables us to narrow the scope of this research without neglecting the interrelationship with other resources or capabilities for the high-technology firm.

Prior studies use a Likert-scale questionnaire to measure a firm's resource depth (Laamanen, 2005), capability position (Huang, 2011; Jaffe, 1986) or knowledge position (Gupta and Govindarajan, 2000; Wiklund and Shepherd, 2003). However, since a firm's specific assets facilitate a firm's strategic posture of competitive advantage, we used technological assets to interpret the position of a firm's technological resources and capabilities. Patent data have been increasingly used as an indicator of corporate technological capabilities or assets in management research (Almeida and Phene, 2004; Huang, Wu, Dyerson and Chen, 2012; Jaffe, 1986; Mowery, Oxley and Silverman, 1996; Patel and Pavitt, 1994; Silverman, 1999). In particular for high-technology firms patent data offer richer information on technological strengths possessed by a firm (Silverman, 1999). However, patent data have some limitations. For instance, much of a firm's technical knowledge may remain unpatented (Silverman, 1999). While patents may not directly measure a firm's non-codifiable knowledge or resources, they should function as a partial and noisy indicator of its unpatented technological resources (Robins and Wiersema, 1995; Silverman, 1999). Thus, our study used patent stock as an indicator of a firm's technological resource and capability position since it can represent the entire patented and unpatented resources and capabilities of a technological firm. Consequently, to measure a firm's technological resource and capability position, our study used the total number of applied patents for each firm, as suggested by Almeida and Phene (2004), between 2003 and 2005.

Results

Descriptive statistics and correlations

Table 1 summarizes the descriptive statistics for the 165 firms of this study. The mean of outcomes of TCA (three-year ROA) was 5.05%, while the mean of outcomes of SCA (six-year ROA) was 4.61%. Moreover, the mean of technological resource and capability position was 11.73 while the mean of market position was 2.98 in this research. Table 1 also presents the correlation matrix among the variables. The results show that problems of multicollinearity should not significantly influence the stability of the parameter estimates since the variance inflation factor of all independent variables was less than 10.

Hypothesis testing

The structural relationship was tested using path analysis via a structural equation procedure. Calantone, Schmidt and Song (1996), Cavusgil

Table 2. Hypothesis testing results

Hypothesis	Causal path	Coefficient	t-value
H1	Market position → outcomes of TCA	0.21	2.42**
H2	Outcomes of TCA → technological resource and capability position	0.51	6.63**
H3	Technological resource and capability position → outcomes of SCA	0.88	20.78**

**$p < 0.05$.

and Zou (1994) and Price, Arnould and Tierney (1995) proposed using a summary of item scores to test relations among constructs because this method yields an acceptable variable to sample size ratio and simplifies the model. Path analysis in LISREL was performed for hypothesis testing.

The model fit indices indicated that the model was acceptable ($\chi^2_{(3)} = 3.61$, root mean square error of approximation (RMSEA) 0.040, goodness-of-fit index (GFI) 0.986, confirmatory fit index (CFI) 0.998, non-normed fit index (NNFI) 0.995). All of the three hypotheses are supported (see Table 2): Hypothesis 1 (the outcome of TCA increases with market position) ($\beta = 0.21$, t-value 2.42), Hypothesis 2 (technological resource and capability position increases with the outcome of TCA) ($\beta = 0.51$, t-value 6.63) and Hypothesis 3 (the outcome of SCA increases with technological resource and capability position) ($\beta = 0.88$, t-value 20.78).

A rival model testing

In our hypothesized model, the focal or central variable is the technological resource and capability position because it performs as a mediator between the antecedents and the consequence constructs. In other words, the hypothesized model does not have direct paths from the antecedents (market position and outcomes of TCA) to the consequence constructs (outcomes of SCA). Based on the strategy management literature on market position and outcomes of TCA, a potential alternative model would be that these two constructs may have a direct impact on outcomes of SCA. In the rival models, three conditions are allowed to test the relationship between original antecedent variables (i.e. market position and outcomes of TCA) and outcomes of SCA. Thus, in the rival models, technological resource and capability position does not completely mediate.

Following Bollen and Long (1992), this study compared the hypothesized model with three rival models: model 1– adding 'market position to outcomes of SCA' path; model 2 – adding 'outcomes of TCA to outcomes of SCA' path; and model 3 – adding both of them (shown in Table 3). This helps us test the nomological status of the focal variable (e.g. Morgan and Hunt, 1994; Ramani and Kumar, 2008). Because all the models use exactly the same covariance structure as the input, and thus are nested, this study compared the models using the following criteria: (1) the chi-squared difference test, (2) overall fit of the model, as measured by the RMSEA, CFI and NNFI, and (3) percentage of the model's significant structural paths.

As shown in the results in Table 3, the rival model was less parsimonious than the hypothesized model (comparison in number of distinct parameters to be estimated). The test results indicated that none of the rival models explained the covariance structure any better than the hypothesized model. Moving to comparing the criteria indices, these results also indicated a preference for the hypothesized model over other rival models, so favouring the original model. Finally, the percentage of estimated paths supported in the hypothesized model (3/3 = 100%) was greater than the percentage of estimated paths supported in all rival models (3/4 = 0.75% for models 1 and 2; 3/5 = 60% for model 3). Our study therefore prefers the more parsimonious hypothesized model to the rival models. This result also implies that the technological resource and capability position holds a central nomological status and is therefore a key construct in explaining a firm's outcome of SCA.

Since the cross-sectional nature between outcomes of TCA and the technological resource/capability position may cause concern for reverse causality and endogeneity issues in this study, we provided the remedies by testing reverse causality models and using the two-stage Heckman procedure (Heckman, 1978, 1979) respectively. The results show that both reverse causality and endogeneity issues are not serious concerns in our research (see Appendix 2).

Table 3. Results of the rival model testing

	Hypothesized model	Rival model 1	Rival model 2	Rival model 3
Market position to outcomes of TCA	(0.21) 2.42**	(0.21) 2.42**	(0.21) 2.42**	(0.21) 2.42**
Outcomes of TCA to technological resource and capability position	(0.51) 6.63**	(0.51) 6.63**	(0.51) 6.63**	(0.51) 6.63**
Technological resource and capability position to outcomes of SCA	(0.88) 20.78**	(0.87) 20.54**	(0.89) 18.24**	(0.89) 18.18**
Market position to outcomes of SCA		(0.03) 0.75		(0.03) 0.82
Outcomes of TCA to outcomes of SCA			(−0.03) −0.58	(−0.03) −0.66
χ^2/df	3.61/3 = 1.20	3.02/2 = 1.51	3.20/2 = 1.60	2.56/1 = 2.56
RMSEA	0.040	0.063	0.068	0.110
NNFI	0.995	0.987	0.984	0.959
CFI	0.998	0.996	0.995	0.993
GFI	0.986	0.988	0.988	0.990
	Dominating			

** $p < 0.05$.

Discussion

Market position and outcomes of temporary competitive advantage

As shown in Table 2, Hypothesis 1 was supported, suggesting that a firm's market position in an industry was positively associated with a firm's outcome of TCA. As suggested by the IO economists, firms with a stronger market position may create an entry barrier constraining the entry of potential competitors and therefore achieve a better competitive advantage. Our results supported the IO theorists' proposition that a firm's TCA can be gained via strengthening its market position in an industry. Going further, rival model 1 and rival model 3 suggested that a firm's market position in an industry was observed as having no influence on a firm's outcome of SCA. These results support our argument that the competitive advantage resulting from entry barriers or market concentration is temporary. Such competitive advantage helps firms to reach an outcome performance in the static equilibrium at a specific point in time (i.e. TCA), but it will not be sustained if the environment changes dramatically, such as through creative destruction in technology development (Schumpeter, 1934) or hypercompetition (D'Aveni, 1994). More importantly, this implies that the TCA attained at the specific point in time via a strong market position will struggle to be sustainable if firms only focus on exogenous factors influencing market position.

Transforming temporary competitive advantage to technological resource/capability position

As shown in Table 2, Hypothesis 2 was also supported, suggesting that a firm's short-term superior economic performance contributes to its accumulation of technological resources and capabilities, particularly in the ICT industry. This is very important for helping us to understand how a better outcome of TCA can be transformed into an SCA. While our Hypothesis 1 suggests that a stronger market position helps a firm to generate a superior economic performance for the short term, Hypothesis 2 suggests that the generated superior economic performance can be utilized in the accumulation of the firm's technological resource and capability position. This implies a potential causal relationship between the market position and the technological resource/capability position via the mediation of short-term superior economic performance (or outcomes of TCA), which has not been fully investigated in prior research.

As shown in our rival models 2 and 3, outcomes of TCA (or short-term profits) did not directly contribute to outcomes of SCA. Firms need to have sufficient financial support, generated via a strong market position in the short term, to continuously build, redeploy and reconfigure their resources and capabilities and then to achieve a better position of technological resources and capabilities for sustaining superior economic rents for a longer period of time.

Technological resource and capability position enhances a better outcome of sustainable competitive advantage

Table 2 indicates support for Hypothesis 3, suggesting that a firm's technological resource and capability position is positively associated with a firm's outcome of SCA. Our results were consistent with the prior RBV proposition that a firm's SCA emerges from the firm's specific resources and superior capabilities (Barney, 1991; Penrose, 1959; Wernerfelt, 1984). The observed positive association implies that a firm with a strong technological resource and capability position can sustain its superior economic performance for a period of time and therefore the high-technology firm should accumulate and nurture its technological resources and capability in order to attain dynamic equilibrium and SCA.

Transformation from temporary competitive advantage to sustainable competitive advantage

Our findings partially support Wiggins and Ruefli's (2005) study and provide a more insightful explanation as to how a firm's SCA could be achieved via a series of TCAs. Incorporating market position, resource and capability position, and competitive advantage from the integrated view of the IO and RBV perspectives, our study found that a high-technology firm's TCA can be attained via a stronger market position whereas an SCA can only be secured through strong positions in technological resources and capabilities which are accumulated via a series of TCAs. From our findings, a superior market position is a sufficient condition for TCA while a superior resource and capability position is a sufficient condition for SCA. Most importantly, a TCA is the foundation of improving a firm's resource and capability position, which in turn enhances SCA. Although we do not explore in this paper the exact mechanisms through which a temporary market advantage may be utilized to move the organization into a stronger resource and capability position – these knowledge-based organizational processes have been explored by other scholars (Grant, 1996; Teece, 2009; Zahra and George, 2002) – our results help to clarify the theoretical logic for how a firm can move from TCA to SCA.

Conclusion

Our study suggests that high-technology firms with a stronger market position can help in attaining a better outcome of TCA whereas the firms possessing a superior position in technological resources or capabilities accumulated via a better outcome of TCA can attain a better outcome of SCA. By recognizing the existence of the destruction and mobility assumptions, our research provides an empirical attempt to integrate both IO and RBV perspectives to investigate a firm's competitive advantage at the firm level. Another contribution of our study is that we distinguish between the sources of two different competitive advantages by integrating both IO and RBV perspectives: market position as a source of TCA and resource/capability position as a source of SCA. Our empirical results not only support Wiggins and Ruefli's (2005) proposition that SCA is likely to be achieved via a series of TCAs, but go further in providing a relatively clear set of causal relationships between market position, resource/capability position and competitive advantage (both temporary and sustainable), which has not been fully empirically investigated in prior studies. In arguing the important role of resources and capabilities for SCA, our study shows that market position is an antecedent only for TCA but, nonetheless, the temporary superior economic returns derived from strong market positions can provide capital for accumulating resources and capabilities. Business practitioners can learn lessons from our research by understanding that firms should establish a stronger market position in an industry to maximize outcomes of TCA but also focus on accumulating or nurturing a superior position in resources and capabilities for better outcomes of SCA. In particular, in Taiwan's ICT industry, a high-technology firm should use its strong market position to generate short-term superior economic rents, and then use the generated capital to accumulate its position on technological resources or capabilities (patents in this research) to sustain its superior economic rents for a longer period of time.

By understanding that a firm's SCA is attained via its resource and capability position whereas a firm's TCA is attained via its market position, policy makers can also learn from this study by refining policies for enhancing firm performance. Policy makers could re-examine policies designed to facilitate a supportive environment for firms to develop their resources or capability, which in turn attains SCA. In the meantime, since a weak market position will affect a firm's outcome of TCA, making it vulnerable to insufficient capital to accumulate resources or capabilities, policy makers may facilitate an equal-chance competition environment for firms in an industry.

One of the major limitations is that some cross-sectional data have inevitably been used in this research. Being aware of the drawback of cross-sectional data on causality research, we have deliberately created a time lag between independent variables and dependent variables. However, since we need to examine the effects of market position on outcomes of TCA and SCA simultaneously as well as the sequential effects from market position, outcomes of TCA, technological resource and capability position, to outcomes of SCA, the use of cross-sectional data for outcomes of TCA and the technological resource and capability position (both from 2003 to 2005) is inevitable.[3] Having said that, future studies may improve on our research design. Another research limitation is the possible effect of the interruption of a series of TCAs on SCA. If a series of TCAs is interrupted, SCA might be nullified. However, if the series of TCAs is 'briefly' interrupted but remains to be accumulated after the interruption, then SCA should not be completely nullified. Assuming that the interruption has not lasted for a lengthy period of time or permanently, a short-period interruption should not immediately and completely nullify SCA due to path dependence and organizational inertia on competitive advantage. However, due to the restriction of the research framework and construct measurement, our study was unable to examine whether the interruption of TCA accumulation has an impact on SCA. Future studies are highly encouraged to investigate this line of the research. Furthermore, this research did not examine the mediation effect of technological competences on the relationship between outcomes of TCA and technological resource and capability position due to the limitation of our data structure (i.e. we did not measure a firm's competences between 2003 and 2005). Future studies are encouraged to further investigate this effect. Moreover, patent applications may only partially but not fully explain SCA. Instead of measuring other types of resources or capabilities by asking firms to evaluate the resources or capabilities themselves, we used the accumulated patent number as a proxy to reflect a firm's position or repertoires of technological resources and capabilities for the following reasons. First, patents are an appropriate proxy since they reflect the outcome of a firm's efforts, including technological resources and capabilities, on its business operation. Better combination and reconfiguration of resources and capabilities can help firms to develop new technologies or new products, which are patented to protect their potential of value appropriation. Thus, patents reflect a repertoire of summed technological resources and capabilities which have been invested in. Second, particularly in the high-technology industry, patents are the most important indicator for a firm to demonstrate its ability and potential for appropriate future value creation. Therefore, compared to other resources such as brands, patents can better capture the sources of SCA for high-technology-oriented firms, which were our sample population. However, we also recognize that the limitation of our research design prohibits us from employing different measures for the resource and capability position, and we encourage future studies to use different measures.

[3]As shown in Appendix 3, we attempt to argue that market position only helps firms to attain a better outcome of TCA (Hypothesis 1) instead of a better outcome of SCA (Proposition 1, P1: Market Position to SCA). Thus, while market position was measured in 2002, TCA was measured between 2003 and 2005 (a three-year span) and SCA was measured between 2003 and 2008 (a six-year span), which exhibited a reasonable time lag between the independent (market position) and dependent (outcomes of TCA and SCA) variables. However, in this study, we also test whether a firm will transform its outcome of TCA into an outcome of SCA via its technological resource and capability position (Hypotheses 2 and 3) instead of directly from a TCA to an SCA (Proposition 2, P2: TCA to SCA). If we create a time lag between an outcome of TCA (i.e. 2003–2005) and a technological resource and capability position (i.e. 2004–2006), the 2004–2006's technological resource and capability position cannot then predict the 2003–2008's SCA (Hypothesis 3). If we push the time span for outcomes of SCA further away, e.g. 2005–2010, then our first research purpose may be problematic since there is a three-year gap between market position (2002) and SCA (2005–2010), which may not allow us to compare Hypothesis 1 and P1. Thus, we have to keep the cross-sectional data for the two variables, outcomes of TCA and technological resource and capability position, in order to meet our research purpose in the framework.

Appendix 1: Questionnaire

Market position	
Threats from new entrants	1. Your firm's products are easy to make in large volumes 2. The capital requirement for potential rivals to enter your market is very high 3. It is easy to switch your current product lines to other product lines 4. Your core products are not highly standardized
Supplier power	1. The inputs of your core products can be purchased in markets from a number of alternative suppliers 2. Your main inputs can be replaced easily by other materials for manufacturing your core products 3. Your suppliers are highly dependent on your firm's orders 4. Your suppliers cannot easily enter your market by forward integration
Buyer power	1. There are a large number of buyers for your main products 2. Your outputs account for a large proportion of the cost structure of downstream products 3. Your buyers cannot easily enter your market by backward integration 4. Your buyers are not well informed about current market price for your products 5. Buyers cannot easily replace your core products with rivals' at little or no additional cost 6. What percentage of your total sales goes to large international firms like IBM, Dell, AMD and Intel?
Substitutes	1. How do you rate your firm's competition from substitute products in terms of price? 2. How do you rate your firm's competition from substitute products in terms of functions? 3. In your opinion, your core products will remain the current market for.
Internal rivalry	1. Most firms in your industry concentrate on more than one or two products as their core business 2. What number of competitors do you face for your core products? 3. How do you rate capacity in your industry?
Policy	1. Your firm benefited from 'Five-year Tax Free Statute for High-technology Industry' prior to 2002 2. Your firm benefited from 'Measures for Encouraging Private Enterprise to Develop New Industrial Product' 3. You are highly satisfied with basic infrastructure like electricity and water for the IC industry in Taiwan 4. You are highly satisfied with the performance of the Taiwanese government's R&D policy making 5. You are highly satisfied with the performance of the Taiwanese government's R&D policy implementation 6. You are highly satisfied with the intellectual property protection framework within the IT industry in Taiwan

Appendix 2: Reverse causality test and endogeneity test

Reverse causality test

This study compared the hypothesized model with three reverse causality (RC) models (shown in Figure A1): RC model 1 – adding 'outcomes of SCA to technological resource and capability position' path; RC model 2 – adding 'outcomes of SCA to outcomes of TCA' path; and RC model 3 – adding 'technological resource and capability position to outcomes of TCA' path. The overall disposition of RC model 1 fit indices, including $\chi^2(2) = 3.239$, $p = 0.198$, $\chi^2/df = 1.62$, RMSEA = 0.068, NNFI = 0.978, CFI = 0.993, GFI = 0.988, demonstrated acceptable model fit. The relationship from outcomes of SCA to technological resource and capability position was insignificant ($\gamma = 0.185$, t-value 0.672). The overall disposition of RC model 2 fit indices, including $\chi^2(2) = 0.838$, $p = 0.658$, $\chi^2/df = 0.419$, RMSEA = 0.000, NNFI = 0.995, CFI = 1.000, GFI = 0.997, demonstrated acceptable model fit. The relationship from outcomes of SCA to outcomes of TCA was insignificant ($\gamma = -4.527$, t-value = -1.001). The overall disposition of RC model 3 fit

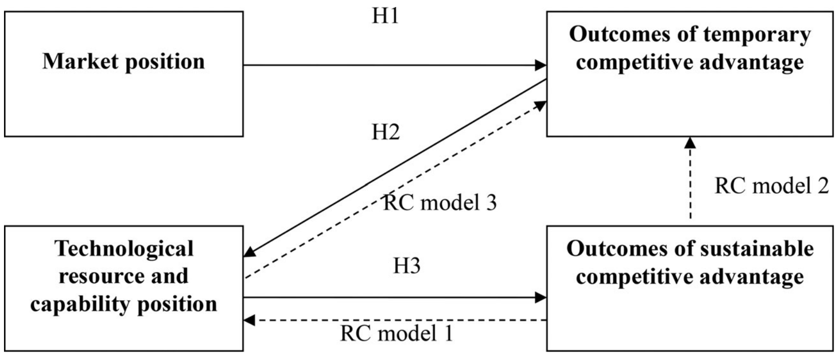

Figure A1. Reverse causality test

indices, including $\chi^2(2) = 0.998$, p = 0.607, χ^2/df = 0.499, RMSEA = 0.000, NNFI = 1.018, CFI = 1.000, GFI = 0.996, demonstrated acceptable model fit. The relationship from outcomes of TCA to technological resource and capability position was insignificant ($\gamma = -1.807$, t-value = −0.824).

This study compared the hypothesized model with three RC models, and the hypothesized model is superior to RC models 1, 2 and 3. Since the values of $\triangle\chi^2(1) = 0.340$, $\triangle\chi^2(1) = 2.741$ and $\triangle\chi^2(1) = 2.581$ were smaller than 3.84, this indicated that the hypothesized model was superior to RC models 1, 2 and 3. The RC models were less parsimonious than the hypothesized model (comparison in number of distinct parameters to be estimated). The test results indicated that none of the RC models explained the covariance structure any better than the hypothesized model. Furthermore, the percentage of estimated paths supported in the hypothesized model (3/3 = 100%) was greater than the percentage of estimated paths supported in all RC models (3/4 = 0.75% for models 1 and 2; 2/4 = 50% for model 3). Our study therefore preferred the more parsimonious hypothesized model to the RC models.

Endogeneity test

Since outcomes of TCA and technological resource/capability position may all be the results of unaccounted factors, leading to endogeneity concerns and a bias in the coefficients on absorptive capacity, we used a common econometric procedure proposed by Heckman (1978, 1979) to control for this potential endogeneity bias. A two-stage Heckman procedure was employed to remedy the model misspecification. This approach re-estimates regression coefficients by introducing an adjustment term, named the inverse Mills ratio, to the regression model. We first estimated a first-stage probit model to specify a selection equation and then calculated the inverse Mills ratio, which was used as a control variable in the second-stage model (Leiblein, Reuer and Dalsace, 2002; Shaver, 1998). In this study, a variable in the first-stage model, market position, was used to predict the outcome variable, outcomes of TCA. Then, we entered the inverse Mills ratio into the second-stage regression model to remove any bias in the coefficients by accounting for endogeneity. An appropriate proxy of the inverse Mills ratio requires that a variable is correlated with the first-stage model's outcome (i.e. outcomes of TCA) but not with the second-stage performance model's outcome (i.e. technological resource/capability position). Therefore, market position was the instrumental variable entered in the first-stage model but not in the second-stage model. As shown in Table A1, the results indicate that the inverse Mills ratio, calculated via the first-stage regression, has no impact on technological resource and capability position, while outcomes of TCA remains to have an impact on technological resource and capability position. The consistent result with our prior path test suggests that endogeneity concerns can be eased in our study.

Appendix 3: Research design

The research framework (shown in Figure A2) is that a firm's market position in 2002 will affect its outcome of TCA in 2003–2005 as well as its position of technological resources and capabilities in 2003–2005, which in turn affects its outcome of SCA in 2003–2008. In addition to the path analysis via a structural equation procedure, in this research we also ran regression models by

Table A1. Endogeneity test

	First-stage regression estimate of outcomes of TCA		Second-stage regression estimate of technological resource/capability position	
Exogenous variable	Model E1		Model E2	
Variable				
Constant	0.003	(0.035)		
Market position	0.183*	(2.327)		
Independent variables				
Outcomes of TCA			0.852**	(5.680)
λ (inverse Mills ratio)			−0.043	(1.062)
F-value	5.416**	224.74**		
Adjusted R-squared	0.027	0.734		

**p < 0.01; *p < 0.05.

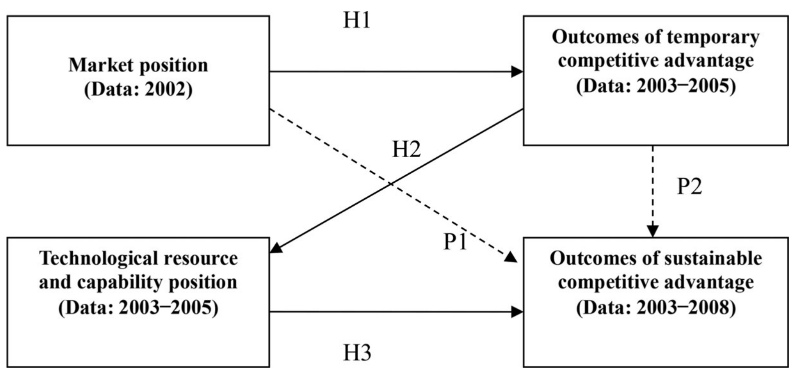

Figure A2. Explanations for research design

controlling the effect of market position on the relationship between outcomes of TCA and technological resource/capability position (Hypothesis 2) as well as the relationship between technological resource/capability position and outcomes of SCA (Hypothesis 3), and the results remained the same. Market position has no impact on technological resource/capability position ($B = 4.660$, $p > 0.05$) while the outcome of TCA continues to have a positive impact on the technological resource/capability position ($B = 0.696$, $p < 0.001$). Market position has no impact on the outcome of SCA ($B = 3.687$, $p > 0.05$) while technological resource/capability position continues to have a positive impact on the outcome of SCA ($B = 0.297$, $p < 0.001$). The results also support our arguments even taking market position as the control variable into account.

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