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Editor's Note

First of all, we would like to extend our warmest welcome to two new area editors—Prof. Jia- Chi Huang and Prof. Yi- Ching Hsieh. Prof. Jia-Chi Huang is an excellent scholar from the Department of Business Administration at National Chengchi University. He has published articles in the top tier journals, specializing in human resource management and organizational behavior. Prof. Yi-Ching Hsieh is a superb researcher from the Department of Information Management at National Central University, with publications seen in renowned journals. She specializes in marketing management, services marketing and management, and Internet marketing. Second, it is our honor to invite Prof. Allaudeen Hameed from Department of Finance at National University of Singapore to join our advisory board. Prof. Hameed has also held visiting positions at the Chinese University of Hong Kong, University of North Carolina at Chapel Hill and the University of Texas at Austin. Prof. Hameed`s research interests include return-based trading strategies, stock return co-movement, liquidity, role of financial analysts and international financial markets. His research work has been published in leading finance journals such as *The Journal of Finance, Journal of Financial Economics, The Review of Financial Studies and The Journal of Financial and Quantitative Analysis.*

With this strong editorial team, *NTU Management Review* aims to achieve the following goals: to uphold high-quality standards of the journal; to improve administrative efficiency; to promote constructive feedbacks to the authors and ensure that everyone can gain throughout the review processes.

Announcements of 2018 Management Theory and Practice Conference

To promote interactions among management scholars in the Asia-Pacific region and around the world, on April 1 and 2 of 2018, National Taiwan University and Southwestern University of Finance and Economics will hold the 2018 Management Theory and Practice Conference: Managing the New Realities in Asia; aiming to provide an academic forum for the exchange of management-related research ideas and to provide suggestions for future researches in the Asia-Pacific region. The conference focuses on management from an Asia-Pacific perspective, aiming to bring together researchers and practitioners to facilitate the discussion on the insights into different fields of management such as accounting, finance, organizational behavior, human resources, marketing, information management, e-commerce, productions and operations management, and corporate strategy. Original

research papers aligned with the conference theme are invited; theoretical, empirical, and qualitative literature review and case studies are welcomed. We welcome research papers that can bring visions and insights into management theories and practices, and we also encourage qualitative studies that depict and interpret up-to-date management practices. Submission will be closed on October 1, 2017. For further information, please check the latest updates on *NTU Management Review* website for more details. Scholars and practitioners throughout the world are welcomed to attend.

Announcements of Call for Papers for Special Issues and T. N. Soong Foundation Award

Recently, a new call for paper on "New Southbound Policy: Challenges & New Implications" has been announced in April, 2017. Guest editors of this special issue are Prof. Yung-Chih Lien from National Taiwan University, Prof. Chia-Ling (Eunice) Liu from National Taiwan University, Prof. Ruey-Jer (Bryan) Jean from National Chengchi University, and Prof. Chia-Wen Hsu from National Chung Cheng University. This special issue is to discuss the challenges and theory implications with the implementation of "New Southbound Policy". All are welcomed to submit. Submission will be closed on March 2, 2018. Please refer to the announcement for possible topics or check the latest updates on *NTU Management Review* website for more details.

We are grateful to T. N. Soong Foundation for its continued support. To encourage research in accounting, auditing, finance, taxation, information, and management in Taiwan, the Foundation has sponsored the Best Master's Thesis Award since 1996. Several winning papers have been published in *NTU Management Review* since then.

Introduction of This Edition

This edition of *NTU Management Review* contains seven articles. The following is a brief introduction of the seven articles.

For the one article in the field of organizational behavior by Chia-Wu Lin et al., it investigates how subordinates' attribution of intention behind leaders' behavior affects their emotions and behaviors. The authors conducted two-wave data collected from 340 subordinates and their results showed that benevolent leadership was less positively or even negatively related to trust and OCB when subordinates perceived high manipulative intention behind leaders' behavior. Also, they found that the above interaction's effect on OCB is partially mediated by trust in supervisor and the organization. This paper cautions that

benevolent leadership does not always lead to positive consequences and needs to demonstrate authenticity and real consideration.

For the one article on research methodology by Haw-Jeng Chiou, it discusses the problem of regression analyses which often rely heavily on hypothesis testing and interpretations of regression coefficients. The paper reviews several indices that can be used to evaluate the effect size and relative importance of predictors, the relative weight analysis (RWA), and the dominance analysis (DA) in multiple regressions. A simulated dataset of 2,325 Taiwanese adults from the 2011 Panel Study of Family Dynamics (PSFD) was used to examine the impacts of multicollinearity, including the enhancement, suppression, and redundancy effects to evaluate the effect size and relative importance of predictors. The author recommended that the indices based on RWA and DA should be used for evaluating the relative importance of predictors. In particular, DA had the advantage of flexible procedures for evaluating the different facets of the dominance of predictors.

For the one article in the field of corporate finance by Wong and Chang, it surveys external growth strategies (including M&A, equity-based alliances such as joint ventures, and non-equity-based alliances) in the Asian market. Specifically, the authors review and discuss journal articles that sampled data from the Asian market and that were published in TSSCI or A Tier SSCI financial journals from 2000 to 2015. These journal articles were divided into two research streams: M&A and alliances. The findings suggest that Taiwanese companies have a prevalence of family businesses, supply chains with closed networks and business groups. The authors believe that these unique characteristics of Taiwanese companies provide scholars an opportunity to develop research focused on M&A and alliances, especially examining niche acquisitions and alliances. Finally, this article provides potential future research topics and studies related to M&A and alliances based on data collected in Taiwan.

For the one operation management article, it applies competitive dynamics perspective from strategy literature to the context of process development and management. Authors develop insights by applying a dynamic, computational model based on an extensive appraisal of the history of process innovation and improvement in the global automobile industry, and draw on the underlying theoretical relationships in the empirical literatures on operations and strategy. From this study, they demonstrate that the leading firm can publicly signal its best practice to induce the follower firm to invest in process improvement capabilities but only for short-term survival, not for long-term purposes or goals. In this way,

the leader firm maintains its leading edge. Their results also underscore the importance of competition in determining the firm-level process development and management practices.

For the one article in the field of IM (information management), it reviews the IS adoption and implementation literature for the period of 2000–2015, based on the top six Taiwanese journals on the information system, management and e-commerce topics. In total, 82 articles were analyzed in terms of theories, research methods, unit of analysis, and research topics. Authors found that Technology Acceptance Model has been the mainstream theory during the past 15 years in the Taiwanese IS journal. The individual level research, which used the survey method, appeared the most. They argued that in terms of the theories, methods, and units of analysis, the IS adoption and implementation literature in Taiwan are considerably affected, with a narrowed scope induced by TAM, lacking of diversity and contextual concern. They further compare their finding with the trend of international IS scholarship, and offer implications for future research directions on IS adoption and implementation, scholars to publish multiple, complementary levels of analysis across individual, organizations, and industries. Macro level study considering the variety of IT innovations and the intersection among different levels of IS adoption, implementation and user is also important.

For the two articles in the field of TIM (technology and innovation management), one examines the impact of managerial ties on the performance difference among entrants in an emerging industry. Empirical findings from firms that entered the cellular phone service industry between 1983 and 1998 suggest the following. Firstly, they find that a manager's tie to an intra-industry association positively moderated the relationship between manager's intra-industry experience and an entrant's new subscribers at the early stage of the focal industry; however, this effect decreases as the industry ages. Secondly, this study reveals that a manager's tie to intra-industry competitors positively moderated the relationship between manager's intra-industry experience and an entrant's new subscribers regardless of industry age. Finally, they observe that a manager's external tie to other firms outside the industry exhibited no moderating impact.

The other article mainly adopted a real option perspective in viewing exploration as creating real options and exploitation as executing those options. They argue that in the face of uncertainty, holding real options can bring firms future opportunities but may not lead to superior performance. Firm performance can be enhanced only if firms execute these real options. By using 25 years of data on semiconductor firms in the United States, this study

examines the influence of uncertainty on exploration and exploitation, and the mediating effect of exploitation on the relationship between exploration and firm performance. This study adopts a novel lag structure model to explicitly consider the time-lag factor in measuring the effects of exploration on firm performance. Their study concludes that uncertainty is positively related to exploration, and exploitation mediates the relationship between exploration and firm performance which support the real-options perspective in elaborating exploration, exploitation, and firm performance.

Shu- Cheng Steve Chi
David Ming- Huang Chiang
San- Lin Chung

從動態競爭觀點審視作業流程管理的創新與改進

Process Innovation and Improvement: A Competitive Dynamics Perspective

陳立民 / 國立政治大學企業管理學系助理教授
Li-Ming Chen, Assistant Professor, Department of Business Administration, National Chengchi University

劉妍 / 利茲大學商學院講師
Yan Emma Liu, Lecturer, Leeds University Business School, University of Leeds

楊曙榮 / 國立臺灣大學工商管理學系副教授
Shu-Jung Sunny Yang, Associate Professor, Department of Business Administration, National Taiwan University

摘 要

營運暨策略管理文獻已廣泛討論透過採用業界認可之最佳管理實務來提升作業流程效率及效力。過去相關研究主要探討一家處於追隨者地位的企業，如何學習該產業標竿企業的最佳作業流程實務來發展並積累自身組織能耐，用以改進其營運績效。本研究引用策略管理文獻之動態競爭觀點來深耕此研究脈絡。根據全球汽車產業的作業流程創新與改進歷史和相關管理文獻的理論框架與實證研究，本文發展出一個動態模型並藉此得到作業流程創新與改進的管理意涵。文章主要命題如下：雖然追隨企業可以投資作業流程創新能耐來追求長期組織成長，但此舉將引起標竿企業的激烈競爭性回應。為保持業界領先地位，標竿企業具有強烈的策略意圖來公開其最佳作業流程管理實務以供追隨企業學習和採用；其目的在於誘導追隨企業投資短期見效的作業流程改進能耐進而喪失創造嶄新業界作業流程管理實務的機會。本文闡述動態競爭對作業流程發展及管理實務的重要性並影響業界最佳實務的演進與開創。

【關鍵字】作業流程創新、作業流程改進、競爭策略、營運策略

Abstract

Operations and strategy literatures have consistently promoted the best practice of accredited management standards for process efficiency and effectiveness. Based on the capability theorizing, studies have investigated how a following firm can improve its operational performance by learning from a leading firm's best practices. Our study extends this research stream by applying competitive dynamics perspective from strategy literature to the context of process development and management. We develop insights by applying a dynamic, computational model based on an extensive appraisal of the history of process innovation and improvement in the global automobile industry and draws on the underlying theoretical relationships in the empirical literatures on operations and strategy. The core proposition in our study is that a follower firm's investment in process innovation capabilities for long-term growth will provoke strong retaliation from leading firms using the current best practice. We demonstrate that the leading firm can publicly signal its best practice to induce the follower firm to invest in process improvement capabilities but only for short-term survival, not for long-term purposes or goals. In this way, the leader firm maintains its leading edge. Our results also underscore the importance of competition in determining the firm-level process development and management practices.

【Keywords】 process innovation, process improvement, competition, operations strategy

1. Introduction

When developing an operational process (either manufacturing or service), a firm may face incumbents with well-established processes that are current industry standards. Operations management and organization researchers have long investigated the effects of process improvement and innovation on firm performance (Kim, Kumar, and Kumar, 2012; Rahmandad, 2012). Although progress has been made in this domain, the existing literature has a major limitation. While much research has examined a firm's decision to invest in process improvement capability for short-term survival, or in process innovation capability for long-term growth (Peng, Schroeder, and Shah, 2008); very few studies have explored how a new best-practice process emerges to replace an industry's existing best-practice process (Shepherd and Patzelt, 2013). Well-known examples of best-practice processes include Craft Production (CP) versus Mass Production System (MPS), and MPS versus Toyota Production System (TPS). This paper addresses this limitation and argues that competitive pressure imposed by the existing best-practice process can negatively impact a follower firm's capability-development trade-offs for building a new best-practice process.

The core proposition that we propose in this study is grounded in two distinctive theoretical perspectives. The capability theorizing perspective suggests that a firm's improvement capability facilitates the achievement of its full potential within the current best practice but that innovation capability creates new industrial operating frontiers (Schmenner and Swink, 1998; Peng et al., 2008). Various studies have examined the firm's capabilities as a primary construct to explain firm heterogeneity and sustainable advantage through effective process management (Boyer, Swink, and Rosenzweig, 2005; Swink and Hegarty, 1998). However, these arguments are problematic as they are based primarily in settings where capability development trade-offs is determined within the boundary of a single firm and overlooks the strategic importance of inter-firm competition. Chen (1996) proposes that the key driver of any competitive action is a set of strategic variables centered on awareness, motivation, and capability to manage interfirm rivalry. This competitive dynamics perspective suggests that process failure occurs when firms are unaware of and/or incapable of coping with possible retaliations from rivals (Schmenner and Swink, 1998; Ferrier, Smith, and Grimm, 1999). It is the missing piece in the operations management literature that captures the competitive dynamics of process improvement and innovation.

This study views the dynamics of process development and management as an evolution of *process competition*; that is, a firm improves and innovates its processes by considering rivals' reactions and their resulting effects on its operations strategy. This notion

explicitly considers the dynamic, disruptive nature of process development and management (Young, Smith, and Grimm, 1996). Our core argument is that the likelihood of effective process development and management for a focal firm depends not only on its own operational excellence (Micro-level), but also the (non-)responses of its rivals (Macro-level) (i.e., the multilevel interactions between inner-firm capability development trade-off and inter-firm competition).

We follow the work of dynamic computational theory proponents such as Sterman, Henderson, Beinhocker, and Newman (2007), Vancouver, Weinhardt, and Schmidit (2010), and Rahmandad (2012); to model process competition, and of scholars who espouse simulation methods for theory development in entrepreneurship, management and organization (see, Adner, Polos, Ryall, and Sorenson, 2009; Davis, Eisenhardt, and Bingham, 2007; Harrison, Lin, Carroll, and Carley, 2007; Yang and Chandra, 2013; Keyhani, Lévesque, and Madhok, 2015). Dynamic computational theory refers to the mathematical and empirical specifications of a theoretical account of how key constructs (or variables) influence each other over time (Vancouver et al., 2010). Such theory can be simulated to examine how variables in a multilevel, interconnected system changes from a given set of starting values (Jayanthi and Sinha, 1998). Moreover, in line with Bendoly, Croson, Goncalves, and Schultz (2010) and Nair, Narasimhan, and Choi (2009), we take the low church approach of capability theorizing, one that relies on a behavioral standpoint, as opposed to the high church approach that derives theory from equilibrium and rationality assumptions (Rahmandad, 2012). Although the findings are somewhat restricted by the model settings, this research can help decision makers make informed choices on process capability development and contribute to the process management and operations strategy literatures. The theory we develop depicts a dynamic, causal mechanism through which firms are "aware" of, "motivated" by, and "capable" of developing new best practices or improving the existing best practice in their focal industry.

Our main contribution is the simulations that produce new insights from established constructs and their relationships. Specifically, we re-examine the history of process innovation in car manufacturing (i.e., CP to MPS then to TPS) and use an in-depth review of the existing empirical and theoretical literatures coupled with the system dynamics methodology (Sterman, 2000; Repenning, 2002; Größler, Thun, and Milling, 2008; Bendoly et al., 2010; Cui, Zhao, and Ravichandran, 2011). We identify the key constructs of fundamental dynamics of process competition from the literature and assess their relationships parsimoniously using dynamic computational theory. Hence, our model is well

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grounded in the literature and empirical evidence. The end result is an internally consistent theory that offers a deeper understanding of process competition (Schmenner and Swink, 1998; Choi, Dooley, and Rungtusanatham, 2001; Schroeder, 2008).

This paper's primary contribution is demonstrating that the firm's competitive tension substantially impacts rivals' process development resisting them to replace its current best practice. Instead of treating competition as an exogenous factor as is the norm in the existing literature, we find that firms may act strategically to manage the competitive tension. Operations management literature suggests that a firm is more likely to invest in innovation when its rival builds greater barriers to its process improvement over time such that the frequency of process innovation increases in parallel with the intensity of competition (Mendelson and Pillai, 1999). Contrary to this accepted wisdom, our analysis shows that competition can decrease the frequency of process innovation for the followers. In other words, a leading firm with the current industrial frontier of operational processes can publicize its superior processes to elicit its rivals' investment in improvement capability. Thus, the ease of imitation, together with the threat of strong retaliation from the industry leader, curbs the follower firms' radical process innovation, and reduces their likelihood of developing innovative processes. We justify this insight and other results in subsequent sections.

2. Process Competition: An Illustration

Operational excellence plays a crucial role in the automobile industry, which organizes human and physical resources to manufacture vehicles in pursuit of a competitive edge. Since the dawn of the Industrial Revolution, manufacturing firms have faced increasing competition with every technology advancement. With the Digital Revolution, today's manufacturers are facing ever increasing pressure to improve and innovate processes at faster rates just to keep pace. From the days of CP to the rise of MPS, then TPS, manufacturing processes have co-evolved with competition. To better understand process competition in this industry, we surveyed literature and synthesized their empirical findings. One finding stands out: A revolutionary process emerges to improve the weaknesses of the existing best practice and outmaneuver it *during the action-reaction exchanges* under competition.

In the CP age, the manufacturing system served customers by making exactly what the customer requested, one at a time (Womack, Jones, and Roos, 1990). Yet the goods were rather costly. In the early twentieth century, a competing process, MPS, was developed to address the CP's flaw in affordability by offering low-priced mass-produced goods

(Fujimoto, 1999). The use of sophisticated, single-purpose machines and semi-skilled or unskilled workers greatly increased productivity (Womack et al., 1990).

MPS was the accepted standard as the best practice in the automobile industry, until Taiichi Ohno and his *Toyota Production System (TPS)* (also called *Lean Manufacturing*) joined the competition in 1950s. Far ahead of his peers using MPS manufacturing, Ohno identified and examined the flaws of MPS, experimented with alternative processes and devised a new system (Fujimoto, 1999). Mass producers had added many buffers to the MPS production system to ensure smooth production since the machinery was expensive and costly to fix production disruptions; in contrast, the revolutionary TPS employed just-in-time production and flexible machines to minimize the buffers, eliminating wastes of materials, machine time and worker hours (Schonberger, 2007). In essence, TPS is a synthesis of CP and MPS, but without the high cost as the CP system or the rigidity of the MPS system (Womack et al., 1990). Ultimately, TPS's superior productivity, quality, and flexibility successfully challenged the MPS practice in the industry.

Surprisingly, we observe in practice that the manufacturing leaders today deliberately explicate their processes to attract challengers' improvement efforts. The resulting constraints on challengers' process innovation capability development ultimately decrease the threat to the leading firms. For instance, the apprenticeship in the CP age, which enabled the greatest access to the leading process, did not trigger process innovation for hundreds of years. Furthermore, consider Toyota's openness to opening its process to its rivals via factory tours. Many rival firms have visited Toyota's factories and consequently developed "Toyota-like" operational processes with small improvements. Despite their efforts to replicate Toyota's success, its rivals have not been able to match Toyota's systematic improvement process, which continuously improves quality and cost competitiveness (Schonberger, 2007). To date, TPS remains the industry leader in process management and has been for over fifty years. In short, the pressure from competition prompts the leader to defend itself, for example, by "locking" rivals into small-scale process improvement.

3. Theoretical Background

Anecdotal evidence suggests that the firm generates a superior process that evolves during its interactions in competing with competitors' processes over time. The literature identifies two possible tensions in process competition. One is between competing processes (a firm's current process versus its rival's process) from the external view of competition in business strategy (Porter, 1980). The other tension derives from the internal view of

operations strategy (Peng et al., 2008) stemming from the trade-off between incremental improvement and radical innovation capabilities. These two tensions co-exist and interact to influence the firm's process management and development (Chen and Miller, 2012).

We introduce the competitive dynamics perspective to capture the essence of these two tensions. One major goal of competitive dynamics research is to investigate performance consequences of the firm's actions and the corresponding responses from the firm's competitors (see Chen and Miller (2012) and Smith, Ferrier, and Ndofor (2001) for a comprehensive review). In this research stream, a competitive move is the unit of analysis used to explore the micro dynamics of competition. Firms act strategically to enhance their competitive advantage and gain abnormal profits, but their successful actions attract rivals' countermoves that can erode the benefits of these competitive moves (Chen and MacMillan, 1992). Therefore, the best possible outcome can be achieved if continuous actions are unchallenged (Porter, 1980). In this study, we recognize the improvement or innovation of a process resulting from capability development as a competitive move. The focal firm improves its performance by successfully deterring rivals from challenging its business process.

We study the tensions in process competition by employing the cognitive framework of Awareness-Motivation-Capability (AMC) as applied to the firm, to make sense of the competitive environment and make corresponding re/actions (Chen, 1996; Chen, Su, and Tsai, 2007). As Figure 1 reveals, we embed the capability development trade-offs within the competitive context. Process competition is initiated when the firm is aware of, motivated by, and capable of developing the best practice, which in turn influences the dynamics of competition. The details of the cognitive process of strategic decision-making in process development and management are as follows.
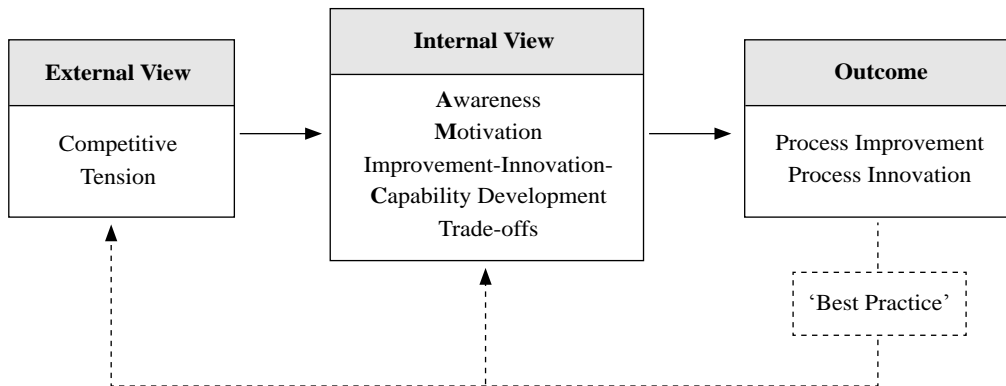
Figure 1 An Awareness-Motivation-Capability Perspective of Process Competition

3.1 Capability

The concept of "capability" refers to the firm's resource deployment and ability to implement an action during process competition. We follow Schmenner and Swink (1998) and Swink and Hegarty (1998) and focus on two key capabilities: improvement and innovation capabilities. "Improvement capabilities" are developed to carry out small-scale changes using the firm's existing physical assets and operating policy, such as enhancing technology utilization (March, 1991) and waste reduction (Swink and Hegarty, 1998). In contrast, "innovation capabilities" are characterized as the ability to pursue new manufacturing approaches by targeting large-scale, radical process changes, which generally require major structural changes in equipment and/or facilities (Schroeder, 2008; Eisenhardt and Martin, 2000; Peng et al., 2008).

Scholars suggest that firms can simultaneously develop improvement and innovation capabilities (Adler, Goldoftas, and Levine, 1999), but they require rather distinct resources (Peng et al., 2008). Therefore, constrained by scarce organizational resources, firms often make trade-offs between the two capabilities: improvement and innovation (Swink and Hegarty, 1998; Rahmandad, 2012). The strategic decision of capability development trade-offs can get more complicated in the presence of competition, as explained in the following section.

3.2 Awareness and Motivation

In a competitive environment, full awareness is a prerequisite for process competition initiatives (Chen, 1996). "Awareness" refers to the firm's perception of the competitive environment including major rivals. Fully understanding its rivals' processes gives the firm relative broad range of knowledge, which is necessary to anticipate the various consequences of proposed process change actions. A firm with low awareness may underestimate the competitive pressure imposed by rivals or allow a rival's action to go unnoticed, hence hinder its ability to attain anticipated outcomes (Tsai, Su, and Chen, 2011).

"Motivation" stimulates a firm to engage in process competition. A firm is likely to make a commitment to a process change action when it perceives large gains from taking action or great losses from non-action (Smith et al., 2001). Competitive tension is frequently used to capture this decision-making threshold (Chen et al., 2007). Specifically, competition favors a firm's bias towards improvement capabilities that pay off in the relative short term, i.e., "short-termism" (Rahmandad, 2012). For instance in production planning and control, reactive maintenance is chosen over preventive maintenance (Sterman, 2000), and

firefighting behaviors (or ad hoc problem solving) get more attention from managers and even more credit than preventive actions (Repenning and Sterman, 2002).

The dynamism of the market is a primary reason for the recent increased investment in process innovation. The firm can use breakthroughs in process management as strategic weapons to destabilize the market and threaten rivals' competitive position (Teece, Pisano, and Shuen, 1997). Indeed, the firm experiences "worse-before-better" dynamics when shifting away from improvement capabilities (Sterman, 2000). From a long term perspective, however, innovation capabilities ultimately compensate the firm for the initial performance loss. Accordingly, investment in innovation capabilities is vital to improve performance.

We argue that managing process improvement and innovation requires a dynamic, strategic orientation so that firms can simultaneously analyze multiple interdependent relationships within the underlying, complex dynamic system (Choi et al., 2001; Größler et al., 2008; Bendoly et al., 2010). While most contemporary methodologies are static in nature, dynamic modeling offers a powerful method to capture simultaneously on-going processes and procedures that influence each other (Davis et al., 2007). Dynamic modeling is particularly useful in developing dynamic computational theory by highlighting feedback processes (i.e., circular causal relationships) in which variables influence and, in turn, respond to each other (Sterman, 2000; Repenning, 2002; Cui et al., 2011). Hence, such methodology can reveal novel insights into the means by which firms improve and innovate their operational processes in dynamic competition.

4. Model

In this section, following the lead of Sterman et al. (2007) about dynamic competition and simulation settings as well as the lead of Größler et al. (2008) about the role of feedback in process management, we develop a dynamic systems model of process competition based on the AMC perspective with consideration of both internal capability development trade-offs and external competition. The model starts with the firm's awareness of the external environment derived from multimarket contacts with competing firms. We then turn to an analysis of competitive tension impacting the firm's motivation. The capability section captures the trade-off between improvement and innovation efforts and the resulting market performance.

This model considers a duopoly for the analysis of process development and management from the viewpoint of rent searching. The *leader* maintains dominant position in the industry because it employs the current best practice. The *follower* aims to improve its

strategic position by incrementally improving the leader's process (i.e., process improvement) and/or radically creating a new one (i.e., process innovation). In the model, we take the follower firm's viewpoint to examine the causal mechanism through which the follower recognizes the leader's best practice, and then imitates and develops it.

The model was formulated in continuous time as a set of nonlinear differential equations as do Sterman et al. (2007) and Rahmandad (2012). To justify our model, we present the theoretical foundations and empirical evidence for the proposed causal relationships with each model equation.

4.1 Awareness: Multimarket Contact

The literature on multimarket competition suggests that firms interacting across multiple markets are familiar with each other's mindset and action patterns (Gimeno and Woo, 1996; Tsai et al., 2011). Therefore, the follower firm's awareness is expected to increase with market commonality, M, defined as the degree of its presence in the common markets (Chen, 1996). Market commonality serves as a state variable in our model with a 0 to 1 range, increases in Entry into Rival's Markets, I, and decreases in Withdrawal from Common Markets, E:

$$dM/dt = I - E. \tag{1}$$

When firms competes in common markets they create substantial deterrent effect because the firms establish a mutual foothold, f, to signal their ability to enter into each other's markets (Baum and Korn, 1999). Consequently, they are less likely to be forced to exit the common markets due to mutual forbearance. Specifically, the multimarket contact literature has identified a curvilinear relationship between multimarket contact and market entry/exit with a diminishing increase rate (Gimeno and Woo, 1996; Baum and Korn, 1999). Therefore, we assume a logarithmic relationship between market commonality and the follower's established mutual footholds in the model:

$$E = 1/(a_1 \cdot f \cdot t_w), \tag{2}$$
$$f = \ln(M + a_2), \tag{3}$$

where a_1 and a_2 are set at constant to ensure that market commonality is within the 0 to 1 range, and t_w is the average time spent by the follower to withdraw from one market.

The ever-increasing mutual footholds eventually lead to restraint and competitive stability, which lower the follower firm's entry rate (Baum and Korn, 1999). That is, the risk of retaliation, r, tends to outweigh the benefits of the follower's additional market-entry actions (Gimeno and Woo, 1996). The leading firm is likely to react aggressively to the follower firm's market entry. In addition, such retaliation may not only be limited to the localized markets, but also escalate to all the other shared markets. Therefore, within the context of a multimarket rivalry, the follower has an incentive to avoid entering a new market that is occupied by the leader to discourage potential multimarket retaliation (Chen and MacMillan, 1992). Formally:

$$r = \exp(f + a_3) + m, \tag{4}$$

where a_3 is a constant to ensure that market commonality is within the range from 0 to 1, and m represents the tension derived from small-scale improvement actions, which will be explained later.

Accordingly, we obtain an inverted U-shaped relationship between the firms' multimarket contact and the follower's rate of market entry as stated in Baum and Korn (1999):

$$I = (f - r)/t_i, \tag{5}$$

4.2 Motivation: Competitive Tension and Commitment

Competitive tension, H, is affected by the levels of survival pressure derived from direct competition, D, and growth pressure derived from indirect competition, N (Rahmandad, 2012). A direct (i.e., head-on) competition will greatly raise the tension between opponents, and in an indirect competition, their devious actions will lower the tension:

$$dH/dt = D - N. \tag{6}$$

In fact, the leader's various actions could cause the follower to interpret the competitive tension in different ways. Notice that the (re)actions taken to developing process improvement and/or innovation capabilities, such as a TQM program, which often involves a large lump sum investment (Repenning and Sterman, 2002; Kim et al., 2012). This investment signals a firm's commitment and the irreversibility of its actions (Chen and

MacMillan, 1992). Chen, Venkataraman, Black, and MacMillan (2002) further distinguish internal and public commitments: Internal commitment, q, is generated from sunk costs, consistent leadership, and organizational inertia; public commitment, p, is generated from social and institutional pressures to protect the firm's reputation. They have diverse impacts on competitive tension, explained as follow.

With high public commitment, the follower firm tends to decrease its response delay and offers a matching response to signal its commitment to its self-defense (Chen et al., 2002). The competitor's subsequent response will consequently escalate to a direct (head-to-head) competition (Smith et al., 2001). The resulting competitive tension will increase the likelihood of a next-round, action-reaction exchange:

$$D = (p \cdot H)/s, \tag{7}$$

where s is the response speed of the follower to protect the reputation and defend the existing product markets.

Consider the follower's market-entry decision. Often it will require approval from top management as it could receive much public attention (high p). Once the leader reacts, A (i.e., leader's attack), the follower will have great incentive to justify its past action by escalating its resource commitment. Formally:

$$p = \ln(f + a_4) + A, \text{ and} \tag{8}$$

$$A = \begin{cases} a_5 \cdot r, & \text{if } x \leq r \leq y, \\ 0, & \text{otherwise,} \end{cases} \tag{9}$$

where a_4 is a constant employed to ensure that public commitment remains positive, and a_5 is the coefficient to reflect the leader's attack volume. Note that the leader does not respond to the follower's every move because of risk incurred with (re)actions. The leader attacks only within a given range of retaliation risk between x and y, that is, when the follower's threat is substantial (i.e., above x) and before such (re)action becomes too risky (i.e., below y).

In contrast, the follower's internal commitment tends to lessen the competitive tension in an indirect competition. Recall that mutual market footholds of both the follower and leader increase the likelihood of retaliation from each other. To avoid such retaliation, the follower may turn its attention to internal development. The strategic evasion from an

intensive conflicting inter-firm relationship gives the follower a chance to enhance its competency. That is,

$$N = (q \cdot H)/g, \tag{10}$$
$$q = a_6 \cdot r, \tag{11}$$

where g is the response delay due to the follower's internal concentration of resources on self-development; a_6 is the coefficient that reflects the follower's commitment to internal capability development.

4.3 Capability: Process Development Trade-Off

The follower often faces a substantial barrier when learning from the leader's superior processes (Cohen and Levinthal, 1990). If the follower possesses similar types of resources as the leader, the follower is more likely to digest the leader's process knowledge and make improvements based on this knowledge (Swink and Hegarty, 1998). For Chen (1996) and Laamanen and Wallin (2009), resource similarity, S, reflects the extent to which the follower possesses strategic endowment comparable to that of the leader. The resource similarity will increase based on the follower firm's investment in improvement capabilities, V, and will decrease based on the amount of innovation capabilities, O:

$$dS/dt = V - O. \tag{12}$$

The follower's sustained incremental process improvement, m, grounds the existing process, creating small wins that collectively translate into superior performance (Bessant and Francis, 1999). The follower's efficiency gain and cost reduction from m further reinforce its commitment to continuous improvement:

$$m = S \cdot u_i, \tag{13}$$

where u_i reflects the effectiveness of developing process improvement capabilities.

In contrast, the follower may recognize the value of process innovation in pursuit of competitive advantages (Schroeder, Scudder, and Elm, 1989; Rahmandad, 2012). Indirect competition offers it a break to explore new and promising technologies to enhance its process effectiveness and improve innovation differentiation, l. Innovation differentiation is

achieved by superior or unique product performance and patented technologies resulting from strong process innovation capabilities (Swink and Hegarty, 1998). The follower can then effectively defend itself against quick retaliations from the leader. In other words, its self-invented capabilities can create learning barriers for the leader. Formally,

$$l = O \cdot v_i, \tag{14}$$

where v_i reflects the effectiveness of developing innovation capabilities, such as the ability to integrate the innovation with a wider range of process capabilities.

Generally, the follower firm prefers to see the leader's process as a benchmark and as a target goal, largely due to the great achievement, high visibility, and institutionalization of this process (Ferrier et al., 1999). In particular, intensive competition forces the follower to take an imitative strategy to avoid falling behind other rivals in the market which rewards fast responders (Rahmandad, 2012). To be fast, the follower then must limit its action to only small-scale process improvements (Repening and Sterman, 2002; Rahmandad, Repenning, and Sterman, 2009). In other words, the strong competitive tension limits the follower because of the survival pressure, and thus it will choose to concentrate on the logical competitive advantage option of developing process improvement capabilities:

$$V = (1 - z)D, \tag{15}$$

where z reflects the follower's resource percentage invested in process innovation capabilities. This tension reflects the capability development trade-off; given the total resources, an increase in innovation capability means a decrease in improvement capability. Alternative formulations for modeling diverse trade-offs are discussed in the next section.

When there is not enough resource similarity to support continuous process improvement, the follower needs to switch to search for new opportunities (Schmenner and Swink, 1998). To illustrate this, Toyota's Just-in-Time process was, remarkably, largely the firm's response to the historical imperative and its low resource similarity of MPS firms (Fujimoto, 1999). Meanwhile, established MPS firms, acknowledging Toyota's weaknesses, did not treat it as a major competitor (threat) (Womack et al., 1990). Likewise, such 'constraints' on the follower side can single-handedly generates a less intensely competitive environment, reduce the leader's retaliation threat, and facilitate the follower's process innovation:

$$O = z \cdot N. \tag{16}$$

4.4 Methodology and Justification

Davis et al. (2007), Harrison et al. (2007), and Nair et al. (2009) note that when a study does not seek to predict the outcome of a particular set of equations, as is the case in our study, a computational model using a set of parameter values qualifies as a carefully planned and valid experimentation process as long as it satisfies the general conditions of the problem being studied and shows the existence of some property of general interest. If the outcome from computer simulations matches the behavior of the dynamic systems theorized, the computational model then presents a viable explanation, at least until another contender better matches or more parsimoniously matches it (Vancouver et al., 2010). In the next section, we follow the practice for developing dynamic computational theory through a computer simulation (Sterman, 2000).

5. Analysis

In this section, we evaluate the follower firm's various process capability development trade-offs. We begin by addressing the effect of competition on process improvement and innovation, emphasized by Rahmandad (2012), and follow Laamanen and Wallin (2009) process of varying the three types of capability development trade-offs: constant-fraction, short-termism, and long-term development. We then evaluate how each trade-off shapes the follower's process management and development to address its competitive interactions with the leader. We derive the subsequent effect of the investment on follower's ability to survive and grow in a competitive environment.

Specifically, the follower's capability development trade-off with constant fraction between innovation and improvement capabilities is consistent with prior studies in the absence of competition (Repenning and Sterman, 2002). In this case, the follower does not consider competitive tension at all and is likely to develop process improvement capability as a general rule as long as it has adequate resources to support learning from the leader. Otherwise, the follower will shift its investment to continuously develop its process innovation capabilities. Second, a short-termism follower might appreciate the value of process innovation, but the competition will pressure it to commit only to incremental process improvement (Rahmandad, 2012). In this case, the percentage of innovation capability is negatively related to competitive tension. Finally, the follower adopting a long-term-growth capability development trade-off is not satisfied with the small wins from its

incremental changes. Rather, it tends to keep searching for new opportunities and differentiate itself from its competitor (Porter, 1980). That is, the percentage of innovation capability here is positively related to competitive tension in the model.

To characterize the range of behavior our model produces, and to understand the impact of each parameter including competitive tension and resource similarity, we have extensively analyzed the model using a variety of methods. To highlight its most interesting dynamics, we present a small subset of these experiments. In the simulation experiments that follow, we rigorously examine the dynamics between two competing processes during a 10-year period, and observe process evolvement patterns to further understand the interrelationship between process competition and process capability development trade-offs. We use Vensim™ software to simulate the model by Euler integration with a time step of 0.25 months. The results are insensitive to the use of smaller time steps or high-order integration methods such as fourth-order Runge-Kutta. Table 1 provides the parameter values used in the base case reported in this paper.

Table 1 Parameters and Initial Conditions for the Base Case

Parameter			
t_i	Time to entry into rival's market		6
t_w	Time to withdraw from common market		3
s	Response speed		1.5
g	Response delay		3
u_i	Effectiveness of developing process improvement capabilities		0.3
v_i	Effectiveness of developing process innovation capabilities		0.3
a_1	Adjustment value for logarithmic value of market commonality		3
a_2	Weight on the established mutual footholds		4
a_3	Adjustment for exponential value of established mutual footholds		-3
a_4	Adjustment value on public commitment without competition		1
a_5	Weight on the volume of retaliation attack		0.6
a_6	Weight on internal commitment by considering competition		0.8
Initial Conditions			
M_0	Initial value of market commonality		0.2
H_0	Initial value of competitive tension		0.1
S_0	Initial value of resource similarity		0.2

5.1 Process Capability Development Trade-Off with Constant Fraction

First, consider the case in which the follower manages the capability development trade-off with constant fraction. Our simulations reveal that without considering competition,

the follower cannot replace the leader's best practice regardless of the similarity of resources. In the left panel of Figure 2, low resource similarity cannot provide the follower effective learning from the leader's process. Therefore, the follower has to experiment with various innovative processes, bearing the risk of exploring unknown territories. Figure 2c, however, shows that the competitive tension drops below zero at month 18.5, which indicates that the follower is no longer a threat to the leader's market position; that is, the follower's process terminates.

2a) Resource Similarity ($S_0 = 0.2$)

2d) Resource Similarity ($S_0 = 0.85$)

2b) Innovation Capability Fraction ($S_0 = 0.2$)

2e) Innovation Capability Fraction ($S_0 = 0.85$)

2c) Competitive Tension ($S_0 = 0.2$)

2f) Competitive Tension ($S_0 = 0.85$)
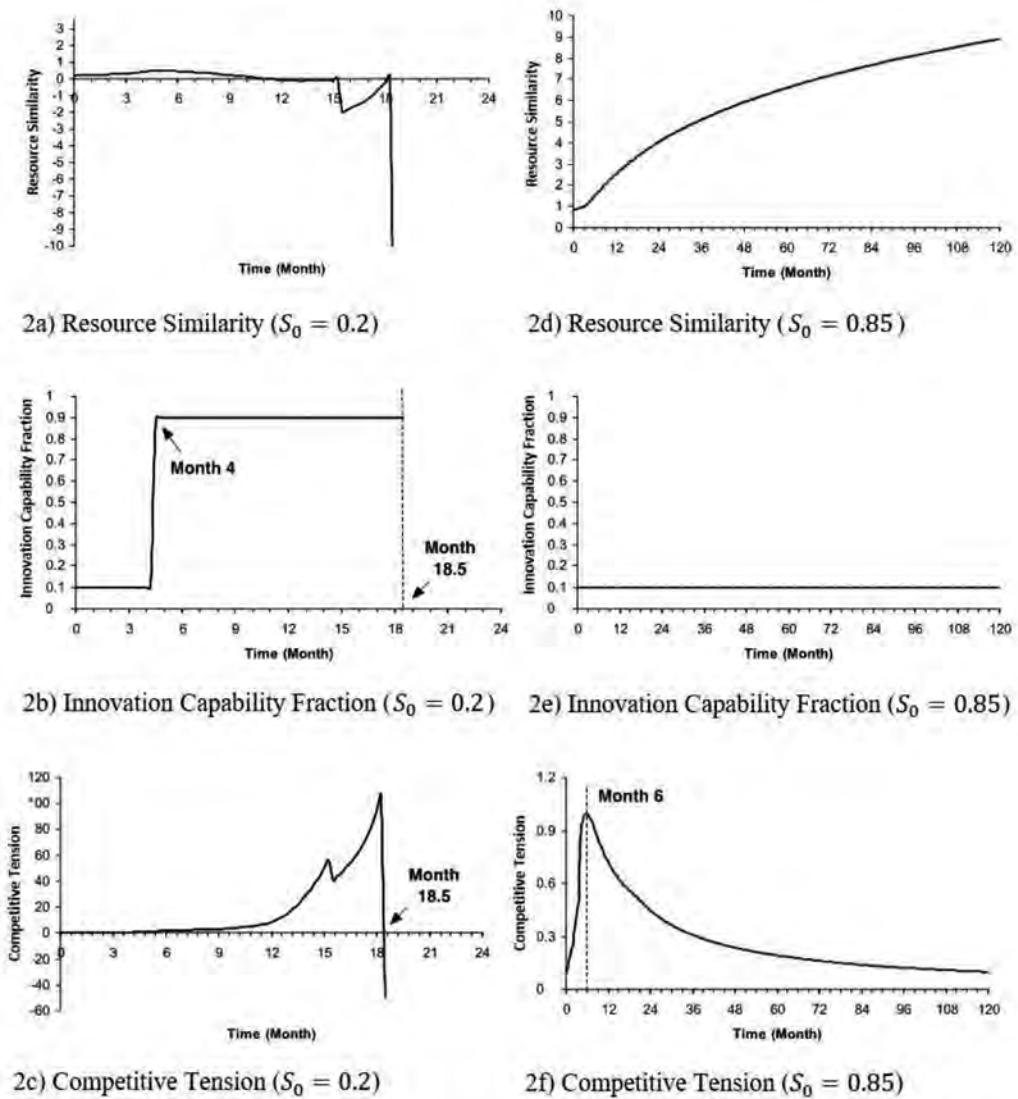
Figure 2 Operational Performance under Constant-Fraction Capability Development Trade-Off

As we move to the right panel, high resource similarity facilitates the follower's investment in continuous process improvement (see Figure 2d); following this, the resource similarity increases as expected. Surprisingly, the competitive tension shown in Figure 2f, with an initial (slight) increase, drops gradually after month 6. We carefully analyze our results to uncover the cause of this intriguing issue, to be discussed later.

5.2 Process Capability Development Trade-Off with Short-Termism

Under short-termism, we illustrate the operational performance of a start-up follower as shown in Figure 3. Initially, the firm must accumulate capabilities via modest process innovation as a result of low resource similarity to the leader. Yet its increased operational performance soon attracts the leader's attention. The resulting high level of competitive tension imposes strong survival pressure to the follower at month 6 (see Figure 3b). Ignorance of such pressure may eventually lead to firm termination. Consequently, the follower must adjust its capability trade-off to match the leader's responses. As shown in Figure 3a, the follower almost withdraws all efforts to develop innovation capabilities after approximately the second year of experimentation. From then on, it turns its attention to small-scale improvements with predictable short-term outcomes.

The result here is rather similar to those of the capability development trade-offs with constant fraction. Neither can facilitate sustained process innovation. This suggests that a steady and continuous investment in innovation capabilities is required to achieve long-term benefits.

5.3 Process Capability Development Trade-Off with Long-Term Growth

The long-term growth shown in Figure 4 sheds light on the answer to the opening question: how does a new best-practice process emerge to replace an existing best-practice process? In this setting, competitive tension first increases resulting from the follower's large-scale efforts to learn the leader's process. In hopes of relaxing the ever-increasing competitive pressure, the follower increases investments in process innovation capabilities. This smart move effectively distracts the leader's attention from the follower's escalation of competition due to its perception of the follower's subordinate (i.e., weaker) role. However, the less intense competitive market environment allows the innovated process to develop, facilitating increased operational performance. Ultimately, in the long run, the follower can take over the leader's position. Thus, the competitive tension eventually rises between the follower and leader.

This capability development trade-off reveals another important feature of process competition: A continuous investment in innovation capabilities, while relaxing the competitive pressure in the short term, will increase the tension in the long run.
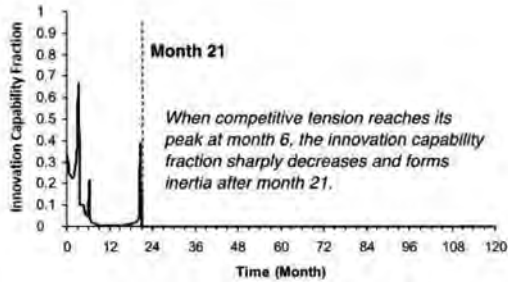
3a) Innovation Capability Fraction
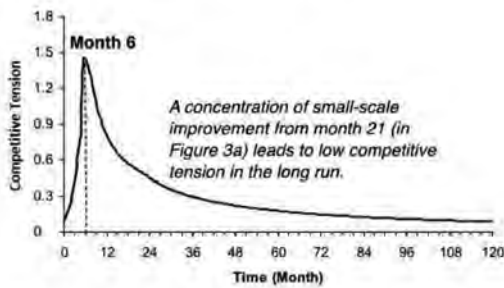
3b) Competitive Tension
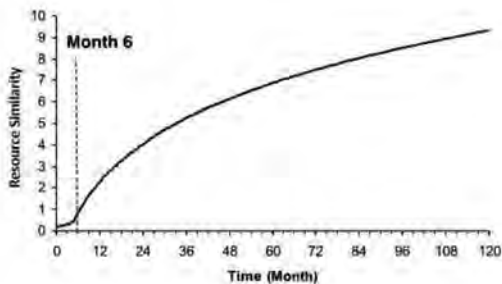
3c) Resource Similarity

Figure 3 Operational Performance under Short-Termism Capability Development Path
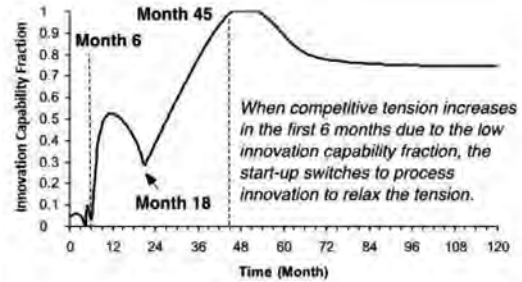
4a) Innovation Capability Fraction
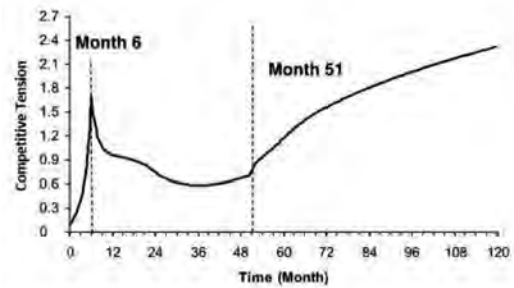
4b) Competitive Tension
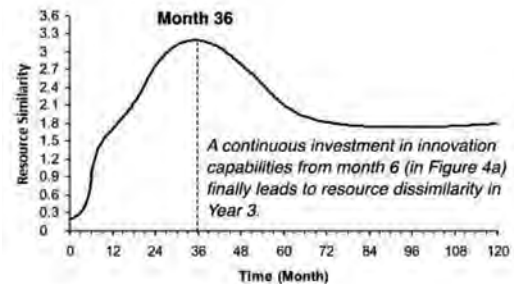
4c) Resource Similarity

Figure 4 Operational Performance under Long-Run Growth Capability Development Path

18

5.4 Impact of Process Improvement and Innovation Effectiveness

The trade-offs are influenced by the effectiveness of improvement and innovation capability development. As the two parameters are exogenous in our model, a sensitivity analysis is conducted to further understand the impact of capability development trade-offs on competitive tension.

The attractiveness of short-termism trade-off increases in the effectiveness of process improvement capability development. Then the investment in innovation capabilities is expected to decrease over time. Our simulation result is consistent with intuitive expectations as illustrated in Figure 5a. Even though the follower eventually recognizes the importance of developing firm-specific capabilities through process innovation, it significantly delays committing to such investments due to the high improvement effectiveness. Consequently, we expect that firm resources become more similar to each other as shown in Figure 5b. The innovation differentiation (Figure 5c) and competitive tension (Figure 5d) both decrease in terms of process improvement effectiveness.
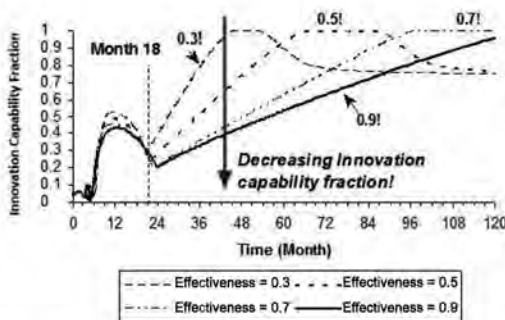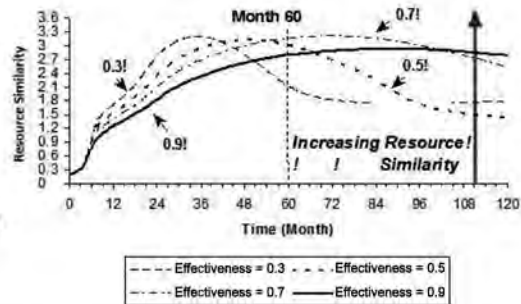
5a) Innovation Capability Fraction 5b) Resource Similarity
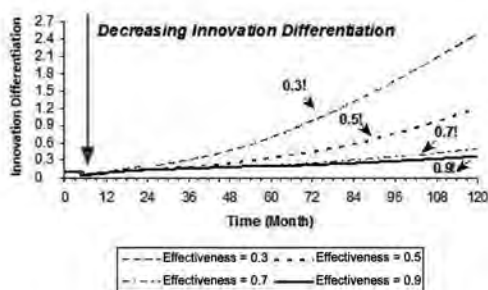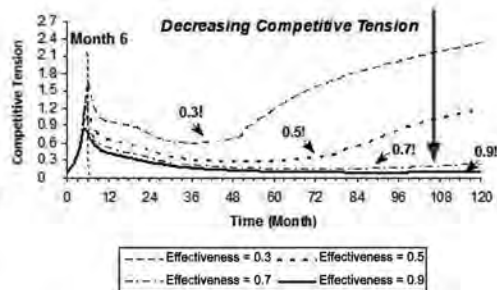
5c) Innovation Differentiation 5d) Competitive Tension

Figure 5 Operational Performance for Various Improvement Effectiveness

In Figure 5, we show that while the increasing improvement effectiveness results in a lock-in effect of the follower's behavior, its additional benefit also decreases. The follower can diminish this effect by increasing its process innovation effectiveness, as illustrated in Figure 6.
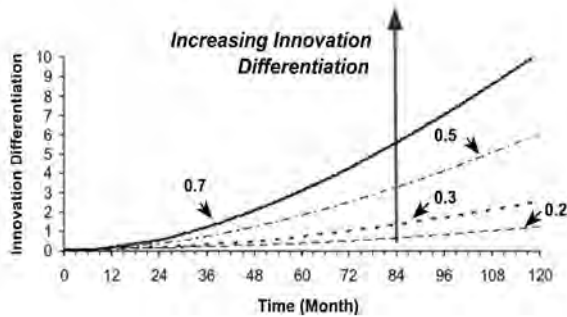
Figure 6 Innovation Differentiation for Various Innovation Effectiveness
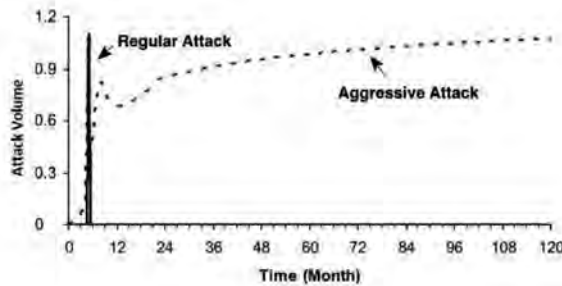
7a) Leader's Attack Volume
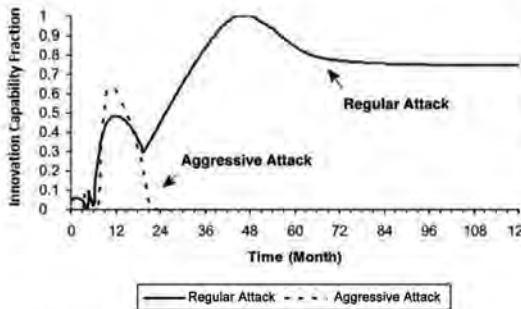
7b) Innovation Capability Fraction under Different Leader's Attack Volume
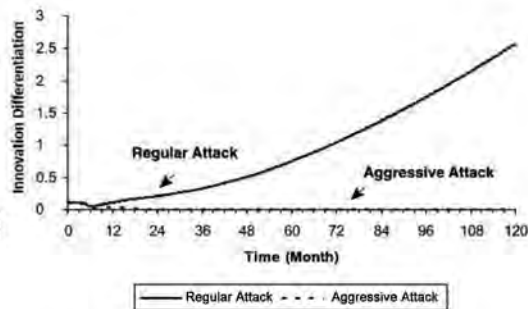
7c) Innovation Differentiation under Different Leader's Attack Volume

Figure 7 Capability Development Trade-Offs under Various Leader's Attack

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5.5 Impact of Leader's Attack

We test two types of leader attacks. In one setting, the leader regularly attacks the follower. In another setting, the leader acts aggressively to clearly signal its intent to protect its leading position. A comparison of the two attack types shows remarkable differences, as illustrated in Figure 7. We can see that aggressive attacks make the follower less likely to invest in innovation since it is under constant survival pressure. In this circumstance, the follower makes a capability development trade-off in the short term at the expense of long-term growth.

6. Implications and Discussion

Anecdotal evidence shows that a firm's superior operational process is generated and evolves during interactions with its competitor's competing process over time (Fujimoto, 1999). By re-conceptualizing process capability development as a competitive move at the firm level, we develop a dynamic computational theory of process competition (Sterman, 2000; Peng et al., 2008; Vancouver et al., 2010; Chen and Miller, 2012). This study depicts a two-way interaction between inner-firm capability development trade-off (Operations Strategy Perspective) and inter-firm competition (Business Strategy Perspective). To the best of our knowledge, research on conditions and causal mechanisms that influence process development and management practice under this interaction effect has not yet been reported in the operations and strategy literature. We therefore ask a fundamental question: Under which conditions can the new and best process development and management practice emerge in a competitive environment?

6.1 Capability Development Trade-Offs as a Feedback to Process Competition

The conceptualization of process competition relies on a dual consideration of firm-level capability development trade-offs and industry-level competition. On one hand, competition shapes the firm's capability development trade-offs while pursuing survival and/or growth. On the other hand, the trade-offs and the resulting operational performance feeds back to the competitive environment.

Without this integration, the literature can only suggest that the leader will vigorously defend its pioneer position against the follower's investment in imitative and small-scale improvement capabilities (Chen et al., 2002). As a result, the intensity of competitive tension rises sharply (Chen et al., 2007). Likewise, process innovation capabilities, due to their associated high risk and resource commitment, result in a relatively long response lag, which

alleviates the competitive tension (Chen and MacMillan, 1992). By comparing different capability development trade-offs (Figures 2 to 4), however, our analysis shows the opposite outcomes: surprisingly, through the phase plot analysis (Figure 8), we find the follower's investment in improvement capability may relax the competitive tension, a counterintuitive positive relationship.
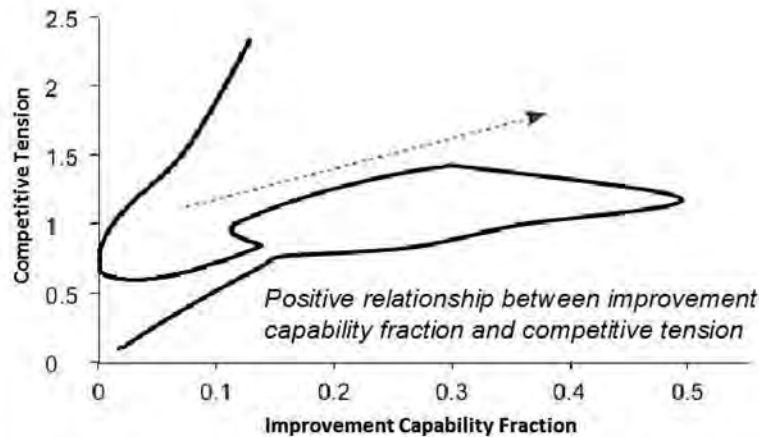
Figure 8 The Impact of Improvement Capability Fraction on Competitive Tension

Now consider process improvement, as illustrated in Figures 2b and 3a. Indeed, by developing process improvement capabilities, the follower clearly signals its attempt to eliminate operational inefficiencies. It invests massive resources, signaling high internal commitment, to achieve this objective. Yet such improvement occurs within the current frontier rather than by creating a new frontier (i.e., a new best practice) (Swink and Hegarty, 1998). Therefore, this is rather good news to the leader since he/she needs not to worry about being dethroned. In other words, the follower's apparent public commitment to its investment discourages the leader from reacting aggressively. Consequently, the follower falls into improvement inertia so that resource similarity increases and the intensity of competition decreases in the long run (as illustrated in Figures 2f and 3b). In terms of process innovation capabilities, the follower publicly commits to developing new processes that go beyond the frontier occupied by the leader. The follower's ultimate objective is to compete with and surpass the leader for rent generation. Therefore, the leader expects to engage in direct competition as long as the follower achieves any positive outcome through developing innovation capabilities (see Figure 4b). Formally,

Proposition 1a. In process competition, an increase in investment in process innovation capabilities leads to an increase in competitive tension.

Proposition 1b. In process competition, an increase in investment in process improvement capabilities leads to a decrease in competitive tension.

The premise of our theory is highlighted by the findings that competition is a key driver of process innovation. Our simulation results clearly depict that the three capability development trade-offs lead to distinct operational performance under competition. Specifically, if the follower fails to consider competition (i.e., a capability development trade-off with constant fraction) or simply focuses on survival pressure (i.e., a short-termism capability development trade-off), its chances of adjusting its process capabilities to align with the dynamic competitive environment are slim. Ultimately, it will not generate a revolutionary process. On the contrary, the competitive tension will motivate the follower to recognize the value of radical innovation for long-term capability development. As proposed by Mendelson and Pillai (1999), today's dynamic and highly competitive global environment has dramatically increased the pace of firms' internal operations development. Therefore, a sustained investment in innovation capabilities will facilitate a better operational performance. Formally,

Proposition 2. In process competition, the positive relationship between process innovation capabilities and competitive tension is mediated by process capability development trade-offs: This positive relationship is negatively mediated by either the constant-fraction or short-termism capability development trade-off but positively mediated by the long-term-growth capability development trade-off.

6.2 The Lock-In Effect

Our conceptualization of process competition captures the action-reaction exchanges between rivals. In a competitive environment, the leader can directly influence the follower's capability development trade-offs in two ways. The first is to build barriers to prevent effective learning of the current best practice, which, in our model, is measured as improvement effectiveness. The second way is to embrace intensive retaliation threat to raise the follower's survival pressure, which in our model, is measured as the leader's aggressive attack.

In terms of learning barriers, the simulation outcomes (Figure 5a) show a counterintuitive phenomenon. Low barriers effectively enhance the follower's level of improvement effectiveness. Remarkably, this creates a lock-in effect, i.e., the follower sticks to incremental changes in its operational process. Hence, the leader effectively restrains the follower's process innovation capability, thus preventing radical changes. This outcome contradicts the prevailing wisdom in the strategy literature: A leading firm should create causal ambiguity to raise learning barriers, thus preventing the diffusion of its successful processes and resources (Dierickx and Cool, 1989; Cohen and Levinthal, 1990). Rather, we find that the follower's process improvement effectiveness increases due to the leader's open and explicit process, but that the follower's motivation to carry out process innovation simultaneously decreases. As a result, the likelihood for the follower to lock in process improvement increases. Indeed, it is not rare that many leading firms readily share their superior business processes even with their rivals. For example, General Electric (GE) and Motorola enthusiastically exhibited their innovative process methodology, the six sigma, to the public. Additionally, in our background case, Toyota has never hesitated to give a factory tour to its rivals that were eager to import its famed JIT system. While the current literature cannot fully rationalize such behavior, our framework sheds lights on this unexplained puzzle. Formally:

Proposition 3. In process competition, an increase in investment in process innovation capabilities leads to a decrease in process improvement effectiveness. This negative relationship is weakened by process innovation effectiveness.

The retaliation risk from the leader threatens the success of the follower's process capability development. In particular, the leader is expected to prioritize process innovation before it is too late (Gimeno and Woo, 1996). Process capability development takes time. To protect its market position, the leader must be alert to the follower firm's actions and prepare to launch attacks when necessary. Facing an aggressive leader who initiate attacks with an early (action timing) and continuous fashion (action volume), the follower will experience difficulties in developing process innovation capabilities (Ferrier et al., 1999). Formally:

Proposition 4a. In process competition, the lock-in effect is positively moderated by the speed of the leader's attack.

Proposition 4b. In process competition, the lock-in effect is positively moderated by the volume of the leader's attack.

6.3 Conclusion

Whereas researchers and practitioners have substantially investigated methods to guide the balance between process improvement and innovation capabilities in a monopoly setting, competition greatly influences firm-level capability development trade-offs. We suggest that researchers and decision makers use a dynamic framework to further explore such effects and the disruptive nature of process innovation. The dynamic modeling used in our study shows a promising future for advancing management, organization, and psychology studies (Davis et al., 2007; Harrison et al., 2007; Vancouver et al., 2010) due to the model's ability to depicting nonlinear relationships and dynamic competition (Sterman et al., 2007; Rahmandad, 2012). This approach is based on differential equations and has been widely used in the study of biology, ecology, evolutionary economics, and strategy. According to Bendoly et al. (2010), Schroeder (2008), and Größler et al. (2008), dynamic modeling is useful for investigating specific operational problems since the operations management field is characterized by feedback, resource accumulation, and delay. Dynamic modeling therefore enables us to further explore the complicated and unforeseen interactions within this complex adaptive system (Choi et al., 2001; Repenning, 2003; Keyhani et al., 2015).

We offer a dynamic, competition lens to better understand improvement-innovation capability trade-offs in process development and management. This perspective fills the void in the operations management literature that overlooks rivals' retaliation, which has blocked the examination of the interaction between inner capability trade-offs and outer competition. Specifically, we show that one firm, in pursuit of process superiority, can take the long-term-growth capability development path. Yet it can be led astray by imitating leading firms that intentionally make their superior processes easy to imitate. This study adds a unique message to market leaders about the potential benefits of easy-to-imitate capabilities: In publicizing the best practice to follower firms, leading firms experience less threat of radical process innovation from them.

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作者簡介

陳立民

　　Li-Ming Chen received the Ph.D. degree in industrial and systems engineering from the University of Florida, USA. He is currently an assistant professor at the Department of Business Administration, College of Commerce, National Chengchi University, Taiwan (R.O.C.). His research has appeared in international academic journals including *Naval Research Logistics, Transportation Research,* and *Journal of the Operational Research Society*. His areas of research include supply chain management, inventory control, and dynamic pricing.

劉妍

　　Yan Emma Liu received the Ph.D. degree in business administration from the University of Essex, UK. She is currently a lecturer (assistant professor) at the Centre for International Business, Leeds University Business School, University of Leeds, United Kingdom. Her research has appeared in international academic journals including *Transportation Research* and *Journal of the Operational Research Society*. Her areas of research include entrepreneurship, supply chain management, and quantitative methods.

＊楊曙榮

　　Shu-Jung Sunny Yang received the Ph.D. degree in management from the Australian Graduate School of Management (AGSM), University of New South Wales and University of Sydney, Australia. He is currently an associate professor at the Department of Business Administration, College of Management, National Taiwan University, Taiwan (R.O.C.). His research has appeared in international academic journals including *Production and Operations Management, Journal of Retailing, European Journal of Operational Research, Transportation Research, Journal of the Operational Research Society,* and *International Journal of Production Research*. His areas of research include operations and supply chains, marketing, entrepreneurship, and their interfaces.

仁慈領導一定能讓部屬產生組織公民行為嗎？領導者操弄意圖知覺與部屬信任的中介式調節作用

Does Benevolent Leadership Always Lead to Organizational Citizenship Behavior? The Mediated Moderation Effect of Manipulative Intention and Trust

林家五 / 國立東華大學企業管理學系教授
Chia-Wu Lin, Professor, Department of Business Administration, National Dong Hwa University

胡宛仙 / 國立東華大學企業管理學系兼任研究助理
Wan-Hsien Hu, Part-Time Research Assistant, Department of Business Administration, National Dong Hwa University

施建彬 / 大葉大學休閒事業管理學系助理教授
Jian-Bin Shih, Assistant Professor, Department of Leisure and Recreation Management, Da-Yeh University

摘 要

依據領導的歸因理論，部屬對領導行為背後動機的歸因，會影響部屬後續的情緒與行為；因而，本研究推論部屬對於領導者操弄意圖知覺，將調節仁慈領導對於部屬對組織與對主管的信任，以及組織公民行為的效果，研究者提出了中介式調節模型並做後續驗證。針對 340 位部屬兩階段的調查結果顯示，當部屬知覺領導者有高度操弄意圖時，仁慈領導對於部屬之組織信任、主管信任及組織公民行為呈現較低正相關或負相關；反之，當部屬知覺領導者的操弄意圖低時，仁慈領導對於部屬之組織信任、主管信任及組織公民行為則呈現正相關；此外，仁慈領導與操弄意圖知覺的交互作用，會透過信任組織與信任主管的部分中介，間接影響部屬的組織公民行為；本文最後除了說明結論與討論外，也針對研究限制與未來研究提出數點建議。

【關鍵字】歸因理論、仁慈領導、操弄意圖、信任、組織公民行為

Abstract

Drawing on the attribution theory of leadership process, the subordinates' attribution of intention about leaders' behavior will affect their emotion and behavior. To address the attribution-consequence process, we hypothesize that perception of leaders' manipulative intention moderated the positive relationship between benevolent leadership and trust, (i.e., in supervisor and organization) and organizational citizenship behavior, a mediated moderation model was proposed and tested. Two-wave data collected from 340 subordinates displayed results which demonstrated that benevolent leadership was less positively or even negatively related to trust and OCB when subordinates perceived high manipulative intention of their leaders' behavior. On the contrast, benevolent leadership was positively related to trust and OCB when subordinates perceived low manipulative intention. Another finding is that benevolent leadership is most effective when they interact with the manipulative intention–the interaction effect on OCB partially mediated by trust in supervisor and organization. Finally, research limitations and suggestions for future research are also discussed.

【Keywords】attribution theory, benevolent leadership, manipulative intention, trust, organizational citizenship behavior

壹、前言

在華人地區，組織的領導者多會以父親般的仁慈來對待部屬，關懷部屬工作以外的生活狀態，進而建立高績效的工作團隊（鄭伯壎、周麗芳與樊景立，2000；Farh and Cheng, 2000; Pellegrini and Scandura, 2006, 2008）。儘管，現今的華人組織面臨現代化與全球化的轉變，這種關懷部屬私生活的領導方式，其正面效應幾乎不受任何影響 (Cheng, Chou, Wu, Huang, and Farh, 2004)。鄭伯壎等 (2000) 將這種關懷部屬的領導風格定義為「仁慈領導」，是指領導者就部屬工作上，公私領域的個人福祉做個別、全面而長久的關懷。典型的仁慈領導者會視部屬為家族的一份子且積極地協助、處理或涉入部屬私人的事務與活動，而這些行為將滿足部屬對於領導者的期待，進而提升部屬對領導者的感激與忠誠或者是較高的工作滿足感、組織承諾以及組織公民行為 (e.g., Cheng et al., 2004; Cheng, Shieh, and Chou, 2002; Chou, Cheng, and Jen, 2005; Hsu, Hu, Ling, Cheng, and Chou, 2004; Pellegrini and Scandura, 2006)。

雖然以往研究多指出華人組織的仁慈領導將導致正面的結果，但倘若部屬認為這樣的領導是為了攏絡、控制與收買人心的虛偽仁慈，能否有效影響部屬的行為，是一個值得探討的議題；因此，在部屬不再感激領導者付出的情況下，仁慈領導不僅無法有效地感動部屬，同時也將導致主管與部屬之間關係的衝突以及人際和諧的破壞 (Farh and Cheng, 2000; Farh, Liang, Chou, and Cheng, 2008)。然而，以往的研究對此探討仍舊不足。明確來說，是什麼因素導致部屬不再被領導者的仁慈所感動，以及不被部屬感動的仁慈領導者將會產生什麼樣的結果。基於上述的研究缺口，本研究目的主要在探討可能導致仁慈領導不再被部屬感動的因素，並驗證不再被部屬感動的仁慈領導會對部屬的工作行為產生何種影響。

依據歸因理論 (Heider, 1958; Kelley, 1973; Weiner, 1986) 觀點，認為個人對於行為或事件會產生因果解釋 (Martinko, Harvey, and Dasborough, 2011; Martinko, Moss, Douglas, and Borkowski, 2007)，其基本假設是人們天性會渴望了解，在他們生活中造成重要後果的原因，而人們的歸因會影響對此結果的反應 (Heider, 1958)，通常對於後果的歸因解釋，包括能力、努力、任務的本質及運氣。而人們對他人行為背後原因的推論 (Causal Reasoning)，也會影響其後續的反應，這種折扣原則 (Discounting Principle) 在社會知覺的研究中，已被提出一段時間 (Morris and Larrick, 1995)。另外，將歸因的概念運用到領導理論中，則可回溯至 Green and Mitchell (1979) 的研究 (Martinko, Harvey, and Douglas, 2007; Martinko et al., 2011)，該研究指出與部屬行為相關的資訊、線索會影響領導者的歸因，進而影響領導者如何對待部屬；接著，Dasborough and Ashkanasy (2002) 則認為，部屬對特定領導行為背後動機的歸因，會影響了部屬後續的情緒反應與行為；亦有學者從領導者與部屬雙向的角度，探討歸因風格對於領導者—成員交換關係 (Leader-member Exchange; LMX) 的影響 (Martinko,

Moss, et al., 2007)；由此可知，部屬的歸因在領導影響過程中，扮演了重要角色；本研究將從部屬的角度，探索部屬對領導行為的歸因，是否影響了仁慈領導與部屬行為之間的關係。

由於組織公民行為提升了組織的管理效率、讓部屬能有效地使用組織內稀少的資源及減少資源的浪費，進而導致較佳的組織績效 (Podsakoff, MacKenzie, Paine, and Bachrach, 2000)，所以許多領導研究將組織公民行為，視為一個重要的效標變項 (e.g., Cheng et al., 2002; Hsu et al., 2004; Podsakoff, MacKenzie, and Bommer, 1996; Podsakoff, MacKenzie, Moorman, and Fetter, 1990)，或是正向組織行為 (Positive Organizational Behavior; POB) 之一 (e.g., Cameron, Dutton, and Quinn, 2003; Luthans and Youssef, 2007)。因此，本研究將以組織公民行為做為仁慈領導的效標變項，討論部屬對於知覺操弄意圖的調節效果。

以往關於華人領導與部屬績效間關係的研究，多數忽略了部屬的心理機制 (Chen, Eberly, Chiang, Farh, and Cheng, 2014) 所造成的影響，因而 Chen et al. (2014) 的研究，依據階層與關係主義的觀點，指出情感性信任 (Affective Trust) 會中介家長式領導分別與部屬角色內 (In-role) 及角色外 (Extra-role) 績效的關係；其中，仁慈領導對部屬展現關懷與照顧，基於人際互惠，讓部屬對領導者產生信任的情感，進而體現在工作績效上以回報主管的關照；因此，本研究提出一個中介式調節 (Mediated Moderation) 模型，也就是探討仁慈領導與部屬知覺領導者的操弄意圖的交互作用，是否會透過信任主管與信任組織的中介，進而影響部屬的組織公民行為。

貳、文獻探討

一、仁慈領導與組織公民行為

許多研究指出，華人組織的領導者對於部屬的關懷往往擴及到員工工作以外的場域，並像父親照顧孩子般地照顧部屬 (e.g., Cheng, 1995; Redding, 1990; Westwood, 1997)。舉例來說，Redding (1990) 在訪談香港、台灣、新加坡等地的華人企業主持人後指出，華人領導者對於部屬的方式與西方領導者截然不同，華人領導者對於部屬的關懷往往不只侷限於與工作相關的事務，同時他們會也會關心或出席部屬的私生活領域與場合。而鄭伯壎等 (2000) 將這種對於部屬私生活的關懷以及像父親般的領導行為定義為仁慈領導，也就是指領導者對部屬個人以及其的家族的福祉做個別、全面而長久的關懷，主要表現在對於部屬的體諒寬容與個別照顧等領導行為上。體諒寬容，強調對於部屬面子的維護或給予表現不佳的部屬適時的支持與鼓勵；至於個別照顧，則強調對於部屬工作以外的生活狀況關懷。

組織公民行為是領導研究的重要後果變數之一，像是僕人領導 (e.g., Walumbwa, Hartnell, and Oke, 2010)、轉換型領導 (e.g., Piccolo and Colquitt, 2006; Wang, Law,

Hackett, Wang, and Chen, 2005)、魅力型領導 (e.g., Deluga, 1995) 及不當督導 (Abusive Supervision) (e.g., Zellars, Tepper, and Duffy, 2002) 等；組織公民行為意指員工無條件且自動自發的行為表現，而這些行為並非組織直接要求或必要的行為，但卻能幫助組織達成目標 (Organ, 1988)。根據組織公民行為以往研究指出，此行為雖然有助於提升組織運行的效率，卻未與員工個人的利益有明顯且直接的關連；也就是說，員工在從事或展現組織公民行為並非基於個人利益的考量，相對的，利他或是利團體的行為動機，才是決定組織公民行為形成的主因 (e.g., Moorman and Blakely, 1995)。

所以，當領導者表現出關懷部屬、提供協助的仁慈行為時，加上領導者不論是在心理上還是實體上，都是最接近部屬的組織代理人 (Lewin, 1943)，因此，仁慈的領導行為不僅會提升部屬對領導者本身的感恩圖報，也會進一步強化部屬對組織的利社會行為。因此，領導行為不僅能有效地影響部屬對領導者的態度與情感反應，同時部屬對領導者正面的態度與情感反應，往往也會擴及到對組織直接有利的工作行為。例如 Chen, Tsui, and Farh (2002) 的研究指出，部屬對領導者的忠誠對於工作行為的影響力，如角色內行為與組織公民行為，遠大於部屬組織承諾的影響；因為，領導者關懷部屬工作任務內外相關活動，提升了部屬對於領導者的感激，並產生圖報的心理以及對領導者、對組織的忠誠，而這種不計較個人得失的動機，以及對領導者、對組織的正面態度，將促使部屬從事組織公民行為。

雖然，已有研究顯示仁慈領導與針對組織的公民行為有顯著正向關係 (e.g., Chan, Huang, Snape, and Lam, 2013; Chan and Mak, 2012)，但也有研究指出，部屬會藉由展現組織公民行為，以回報支持性的領導行為，其中包含了針對領導者的組織公民行為；這種針對特定對象的公民行為，是屬於一般性或針對組織性的組織公民行為中，一種特殊的社會交換形式 (Walumbwa et al., 2010)，也就是說，針對領導者或是針對個人的組織公民行為，涵蓋於更廣泛的組織公民行為中，以回應領導者的支持；例如幫助同事可減輕主管的工作負擔，等同於協助主管的工作，這些看似是針對個人的組織公民行為，但這種利他的公民行為同樣對整體組織是有益的；雖然以往的研究雖將組織公民區分為不同形式 (e.g., Lavelle, Rupp, and Brockner, 2007; Lee and Allen, 2002; Williams and Anderson, 1991)，但近來的研究，更傾向於將組織公民行為視為單一因素模型 (Bommer, Dierdorff, and Rubin, 2007; Hoffman, Blair, Meriac, and Woehr, 2007; LePine, Erez, and Johnson, 2002; Walumbwa et al., 2010)，這些研究指出將組織公民行為視為單一構念，更能精確估計組織公民行為與其他變數間的關係 (Hoffman et al., 2007; Walumbwa et al., 2010)；據此，我們提出以下假設：

H1：仁慈領導與組織公民行為之間，呈現正向且顯著的關係。

二、部屬知覺的領導者操弄意圖之調節效果

人們行為背後的原因或動機，是歸因理論的核心概念，此想法在管理領域的文獻中並不陌生。對於他人行為意圖的知覺，可以幫助人們更加瞭解與解釋他人的行為 (Heider, 1958)，同時也決定了人們如何對他人行為進行回應 (Baron, 1988; Gordon and Bowlby, 1989; Fedor, Eder, and Buckley, 1989; Martinko, 1995; Thomas and Pondy, 1977)。Ferris, Bhawuk, Fedor, and Judge (1995) 認為，人們會根據他人行為的目的，將觀察到的行為，重新給予定義與標示，並就重新定義的行為與標示進行回應。在領導的文獻上，歸因理論的應用，是由 Ferris et al. (1995) 率先提出。Dasborough and Ashkanasy (2002) 則在領導的歸因理論中，特別強調部屬對領導者意圖 (Intentionality) 的歸因。他們認為部屬的情感性反應與行為反應，會被其所知覺到的領導者行為背後的動機所影響。若部屬覺得領導者是基於操控動機 (Manipulative Motives)，是以自己的利益為出發點或以潛在報酬為目標，且可能會損及組織的利益，則反而會出現負面的反應；若部屬覺得領導者是基於真心動機 (Sincere Motives)，其目標是對組織或群體有利的意圖，則會提升其正面的反應傾向。

曾有學者提出虛偽轉換型領導 (Pseudo-transformational Leadership) 的概念 (e.g., Barling, Christie, and Turner, 2008; Bass and Steidlmeier, 1999; Dasborough and Ashkanasy, 2002)。Dasborough and Ashkanasy (2002) 認為部屬對於領導者行為意圖的知覺，將決定轉換型領導者的類型。明確來說，當部屬認為轉換型領導者有較高的操弄意圖時，會難以判斷領導者在意圖與動機上的合法性，也就是當部屬知覺到的領導者行為的動機，是基於個人私利的程度，部屬將會歸因該領導者為虛偽轉換型領導者，並進一步產生對領導者負面的態度與行為反應，例如對領導者心生畏懼，或老是覺得受到領導者辱罵 (Barling et al., 2008)。

既然，部屬知覺到的領導者行為意圖，可能會決定部屬如何歸因領導者的行為，我們認為當部屬認為領導者的行為處事是基於個人利益時，領導者的仁慈將被部屬視為虛偽的仁慈領導 (Pseudo Benevolent Leadership)。虛偽的仁慈，是指部屬認為領導者對於他工作任務以及私生活的關懷與照顧，只是領導者拉攏人心的手段與工具。也就是說，虛偽的仁慈的形成，是領導者以仁慈行為來對待部屬，但卻被部屬認為領導者有明顯的操弄意圖，此兩要素共同決定的。所以，對領導者來說，部屬對於其仁慈行為與態度背後動機的推論，將是他們區別領導者是「真實的仁慈」還是「虛假的仁慈」的基礎。

接著，就歸因結果的影響層面來說，Smith, Haynes, Lazarus, and Pope (1993) 發現個體對意圖的歸因，與其情緒的反應有直接的關連性，例如，生氣、感恩、憐憫等。所以，再加上 Ferris et al. (1995) 與 Dasborough and Ashkanasy (2002) 的論點，我們預期部屬知覺到的領導者的操弄意圖後，將改變部屬對於領導者仁慈行為的情緒反應與

態度，進而改變仁慈領導對於組織公民行為的影響力。也就是，當仁慈領導者被部屬認為其行為背後的原因是別有意圖，是基於操控動機下產生的仁慈行為，部屬可能會出現生氣的反應，並進一步減損其仁慈的效益；而當部屬認為仁慈領導者是發自心底，真正表現出其正直、無私且真心對待的行為，其仁慈領導的影響力將更加強烈。

明確來說，在部屬認為領導者的行為動機是基於自身的利益，仁慈領導將被部屬視為是一種虛偽的仁慈。這樣的情況下，領導者對於部屬在工作任務以及私生活的照顧，將難以感動部屬並讓他們感激領導的仁慈對待，以及對領導者盡忠與順從。而這種領導者對部屬施以仁慈而部屬卻沒有善盡自己的角色義務的情況，將導致領導者與部屬之間關係的緊張、衝突以及人際和諧的破壞 (Farh et al., 2008)，這將對組織公民行為產生負面的影響。相反的，在部屬認為領導者操弄意圖較低的情況下，部屬會傾向認為領導者對於他們的協助與關心是發自領導者的真心 (Heider, 1958)。因此，部屬會對領導者的仁慈心存感激、力求圖報並對領導者更加的順從與盡忠，最後導致組織公民行為的產生。因此，我們提出以下假設：

H2：部屬知覺到領導者操弄意圖的程度將負向調節仁慈領導與組織公民行為之間的關係；若部屬知覺領導者操弄意圖程度低，則仁慈領導與組織公民行為間的正向關係愈強，反之，若部屬知覺領導者操弄意圖程度高，則仁慈領導與組織公民行為間的正向關係愈弱。

三、信任的中介效果

領導者能否對部屬產生有效的影響，信任是重要的決定因素 (Burke, Sims, Lazzara, and Salas, 2007) 之一；依據 Nyhan and Marlowe (1997) 的討論，信任是指個體對某人的能力或某人願意以公平、道德及可預測的做事方式的一種信任程度；信任是一個多構面構念，包含了人際信任、信任組織、政治性信任或社會性信任，還有前言所提的情感性信任，或是認知性信任等等 (Joseph and Winston, 2005)；本研究著重在對主管的信任與對組織的信任，所產生的中介效果。

已有許多研究支持領導與組織公民行為間的關係，存在著不同的中介變數；其中，領導者－成員交換關係 (LMX) 的中介效果已受到實證的支持 (e.g., Chan and Mak, 2012)，領導者－成員交換關係的重要內涵之一是建立彼此的信任，因而，信任也是常被探討的中介變數之一 (e.g., Chen et al., 2014; Dirks and Ferrin, 2002; Joseph and Winston, 2005; Wu, Huang, Li, and Liu, 2012)，或是以信任機制來推論領導與結果變數間的關係；例如 Wang and Cheng (2010) 指出因為仁慈領導提供舒適與信任的環境，可提升部屬的創造力，或是讓部屬更勇於提出建言 (e.g., Chan, 2013)；仁慈領導提供的關懷與照顧，讓部屬感受到容易溝通與支持性的行為，且對領導者的能力產生信心

(Burke et al., 2007)，進而更容易從事角色外行為；此外，領導者的作用之一是建立組織的信任文化 (Joseph and Winston, 2005)，且領導者是組織中的角色模範，當仁慈領導者對部屬提供全面的關照時，也可使部屬感受到組織對部屬的關照，因為領導者是組織的代理人 (Lewin, 1943)，進而產生組織公民行為；信任對於仁慈領導與組織公民行為的中介效果，已受到一些實證研究的支持 (e.g., Chen et al., 2014; Wu et al., 2012)；然而，如同前述，當部屬知覺到領導者操弄意圖程度高時，可能會降低仁慈領導對信任主管與信任組織的效果，也可能降低仁慈領導對組織公民行為的影響。

因此，本研究提出一個中介式調節模型，也就是仁慈領導與知覺操弄意圖的交互作用，將透過信任主管與信任組織的中介，間接影響組織公民行為；本研究第三項假設為：

H3a： 仁慈領導與知覺操弄意圖的交互作用，透過信任主管的中介，間接影響組織公民行為。

H3b： 仁慈領導與知覺操弄意圖的交互作用，透過信任組織的中介，間接影響組織公民行為。

本研究架構如圖 1 所示。
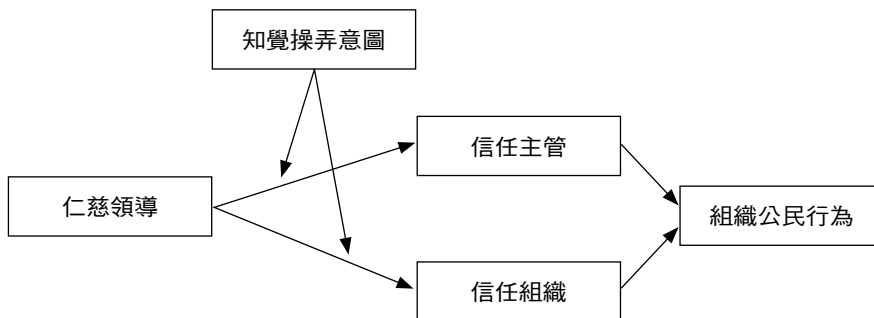
圖 1 研究架構

參、研究方法

一、樣本

本研究以民營企業的全職上班者為對象，由部屬的觀點來評估「直屬」主管的仁慈領導行為，以及自身的信任主管、信任組織、組織公民行為，及知覺領導者操弄意圖等變數。研究採用便利抽樣方式進行資料收集，首先先以電話聯繫獲得受試企業的同意後，再將第一階段問卷與回郵信封寄給該企業的聯絡人，約隔一週後，研究者進行跟催與回收第一階段問卷，再間隔約一至二周後，將第二階段問卷與回郵寄給聯絡人。

為了避免共同方法變異 (Common Method Variance; CMV)，本研究在兩個時間點，分別請受試者就主管的仁慈領導行為，及受試者自身的組織公民行為、知覺領導者操弄意圖等變數進行填答 (Podsakoff, MacKenzie, Lee, and Podsakoff, 2003)。第一階段的問卷，請受試者就仁慈領導及部屬的個人基本資料（性別、年齡、教育程度、工作類型、工作年資及與主管共事的時間等）進行填答；第二階段，則針對知覺領導者操弄意圖、信任主管、信任組織及組織公民行為的部份進行測量，兩份問卷的時間間隔約二至三週左右。

在兩階段問卷調查中，一開始共發放 1,340 份問卷，第一階段總共回收 771 份問卷，第二階段回收 482 份問卷。扣除無法成功配對、胡亂填答的問卷及與主管互動時間未達 4 個月以上之樣本後，有效的樣本數為 340 份；以初始發放的問卷數為分母，有效問卷回收率為 25.37%。接著，依據 Armstrong and Overton (1977) 建議進行無反應偏誤 (Non-response Bias) 檢驗，由於未回應樣本特性近似晚回應樣本的推論，因此將兩階段皆在期限內回覆且配對成功的早期回收有效樣本 190 筆與兩階段皆需催收後才回覆的晚期回收有效樣本 84 筆，進行獨立樣本 t 檢定，結果顯示仁慈領導、知覺操弄意圖、信任主管、信任組織及組織公民行為等變數的平均數比較，均未達顯著差異，由此可知無反應偏誤的影響不大。

樣本組成方面，女性居多，約 210 人，佔總樣本數的 61.80%；在教育程度方面，以大學學歷最多，約 175 人次，佔總樣本數的 51.50%；員工年齡的平均數，約為 31.37 歲 (SD = 7.64)；工作年資及與主管的互動時間的平均值，分別為 8.25 年 (SD = 7.07) 以及 2.67 年 (SD = 2.26)。

二、測量變數

（一）仁慈領導

採用鄭伯壎等 (2000) 所編製的仁慈領導量表，共計 11 題，分為個別照顧（6 題）與體諒寬容（5 題）兩構面。以 Likert 6 點尺度進行衡量（1：非常不同意；6：非常同意），$\alpha = .91$。例題如「我的主管會關懷我私人的生活與起居」與「當我碰到難題時，我的主管會即時給我鼓勵」。

（二）部屬知覺領導者的操弄意圖

　　採用 Dasborough and Ashkanasy (2004) 所編制的量表，共 3 題。以 Likert 5 點尺度進行衡量（1：完全不同意；5：非常同意），$\alpha = .79$。例題如「我覺得我主管的行為是為了他個人的私利」與「我覺得我的主管會為了達到他自身的目標而操控我」。

（三）信任主管

　　採用 Nyhan and Marlowe (1997) 所編製的量表，共計 8 題。以 Likert 7 點尺度進行衡量（1：幾乎是零；7：接近 100%），$\alpha = .94$。例題如「我對主管會堅持到底完成任務的信心程度」與「當主管告訴我某件事，我可以信賴他（她）所告訴我內容的信心程度」。

（四）信任組織

　　同樣採用 Nyhan and Marlowe (1997) 所編製的量表，共計 4 題。以 Likert 7 點尺度進行衡量（1：幾乎是零；7：接近 100%），$\alpha = .86$，例題如「這個組織能夠公平對待我，我對此點的信心程度」與「在這個組織中，我們可以依賴彼此的程度」。

（五）組織公民行為

　　採用 Farh, Earley, and Lin (1997) 等人所編製的 20 題組織公民行為問卷，以 Likert 6 點尺度進行衡量（1：非常不符合；6：非常符合），$\alpha = .88$。組織公民行為問卷總計有五個構面，各構面與樣本題項分別為：認同公司，例題如「我會主動提出對公司有利的改善方案」；人際和諧（均為反向題），例題如「我會假公濟私，利用職務牟取個人利益」；恪守本分，例題如「常常提早到公司，並且立刻開始工作」；協助同事，例題如「我會主動幫助新來的同事適應工作環境」；保護公司資源（均為反向題），例題如「我會利用上班時間處理私人事務」。

（六）控制變數

　　研究以部屬的性別、年齡、教育程度、工作年資及與主管共事時間，做為控制變數 (e.g., Chan, 2013; Chan and Mak, 2012; Chen et al., 2014; Wang and Cheng, 2010; Zellars et al., 2002)。

（七）共同方法變異的控制與檢測

　　控制共同方法變異的部分（彭台光、高月慈與林鉦棽，2006），本研究採取兩種事前防範之方法，首先是時間隔離法，本研究採取在不同時間點蒐集不同變數資料，第一階段問卷測量自變數（即仁慈領導）與人口統計變數，第二階段問卷測量中介變數（信任主管與信任組織）、調節變數（知覺操弄意圖）及依變數（組織公民行為），還有做為配對使用的人口統計變數；這種作法在於排除同一時間點的干擾因素。其次是問卷編排設計法，本研究亦從測量工具的設計和問卷內容的編排方面著手，以避免對答卷者心理造成沒有必要的干擾。問卷編排設計採用了題項意義隱匿與題項隨機配置。

　　即使某些組織行為與心理學者認為共同方法變異的影響有限 (e.g., Spector, 2006)，

但多數學者仍舊認同共同方法變異的影響不容忽略；因此本研究除了事前防範之外，另外進行了兩個事後檢測，分別採用哈門氏單因子檢驗法 (Harman's One-factor Test) (Harman, 1967) 與共同潛在變數 (Common Latent Variable; CLV) (e.g., Podsakoff et al., 2003) 兩種方法，以瞭解共同方法變異的影響；哈門氏單因子檢驗法方面，因素分析顯示未轉軸情況下總共萃取九個因素，總累積變異量為 66.04%，第一個萃取因素變異量為 27.17%，未達總累積變異量的二分之一。其次，使用共同潛在變數檢驗 CMV 時，OCB 二階構念的 20 個題項標準誤 (Standard Error) 過大，因素負荷量皆超過 1 且不顯著，可能是因為人際和諧與保護公司資源兩構面的反向題，產生的方法效應 (Method Effect) 干擾測量結果 (e.g., Corwyn, 2000; DiStefano and Motl, 2009)，使受試者在填答時產生回應偏誤；因此，以 OCB 一階的五個因素與其他四個變數（即九個構念與其對應的題項）的所有題項進行 CMV 檢驗，此時所有題項因素負荷量皆呈現顯著，且沒有過大的標準誤；所有題項的 λ 係數為 .118 ($p < .01$)，其平方值為 .014，顯示共同變異約為 1.4%，而有 CLV 與無 CLV 的標準化迴歸係數差異絕對值，介於 .003 至 .013 之間；由此可知，透過哈門氏單因子檢驗與共同潛在變數檢驗顯示，本研究受到共同方法變異的影響並不嚴重。

肆、研究結果

一、效度

　　首先，進行驗證性因素分析 (CFA) 以檢驗各變數的區別效度。以本研究的五個變數（即仁慈領導、信任主管、信任組織、知覺操弄意圖及組織公民行為）為基礎模型 (Baseline Model)，其中，仁慈領導與組織公民行為皆採用二階指標，知覺操弄意圖、信任組織及信任主管採用一階指標，CFA 結果顯示五因素模型有相對較佳的模型配適度 ($\chi^2 = 709.56$, $df = 199$, GFI = .84, NFI = .86, CFI = .89, RMSEA = .09)，其餘四因素、三因素、二因素及一因素模型的卡方值，均比五因素模型顯著高出許多（詳見附錄一），且模型配適度指標相對較差，顯示五因素模型較佳，各變數間具可接受的區別效度。

二、相關分析

　　表 1 為本研究各變數的平均數、標準差及相關係數。主要研究變數的部份顯示，仁慈領導與組織公民行為呈現正向且顯著的相關，相關係數為 .15 ($p < .01$)；而部屬知覺領導者的操弄意圖分別與信任主管、信任組織及組織公民行為，皆呈現負向相關，相關係數分別為 -.42 ($p < .01$)、-.34 ($p < .01$) 及 -.13 ($p < .05$)。

表 1 本研究各變數之描述性統計與相關係數

變數	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. 性別（0：男；1：女）	0.62	0.49										
2. 年齡	31.37	7.64	-.20**									
3. 教育程度	2.96	0.81	-.17**	.15**								
4. 工作年資（年）	8.25	7.07	-.12*	.85**	-.05							
5. 與主管互動時間（年）	2.67	2.26	-.02	.35**	-.17**	.35**						
6. 仁慈領導	3.70	0.89	-.06	-.07	-.02	-.05	.05	(.91)				
7. 知覺操弄意圖	3.15	0.83	.03	-.06	-.05	-.07	.00	-.41**	(.79)			
8. 信任主管	4.66	0.97	-.07	-.05	.01	.00	.02	.58**	-.42**	(.94)		
9. 信任組織	4.35	0.90	-.06	-.08	.04	-.04	.03	.48**	-.34**	.57**	(.86)	
10. 組織公民行為	4.41	0.56	-.08	.31**	.09	.26**	.15**	.15**	-.13*	.31**	.31**	(.88)

註：*：$p < .05$；**：$p < .01$；括弧內為各變數的信度。

三、迴歸分析

接著以階層迴歸檢驗各項假設。根據 Cohen, Cohen, West, and Aiken (2003) 的建議，將仁慈領導、知覺操弄意圖、信任主管及信任組織等變數，皆進行標準化分數的轉換，並根據轉換過後的分數相乘，成為互動效果的分數。另外，本研究依據 Muller, Judd, and Yzerbyt (2005) 與 Preacher, Rucker, and Hayes (2007) 建議的方法，進行中介式調節的檢驗，結果如表 2 與表 3 所示。

依據 Muller et al. (2005) 的檢驗流程，第一個步驟是觀察自變數與調節變數的交互作用，能否顯著預測依變數；第二步是觀察自變數與調節變數的交互作用，能否顯著預測中介變數；第三步則是控制調節變數與自變數的交互作用及調節變數與中介變數的交互作用之後，中介變數能否顯著預測依變數。

仁慈領導可顯著預測組織公民行為（$\beta = .15$，$p < .01$，表 2 與表 3 中的 M5），因此 H1 獲得支持；中介式調節的迴歸分析則顯示，仁慈領導與知覺操弄的交互作用，可顯著預測組織公民行為（$\beta = -.24$，$p < .001$，表 2 與表 3 中的 M6）；其次，仁慈領導與知覺操弄的交互作用，分別可顯著預測信任主管（$\beta = -.12$，$p < .01$，表 2 中的 M3）與信任組織（$\beta = -.13$，$p < .01$，表 3 中的 M3）；控制仁慈領導與知覺操弄的交互作用後，信任主管與信任組織，仍舊可顯著預測組織公民行為，迴歸係數分別是 .31 與 .29（$p < .001$，表 2 與表 3 中的 M7）。因此 H2、H3a 及 H3b，皆獲得支持。

表 2 仁慈領導與知覺操弄的交互作用，透過信任主管的中介對 OCB 的迴歸分析

	信任主管				OCB			
	M1	M2	M3	M4	M5	M6	M7	M8
性別	-.08	-.04	-.04	-.01	.00	.00	.02	-.02
年齡	-.24*	-.17	-.17	.27*	.29**	.30**	.35**	.35**
學歷	.04	-.03	.02	.06	.06	.04	.03	.03
工作年資	.18	.15	.15	.01	.01	.00	-.05	-.05
與主管共事時間	.04	.00	.00	.06	.05	.05	.05	.05
仁慈領導		.48***	.49***		.15**	.18**	.02	.02
知覺操弄意圖		-.22***	-.21***		-.05	-.03	.04	.04
仁慈領導 × 知覺操弄			-.12**			-.24***	-.20***	-.18**
信任主管							.31***	.31***
信任主管 × 知覺操弄								-.05
Adj. R²	0.00	0.37	0.38	0.09	0.11	0.17	0.23	0.22
△ R²	-	0.37	0.01		0.02	0.06	0.06	-0.01
△ F	1.16	98.38***	7.41**	7.64***	5.76**	22.87***	24.69***	0.57

註 1：$N = 340$。表格中為標準化迴歸係數。
註 2：*：$p < .05$；**：$p < .01$；***：$p < .001$。

表 3 仁慈領導與知覺操弄的交互作用，透過信任組織的中介對 OCB 的迴歸分析

| | 信任組織 | | | | OCB | | | |
	M1	M2	M3	M4	M5	M6	M7	M8
性別	-.07	-.04	-.04	-.01	.00	.00	.02	.02
年齡	-.30**	-.25*	-.24*	.27*	.29**	.30**	.37***	.37***
學歷	.09	.08	.07	.06	.06	.04	.02	.02
工作年資	.18	.16	.16	.01	.01	.00	-.05	-.05
與主管共事時間	.09	.06	.06	.06	.05	.05	.03	.03
仁慈領導		.39***	.41***		.15**	.18**	.06	.06
知覺操弄意圖		-.18**	-.17**		-.05	-.03	.02	.02
仁慈領導 × 知覺操弄			-.13**			-.24***	-.20***	-.20**
信任組織							.29***	.29***
信任組織 × 知覺操弄								-.02
Adj. R²	0.01	0.25	0.27	0.09	0.11	0.17	0.23	.23
△ R²	-	0.24	0.02	-	0.02	0.06	0.06	0.00
△ F	1.98	54.14***	7.12**	7.64***	5.76**	22.87***	27.10***	0.06

註 1：$N = 340$。表格中為標準化迴歸係數。
註 2：*：$p < .05$；**：$p < .01$；***：$p < .001$。

　　另外，為更清楚得知交互作用的方向，進行交互作用圖的繪製及簡單斜率值 (Simple Slope) 的檢定 (Cohen et al., 2003)。圖 2 與圖 3A、3B 為交互作用示意圖；圖 2 中顯示，在知覺領導者操弄意圖為低分的情況下，仁慈領導與組織公民行為，呈現正向顯著的關係 ($\beta = .23$; $p < .001$; 95% CI [.14, .32])；相反的，在知覺領導者操弄意圖為高分的情況下，仁慈領導與組織公民行為的關係不顯著 ($\beta = -.03$; n.s., 95% CI [-.11, .04])。交互作用圖與簡單斜率檢驗結果顯示，當部屬認為領導者有較低的操弄意圖時，仁慈領導較能有效地提升部屬從事組織公民行為的意願。相反的，當部屬認為領導者的照顧是別有所圖時，仁慈領導無法有效提升部屬從事組織公民行為的意願。由此可知 H2 受到支持。
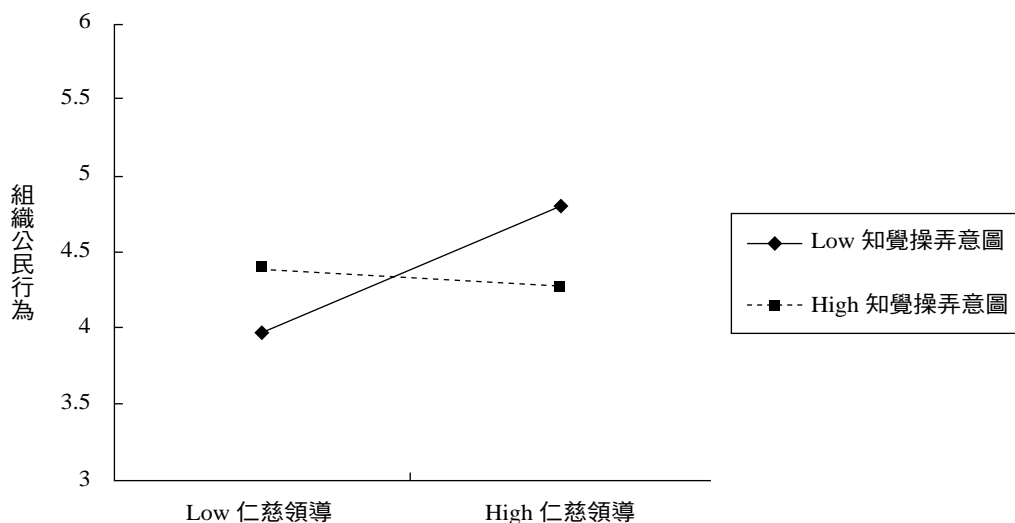
圖 2 知覺操弄意圖對於仁慈領導與組織公民行為間關係的調節效果圖

　　此外，本研究也檢驗仁慈領導與操弄意圖的交互作用，對於信任主管與信任組織的效果，圖 3A 中顯示，在知覺領導者操弄意圖為低分的情況下，仁慈領導與信任主管，呈現正向顯著的關係 (β = .60; p < .001; 95% CI [.47, .72])；另外，在知覺領導者操弄意圖為高分的情況下，仁慈領導與信任主管仍呈現正向且顯著的關係 (β = .37; p < .001; 95% CI [.25, .49])。圖 3B 中，在知覺領導者操弄意圖為低分的情況下，仁慈領導與信任組織，呈現正向顯著的關係 (β = .48; p < .001; 95% CI [.35, .60])；另外，在知覺領導者操弄意圖為高分的情況下，仁慈領導與信任組織仍呈現正向且顯著的關係 (β = .25; p < .001; 95% CI [.14, .37])。
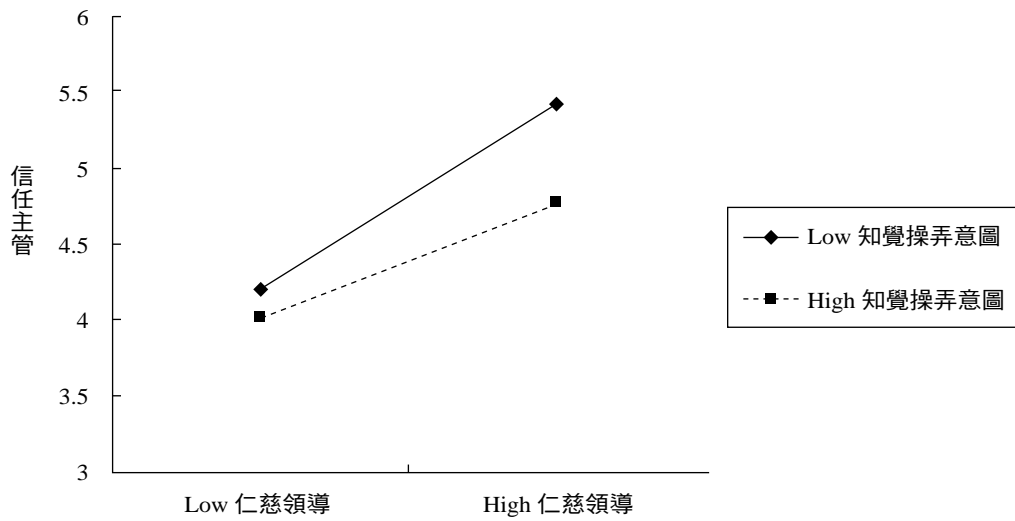
圖 3A 知覺操弄意圖對於仁慈領導與信任主管間關係的調節效果圖
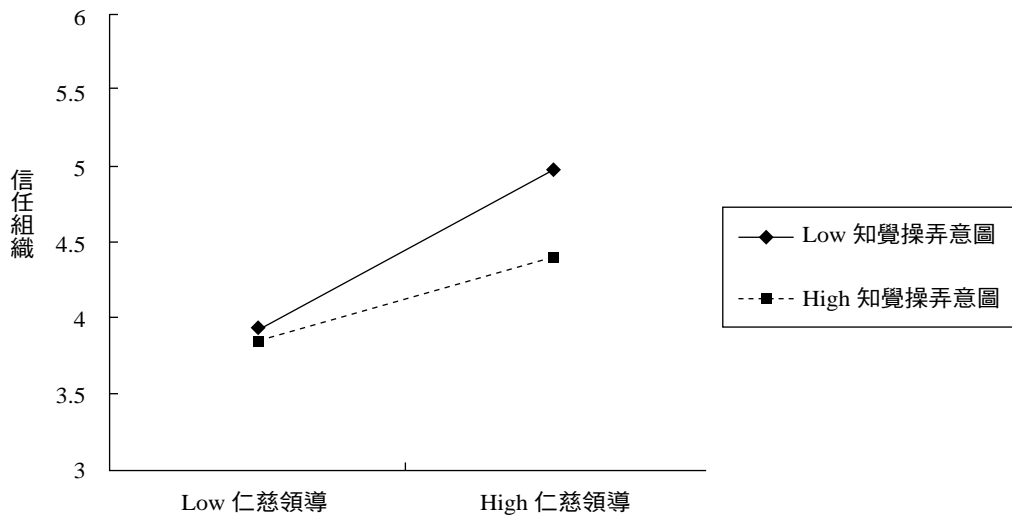
圖 3B 知覺操弄意圖對於仁慈領導與信任組織間關係的調節效果圖

伍、結論與討論

　　本研究結果顯示，當部屬知覺領導者有高度操弄意圖時，仁慈領導對於部屬對信任組織、信任主管及組織公民行為皆呈現負相關；反之，當部屬知覺領導者的操弄意圖低時，仁慈領導對於部屬對信任組織、信任主管及組織公民行為則呈現正相關；本研究檢驗仁慈領導與部屬的組織公民行為呈正向關係，與以往的研究相似 (e.g., Chan et al., 2013; Chan and Mak, 2012)，然而，這個正向關係在部屬知覺到主管高度的操弄意圖下將會反轉，並非所有的仁慈領導都有正向結果；此外，仁慈領導與操弄意圖知覺的交互作用，會透過信任組織與信任主管的部分中介，間接影響部屬的組織公民行為。以下說明理論與實務意涵，還有研究限制與未來研究建議。

一、理論與實務意涵

　　理論意涵方面，Pellegrini and Scandura (2008) 與 Pellegrini, Scandura, and Jayaraman (2010) 曾呼籲，華人新興的家長式領導（包含仁慈領導）的實證研究仍落後許多，本研究結果除了回應此項呼籲外，更延伸了以往仁慈領導與正向部屬產出的關係連結，以及此關係間的心理機制 (e.g., Chen et al., 2014)；本研究有幾項貢獻分述如下。

　　第一，本研究擴展了仁慈領導與組織公民行為間的關係連結，結果顯示，在不同情境下，並非所有的仁慈領導都有正向結果；本研究檢驗仁慈領導與部屬的組織公民行為呈正向關係，與以往的研究結果相符 (e.g., Chan et al., 2013; Chan and Mak, 2012; Chen et al., 2014; Wu et al., 2012)。當部屬知覺操弄意圖程度低時，仁慈領導可提升部屬的組織公民行為，但是，這個正向關係在部屬知覺到主管高度的操弄意圖下將會反轉，也就是仁慈領導與部屬的組織公民行為的關係呈現不顯著。也就是，當部屬知覺領導者的操弄意圖程度低時，較為願意從事組織公民行為，以回報主管的關懷與照顧；但是當部屬知覺主管的仁慈是虛情假意，部屬可能會降低角色外行為；或是主管的仁慈，被部屬視為對隱私權的侵犯（性別、年齡、教育程度、工作類型、工作年資及與主管共事的時間等）（鄭伯壎、樊景立與周麗芳，2006），部屬可能知覺主管對部屬於公於私的關懷，是為了找到「把柄」以利用與控制部屬的「回報」，因此，對於實際有益於組織的角色外行為，恐無法產生顯著的影響；當部屬知覺主管具有高度的操弄意圖時，仁慈領導與組織公民行為間的關係呈現不顯著，顯示部屬認為仁慈的主管不一定是真正關心部屬的工作與生活，仁慈的背後目的可能是為了提升績效與領導者自身的升遷，因而無法鼓勵部屬從事角色外的行為。

　　第二，本研究也進行了信任的簡單中介分析，結果顯示，信任主管與信任組織會完全中介仁慈領導與組織公民行為間的關係（當置入信任主管時，仁慈領導對組織公民行為的效果由 $\beta = .17, p < .01$ 降為 $\beta = -.02, p > .05$；當置入信任組織時，此效果降為 $\beta = -.02, p > .05$），此結果再次支持，仁慈領導與組織公民行為之間，信任是一項重要的中介變數 (e.g., Chen et al., 2014)。

第三，截至目前，僅有少數的研究探討仁慈領導與部屬績效間的心理機制，而整合性探討這之間的中介與調節機制的研究，更是寥寥無幾；因而，本研究回應 Chen et al. (2014) 與 Wu et al. (2012) 的研究發現，除了支持「信任」是一個重要的部屬心理機制之外，本研究更納入部屬對領導者操弄意圖知覺的調節分析；結果顯示高度的仁慈領導，將使部屬不論對領導者或對組織，感到更加的可信；然而，這項效果可能會打折，也就是當部屬知覺領導者操弄意圖高時，容易對領導者的善意關懷產生其他的歸因，從而降低了對領導者與組織的信任，也降低了從事角色外行為的意願。

實務意涵上，本研究結果顯示不論知覺操弄意圖的高低，仁慈領導均與信任組織與信任主管呈現顯著的正向關係，顯示仁慈領導確實能提升部屬對主管與對組織的信任，但相較於低度知覺操弄意圖而言，部屬知覺領導者的高度操弄意圖的話，確實會降低部屬的信任，但不至於對仁慈領導與組織失去信任，就長期而言，仁慈領導者應儘量展現真誠仁慈的一面，避免過度的操弄；Howell (1988) 與 Conger (1990) 就曾指出，領導者的功能之一是控制著資源與資訊，因而使得領導者有機會操弄部屬，像是交易型領導者容易藉著操控部屬的期望（例如薪資或升遷）以交換部屬的順從 (Bass, 1985; Burns, 1978; Pounder, 2003)；仁慈領導者也可能藉由展現關懷部屬的一面要求部屬加班或協助主管處理私事等，讓部屬感到領導者的關懷別有意圖；此外，雖然領導者無法有效控管部屬如何歸因，但領導者若能降低過度的操弄，展現出對部屬誠懇的關懷，則可能將對組織與對領導者的信任，化為實際的有利組織的行動，也就是組織公民行為。

領導者應展現適度的仁慈，而非明顯有失公平與客觀性的仁慈，也就是對部屬過度的關懷與賦予資源，這樣的仁慈不僅造成其他部屬的知覺不公平，也可能使目標部屬懷疑主管的動機，對主管與對公司產生不信任感；此外，受到仁慈領導者的關照，從社會比較的觀點，也可能使該部屬在部門中容易處於被比較的目標，華人社會講究中庸之道，亦即過與不及的仁慈皆可能產生反效果，因此，仁慈領導者應適時留意部屬的反應與環境線索，對於部屬個別關懷但也切記莫要造成部屬的猜疑與不信任，或是應該將仁慈關懷擴及對整體部門的關照，例如為部門爭取資源或加薪，而非針對單一部屬。

二、研究限制與未來研究建議

本研究雖擴展仁慈領導理論的應用，但也有幾項限制與建議需要說明；其一，雖然本研究區分兩階段蒐集資料，但仍由部屬填答所有問卷，可能無法完全避免同源偏誤的影響，未來研究建議仍採用多重來源的資料，尤其是組織公民行為的調查，除了主管、同事及部屬本身的自評外，另外可採用重要第三人的評估，例如家人，因為組織公民行為有時不在職場中發生 (Bolino and Turnley, 2005)，多重來源的調查應可有效降低同源偏誤的影響；除了不同來源之外，組織公民行為亦可採用不同的量測方式，

例如採用實驗設計，操弄組織公民行為的高低程度，探討應徵者的組織公民行為對於甄選決策的影響 (Podsakoff, Whiting, Podsakoff, and Mishra, 2011)。

第二，Chan (2013) 的研究指出，家長式領導中的德行與仁慈領導，會塑造一個信任的職場環境，讓部屬更勇於提出建言，雖然實證分析上，Chan (2013) 的迴歸分析，並未發現仁慈領導與建言行為有顯著的關係 ($\beta = .04$, $p > .05$)，但兩者的相關呈現正向且顯著 ($\gamma = .16$, $p < .01$)；若將建言行為視為角色外行為的一種 (e.g., Podsakoff et al., 2011; Van Dyne and LePine, 1998)，則 Chan (2013) 的發現與本研究結果產生分歧。然而，最近的研究還是發現仁慈領導與建言間有正向關係 (e.g., Zhang, Huai, and Xie, 2015)；儘管已有研究建議將組織公民行為視為單一構念 (Hoffman et al., 2007; Walumbwa et al., 2010)，但角色外行為繁多，因此，未來研究可繼續探討仁慈領導對於不同的組織公民行為構面的影響，以釐清仁慈領導與組織公民行為間的不一致性關係，或是發現其他的條件變數。

第三，本研究雖然發現仁慈領導會透過信任組織與信任主管的中介，進而提升部屬的組織公民行為，但本研究並未以針對組織的公民行為 (Organizational Citizenship Behavior-organization; OCBO) 與針對個人的公民行為 (Organizational Citizenship Behavior-individual; OCBI) (Lee and Allen, 2002; Williams and Anderson, 1991) 作為效標變項，以對應信任組織與信任主管；因為，部屬可能會因為主管的關照而信任主管，進而展現對領導者個人的組織公民行為，例如協助主管的工作與帶領新進同仁；也可能因為信任組織展現出對群體的組織公民行為，例如自願加班完成工作與維護公司聲譽；如同前一項建議，未來研究可深入探討仁慈領導與不同的角色外行為構面之間的影響路徑，以深化仁慈領導與對組織公民行為影響的理論貢獻。

第四，本研究仍屬橫斷面 (Cross Sectional) 檢驗，結果難以推論長時間的因果關係，因此未來研究建議採用縱貫面 (Longitudinal) 的測量。此外，家長式領導的另外兩種要素，即威權與德行領導，在部屬知覺操弄意圖的情況下，對於組織公民行為的影響，未來研究亦可納入探討。

第五，仁慈領導可視為家長式領導中最有效的領導 (Sheer, 2013)，但是不同脈絡中，部屬知覺的仁慈領導是否有差異，還有對於部屬產出的影響為何，仍舊是值得探討的議題，因此未來研究建議採用跨層次分析 (Hierarchical Linear Modeling; HLM)，檢驗仁慈領導的影響機制 (Lam, Huang, and Lau, 2012)。

最後，近來學者紛紛重視組織公民行為的自利動機或是負面效果 (Bolino, Klotz, Turnley, and Harvey, 2013; Bolino and Turnley, 2005; Bolino, Turnley, and Niehoff, 2004)，例如過多的角色外行為，可能造成員工的工作負荷量增加與績效降低；或是從事組織公民行為的動機是為了形象管理 (Bolino and Turnley, 2005; Bolino et al., 2013)，因此，未來研究可繼續探討不同的領導前因與調節變數，對於正、負面組織公民行為的影響。

Does Benevolent Leadership Always Lead to Organizational Citizenship Behavior? The Mediated Moderation Effect of Manipulative Intention and Trust

Chia-Wu Lin, Professor, Department of Business Administration, National Dong Hwa University

Wan-Hsien Hu, Part-Time Research Assistant, Department of Business Administration, National Dong Hwa University

Jian-Bin Shih, Assistant Professor, Department of Leisure and Recreation Management, Da-Yeh University

1. Purpose/Objective

Previous studies have indicated that benevolent leadership in Chinese organizations results in positive outcomes. However, one issue that needs exploring is whether benevolent leadership influences subordinates effectively if they regard it as pseudo-benevolent–using manipulation, control, and popular support as leadership skills. If subordinates no longer feel gratitude towards their leader, such leadership actually leads to a conflict between a leader and his or her subordinates and undermines personnel harmony (Farh and Cheng, 2000; Farh et al., 2008). What factors that cause this reaction remain unknown, as do its outcomes for those subordinates. Based on this research gap, this study aims to explore what factors leave subordinates unmoved by benevolent leadership and examine the outcome of such subordinates' behavior.

The attribute theory (Heider, 1958; Kelley, 1973; Weiner, 1986) refers to how individuals explain their own or others' behavior (Martinko et al., 2011; Martinko, Harvey, et al., 2007). The basic assumption is that people want to understand the reasons of significant life events, and how they attribute causes to the events will affect their responses (Heider, 1958). The consequences are attributed to ability, effort, nature of the task, and fortune. The causal reasoning people employ to refer to other's behavior also influences the subsequent response; the so-called discounting principle has been demonstrated in a number of well-known studies in social perception (Morris and Larrick, 1995).

Green and Mitchell (1979) applied the attribution theory to leadership theories (Martinko, Harvey, et al., 2007; Martinko et al., 2011), which proposes that how leaders interpret the subordinates' behavior will affect their leadership and interaction with their subordinates. However, Dasborough and Ashkanasy (2002) suggested that how followers attribute leadership behavior and its motivation also results in emotional reactions and behaviors. Moreover, several studies have examined how attribution styles influence the leader-member exchange (Martinko, Moss, et al., 2007). Therefore, this study attempts to

explore how follower attributions of leader behavior moderate the relationship between benevolent leadership and followers' outcomes.

2. Design/Methodology/Approach

This study is based on original data collected with a two-wave survey from full-time employees in several private businesses in Taiwan. We asked the respondents to evaluate the leadership behavior of their direct supervisor as well as the level of their trust in the supervisors, trust in the organizations, OCB, and manipulative intentions of the leaders. Convenient sampling was used to collect data. The first-wave questionnaire contained measures of benevolent leadership and demographic variables of respondents, whereas the second-wave questionnaire was conducted after two to three weeks and contained measures of perception of leaders' manipulative intentions, trust in leaders, trust in organizations, and OCB. In all, 482 employees returned the questionnaire. After removing samples with missing values, samples that are incomplete or unpaired, and those with the relationship tenure lasting less than 4 months; a total of 340 valid samples remained.

3. Findings

Drawing on the attribution theory of leadership, subordinates' attribution of intention about leaders' behavior will affect their emotions and behavior. To address the attribution-consequence process, we hypothesize that perception of leaders' manipulative intention moderates the positive relationship between benevolent leadership and trust, (i.e., in supervisor and organization) as well as OCB. We proposed and tested a mediated moderation model. The results demonstrated that benevolent leadership is less positively or even negatively related to trust and OCB when subordinates perceived their leaders as highly manipulative. In contrast, benevolent leadership was positively related to trust and OCB when subordinates perceived low manipulative intention. Another finding is that benevolent leadership is most effective when they interact with the manipulative intention, which the interaction effect on OCB is partially mediated by trust in supervisor and organization.

4. Research Limitations/Implications

Although this study extended the application of attribution theory and benevolent leadership theory, it does have several limitations, suggesting future research. First, two-wave data collection only from subordinates might not avoid common method bias (CMV);

future research might adopt an experimental or longitudinal design with multiple sources to diminish the CMV effect. Moreover, with expection to the supervisor, colleague, and self-report; the OCB examination also needs a third party to provide evaluations (Bolino and Turnley, 2005).

Second, Chan (2013) empirically found out that benevolent leadership behavior did not lead to employees' voice behavior; however, our results did not appear to back him up. Voice behavior is regarded as one of OCB (e.g., Podsakoff et al., 2011; Van Dyne and LePine, 1998); the result of Chan (2013) and our studies demonstrated the inconsistent outcome for the relationship between benevolent leadership and OCB. Therefore, future research might examine the relationships between benevolent leadership and various dimensions of OCB.

Third, although the results revealed that trust in organizations and in leaders mediated the positive relationship between benevolent leadership and OCB, we did not separate OCB to OCBO and OCBI (Lee and Allen, 2002; Williams and Anderson, 1991) as criterion variables to respectively correspond to those two forms of trust. Future research should do so.

Fourth, the multilevel method has become an issue in leadership research; future research might adopt hierarchical linear modeling to examine the influence of benevolent leadership in a multilevel context (Lam, Huang, and Lau, 2012).

Finally, scholars are increasingly concerned about the self-interest and negative effects of OCB (Bolino et al., 2013; Bolino and Turnley, 2005; Bolino et al., 2004). For instance, too many behaviors outside one's role in becoming in-role obligations might result in overloaded and lower performance. Thus, the effect of various antecedents and moderators on positive and negative OCBs should be discussed in future research.

5. Originality/Contribution

Our results, similar to previous reports (e.g., Chan et al., 2013; Chan and Mak, 2012), show the positive effect of benevolent leadership on OCB. This positive relationship, however, could be reversed if subordinates perceive high manipulative intention from a leader. That is, benevolent leadership does not always lead to positive consequences. Moreover, the interaction of benevolent leadership and perceived manipulative intention influences OCB and this effect is mediated by trust in supervisor and organization.

This study responds to previous researches (e.g., Pellegrini and Scandura, 2008; Pellegrini, Scandura, and Jayaraman, 2010) that pay more attention to empirical examinations on Chinese leadership, which includes the benevolent leadership. It also

extends the link between benevolent leadership and positive outcomes as well as discussing the psychology behind it (e.g., Chen et al., 2014).

There are several contributions to our work. First, according to the attribution theory of leadership process, this empirical study demonstrates that benevolent leadership does not always results in positive outcome if a subordinate perceives strong manipulative intention from his or her leader. On the other hand, perceiving little manipulative intention implies that an employee engages more OCB to reciprocate genuineconcern and care from the supervisor.

Second, we also conducted a simple mediated test and the result revealed that trust in leader and in organization completely mediated the relationship between benevolent leadership and OCB, which implies that trust is indeed an important mediator of leadership processes (e.g., Chen et al., 2014).

Third, up to now, only few research works have examined the psychological mechanism between benevolent leadership and employee outcomes, let alone the mediated moderation effect of the mechanism. To fill this research gap, our research identified that a high level of benevolent leadership and low level of perception of manipulation could lead to high levels of employee trust and OCB.

In practical terms, a benevolent leader should demonstrate authentic benevolence and avoid manipulating employees. Once subordinates perceive too much manipulative behavior from their leader, they will reduce trust as well as OCB. The leaders should perform their benevolence appropriately and distribute resources with fairness and objectivity. Too much concern and too many resources offered to a specific employee may cause him or her to doubt the motivation of the leader, whereas other employees also lose trust in both the leader and the organization. Leaders need to find the equilibrium between both excessive and deficient care and concern.

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附錄一 區別效度分析

Models	χ^2	df	$\triangle\chi^2$	$\triangle df$	GFI	NFI	CFI	RMSEA
A	709.56	199	-	-	.84	.86	.89	.09
B	962.38	203	252.82***	4	.79	.81	.84	.11
C	916.14	203	206.58***	4	.80	.82	.85	.10
D	1131.05	203	421.49***	4	.76	.77	.80	.12
E	1036.65	206	327.09***	7	.73	.75	.78	.12
F	1274.65	206	565.09***	7	.71	.74	.77	.12
G	1759.09	208	1049.53***	9	.65	.64	.67	.15
H	1934.95	209	1225.39***	10	.63	.61	.63	.16

註 1：***：$p < .001$。

註 2：模型 A 為五因素模型。

模型 B 為四因素模型，表示仁慈領導與信任組織結合為一因素。

模型 C 為四因素模型，表示仁慈領導與信任主管結合為一因素。

模型 D 為四因素模型，表示仁慈領導與組織公民行為結合為一因素。

模型 E 為三因素模型，表示仁慈領導、信任組織及信任主管結合為一因素。

模型 F 為三因素模型，表示知覺操弄意圖、信任組織及信任主管結合為一因素。

模型 G 為二因素模型，表示知覺操弄意圖、信任組織、信任主管及組織公民行為結合為一因素。

模型 H 為一因素模型，表示仁慈領導、知覺操弄意圖、信任組織、信任主管及組織公民行為結合為一因素。

作者簡介

* 林家五

　　國立臺灣大學商學研究所博士，現職為國立東華大學企業管理學系教授，研究領域包括領導與決策、華人組織行為、組織認同、正向組織行為與消費者行為等等。學術論文曾發表於 Journal of Business Research、Journal of Occupational and Organizational Psychology、Asian Journal of Social Psychology、Asian Case Research Journal、臺大管理論叢、本土心理學研究、管理學報、中山管理評論、電子商務學報、產業與管理論壇、人力資源管理學報等學術期刊，並譯有《企業研究方法》、《組織行為》、《管理學中大師中的大師》等書。美國西雅圖華盛頓大學管理與組織學系富爾布萊特訪問學者 (2011)、第三屆聯電經營管理論文獎傑出獎得主 (2013)。

胡宛仙

　　國立東華大學企業管理學系博士，現職為國立東華大學企業管理學系兼任研究助理，研究領域主要為華人領導與組織行為。學術論文曾發表於人力資源管理學報、中山管理評論、本土心理學研究及臺大管理論叢等。

施建彬

　　英國牛津布魯克斯大學心理學博士，現職為大葉大學休閒事業管理學系助理教授。研究領域包括工作團隊、幸福感、華人領導等。學術論文曾發表於人力資源管理學報、臺大管理論叢、人文暨社會科學期刊、大葉學報等。

多元迴歸的自變數比較與多元共線性之影響：效果量、優勢性與相對權數指標的估計與應用

The Impact of Multicollinearity on the Evaluations of Regressors: Comparisons of Effect Size Index, Dominance Analysis and Relative Weight Analysis in Multiple Regression

邱皓政 / 國立臺灣師範大學企業管理學系教授
Haw-Jeng Chiou, Professor, Department of Business Administration, National Taiwan Normal University

摘 要

迴歸分析雖廣泛應用於社會科學研究，但過度仰賴顯著性檢定與迴歸係數而忽略了效果量與相對重要性的評估，本文除了檢視乘積係數等早期指標，並整理近來提出的優勢分析與相對權數分析，以模擬數據進行增強、壓抑與重疊等不同型態的共線性效果下各種指標的表現差異，並以「華人家庭動態資料庫」2011 年的調查資料，檢驗人口變數與人力資本變數對於 2,325 名臺灣民眾的薪資差異的影響。研究結果指出，多元共線性對於自變數效果量與相對重要性的影響非常明顯，相對權數分析與優勢分析的相對重要性指數的表現最為穩定，其中優勢分析具有相當彈性能夠提供更豐富的變數效果與重要性資訊。最後本文對於各種指標策略進行整理比較，並說明在多元迴歸上的應用策略。

【關鍵字】相對權數分析、優勢分析、壓抑效果

Abstract

Regression analysis is frequently used in social sciences. However, regression analyses often rely heavily on hypothesis testing and interpretations of regression coefficients. As a result, the effect sizes of regression models as well as the qualities of individual predictors have long been ignored. This paper reviews several indices that can be used to evaluate the effect size and relative importance of predictors, the relative weight analysis (RWA), and the dominance analysis (DA) in multiple regressions. A simulated dataset is used to examine the impacts of mutlicollinearity, including the enhancement, suppression, and redundancy effects, on the evaluation of the effect size and relative importance of predictors. A sample of 2,325 Taiwanese adults selected from the 2011 Panel Study of Family Dynamics (PSFD) are used to demonstrate the use of those indices in predicting the salary differences. Results suggest that the indices based on RWA and DA are recommended for evaluating the relative importance of predictors. In particular, DA has the advantage of flexible procedures for evaluating the different facets of the dominance of predictors. The properties of the recommended index were summarized in the end of the paper.

【Keywords】relative weight analysis, dominance analysis, suppression effect

壹、緒論

迴歸分析是組織與管理等社會科學領域最重要的分析策略之一 (Aguinis, Pierce, Bosco, and Muslin, 2009; Cascio and Aguinis, 2008; Casper, Eby, Bordeaux, Lockwood, and Lambert, 2007)，其之所以普遍受到學者重視，主要是因為迴歸可以利用直觀的線性模型來對於研究者所關切的某個依變數 (Dependent Variable; DV)，投入多個自變數 (Independent Variable; IV) 來進行預測與解釋 (Cohen, Cohen, West, and Aiken, 2003; Pedhazur, 1997; Stevens, 2009)。然而迴歸分析雖被廣泛應用，但對於多元迴歸分析本身的數學特性，以及各種係數所代表的意義與應用方式，學者未必有充分的瞭解，甚至會有誤用的現象（林新沛，2005；溫福星，2013），尤其對於過度仰賴顯著性檢定與迴歸係數的解釋，遭到許多學者的挑戰與批評（例如 Courville and Thompson, 2001; Kelley and Preacher, 2012; Nimon and Oswald, 2013）。

傳統上，迴歸模型本身或某一個自變數是否具有意義 (Significance)，主要是由虛無假設顯著性檢定 (Null Hypothesis Significance Test; NHST) 來決定。但是，統計上具有顯著性並不代表研究者所關心的現象是重要的 (Important) 或有效的 (Effective)，基於 NHST 所得到的結論，僅能說明研究者所觀察的「效果」是否大於「隨機現象」，此一程序所檢驗的是統計意義 (Statistical Significance)，而並無法確知效果本身的強弱意義，亦即實質意義 (Substantive Significance) 並無法從 NHST 來判定，需要仰賴效果量指標來反映。

在多元迴歸中，多元相關平方 (Squared Multiple Correlation; R^2) 普遍被作為模型優劣好壞的判定指標，其所反映的是 IV 的線性整合能夠解釋依變數變異的多寡，亦即迴歸模型的整體效果量 (Omnibus Effect Size) (Kelley and Preacher, 2012)。一般在研究實務上，當 R^2 達到顯著水準，研究者多即宣稱迴歸模型能夠有效解釋或預測 DV，進而檢視個別 IV 的影響力（迴歸係數）。但是效果輕微的 R^2 也可能達到顯著水準（例如當樣本規模很大時），而 R^2 達顯著也不代表每一個 IV 都具有解釋上的意義，因此除了檢視 R^2 與迴歸係數的統計顯著性與數值大小之外，研究者必須選擇適當的係數或指標來說明 R^2 如何被各 IV 分割，藉以判定各 IV 對於模型整體解釋力的貢獻比例，此即 IV 相對重要性 (Relative Importance) 的定義 (Budescu, 1993; Johnson, 2000; Johnson and LeBreton, 2004)。

相對重要性的概念之所以受到重視，是因為具有統計意義的 R^2 雖是多元迴歸後續分析的先行條件，但是效果量才能提供模型本身與各變數在理論與實務上的實質意義。因此 R^2 一般被視為模型的總效果，個別 IV 必須能夠有效分解 R^2 才能獲知其意義與重要性，但是由於 IV 間通常帶有一定程度的相關，甚至存在多元共線性 (Multicollinearity)，以相關或迴歸係數等傳統指標並無法有效分解 R^2。近年來，迴歸方法的主要進展之一，即是關於 IV 個別效果量估計與相對重要性檢驗策略的發展，

並配合模擬研究建立拔靴信賴區間來據以進行比較，然而不同的方法各有優劣與適用時機，受到多元共線性影響的程度也不相同。本文的主要目的，即在整理並比較多元迴歸當中關於效果量、優勢性與相對權數分析的原理與方法，並利用模擬資料與實徵數據進行分析，探討 IV 間不同的多元共線性型態所可能造成的影響。文中除了檢驗不同指標與估計方法的優劣特性，並試圖提出使用這些指標的具體建議。

貳、多元迴歸的效果量與重要性

從統計的角度來看，效果量 (Effect Size) 是指估計所得到的參數實質意義或評估研究者所操弄的自變數效果強弱。因此廣義來說，相關係數、百分比、平均數差異都可以作為效果量的指標 (Cumming and Fidler, 2009)，在迴歸當中則涉及許多不同的指標與係數[1]，以下即針對多元迴歸當中的各種效果量指標與 IV 的比較策略進行整理說明。

一、迴歸模型效果量指標

（一）多元迴歸方程式

對於帶有 p 個 IV（以 $X_1,..., X_p$ 表示）來解釋某個 DV（以 Y 表示）的多元迴歸模型可由方程式 (1) 表示：

$$(1)\ Y = b_0 + b_1 X_1 + ... + b_p X_p + \varepsilon$$

其中 b_0 為迴歸方程式的截距，IV 對 DV 的影響由迴歸係數 b_1 至 b_p 反映（亦即斜率）。透過這一組迴歸係數，可將 p 個 IV 進行線性整合得出 Y 的投射值（或稱為 Y 的預測值或估計值，以 $\hat{Y}$ 表示）

$$(2)\ \hat{Y} = b_0 + b_1 X_1 + ... + b_p X_p$$

Y 與 $\hat{Y}$ 間的差距即為估計誤差，亦即 $\varepsilon = Y - \hat{Y}$，服從以 0 為平均數、$\sigma_\varepsilon^2$ 為變異數的常態分配，$\varepsilon \sim N(0, \sigma_\varepsilon^2)$。若令誤差變異最小化求得最適配之迴歸方程式，稱為一般最小平方迴歸或 OLS 迴歸 (Ordinary Least Squares Regression)，迴歸係數稱為 OLS 估計數，其數值反映了當其他 IV 維持恆定的情況下，各 IV 對於 DV 的淨影響力（或邊際解釋力）。

1　在文獻上，「效果量」與「重要性」一般被視為可互換的同義字 (Nunnally and Bernstein, 1994; Nakagawa and Cuthill, 2007; Kelley and Preacher, 2012)。

（二）整體效果量

迴歸分析當中最常被視為迴歸模型效果量的是多元相關平方 (R^2)，多元相關 R 是指 Y 與 $\hat{Y}$ 的相關，將 R 取平方反映 DV 變異被 IV 解釋的比例，亦即全體 IV 能夠削減 DV 的變異比例（1– 殘差變異比例），或由標準化迴歸係數與相關係數的乘積累加獲得 (Green, Carroll, and DeSarbo, 1978; Darlington, 1968; Thompson, 1995)，如方程式 (3) 所示。

$$(3) \quad R^2 = 1 - \frac{SS_{residual}}{SS_Y} = \rho_{\hat{Y}Y}^2 = \beta_1 r_{YX_1} + \beta_2 r_{YX_2} + ... + \beta_p r_{YX_p}$$

由於 R^2 並未考慮自由度的影響，因此 R^2 並非母體的不偏估計值，因此當樣本數偏低時（例如低於 30）或 IV 數目太多時，較佳的效果量指標是調整後 R^2 (Adjusted R^2)，如方程式 (4) 所示。

$$(4) \quad R_{adj}^2 = 1 - (1 - R^2)\frac{N-1}{N-p-1}$$

雖然調整後 R^2 為母體不偏估計值，得以作為整體模型效果強弱的理想指標，但是即因為經過自由度調整而失去變異拆解的可加性，無從判定其統計顯著性。因此在進行效果量拆解或衍生指標的運算時，仍以 R^2 進行，其統計意義可利用 F 檢定來判定。Cohen (1988) 以 R^2 為基礎，求取解釋變異與誤差變異的比值，發展出另一個整體效果量統計量 f^2，如方程式 (5) 所示。

$$(5) \quad f^2 = \frac{R^2}{1 - R^2}$$

（三）局部效果量

R^2 與 Cohen's f^2 統計量是一種整體性指標，如果研究者關心不同 IV 投入對於整體模型解釋力增減的影響時，可利用嵌套模型的比較原理，計算出效果增量 (ΔR^2)，進行局部效果量 (Local Effect Size) 的估計，亦即目標效果量 (Kelley and Preacher, 2012)。局部效果是否具有統計意義，亦可利用 F 檢定來判定，俗稱 F 改變量檢定 (F Change Test) (Cohen et al., 2003)。

同樣的，Cohen's f^2 統計量也可以應用在階層迴歸局部效果量的估計，如方程式 (6) 所示。

$$(6)\ f_{local}^2 = \frac{R_{M1}^2 - R_{M0}^2}{1 - R_{M1}^2}$$

其中 R^2_{M0} 為帶有 k 個 IV 的基準模型 (M0) 的解釋變異，R^2_{M1} 為投入額外一個或多個 IV 後的新模型 (M1) 的解釋變異，因此 f^2_{local} 統計量可視為增量效果。

（四）殘差削減效果量

R^2 所關注的是全體 IV 對於 DV 變異的解釋力，相對之下，殘差削減法則是以殘差變異為焦點，探討投入 IV 對於迴歸殘差的影響 (Berry and Mielke, 2002)。利用殘差削減 (Proportional Reduction in Error; PRE) 的概念，當越多的 IV 投入方程式，殘差變異降低越多，當某個已帶有 k 個 IV 的迴歸模型作為參照模型 (M0)，若額外再多投入一個或多個 IV 作為比較模型 (M1)，M1 的殘差變異必然小於 M0，因而得以導出一個改善比效果量 (ES_e)，如方程式 (7) 所示。

$$(7)\ ES_e = 1 - \sqrt{\frac{SS_{residual(M1)}}{SS_{residual(M0)}}}$$

由於增加 IV 時的殘差變異為單調遞減，因此 ES_e 數值介於 0 至 1 間，數值越大表示新增的 IV 解釋力越強。而且由於 ES_e 為不同模型的殘差比值，因此也類似於調整後 R^2，並無相對應的抽樣標準誤得以進行顯著性檢定，但可利用拔靴法來建立信賴區間以進行比較 (Preacher and Kelley, 2011)。

二、個別效果量指標

（一）以積差相關為基礎的指標

為瞭解個別 IV 對於 DV 的影響程度，最直接的方法就是觀察 X 與 Y 兩者間的相關係數 r_{XY}。相關越高表示兩者關係越強，而且 r_{XY} 為標準化係數，因此可相互比較。但由於相關係數僅考慮了 X 與 Y 兩變數間的關係，完全不考慮模型當中所存在的其他變數，因此稱為零階相關 (Zero-order Correlation)。如果要將其他 IV（以 Z 表示）的效果移除，可以採取淨相關 (Partial Correlation; r_p)（方程式 (8)）或半淨相關 (Semipartial Correlation; r_{sp})（方程式 (9)）：

$$(8)\ r_p = r_{YX.Z} = \frac{r_{XY} - r_{XZ}r_{YZ}}{\sqrt{1 - r_{XZ}^2}\sqrt{1 - r_{YZ}^2}}$$

$$(9)\ r_{sp} = r_{Y(X.Z)} = \frac{r_{XY} - r_{XZ}r_{YZ}}{\sqrt{1 - r_{XZ}^{2}}}$$

淨相關的原理是在計算 X 與 Y 的相關時，把 Z 與 X 以及 Z 與 Y 的關係完全排除，表示 X 與 Y 的關係完全不受其他 IV 的干擾。但如果殘差（分母）僅移除 X 與 Z 的相關而不移除其他 Z 與 Y 的關係，則為半淨相關。

此外，由於多元迴歸的目的多在預測，因此實務上研究者多試圖建立預測分數 $\hat{Y}$ 來取代 Y，因此 Thompson and Borrello (1985) 及 Courville and Thompson (2001) 主張以結構係數 (Structure Coefficient; r_s) 來估計特定 IV 與 $\hat{Y}$ 的相關，藉以反映 IV 的個別效果，如方程式 (10) 所示。

$$(10)\ r_s = r_{\hat{Y}X} = \frac{r_{YX}}{R}$$

由於 $\hat{Y}$ 是所有 IV 線性整合後的投射值，因此結構係數可以直接由多元相關 R 導出，其性質與典型相關當中典型成分與各指標間的典型係數相同 (Thompson, 2000)，也類似於主成份分析或因素分析中的觀察變數與組合變數之間的相關 (Cooley and Lohnes, 1971)。

（二）以迴歸係數為基礎的指標

由方程式 (3) 可知，迴歸模型的整體解釋力是由個別 IV 累積而成。方程式 (2) 中的斜率 b_1 至 b_p 是保有原測量單位的未標準化迴歸係數，雖然帶有單位便於解釋各係數的意義，但是因為沒有共同尺度，除非進行標準化，齊一各變數單位，否則無法作為強度大小的衡量指標或相互比較。其標準化原理如方程式 (11)，得以去除 IV 與 DV 兩變數的單位的影響。

$$(11)\ \beta = b \times \frac{s_X}{s_Y}$$

在一般的情況下，β 係數介於 ± 1 之間，其數值大小反映了當其他 IV 維持固定的情況下，某 IV 變動一個標準差時 DV 變動幾個標準差。迴歸係數在計算過程中會移除 IV 間的共變效果，若兩個 IV 與 DV 的相關分別為 r_{Y1} 與 r_{Y2}，兩個 IV 間的相關為 r_{12}，第一個 IV 的標準化迴歸係數如方程式 (12) 所示。

(12) $\beta_1 = \dfrac{r_{Y1} - r_{Y2} \times r_{12}}{1 - r_{12}^2}$

β 係數不僅具有標準化的特性，同時也能將 IV 間的共變加以排除，得以反映個別 IV 的「額外」貢獻，因此經常看到許多論文甚至是教科書（例如 Afifi, May, and Clark, 2011; Hair, Black, Babin, Anderson, and Tatham, 2006）將 β 係數作為判斷哪一個 IV 比較重要的指標。但值得注意的是，若將方程式 (12) 與方程式 (8) 與 (9) 相比較可知，β_1 的殘差變異扣除了 r_{12}，但未扣除 r_{Y2}，因此 β 係數的性質近似半淨相關 r_{sp}。當 $r_{12} = 0$ 時，$\beta = r_{sp} = r$。當 IV 間的相關越高，β、r_{sp} 與 r 的差距越大，反映了 β 係數受到 IV 間相關的影響相當大。

（三）乘積指數

乘積指數 (Product Measure) 是指相關係數與標準化迴歸係數的乘積，用以反映個別 IV 對於整體 R^2 的貢獻程度 (Hoffman, 1960; Pratt, 1987)。

(13) $PM = r\beta$

乘積指數的主要特徵是其總和等於整體效果量，亦即 $\Sigma r\beta = R^2$，換言之，乘積指數可對 R^2 進行完全拆解，在不減損總體解釋力的前提下，計算出各 IV 的解釋力所佔的比例，理應是最適合作為獨特貢獻的統計量。但是乘積指數有一個關鍵的限制，是當相關與迴歸係數符號方向相反（異號）時，其數值範圍將出現負值，此時效果量分割原則即被破壞，尤其容易發生於當 IV 間具有高度共線性時。因此 Green et al. (1978) 引用 Gibson (1962) 的代理變數策略，將 IV 經過線性整合得到 k 個新的正交變數 Z_k，再將正交變數對各 IV 作迴歸，定義出 δ^2 指數，藉以維持乘積指數的正交切割可加性。

(14) $\delta_j^2 = \sum \gamma_{jk}^{*2} \beta_k^{*2}$

方程式 (14) 中的 γ_{jk} 為構成正交代理變數與 IV 變數的轉換係數，係數上加註 * 號表示正交化的參數估計。但是 δ^2 指數提出後遭致諸多批評而未被學者接受，例如 Jackson (1980) 指出轉換係數在 IV 具有相關時甚至比 β 係數不如，無法傳遞正交代理變數的相對重要性訊息。其後 Johnson (2000) 針對 δ^2 指數的估計問題進行修正，進而發展出相對重要權數來取代 δ^2 指數，介紹如下。

三、相對權數分析

相對權數分析 (Relative Weight Analysis; RWA) (Fabbris, 1980; Johnson, 2000) 主要引用 Gibson (1962) 的正交代理變數轉換法，來處理 IV 間具有相關時的 R^2 拆解與 IV 比較問題。代理變數的轉換原理，也是將一組自變數 X 透過線性轉換創造出一組完全正交獨立的代理變數 Z，藉以去除自變數間的相關，進而估計各個 IV 的獨特貢獻。若以矩陣式來表示，X 矩陣的轉換係透過 P 與 Q 兩者進行：

(15) $X = P\Delta Q'$

P 與 Q 分別為由 XX' 與 X'X 轉換得出的特徵向量，Δ 則為 XX' 與 X'X 的對角線上的特徵值平方根。若任何兩個 IV 具有完全相關時，$\Delta = 0$，否則 Δ 即為全秩矩陣，進而可導出一組最適配 X 的正交變數 Z (Johnson, 1966)：

(16) $Z = PQ'$

若將依變數 Y 對正交變數 Z 作迴歸，迴歸係數矩陣定義如下：

(17) $B^* = (Z'Z)^{-1}Z'Y = QP'Y$

事實上，Green et al. (1978) 的 δ^2 指數即是利用前述原理來進行 X 變數的正交化，其演算特徵是將 Z 作為依變數來對 X 作迴歸，藉以得到 Γ 矩陣，亦即：

(18) $\Gamma = (X'X)^{-1}X'Z = Q\Delta^{-1}Q'$

如此一來即使得 IV 間的相關又回到 Γ 矩陣中，造成共線性排除失效 (Jackson, 1980)。Johnson (2000) 則以反向操作，將 X 作為依變數來對 Z 作迴歸，導出正交化係數矩陣 Λ：

(19) $\Lambda^* = (Z'Z)^{-1}Z'X = Q\Delta Q'$

由於方程式 (19) 中以 X 作為依變數，因此這一組代理變數 Z 對於 X 所進行解釋的迴歸係數 Λ 即不帶有 IV 間的相關資訊。IV 間的相關則由 $Z_k \rightarrow X_j$ 的殘差相關來吸收。最後，依照乘積係數交乘原理，將 Λ 與 β 相乘，得到相對重要權數 (Relative Importance Weights; RIW)，如方程式 (20) 所示。

(20) $RIW = \Lambda^{*[2]}\mathbf{B}^{*[2]}$

對於一個帶有 p 個自變數的迴歸模型，以 k 個代理變數所進行的正交轉換，得到第一個自變數的相對權數定義如方程式 (21) 所示，RIW 係數運算所涉及的各係數關係如圖 1 所示。

(21) $RIW_1 = \varepsilon_1 = \lambda_{11}^2\beta_1^2 + \lambda_{12}^2\beta_2^2 + \lambda_{13}^2\beta_3^2 + ... + \lambda_{1k}^2\beta_k^2$

從方程式 (20) 與 (21) 可知，RIW 係數主要是由兩組與代理變數 Z 有關的轉換係數 λ（由 $Z_k \rightarrow X_j$）與 β（由 $Z_k \rightarrow Y$）所構成，將 $\lambda_{jk}^2\beta_k^2$ 進行加總可得出屬於各 IV 對於依變數 Y 進行解釋的變異數比例。
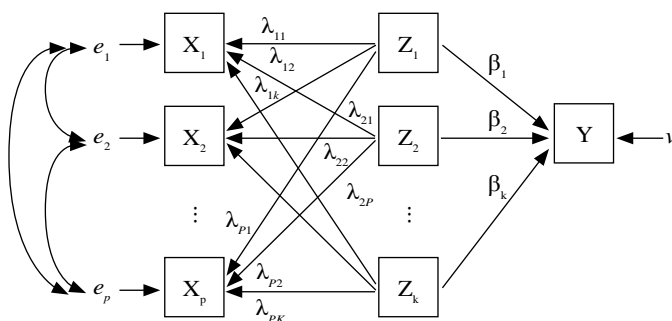
（修改自 Tonidandel, LeBreton, and Johnson (2009), p.390, Figure1）

圖 1 帶有 p 個自變數的 RIW 係數運算過程圖示

RIW 係數的演算程序與乘積指數類似，且 RIW 係數的總和等於整體模式解釋力，亦即 $\Sigma RIW = R^2$，使得 RIW 係數能對 R^2 進行正交分割而保持整體模型解釋力在固定的基準上，若將各 IV 的 RIW 係數除以 R^2，得到重新量尺化重要權數 (Rescaled Importance Weights)，亦即各 IV 分割 R^2 的比例（各 IV 的正交化解釋百分比）。

對於 RIW 係數的統計意義，Tonidandel et al. (2009) 發展出以拔靴程序為基礎的顯著性檢定法，除了能夠檢驗 RIW 係數是否顯著不為零的 NHST，也可建立 95% 信賴區間來進行 RIW 係數的差異比較。但是在小樣本（例如 $n < 30$）時即使以拔靴標準誤進行討論仍會有偏誤產生，因此必須在有相當充分樣本規模時才採用 (Tonidandel and LeBreton, 2011)。經過模擬研究（例如 LeBreton, Ployhart, and Ladd, 2004; LeBreton and

Tonidandel, 2008; Tonidandel and LeBreton, 2010）與實徵資料分析（例如 Cooper-Thomas, Paterson, Stadler, and Saks, 2014; LeBreton, Binning, Adorno, and Melcher, 2004; LeBreton, Hargis, Griepentrog, Oswald, and Ployhart, 2007; Periard and Burns, 2014），均證實 RIW 具有相對穩定的特質。尤其是在包含多個自變數甚至多個依變數的複雜迴歸模型中，即使變數多，RIW 的計算也並不困難 (LeBreton and Tonidandel, 2008)，為其重要優勢之一。

四、優勢分析

優勢分析 (Dominance Analysis; DA) 係基於決策理論 (Decision Theory) (French, 1988) 的觀點，利用 IV 投入迴歸方程式的多重比較歷程來判定 IV 的優劣次序，藉以決定各 IV 的相對重要性，Budescu (1993) 稱之為優勢性 (Dominance)。DA 與 RWA 的最大不同，在於 DA 的焦點並非參數估計的本身，而是各 IV 所創造的 R^2 增量，也正由於 DA 對於 IV 的優勢判斷並不涉迴歸係數，因此可避開係數比較上可能發生的問題。

DA 的估計原理係利用模型效果增量 (ΔR^2)，進行所有可能的 IV 組合所進行的迴歸分析的解釋力變化，藉以判定 IV 的相對重要性。對於特定兩個 IV 所進行的優勢分析可能會出現三種狀況：完全優勢 (Complete Dominance)、條件優勢 (Conditional Dominance) 與一般優勢 (General Dominance) (Azen and Budescu, 2003; Budescu, 1993)。其中完全優勢與條件優勢是以 IV 的排序來呈現，一般優勢則是以單一係數值 (D_g) 來反映各 IV 的平均解釋力，其數值高低也可用來排列各 IV 的影響力的優劣順序。三種優勢的定義如下：

完全優勢 ($\mathbf{D_{com}}$)。當涉及某個 IV 的各種可能次模型的模型解釋力，均大於涉及另一個 IV 的各種可能次模型的模型解釋力時，稱為完全優勢。例如假設有四個 IV：X_1、X_2、X_3、X_4，R_1^2 表示模型中僅帶有一個 X_1 的模型解釋力，R_{12}^2 表示模型中同時帶有 X_1 與 X_2 時的模型解釋力。若符合下列條件時，即為 X_1 對 X_2 為完全優勢，比較過程中排除了同時帶有 X_1 與 X_2 兩者的次模型，僅比較與 X_1 或 X_2 各自有關的次模型的 R^2，是 IV 配對比較最強的一種優勢。

第一階 (k = 1) $R_1^2 > R_2^2$ and
第二階 (k = 2) $R_{13}^2 > R_{23}^2$ and $R_{14}^2 > R_{24}^2$ and
第三階 (k = 3) $R_{134}^2 > R_{234}^2$

條件優勢 ($\mathbf{D_{cond}}$)。如果 X_1 與 X_2 兩者的解釋力的比較，在前述的三階關係中有任何一項不成立，表示 X_1 與 X_2 之間的完全優勢無法確立，換言之，在某特定情況下並不存在 X_1 優於 X_2 的關係，此時可將包含 X_1 與包含 X_2 的各次模型解釋變異，分就各階

次模型（包含有相同 IV 個數的次模型）分別加以平均後進行比較，若平均解釋力仍具有 $X_1 > X_2$，稱為各階之下 X_1 對 X_2 為條件優勢。

一般優勢 (D_g)。如果 X_1 對 X_2 的各階下條件優勢並非一致，但是將各階下與 X_1 及 X_2 的有關的各次模型解釋變異求取平均後，仍有 $X_1 > X_2$ 的結果，稱為 X_1 對 X_2 有一般優勢。換言之，一般優勢反映的是所有各自與某 IV 有關以及與之無關的各階次模型的解釋變異的平均差異量，是 IV 配對比較最弱的一種優勢，但也是三種優勢分析中，能夠反映各 IV 相對重要次序的單一優勢統計量。

前述三種優勢狀況比較所涉及的各種解釋變異量拆解如表 1 所示（為簡化說明，表中僅有 X_1、X_2、X_3 三個 IV）。完全優勢的判斷可以直接取「各階模式效果」中的整體解釋力來比較。該欄當中的 0 表示模型中沒有任何 IV 時（零階）的解釋變異量為 0，當模型中已有第一個 IV 時（一階）的解釋變異量為 R_1^2，已有第二個 IV 時的解釋變異量為 R_2^2，依此類推。當模型中已有 X_1 與 X_2 時（二階）的解釋變異量為 R_{12}^2，已有 X_1 與 X_3 時為 R_{13}^2，依此類推。當模型納入三個 IV 即為完整模型，總解釋變異量為 $R_{123}^2 = R_{Full}^2$。

由於表 1 帶有三個 IV，因此當 $R_1^2 > R_2^2$ 與 $R_{13}^2 > R_{23}^2$ 兩者成立時，X_1 對 X_2 的完全優勢即成立，可標示為 C+，或稱 X_2 對 X_1 為完全劣勢，標示為 C-。同理，當 $R_1^2 > R_3^2$ 與 $R_{12}^2 > R_{23}^2$ 兩者成立時，X_1 對 X_3 具有完全優勢，或 X_3 對 X_1 具有完全劣勢。

如果完全優勢無法確立，進一步的可以利用表 1 的各階累積效果增量的平均值來進行條件優勢的比較。如在橫列 (A) 中的 R_1^2、R_2^2、R_3^2 為模型中僅帶有一個 IV 的效果量，這三個解釋變異量即為零階相關係數的平方。如果模型中已經存在著一個 IV（例如 X_1），再增加一個 IV（例如 X_2）後所增加的解釋變異量為 $R_{1(2)}^2$；反之，如果模型中已經存在 X_2 後再增加 X_1，所增加的解釋變異量則為 $R_{2(1)}^2$，兩者的解釋變異加成關係具有對稱性：

(22) $R_{12}^2 = R_1^2 + R_{2(1)}^2 = R_2^2 + R_{1(2)}^2$

方程式 (22) 為帶有兩個 IV 的多元迴歸模型解釋力，後來額外投入的 IV 所創造的 R^2 增量稱為第一階 ($k = 1$) 增效，分別由 (a) 與 (b) 的效果量反映，求平均後可進行一階條件優勢分析 ($D_{cond,k=1}$)，數值較大者被視為在第一階具有條件優勢。同理，當模型中帶有兩個 IV 後再投入一個 IV，計算得出的 R^2 增量稱為第二階 ($k = 2$) 增效。針對各 IV 所計算得出的第二階平均增效，亦即 (c) 的平均值，可即為二階條件優勢 ($D_{cond,k=2}$)，數值較大者得視為在第二階具有條件優勢。

表 1 帶有三個 IV 的不同優勢層次的優勢分析結果摘述

已在模型的 IV	各階整體效果	額外投入 IV 的 R^2 增量			優勢判斷
		X_1	X_2	X_3	
$k = 0$					
無	0	R_1^2	R_2^2	R_3^2	
(A) 零階平均		R_1^2	R_2^2	R_3^2	←相關平方
$k = 1$					
X_1	R_1^2	-	(a)$R_{2(1)}^2$	(a)$R_{3(1)}^2$	
X_2	R_2^2	(a)$R_{1(2)}^2$	-	(b)$R_{3(2)}^2$	
X_3	R_3^2	(b)$R_{1(3)}^2$	(b)$R_{2(3)}^2$	-	
(B) 一階平均		Mean (a,b)	Mean (a,b)	Mean (a,b)	←條件優勢
$k = 2$					
$X_1 + X_2$	R_{12}^2	-	-	(c)$R_{3(12)}^2$	
$X_1 + X_3$	R_{13}^2	-	(c)$R_{2(13)}^2$	-	
$X_2 + X_2$	R_{23}^2	(c)$R_{1(23)}^2$	-	-	
(C) 二階平均		Mean (c)	Mean (c)	Mean (c)	←條件優勢
$k = 3$					
$X_1 + X_2 + X_3$	R_{123}^2	-	-	-	
(D) 整體平均		Mean (a,b,c)	Mean (a,b,c)	Mean (a,b,c)	←一般優勢

註：k 表示階層數，亦即模型中帶有幾個 IV。(a) 與 (b) 表示第一個階層 ($k = 1$) 的新增 IV 的解釋增量，(c) 表示第二個階層 ($k = 2$) 的新增 IV 的解釋增量。

　　最後，所有次模型增效的解釋變異求平均後（如橫列 (D) 所示）即可作為判定各 IV 的解釋變異量增效強弱，其數值即為一般優勢指數 (D_g)，也稱為變數重要性決定指數 (Determining Predictor Importance; DPI)。而橫列 (D) 當中的三個解釋變異量 (D_g) 相加後即為整體模型的解釋變異量R_{123}^2。

　　在 DA 的應用中，最常被拿來與其他指標進行比較的是一般優勢，因為 D_g 係數具有兩個重要特徵：第一，任何迴歸模型的任兩個 IV 必能辨識兩者的一般優勢（只有在小樣本或模擬數據等特殊狀態下，才可能會出現兩個完全相同影響力的 IV 而得出等價的結論而無法進行比較）。第二，D_g 的總和等於 R^2，換言之，個別 IV 的 D_g 為總體解釋變異的完全正交分割，此與 RIW 及乘積指數的性質相同。在一般情況下，RIW 與 D_g 數值以及對 IV 的重要性排序幾乎完全相同 (Kraha, Turner, Nimon, Zientek, and Henson, 2012; LeBreton, Ployhart, et al., 2004; LeBreton et al., 2007; Nimon and Oswald, 2013)。

　　綜合前面各節的討論，可以得知多元迴歸當中可以用來評估迴歸模型或個別 IV 效果的指標相當多元，但是各種指標的適用時機與計量特性並不相同，能夠反映 IV 的「相對重要性」的指標亦屬有限，各種效果統計量的內容摘述於表 2。其中各項指

表 2 各種主要效果量指標與係數的特性與使用時機

指標	整體模式	局部模式	個別效果	統計檢定	標準化	指標反映的內容
整體效果量						
解釋力 (R^2)	YES	YES		F	YES	反映模型的效果量,用於反映整體模式或局部模型的解釋力與重要性
調整後解釋力 (R^2_{adj})	YES	YES			YES	反映模型的不偏效果量,用於反映整體模式或局部模型的解釋力與重要性
Cohen 效果量 (f^2)	YES	YES				反映模型的效果量,用於反映整體模式或局部模型的解釋力與重要性
殘差效果量 (ES_e)	YES	YES			YES	反映模型的效果量,用於反映整體模式或局部模型的解釋力與重要性
個別效果量						
零階相關 (r)			YES	t	YES	未考慮 IV 間關係的線性關係強度,用於描述 IV 與 DV 的原始關聯
淨相關 (r_p)			YES	t	YES	考慮所有變數間關係的線性關係強度,用於描述 IV 與 DV 的淨關聯
半淨相關 (r_{sp})			YES	t	YES	考慮 IV 間關係的線性關係強度,用於反映 IV 共線性的威脅
結構係數 (r_s)			YES	t	YES	未考慮 IV 間關係的線性關係強度,但可反映 IV 與模型預測值結構對應關係
未標準化係數 (b)			YES	t		考慮 IV 間關係,用於描述 IV 與 DV 均為原始量尺下的迴歸效果,可建立迴歸方程式與顯著性檢定
標準化係數 (β)			YES	*	YES	考慮 IV 間關係,用於描述 IV 與 DV 均為標準量尺下的迴歸效果與相互比較
乘積指數 ($r\beta$)			YES	*	YES	考慮 IV 間關係,對 R^2 正交分割,一般情況下可用於 IV 相對重要性比較
優勢分析						
完全優勢 (D_{com})			YES			考慮 IV 間關係,對 R^2 正交分割,可詳細檢驗各階層的解釋力變化,反映多元共線性的影響,適合 IV 相對重要性比較,且應用彈性大
部分優勢 (D_{cond})			YES			
一般優勢 (D_g)			YES	*	YES	
相對權數分析						
相對權數 (RIW)			YES	*	YES	考慮 IV 間關係,對 R^2 正交分割,可反映多元共線性的影響,適合 IV 相對重要性比較

註:* 表示雖然沒有抽樣分配得以進行顯著性檢定,但可利用拔靴法來建立標準誤,進而進行顯著性檢驗與差異比較。標準化是指係數未帶有測量單位或具有固定值域範圍。

標可概分成三類：適用於模式本身的整體解釋力或局部解釋的效果量、個別自變數的效果量與相對重要性指標。這些統計量如果能夠建立抽樣分配，即可使用 NHST 進行參數意義的統計顯著性檢定與區間估計，例如 R^2 可使用 F-test，相關係數與迴歸係數使用 t-test。如果參數的抽樣分配不明確（例如一般優勢指數 D_g 與 RIW 數值），則必須以拔靴法來建立信賴區間，同樣也可以進行區間估計。

　　值得注意的是，由於各指數所排列的 IV 優劣次序通常不一致，對於 IV 何者重要的判斷必須訴諸主觀，因此經常造成研究者在比較與解釋上的困擾。後期學者則致力於提出單一指標與客觀策略來進行相對重要性的判斷，然而許多學者仍主張乘積係數是 IV 相對貢獻高低的主要指標（溫福星，2013；Fields, 2003; Nimon and Oswald, 2013），但近來學者則多主張以 DA 與 RWA 來取代。本文也即是針對相對重要性的核心議題，亦即多元共線性的不同型態，進行探討。

參、多元共線性與壓抑效果

一、共線性的定義與效果分類

　　多元共線性 (Multicollinearity) 問題源自於迴歸分析當中所存在的壓抑效果 (Suppression Effect) 的關注。Horst (1941) 最早發現，某個與 DV 無關的 IV，會因為後來投入的其他 IV 而發生整體效果量提升且係數放大的現象，因而將之定義為壓抑變數 (Suppressor)，因為後來投入的 IV「壓抑」了殘差，使得原來的迴歸效果產生變化。為了區分不同形式的係數變化關係，Conger (1974) 進一步定義出三種不同形式的壓抑效果：傳統壓抑 (Tradiational Suppression)、負向壓抑 (Negative Suppression) 與交互壓抑 (Reciprocal)，對於這三個概念，Cohen and Cohen (1975) 則稱之為典型壓抑 (Classical Suppression)、淨壓抑 (Net Suppression) 與合作壓抑 (Cooperative Suppression)。其中傳統／典型壓抑即是指 Horst (1941) 所發現的係數由不顯著成為顯著的現象，負向壓抑則是指原本對於 DV 有正（負）相關的 IV 在迴歸模型中卻得到負（正）向迴歸係數的逆轉現象 (Darlington, 1968)。最後，交互／合作壓抑則是指兩個 IV 均與 DV 具有正相關，但因為 IV 間存在的負相關而導致兩個 IV 的效果均提升的現象，相關較低者被視為主要的壓抑變數。

　　Conger (1974) 與 Darlington (1968) 等學者對於壓抑效果的定義，皆關注於迴歸與相關係數的比較，亦即 $|\hat{\beta}_{Y1}| > |r_{Y1}|$。其他學者（例如 Currie and Korabinski, 1984; Hamilton, 1987; Schey, 1993; Sharpe and Roberts, 1997; Velicer, 1978）則從模型解釋力的增減來定義壓抑效果，亦即 $R^2 > (r_{Y1}^2 + r_{Y2}^2)$，其中 r_{Y1} 與 r_{Y2} 為 IV1 及 IV2 與 DV 的零階相關。Friedman and Wall (2005) 整合兩者的概念，將壓抑效果再區分成增強 (Enhancement)、壓抑 (Suppression) 與重疊 (Redundancy) 三種型態，並整合統計學者（例如 Lynn, 2003; Neill, 1973; Shieh, 2001; Sharpe and Roberts, 1997）的推導整理出三者發生的條件，如圖 2 所示。
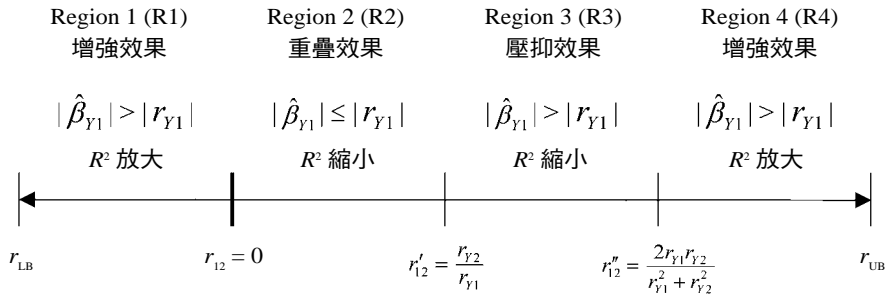
圖 2 不同共線性效果與發生條件圖示

    圖 2 中的橫軸是指兩個 IV 之間的相關強度 (r_{12})，橫軸兩端點 r_{LB} 與 r_{UB} 為當 r_{Y1} 與 r_{Y2} 給定時，r_{12} 存在有正定意義 (Nonnegative Definite) (Neill, 1973; Sharpe and Roberts, 1997) 的下界 (Lower Bound) 與上界 (Upper Bound)，定義於方程式 (23) 與 (24)。

$$(23)\ r_{LB} = r_{Y1}r_{Y2} - \sqrt{(1-r_{Y1}^2)(1-r_{Y2}^2)}$$

$$(24)\ r_{UB} = r_{Y1}r_{Y2} + \sqrt{(1-r_{Y1}^2)(1-r_{Y2}^2)}$$

    圖 2 橫軸上的 r_{12} 數值可被三個臨界值區分成四個區域（由 R1 至 R4 表示）：第一個臨界值是 $r_{12} = 0$，亦即區分 IV 間的相關係數為負值或正值的分割點，另二個臨界值為 r_{Y1} 與 r_{Y2} 的比值，亦即相關比 (Ratio of Correlation) (Lynn, 2003; Shieh, 2001)，存在於 $r_{Y1} > r_{Y2}$（標示為 r'）與 $(r_{Y1}^2 + r_{Y2}^2) < 1$（標示為 r''）的條件下。r' 與 r'' 定義於方程式 (25) 與 (26)。

$$(25)\ r_{12}' = \frac{r_{Y2}}{r_{Y1}}$$

$$(26)\ r_{12}'' = \frac{2r_{Y1}r_{Y2}}{r_{Y1}^2 + r_{Y2}^2}$$

    Friedman and Wall (2005) 利用圖 2 的數學關係定義出三種不同共線性效果的四種狀況。其中增強效果發生在 R1 與 R4 兩個區間內，之所以稱之為「增強」，即因為在這兩個區間內均會發生迴歸係數與 R^2 均放大的「效果擴張」效應 (Currie and

Korabinski, 1984) 或一種正向綜效 (Synergism) (Shieh, 2001; Sharpe and Roberts, 1997; Sharpe and Ali, 2009)，也即符合 Horst (1941) 及 Conger (1974) 所定義的典型壓抑。由圖 2 可知，增強效果可發生於兩種條件下，其中 R1 是指當 IV 間存在負相關時（亦即交互壓抑），R4 則是當 IV 存在高度正相關時。

至於 R3 則是指兩個 IV 之間的正相關所造成的迴歸係數擴張但 R^2 降低的壓抑效果，此一現象可說是模式解釋力被「壓抑」的一種正名。最後，重疊效果 (R2) 雖不被認為帶有壓抑效果 (Cohen et al., 2003; Tzelgov and Henik, 1991)，但普遍常見於當 IV 具有相關時所可能會發生的迴歸係數降低而 R^2 也降低的共線性效果。

二、多元共線性的估計

至於如何判定共線性的強弱，若基於圖 2 的臨界值法則來看，隨著 IV 與 DV 的相關強度的不同，會發生哪一種效果的臨界值並不相同。但一般而言，當自變數間的相關達到 .85 以上即具有明顯的共線性威脅 (Dillon and Goldstein, 1984)，更常用的判定方式則是透過由容忍值 (Tolerance) 或變異數膨脹因素 (Variance Inflation Factor; VIF) (Cohen et al., 2003; Pedhazur, 1997)，如方程式 (27) 所示。

$$(27)\ VIF = \frac{1}{Tolerance} = \left(\frac{1}{1-R_i^2}\right)$$

容忍值為各自變數 IV 自身作為 DV，對自己以外的其他 IV 作迴歸後的迴歸殘差，亦即 $1-R_i^2$，而 VIF 則為容忍值的倒數：當容忍值越高，VIF 越小，表示 IV 的獨立性越高，共線性問題越緩和。Cohen et al. (2003) 認為當 VIF 大於 10 以上為嚴重共線性，Sellin (1990) 主張 VIF 達 2 以上即不能忽略共線性威脅。

為探討多元共線性對於 IV 相對重要性指標的影響，本文將採 Friedman and Wall (2005) 的定義方式，以模擬數據探討增強 (R1 與 R4)、重疊 (R2)、壓抑 (R3) 這三種典型的共線性效果下，各種評估指標的表現。

肆、模擬數據分析

一、模擬分析的設定

為了說明效果量與各種指標的性質與關聯性，並檢驗 IV 之間不同型態的共線性關係如何影響這些指標的估計結果，本節依照 Nimon and Oswald (2013) 的模擬方式，建立 N = 1000、IV = 4、DV = 1 的 N (0,1) 標準常態分配模擬資料母體，進行重複拔靴抽樣 1,000 次的模擬分析。分析工具為 R (R Development Core Team, 2014)，以 yhat 模

組 (Nimon, Oswald, and Roberts, 2014) 進行迴歸分析與 RWA 及 DA 分析，並以 boot 模組 (Canty and Ripley, 2014) 進行重複取樣得到偏誤校正 (Bias Corrected Accelerated; BCA) 拔靴標準誤，藉以建立 95% 信賴區間，分析語法請見附錄。

　　由於模擬資料帶有四個 IV，而且 IV 與 DV 的相關平方總和必須小於 1.00，因此參酌 Friedman and Wall (2005) 的推導 (Figure 3, p.130)，將 IV 與 DV 的相關設定為 .6、.4、.2、.0，藉此得到最大的有效上下界。四個 IV 可形成六種 IV 組合，IV 間相關的正解上下限介於 -.917 至 .980 之間，各種組合的共線性狀態臨界值 r' 與 r'' 如表 3 所示。

表 3 各種模擬狀況的設定條件

| 各模擬 IV 配對下 | | IV 間相關上下界 [2] | | | | IV 間相關的模擬設定 | | |
IV 與 DV 間相關 [1]		r_{LB}	r_{UB}	r'	r''	Case1	Case2	Case3
$r_{Y1} = .60$	$r_{Y2} = .40$	-.493	.973	.667	.923	.00	.90	.00
$r_{Y1} = .60$	$r_{Y3} = .20$	-.664	.904	.333	.600	.00	.40	.80
$r_{Y2} = .40$	$r_{Y3} = .20$	-.818	.978	.500	.800	.00	.40	.00
$r_{Y1} = .60$	$r_{Y4} = .00$	-.800	.800	.000	.000	.00	.00	.00
$r_{Y2} = .40$	$r_{Y4} = .00$	-.917	.917	.000	.000	.00	.00	-.50
$r_{Y3} = .20$	$r_{Y4} = .00$	-.980	.980	.000	.000	.00	.00	.00

註 1：IV1 至 IV4 四個 IV 可形成六種 IV 組合。表中數值為各 IV 與 DV 的相關係數。
註 2：r_{LB} 與 r_{UB} 係依方程式 (24) 所導出 IV 間有效相關的上下界，當 IV 間相關超出此範圍時無法求得迴歸正定解。r' 與 r'' 分別為重疊 (R2)、壓抑 (R3) 與增強 (R4) 效果的分割點。

　　根據前述所設計的母體結構並參考 Courville and Thompson (2001) 的設計方法，本節的模擬分析將建立三種不同的多元共線性情境：

1. Case1（IV 間獨立）：此一情境為無共線性的自變數獨立狀態，因此各 IV 間的相關設定為 0，作為基準模型。

2. Case2（IV 間相依且 R^2 降低）：此一情境涉及重疊與壓抑兩種效果。IV 間相關若介於 r' 與 r'' 之間將獲得壓抑效果 (R3)，因而透過令 $r_{12} = .9$ 與 $r_{13} = .4$ 來達成；IV 間相關若低於 r' 並大於 0 將獲得重疊效果 (R2)，因而透過令 $r_{23} = .4$ 來達成。

3. Case3（IV 間相依且 R^2 增加）：此一情境涉及兩種增強效果，IV 間相關大於 r'' 將獲得增強效果 (R4)，可透過令 $r_{13} = .90$ 達成；IV 間為負相關將獲得增強效果 (R1)，可透過令 $r_{24} = -.5$ 來達成。

表 4　模擬資料的相關矩陣與效果量及相對重要性指標摘要表

Case1 自變數獨立（無共線性）

母體相關係數

	DV	IV1	IV2	IV3	IV4
DV	1.00				
IV1	.600	1.00			
IV2	.400	.000	1.00		
IV3	.200	.000	.000	1.00	
IV4	.000	.000	.000	.000	1.00

相關指數

	VIF	r^2	r_p^2	r_{sp}^2	r_s^2
IV1	1.00	.360	.450	.360	.643
IV2	1.00	.160	.267	.160	.286
IV3	1.00	.040	.083	.040	.071
IV4	1.00	.000	.000	.000	.000
Total		.560	.800	.560	1.000

迴歸與相對重要性指數

	β	$β^2$	rβ	Dg	RIW
IV1	.600	.360	.360	.360	.360
LL	.562		.320	.319	.319
UL	.635		.401	.401	.401
IV2	.400	.160	.160	.160	.160
LL	.359		.126	.126	.126
UL	.441		.196	.196	.196

Case2 自變數相依（壓抑／重疊效果）

母體相關係數

	DV	IV1	IV2	IV3	IV4
DV	1.00				
IV1	.600	1.00			
IV2	.400	.900	1.00		
IV3	.200	.400	.400	1.00	
IV4	.000	.000	.000	.000	1.00

相關指數

	VIF	r^2	r_p^2	r_{sp}^2	r_s^2
IV1	5.32	.360	.360	.301	.778
IV2	5.32	.160	.159	.101	.346
IV3	1.20	.040	.000	.000	.086
IV4	1.00	.000	.000	.000	.000
Total		.560	.519	.403	1.210

迴歸與相對重要性指數

	β	$β^2$	rβ	Dg	RIW
IV1	1.266	1.602	.759	.325	.319
LL	1.178		.689	.292	.287
UL	1.357		.835	.358	.352
IV2	-.734	.539	-.294	.125	.125
LL	-.832		-.333	.112	.112
UL	-.632		-.257	.139	.139

Case3 自變數相依（增強效果）

母體相關係數

	DV	IV1	IV2	IV3	IV4
DV	1.00				
IV1	.600	1.00			
IV2	.400	.000	1.00		
IV3	.200	.800	.000	1.00	
IV4	.000	.000	-.500	.000	1.00

相關指數

	VIF	r^2	r_p^2	r_{sp}^2	r_s^2
IV1	2.78	.360	.720	.538	.456
IV2	1.33	.160	.505	.213	.203
IV3	2.78	.040	.510	.218	.051
IV4	1.33	.000	.203	.053	.000
Total		.560	1.939	1.022	.709

迴歸與相對重要性指數

	β	$β^2$	rβ	Dg	RIW
IV1	1.222	1.494	.733	.449	.449
LL	1.163		.675	.416	.416
UL	1.278		.792	.478	.479
IV2	.533	.284	.213	.187	.187
LL	.494		.178	.156	.155
UL	.573		.248	.218	.219

	Case1 自變數獨立 （無共線性）					Case2 自變數相依 （壓抑／重疊效果）					Case3 自變數相依 （增強效果）				
	DV	IV1	IV2	IV3	IV4	DV	IV1	IV2	IV3	IV4	DV	IV1	IV2	IV3	IV4
	β	β²	rβ	Dg	RIW	β	β²	rβ	Dg	RIW	β	β²	rβ	Dg	RIW
IV3	**.200**	**.040**	**.040**	**.040**	**.040**	**-.013**	**.000**	**-.003**	**.014**	**.019**	**-.778**	**.605**	**-.156**	**.129**	**.129**
LL	.161		.024	.025	.025	-.066		-.010	.008	.012	-.836		-.200	.120	.120
UL	.242		.059	.059	.059	.040		.011	.025	.033	-.727		-.108	.138	.138
IV4	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.267**	**.071**	**.000**	**.027**	**.027**
LL	-.042		.000	.000	.000	-.050		.000	.000	.000	.231		-.015	.020	.020
UL	.041		.003	.003	.003	.042		.004	.004	.004	.302		.017	.036	.038
總和		.560	.560	.560	.560	2.141	.463	.463	.463	.463	2.454	.791	.791	.791	.791
整體模型	R^2 = .560, adjR^2 = .558 Cohen's f^2 = 1.273					R^2 = .463, adj$R^2$2 = .461 Cohen's f^2 = .862					R^2 = .791, adjR^2 = .790 Cohen's f^2 = 3.784				

註：表中符號 VIF：變異膨脹係數，r：零階相關，r_p：淨相關，r_{sp}：半淨相關，r_s：結構係數，β：標準化迴歸係數，rβ：乘積係數，D_g：一般優勢指數，RIW：相對重要權數。UL 與 LL 為 1,000 次偏差校正拔靴法抽樣得出的 95% 區間估計上下限。

二、模擬資料的查核

根據前述設定所創造的三種模擬資料母體的相關係數列於表 4 上方。在 Case1 中，IV 間相關設定為 0，變數間完全沒有共線性（各 IV 的 VIF = 1.0），迴歸模型的 $R^2 = \Sigma r^2 = .6^2 + .4^2 + .2^2 + 0^2 = .56$，迴歸係數、相關係數、半淨相關係數數值相等。

Case2 為 R^2 降低的共線性設計，因而 R^2 由 .560 降至 .463。由於 $r_{12} = .90$，使 IV1 與 IV2 的 VIF 高達 5.32（高度共線）；$r_{13} = r_{23} = .40$，因此 IV3 為微弱共線性 (VIF = 1.2)；$r_{14} = r_{24} = r_{34} = .00$，故 IV4 完全沒有共線性問題 (VIF = 1)。估計結果得到迴歸係數分別為 1.266、-.734、-.013、.000，顯示除了 IV4 不受影響之外，IV 間的共線性在 IV1 與 IV2 造成係數擴張的壓抑效果，在 IV3 造成係數降低的重疊效果，其中有兩個係數出現由正轉負的負向壓抑 (IV2 與 IV3)，符合壓抑與重疊效果的模擬設定。

Case3 利用 $r_{13} = .8$，$r_{24} = -.5$ 來模擬 R^2 擴大的 R1 與 R4 兩種增強效果，四個 IV 的 VIF 僅為 2.78、1.33、2.78、1.33，雖非高度共線，但 Case3 的 R^2 增至 .791，迴歸係數均較零階相關係數放大甚多，從 .6、.4、.2、.0 放大至 1.222、.533、-.778、.267，顯示 Case3 的共線性設計與交互壓抑確實造成了迴歸係數與 R^2 同時放大的兩種增強效果，模擬設計目的均已達成。

三、模型效果與係數比較

（一）自變數獨立 (Case1)

由表 4 可知，當自變數之間無共線性時，$R^2 = .560$，恰為各 IV 與 DV 相關係數與半淨相關平方和，亦等於迴歸係數平方和。個別 IV 的效果或相對重要性，不論是以何種指標來判別，均得到相同重要性次序結果。特別是結構係數平方和恰為 1.00，r_s^2 數值大小恰反映各 IV 對於整體效果 R^2 的分割比例：64.3%、28.6%、7.1% 與 0%，與乘積係數、D_g 與 RIW 皆相同，顯示 Case1 的各項指標皆反映相同的 IV 強弱意義與排序，IV1 > IV2 > IV3 > IV4，與母體初始設定相同。

（二）自變數相依（壓抑／重疊效果）(Case2)

依據 Case2 的設定，IV 間存在一定程度的共線性，使得 R^2 由 .560 降至 .463，IV 之間的相關吸收了 DV 解釋變異的 17.3%，且迴歸係數產生明顯改變。四個 IV 與 DV 的相關原為 .6、.4、.2、.0，標準化迴歸係數成為 1.266、-.734、-.013、.000，IV1 係數變化最為劇烈，甚至超過 1.0 的正常範圍，而 IV2 的迴歸係數不僅增強，更由正轉負，顯示 IV1 與 IV2 間的相關設定引發了非正定現象與負向壓抑。至於 IV3 僅涉及低度的 IV 間相關，IV4 更無關於共線性，因此與 IV3 有關的係數雖有上升但變化不大，IV4 因為不涉及任何共線性設定因此係數指標則不受任何影響。

Case2 所設定的共線性使淨相關、半淨相關與迴歸係數均發生符號由正轉負的劇烈變動，各 IV 解釋比例也無法維持。結構係數的平方和不再是 1.00 而成為 1.210，但

四個 IV 所佔的百分比仍固定不變（與相關係數平方相同），顯示結構係數無法反映任何因為共線性所造成的變動。由此可知，相關與結構係數對於 IV 間的相關並無任何的反映能力，相對之下，迴歸係數與其他帶有淨效果處理的係數則變動劇烈而不適合用來進行 IV 的相對比較。

至於乘積指數、D_g 與 RIW 三者，係數總和皆等於 R^2 = .463，亦即三者皆能對於 R^2 進行正交分割，但是乘積指數卻因為共線性而出現相關與迴歸係數異號而發生負數，數值分割比分別為 .759 (164.3%)、-.294 (-63.6%)、-.003 (-.6%)、.000 (0%)，分割比例完全失效。至於 D_g 與 RIW 兩者數值幾乎完全相同，IV1 與 IV2 間所存在的高相關引發係數擴大，使得解釋比例略微放大，符合壓抑效果的特徵，而 IV3 基於重疊效果設定而存在係數降低現象，IV4 則完全不受影響。D_g 與 RIW 的 95% 信賴區間皆無重疊現象，顯示這兩個指標能適度反映共線性影響但又能維持 IV 重要性的排序，正確判讀 IV1 > IV2 > IV3 > IV4 的次序關係，分割比例具有判定 IV 相對重要性的價值。

（三）自變數相依（增強效果）(Case3)

Case3 在兩組 IV 的配對上分別設定了兩種增強效果條件，使得 R^2 大幅增加至 .791，ΔR^2 = .231。四個 IV 的迴歸係數也均高於相關係數，證實模型中確實存在兩種增強效果，其中 IV1 與 IV3 兩者之間的 .8 雖然相關不至於太高（VIF 僅為 2.78），但卻造成迴歸係數放大至 1.222 的非正定水準，且 IV3 更發生正負異號的負向壓抑現象。至於 IV2 與 IV4 兩者之間的負相關亦使迴歸係數放大，顯示 IV 產生綜效而使迴歸係數與 R^2 放大。

在結構係數部分得到與前述 Case2 類似的結果，亦即平方和不再是 1.00，但各 IV 分割比例卻仍與相關係數平方完全相同，顯示結構係數與相關係數屬於相同的指標，無法反映共線性的影響。同樣的，乘積指數仍受制於係數異號而無法反映 IV 的解釋力。

Case3 的 D_g 與 RIW 數值完全相同，在 R1 與 R4 兩種增強效果上皆能維持理想的正交分割與解釋比例。雖然多元共線性的影響劇烈，四個 IV 的相對重要性指數上升到 .449 (56.8%)、187 (23.6%)、129 (16.3%)、.027 (3.41%)，增加幅度為 .089、.027、.089、.027，增幅在 IV1 與 IV3 之間，以及在 IV2 與 IV4 之間呈現平均分配，合計恰為 ΔR^2，各係數的 95% 信賴區間均不重疊，IV 相對重要性次序維持一致，再次反映了 D_g 與 RIW 能適度反映多元共線性的影響。

（四）綜合比較與優勢分析

綜合前述模擬數據的分析結果，可以得知當 IV 獨立時，不論以任何係數或指標，均可有效反映各 IV 的相對重要性，但是如果 IV 間存在相當程度的相關，除了乘積指數、D_g 與 RIW 之外，各指標無法針對 R^2 進行完整的正交分割，係數數值變動劇烈，無法一致地判定 IV 相對重要性。其中結構係數與相關係數性質完全相同，乘積指數則因異號問題而失效，兩者亦不適合於在 IV 存在多元共線性時作為相對重要性的評

估指標。模擬結果顯示，僅有 D_g 與 RIW 對於共線性的反映相對穩定，不論是哪一種多元共線性狀態所造成的解釋力變動，均可適度被 D_g 與 RIW 吸收。

　　前述的討論曾提及，優勢分析的一個主要優點是能夠進行三種優勢比較來確立自變數在各種組合下的優勢狀態，提供更詳細的 IV 解釋力的資訊。由表 5 的優勢比較結果可知，雖然一般優勢在三種模擬狀況下均穩定地反映了 IV1 > IV2 > IV3 > IV4 的次序關係，但是在 Case3 中卻可發現 IV2 與 IV3 及 IV3 與 IV4 兩組 IV 的完全優勢無法確立。進一步地從第三階的條件優勢可以看出，當模型已經存在另三個 IV 的情況下，再投入 IV2 的增量 (ΔR^2 = .213) 不如 IV3 (ΔR^2 = .218)，顯示完全優勢無法成立的原因是發生在第三階的投入，但平均而言，IV2 的一般優勢 (D_g = .187) 仍比 IV3 (D_g = .129) 來的高，顯示 IV2 較 IV3 來得重要。由此可知，DA 能透過不同階層的優勢比較來判定 IV 組合的影響力，即為 Budescu and Azen (2004) 所主張 DA 優於其他指標的優勢所在。

表 5 RWA 與優勢分析的絕對優勢、條件優勢與一般優勢比較結果摘要表

	r	β	完全優勢				條件優勢				一般優勢	RIW
			IV1	IV2	IV3	IV4	K = 0	K = 1	K = 2	K = 3		
Case1 IV1	.600	.600	-	C+	C+	C+	.360	.360	.360	.360	.360	.360
IV2	.400	.400		-	C+	C+	.160	.160	.160	.160	.160	.160
IV3	.200	.200			-	C+	.040	.040	.040	.040	.040	.040
IV4	.000	.000				-	.000	.000	.000	.000	.000	.000
Total							.560	.560	.560	.560	.560	.560
Case2 IV1	.600	1.266	-	C+	C+	C+	.360	.328	.309	.301	.325	.319
IV2	.400	-.734		-	C+	C+	.160	.128	.109	.101	.125	.125
IV3	.200	-.013			-	C+	.040	.015	.001	.000	.014	.019
IV4	.000	.000				-	.000	.000	.000	.000	.000	.000
Total							.560	.471	.419	.403	.463	.463
Case3 IV1	.600	1.222	-	C+	C+	C+	.360	.419	.479	.538	.449	.449
IV2	.400	.533		-	?	C+	.160	.178	.196	.213	.187	.187
IV3	.200	-.778			-	?	.040	.099	.159	.218	.129	.129
IV4	.000	.267				-	.000	.018	.036	.053	.027	.027
Total							.560	.714	.870	1.022	.791	.791

註： 完全優勢比較結果以 C+ 表示完全優勢，? 表示無法確立。K 代表 DA 的比較階層，K = 0 表示僅有單一 IV 存在迴歸方程式，K = 1 表示已投入任一個 IV 後額外投入一個 IV 的解釋增量平均值，依此類推。

伍、實徵資料分析

一、資料庫與研究變數

前一節以模擬數據來進行共線性問題對於 IV 相對重要性評估的影響。本節則另以華人家庭動態資料庫 (Panel Study of Family Dynamics; PSFD) 所釋放的 2011 年度資料，進行臺灣民眾薪資所得影響因素的實徵數據迴歸分析。在理論基礎上則是依循勞動經濟學中以人力資本理論為基礎，建立薪資迴歸模型，納入不同的人口統計背景變數或人力資本要素來對薪資差異進行解釋。

本節所使用的依變數為受訪者的薪資所得資料，問題為「您這份工作平均每個月的總收入（如：薪資、紅利、加班費、年終獎金、執行業務收入、自營收入等）有多少？」，分析時沿用一般勞動經濟學者（例如 Budig and England, 2001; Glauber, 2007; Waldfogel, 1997）的處理方式，取「薪資對數值」來作為迴歸的依變數。

自變數部分，除了年資、工時與教育年數三個人力資本變數，並將性別、年齡、婚姻狀態與子女數等人口變數納入作為控制變數。其中「教育年數」係將各教育層級轉換成受正式教育年數，「每週工時」則由「您這份工作平均每週大約工作幾個小時？」獲得，各變數的描述統計與相關係數列於表 6。

原資料庫中共有 4,885 筆（主樣本人數 3,983 人，子女樣本 902 人），女性 2,295 人（佔 47%），男性 2,590 人（佔 53%），平均年齡 42.5 歲 (SD = 15.03)。為使分析聚焦，分析時限定於投入職場有正式工作者，年齡範圍為年滿 25 歲至 65 歲強制退休為止。根據編碼簿所設定的無固定工作、無法回答明確薪資（收入不固定無法回答）者或在國外工作者亦不納入分析，最後的有效樣本為 2,325 人，女性 950 人（佔 40.9%），男性 1,375 人（佔 59.1%），平均年齡 37.09 歲 (SD = 9.71)。全體平均薪資為 41,689 元 (SD = 26,640)，取對數後為 4.56。

表 6 實徵資料的描述統計與相關係數 (N = 2,325)

	M	SD	VIF	Y	X1	X2	X3	X4	X5	X6
Y 薪資對數	4.56	0.22	-	**1.000**						
X1 性別	0.59	0.49	**1.05**	**.237****	1.000					
X2 年齡	37.09	9.71	**2.65**	**-.012**	.026	1.000				
X3 已婚	0.59	0.49	**2.04**	**.025**	-.044*	.485**	1.000			
X4 小孩數	1.00	1.16	**3.09**	**-.085****	-.041	.687**	.713**	1.000		
X5 在職年資	7.13	8.07	**1.64**	**.177****	.063**	.621**	.331**	.457**	1.000	
X6 每週工時	47.66	13.38	**1.07**	**.181****	.179**	-.078**	-.009	-.001	-.021	1.000
X7 教育年數	19.77	3.10	**1.41**	**.370****	-.019	-.490**	-.313**	-.476**	-.299**	-.093**

註：性別變數女性編碼為 0，男性編碼為 1。已婚變數以未婚編碼為 0，兩者為二分虛擬變數。

　　* $p < .05$　**$p < .01$

二、分析程序與假設檢驗

實徵資料的分析程序延續前一節的模擬分析，以 R 軟體的 yhat 模組進行多元迴歸、優勢分析、相對權數分析的參數估計，95% 信賴區間則以 boot 模組進行 1,000 次重複取樣的偏誤校正拔靴標準誤來建立。由於 PSFD 所提供的檔案格式為 SPSS 資料庫，因此對於資料的整理與轉換則由 SPSS 軟體進行，並利用 SPSS 的迴歸功能進行殘差分析。

殘差分析結果顯示，未標準化殘差平均數為 10^{-7}，標準差為 .177，偏態與峰度係數分別為 .031 與 4.44，顯示殘差呈現高度集中但是輕微正偏的分配。在 2,325 個觀察值中，僅有 65 筆標準化殘差大於 1.96，60 筆小於 -1.96，經殘差期望機率 QQ 圖與累積機率 PP 圖的檢視，除了少數極端殘差之外，其餘標準化殘差呈現對角直線，各 IV 與 DV 的淨殘差圖則平均散佈，顯示各 IV 的殘差沒有特殊型態，依據一般建議的檢驗程序（例如 Cohen et al., 2003; Hair et al., 2006），本節所執行的多元迴歸殘差分配尚屬對稱常態分配。

三、分析結果

由表 7 可知，「年齡」與「已婚」兩者與薪資無關，其他各 IV 除了「小孩數」(r = -.085) 之外均為正值且達顯著水準，相關強弱依序為「教育年數」(r = .370)、「性別」(r = .237)、「每週工時」(r = .181) 與「在職年資」(r = .177)。

在共線性部分，IV 間相關最高者依序為「已婚者」與「小孩數」(r = .713)、「年齡」與「小孩數」(r = .687)、「年齡」與「在職年資」(r = .621)。VIF 數值顯示「小孩數」的多元共線性最強 (VIF = 3.09)，其次為「年齡」(VIF = 2.65) 與「已婚」(VIF = 2.04)。「教育年數」與各 IV 間為負相關（介於 -.019 至 -.490），「每週工時」也有類似現象，意味著這些 IV 投入模型將造成增強效果。由表 7 的迴歸分析結果即可得知，整體模型的解釋力 R^2 = .332 ($F(7, 2317)$ = 164.52, p < .001)，強度高於 IV 與 DV 的相關平方和 (Σr^2 = .265)，迴歸係數的絕對值除了「性別」之外均高於相關係數絕對值，顯示 IV 間的多元共線性造成解釋力增加的增強效果。

由迴歸係數絕對值來看，各 IV 排序為 7 > 5 > 6 > 1 > 3 > 4 > 2，與淨相關與半淨相關平方的排序相同，但與相關係數及結構係數的排序 (7 > 1 > 6 > 5 > 4 > 3 > 2) 差異甚大（相關係數與結構係數排序與分割比率完全相同）。因而可知迴歸係數的本質是將 IV 間的關係完全排除，但相關與結構係數則完全沒有排除。

IV 影響力排序的另一種順序關係則是發生在三種相對重要性指標中，其共同特徵是皆能對總體效果量進行正交分割，D_g 與 RIW 依序為 7 > 5 > 1 > 6 > 4 > 2 > 3，乘積指數絕對值排序則為 7 > 5 > 1 > 6 > 4 > 3 > 2，僅在最後兩個 IV 排序略微不同，也即是因為「年齡」由負轉正值 (β = .097, p < .001) 發生相關與迴歸係數異號現象，使得相

對重要性的排序發生困難。因此可知 D_g 與 RIW 較乘積指數更能適當反映 IV 間的共變結構來判定 IV 相對重要性的指標。

表 7 薪資對數迴歸分析的各 IV 效果量及相對重要性指標摘要表

相關指標	r	r^2	r_p	r_p^2	r_{sp}	r_{sp}^2	r_s^2	%
X1 性別	.237	.056	.223	.050	.187	.035	.170	21.2%
X2 年齡	-.012	.000	.072	.005	.059	.004	.000	0.1%
X3 已婚	.025	.001	.130	.017	.108	.012	.002	0.2%
X4 小孩數	-.085	.007	-.094	.009	-.077	.006	.022	2.7%
X5 在職年資	.177	.031	.251	.063	.212	.045	.094	11.8%
X6 每週工時	.181	.033	.239	.057	.201	.040	.099	12.4%
X7 教育年數	.370	.137	.461	.212	.424	.180	.413	51.6%
總和		**.265**		**.413**		**.321**	**.799**	**100%**
迴歸指標	β	$β^2$	rβ	%	Dg	%	RIW	%
X1 性別	.191	.037	.045	13.6%	.046	13.8%	.047	14.0%
X2 年齡	.097	.009	-.001	-0.3%	.009	2.7%	.015	4.4%
X3 已婚	.154	.024	.004	1.2%	.008	2.6%	.009	2.8%
X4 小孩數	-.136	.018	.011	3.3%	.011	3.3%	.015	4.6%
X5 在職年資	.271	.074	.048	14.5%	.050	15.0%	.047	14.1%
X6 每週工時	.208	.043	.038	11.4%	.037	11.1%	.036	10.9%
X7 教育年數	.505	.255	.187	56.3%	.171	51.4%	.164	49.3%
總和	**.459**	**.332**		**100%**	**.332**	**100%**	**.332**	**100%**

註：迴歸模型的 $R^2 = .332$, F(7,2317) = 164.52, $p < .01$, adj$R^2 = .330$, Cohen's $f_1^2 = .497$

最後，三種優勢比較的結果與拔靴估計區間的結果列於表 8。透過完全優勢判斷原則，可確立「教育年數」完全優於其他 IV，是解釋「薪資對數值」最重要且穩定的變數。至於「在職年資」則相對於「年齡」、「已婚」與「小孩數」三者具有完全優勢。重要性最低的三個 IV「年齡」、「已婚」與「小孩數」之間雖然無法確立完全優勢，但是三者與其他各 IV 相較之下都處於完全劣勢，可以說是迴歸模型當中雖然具有統計顯著性，但幾無重要性的 IV。

對於無法確立完全優勢者，可進行條件優勢分析。以「在職年資」與「每週工時」為例，「在職年資」除了在第零階 ($k = 0$) 時的效果 (.031) 低於「每週工時」 (.033) 之外，其他各階皆優於「每週工時」。換言之，「在職年資」除了與 DV 的相關 ($r = .177$) 略低於「每週工時」與 DV 的相關 ($r = .181$) 之外，「在職年資」的效果增量均較高，顯示「在職年資」對於「每週工時」的條件優勢普遍為高。而利用信賴區間可針對於相對重要性相近的 IV 進行比較。

表 8 薪資對數值各 IV 相對重要性分析（DA 與 RWA）結果摘述

	投入 IV						
	1 性別	2 年齡	3 已婚	4 小孩數	5 在職年資	6 每週工時	7 教育年數
優勢分析							
1 性別	.046(13.8%) [.031,.063]	?	C-	?	?	?	C+
2 年齡		.009(2.7%) [.007,.013]	?	?	C+	?	C+
3 已婚			.009(2.7%) [.005,.014]	?	C+	C+	C+
4 小孩數				.011(3.3%) [.007,.018]	C+	?	C+
5 在職年資					.050(15.0%) [.033,.068]	?	C+
6 每週工時						.037(11.1%) [.021,.053]	C+
7 教育年數							.171(51.4%) [.143,.201]
條件優勢							
K = 0	.056 [.038,.076]	.000 [.000,.005]	.001 [.000,.004]	.007 [.002,.018]	.031 [.018,.050]	.033 [.016,.051]	.137 [.110,.168]
K = 1	.054 [.036,.072]	.011 [.009,.015]	.007 [.005,.012]	.015 [.010,.024]	.049 [.032,.070]	.033 [.017,.050]	.160 [.132,.191]
K = 2	.051 [.034,.068]	.015 [.012,.020]	.009 [.006,.015]	.016 [.012,.024]	.057 [.040,.078]	.035 [.019,.051]	.174 [.144,.205]
K = 3	.047 [.032,.064]	.014 [.011,.019]	.01 [.006,.017]	.014 [.010,.021]	.058 [.040,.079]	.037 [.021,.053]	.180 [.150,.212]
K = 4	.043 [.029,.059]	.011 [.008,.017]	.011 [.005,.017]	.011 [.006,.018]	.056 [.037,.076]	.039 [.023,.055]	.182 [.153,.213]
K = 5	.039 [.026,.054]	.007 [.004,.014]	.011 [.006,.018]	.008 [.004,.015]	.051 [.034,.070]	.040 [.024,.057]	.182 [.152,.213]
K = 6	.035 [.022,.050]	.004 [.000,.010]	.012 [.006,.019]	.006 [.002,.013]	.045 [.028,.064]	.040 [.025,.058]	.180 [.150,.211]
RIW	.047 [.032,.063]	.015 [.011,.018]	.009 [.006,.014]	.015 [.011,.021]	.047 [.032,.064]	.036 [.021,.055]	.164 [.136,.191]
分割比	14.0% [9.9,18.7]	4.4% [3.7,5.6]	2.8% [1.7,4.3]	4.6% [3.3,6.5]	14.1% [9.9,18.7]	10.9% [6.5,15.9]	49.3% [42.9,54.8]

註：　對角線上的數值為優勢分析的一般優勢指數與分割比（括弧內）。上三角區域內為完全優勢比較結果，
　　　C+ 表示完全優勢，C- 表示完全劣勢，? 表示無法確立。[ ] 當中的數值為 1,000 次拔靴抽樣得出的 95%
　　　區間估計。

陸、討論與結論

工欲善其事，必先利其器。對於迴歸分析此一社會科學研究當中最重要的統計方法，若能充分了解其原理與特性，善用各項係數與指標，有效因應多元共線性等影響多元迴歸正確應用的威脅因素，將能有效協助研究者執行研究工作，達成量化研究的解釋與預測的目標。現將文獻整理與數據分析結果綜合討論如下。

一、各項指標的概念釐清

經過文獻的整理與說明，本文檢視了多元迴歸當中各種效果量的概念與三類關於個別自變數的評估係數與指標，並利用模擬數據與實徵資料進行分析，藉以說明各自的意義與數學特性以及使用時機。

首先，從模型的層次來看，R^2 反映了整個模型的效果，除了可以利用 NHST 檢驗統計意義之外，更是後續個別效果分析的重要基礎。其他的整體效果量指標（例如 f^2 或殘差效果量）雖有類似的性質，但是都不如 R^2 能兼具標準化、變異拆解的分割性、顯著性檢定等多項特性。同時也可利用 ΔR^2 檢驗模型中的局部意義與變數增效，可以說是模型層次最重要的效果量指標。但如果研究者所關注的是個別 IV 的意義解釋與相對比較，必須使用個別效果量而非整體效果量。

多元迴歸的個別效果量從其演算原理可概分成三類，第一類以積差相關為基礎，又可區分為不受共線性影響的零階相關與結構係數，以及將 IV 間共變關係納入考量的淨相關與半淨相關兩種。第二類則是涉及迴歸的估計，包括迴歸係數（未標準化與標準化係數）與乘積指數。這些係數或指標中，除了乘積指數能保有對於整體效果的正交切割之外，其他均受到多元共線性的影響而產生不同程度的變動，對於個別 IV 的意義得出不同的推論與優劣排序。第三類指標包括 RIW 與 D_g 兩者，由於這兩種策略即是為了克服 IV 之間的共線性問題而提出，因此可稱為相對重要性指標，具有能對 R^2 進行正交分割，以及對 IV 間的共變結構進行有效轉換，適當分配共線性關係到各 IV 個別效果的多項優點。

值得注意的是，RIW 與 D_g 雖有諸多優點恰可能也是盲點。相關與迴歸係數面對多元共線性雖然有著過或不及的遺憾，但是也能夠呈現自變數在不同運算條件下的數量特徵，尤其是當我們面對複雜的多元共線性威脅時，若能同時關注各係數指標的消長變化，則更可理解數據的狀態，對於研究結果做出最佳的結論。相反的，如果研究者不熟悉各種指標的特性、優劣異同與使用時機，將可能會導致方法的誤用與結論的誤導。關於多元迴歸傳統至今的各種指標與方法的介紹與釐清，也即是本文的主要貢獻所在。

二、多元共線性的威脅與因應

多元迴歸最大的優點是「多元」，但最大的威脅也正來自於多元自變數間的共線性。長期以來，學者們對於多元共線性議題雖多有關注，但是對其成因、影響，乃至於分類方法與定義多有歧見 (Darmawan and Keeves, 2006; Pedhazur, 1997; Sharpe and Ali, 2009; Shieh, 2006)。本文針對多元共線性造成 R^2 的擴張（增強效果）與降低（壓抑與重疊效果）進行模擬分析，在實徵資料分析中也發現類似的現象，顯示不同類型的共線性效果可能同時發生在某項研究中，凸顯了相對重要性指標的重要價值。基於本文的文獻整理與數據分析，針對幾項主要係數與相對重要性指標受到共線性與壓抑效果影響的比較整理列於表 9。

表 9 主要的個別效果量指標受到共線性影響的比較表

	r^2	r_s^2	β^2	$r\beta$	RIW	D_g
原理	積差相關平方	預測值與 IV 相關平方	IV 邊際解釋力平方	整體解釋力的線性分割	代理變數正交化	多重配對比較
IV 共線性控制	無	無	有 IV 間相關完全排除	有 IV 間相關線性拆解	有 IV 相關線性拆解	有 多重配對比較
R^2 拆解	僅獨立時可正交拆解	僅獨立時可正交拆解	僅獨立時可正交拆解	正交拆解可計算比例	正交拆解可計算比例	正交拆解可計算比例
壓抑效果影響						
增強效果（β 放大 R^2 放大）	無關	無關	敏感	威脅低但有異號問題	威脅低	威脅低
壓抑效果（β 放大 R^2 縮小）	無關	無關	敏感	威脅低但有異號問題	威脅低	威脅低
重疊效果（β 縮小 R^2 縮小）	無關	無關	敏感	威脅低但有異號問題	威脅低	威脅低
優點	簡單易懂使用普及計算方便	對預測值結構組成具有解釋上的便利	簡單易懂使用普及計算方便	除非異號否則能對 R^2 拆解計算方便	能對 R^2 拆解計算相對簡單	能對 R^2 拆解使用彈性大可針對不同需要進行限定比較
缺點	無法反映 IV 間共變關係	無法反映 IV 間共變關係	過度反映 IV 間共變關係 係數不穩定	異號問題影響判斷 係數不穩定	使用彈性較低	計算繁瑣耗時

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　　在各種係數中，多元共線性對相關與結構係數的估計沒有任何影響，對迴歸係數的影響則最為劇烈，這三種係數均只有在 IV 完全獨立時才可對 R^2 正交分割（此時各種係數數值相等），然而結構係數平方和雖不為 1，但並不損及結構係數作為反映預測分數與 IV 對應關係的特性，其係數平方與排序仍可作為各 IV 在預測分數上的關聯強弱判斷之用（即如同因素分析進行斜交轉軸後以結構係數矩陣來協助因素命名），因此結構係數在預測實務與理論關係的解釋上仍有其便利性，但是當面臨共線性威脅時則不建議採用結構係數來進行 IV 的相對比較。

　　至於乘積指數雖能對 R^2 正交分割，但是 r 與 β 異號現象是乘積指數的致命限制。在本文中，異號問題不僅在模擬數據中可清楚看到，在 PSFD 實徵數據的分析上也可以發現其蹤影。換言之，多元共線性中的負向壓抑可說是乘積指數最大的威脅。如果沒有異號問題，乘積指數以其簡單容易計算與 R^2 正交分割的良好特性，不失為評估 IV 相對重要性的快速比較策略。

　　多元迴歸的 IV 相對重要性比較，除了必須考量共線性的強弱大小，也需考量壓抑效果的不同形式，很明顯的是，如果僅仰賴相關或迴歸係數，並無法有效判斷自變數的相對效果與意義。RIW 的代理變數的正交轉換策略則能夠提供理想的單一指標來評估 IV 的相對重要性，與 DA 之間也具有相當的一致性。

　　DA 與 RWA 的不同，在於 DA 除了一般優勢指標 (D_g) 指標之外，還有完全優勢與條件優勢兩種分析程序，可以協助研究者判斷 IV 在不同組合狀況下的相對重要性，在面對 IV 具有不同共線性威脅時，三種優勢比較能夠對於 IV 的特性進行更細膩的分析，應用彈性甚至較 RWA 來得更高。因此本文建議未來研究者可兼採 DA 與 RWA 來進行 IV 相對重要性的評估。值得注意的是，RIW 與 D_g 均需搭配拔靴區間來判定 IV 的相對重要性是否具有顯著差別，如果拔靴區間相互重疊，則不宜做出兩個 IV 何者較為重要的結論。

三、方法學與實務意涵

　　由本文的原理說明與數據分析結果可以得知，多元迴歸中對於各 IV 的意義的討論涉及不同的概念，也有諸多不同的係數與指標或評估程序可以加以運用。但是有幾點重要的方法學概念必須釐清。第一，基於統計推論的基本原理，多元迴歸必須遵循一般抽樣方法與統計檢驗的基本程序，先行確立迴歸模型，再就個別參數的估計結果進行討論。所謂確立迴歸模型，意指迴歸模型的整體效果 (R^2) 必須具有統計意義，過於微弱的迴歸效果實無進行個別 IV 討論的必要，也可避免微小效果卻過度推論的問題 (Cohen et al., 2003)。其次，模型確立後的個別 IV 的意義解釋與相互比較，必須清楚說明是在進行「個別效果的評估」，或是進行「相對重要性比較」。若研究者的目

的是在瞭解個別 IV 的效果，可以就各種係數的演算原理，配合 NHST 來說明個別 IV 是否「重要」或「有效」，例如相關係數及其 NHST 可以說明當不考慮其他 IV 時的個別 IV 的效果與統計意義（結構係數的意義則與相關係數完全相同），相對之下，迴歸係數及其 NHST 則完全排除其他 IV 的共變關係後再評估個別 IV 的重要性與統計意義（淨相關與半淨相關也具有類似的特性）。但是，除非 IV 間完全獨立，否則這些係數由於並未對於 IV 間的共變結構進行合理的分割與估計，因此無法基於 R^2 正交分割的前提來判定 IV 的「相對重要性」，本文的模擬與分析結果支持了當 IV 間存有複雜的多元共線性時，以 DA 與 RWA 最能反映 IV 的相對重要性。

另一個方法學上的重要議題，在於「機制」的探討應在指標技術的考量之上。對於 IV 間所存在的高度共線性或增強／壓抑效果，未必僅是變數間的彼此干擾現象 (Confounding Effect) 的反映，也可能是變數之間存在著複雜的中介歷程或交互作用，對於重視實務意涵的管理研究而言，尤其更需對 IV 與 IV 間以及 IV 與 DV 間的多重複雜關係，更積極檢視中介作用 (Mediation Effect) 或調節效果 (Moderation Effect) (Baron and Kenny, 1986; Hayes, 2013) 存在的可能性，而非僅以技術手段來進行共變結構的分割與估計來解決多元共線性所存在的問題。

另一方面，IV 間所存在的高度共線性（例如模擬研究 Case2 中的 $r_{12} = .90$）更可能反映了這兩個 IV 是非常相似的概念而無法區分，此時研究者除了需再次檢視各 IV 的理論內涵與操作型定義，確認其各自存在的正當性與必要性，同時也可以從測量的角度來檢驗兩者是否因為缺乏區辨效度 (Discriminant Validity) 而必須加以整合 (Hair et al., 2006; Nunnally and Bernstein, 1994)，此時最簡單的處理方式是取其一或將兩者加以合併，而無必要將其同時保留於模型中造成共線性問題，事後才以統計方法來尋求補救，過度仰賴甚至誤用了 DA 與 RWA 這些替代技術。

延續前述所討論的方法學議題，在實務意涵方面，本文所揭示的多元共線性威脅與自變數的比較問題，其意義不僅應從方法本身來關切，更重要的是反映了管理議題所存在的複雜與混淆關係，並非單以統計方法能夠解決，更重要的是能夠搭配理論觀點與實務意義上的支持，才能相輔相成。例如在實徵資料分析中可看出，不同指標對於哪一個 IV 能夠有效解釋薪資所得有不同的結論，此時能夠協助我們瞭解薪資差異更需要理論的智慧與實務上的證據，甚至能夠據此開展研究課題的新頁。

四、研究限制與未來研究建議

為了瞭解不同型態的多元共線性如何影響各項指標的應用，本文同時採用了模擬數據與實徵資料來進行分析說明。但是由於多元共線性的影響與壓抑效果的型態，會隨著 IV 間的相關強度與組合關係的不同而有差異，對於各項指標與 RWA 及 DA 分析

的影響也可能不同，本文僅就幾種典型的多元共線性狀況進行討論，目的在於示範說明而無法窮盡各種狀況，因此對於數量分析所得到諸項結論在推論上必須有所保留，是本文的主要限制之一。如果要對各種不同的共線性狀況與壓抑效果的影響進行完整推論，應進行更嚴謹的模擬研究，以不同的影響因子模擬各種狀況，這也是 RWA 與 DA 等分析方法尚未完整進行探究的部分，值得未來研究進一步深入討論。

　　本文的模擬數據僅以 .6、.4、.2、.0 四種 IV 與 DV 的相關強度配合三種共線性狀態來建立模擬母體資料，藉以進行 IV 重要性排序的比較，這種「理想化」的數據結構僅是為了模擬與示範的目的，在實務上並不容易發生。而模擬結果證實 RWA 與 D_g 能得出與母體相關最為一致的排序，可能造成讀者認為以積差相關即可判定 IV 相對重要性的誤解。事實上，在真實的研究情境中，研究者並無從得知母體的變數相關結構，也無法確知 IV 間的共變關係，因此相關係數最可能反映虛假關係 (Spurious Relationship) (Cohen et al., 2003; Pedhazur, 1997) 而誤判了 IV 的相對意義，這就是為何本文另以實徵研究的數據來進行分析示範，不僅發現 IV 與 DV 的相關偏低（未超過 .4）且相近，相關係數的排序與 RWA 與 DA 亦存有若干差異，顯示在母體資訊不明的情況下，研究者還是必須參酌各種係數與指數的特性來進行 IV 相對重要性的判斷。

　　在實徵數據分析部分，由於本文取用資料庫的部分資料進行示範說明，除了受限於資料庫本身的建置目的與資料內容，加上為了凸顯 IV 間的共線性而特別取用具有中高相關的自變數來解釋薪資所得，並非從理論角度推導得出對於薪資所得最理想的一組 IV，因此雖然迴歸整體解釋力具有統計意義，殘差分析也未發現明顯的假設違反現象，但是所使用的線性模型未必是最適配這些實徵資料的理想模型，變數間所可能存在的交互作用或其他非線性關係也並未加以檢驗，因此所得到的分析結果僅能從方法應用的角度來討論，而不宜就其實務意涵做出結論。對於薪資所得的影響機制有興趣的讀者，可從理論觀點進行完整討論後另行蒐集實徵資料，屆時得以利用 RWA 來比較各 IV 的相對重要性，或利用 DA 來討論各 IV 的優勢性，並與本文結果進行對照討論。

五、結論

　　傳統以來，迴歸分析的模型優劣與參數意義多仰賴顯著性檢定來判定，但是顯著性檢定並無法辨別多重 IV 的相對意義。當多元迴歸模型確立之後（R^2 具有統計意義），應就各種係數的特性進行個別 IV 效果的說明。其中各 IV 與 DV 的零階相關可作為每一個 IV 的「初始效果」的比較，迴歸係數則是排除所有其他 IV 後的淨效果，可作為各 IV 對於 DV 影響的最終的「淨效果」相對比較。然而當 IV 間的多元共線性越強，淨效果與初始效果間的波動越大，相關與迴歸係數皆不利於 IV 效果的解釋，應採用

RWA 與 DA 來進行 IV 相對重要性的分析。雖然乘積指數、RIW 與 D_g 指數都可進行總體效果的 R^2 正交分割，有效反映共線性存在下的效果分割，但乘積指數僅適用於相關與迴歸係數不存在異號的情況。此外，配合模擬技術的應用，RIW 與 D_g 指數的區間估計得以有效建立。對於各種係數與指標，迴歸分析使用者必須合理使用與正確解釋推論，此一目標的達成有賴於研究者對於迴歸方法有一充分且完整的理解，以及對於相關指標與檢驗方法的充分認識與正確運用。

The Impact of Multicollinearity on the Evaluations of Regressors: Comparisons of Effect Size Index, Dominance Analysis and Relative Weight Analysis in Multiple Regression

Haw-Jeng Chiou, Professor, Department of Business Administration, National Taiwan Normal University

1. Purpose

Regression analysis is frequently used in the social sciences (Aguinis et al., 2009; Cascio and Aguinis, 2008; Casper et al., 2007). The purpose of this paper is to review the properties of the effect size index and the measures of relative importance derived from the relative weight analysis (RWA) and the dominance analysis (DA) that are used to evaluate the predictors under multicollinearity. The general purpose of multiple regressions is to learn about the relationship between several predictors (i.e., regressors) and a criterion variable. Regression analyses, however, often rely heavily on hypothesis testing and interpretations of regression coefficients and ignore the effect sizes of regression models and the qualities of individual predictors (Courville and Thompson, 2001; Kelley and Preacher, 2012; Nimon and Oswald, 2013). This issue is particularly important when there exists multicollinearity among the regressors/predictors. The focus of this paper is on the performances of the relevant statistics from the RWA and the DA, as well as several index of effect sizes, under three effects of multicollinearity (enhancement, suppression, and redundancy) (Friedman and Wall, 2005).

In this paper, the following effect size index are considered: zero/partial/semi-partial coefficients, structural correlations, regression coefficient-based statistics, and product measures. On evaluating the relative importance of the predictors, the RWA creates the relative importance weights (RIW) (Tonidandel et al., 2009) that addresses the properties of correlated predictors by creating the orthogonal counterparts of the original predictors. On the other hand, the DA creates the Dg coefficient that can reflect the relative importance of predictors (Azen and Budescu, 2003; Budescu, 1993). Based on the examination of the R^2 values for all possible subset models, the DA generates the D_g coefficient and two different measures of dominance that differ in the strictness of the dominance definition (the conditional dominance and the complete dominance). Compared to the traditional correlation-based and regression-based coefficients, the RIW and the D_g coefficient are more intuitive, meaningful, and informative measures that can indicate the importance of predictors. In this paper, a simulation and a survey data analysis are used to demonstrate the performances of these index statistics under multicollinearity.

2. Research Design

Following a simulation demonstrating these effects, a sample of 2,325 Taiwanese individuals selected from the 2011 Panel Study of Family Dynamics is used to show the use of those statistics and effect sizes in explaining salary differences.

Simulation

A simulated dataset of one dependent variable and four independent variables (with different correlations with the dependent variable) are drawn from a multivariate normal distribution. Based on six possible correlations between a pair of predictors, this study conducts three cases of simulations to distinguish the three different effects of multicollinearity.

Case1: *Uncorrelated predictors*. The four predictors are perfectly uncorrelated with each other. This is the baseline model for comparisons.

Case2: *Correlated predictors and a decreased R^2*. A simulation of the *suppression* effect is created by a positive inter-correlation between two predictors, and the *redundancy* effect is created by a lower inter-correlation.

Case3: *Correlated predictors and an increased R^2*. A simulation of the *enhancement* effect is created by a strong positive inter-correlation or a negative inter-correlation between two predictors.

Depending on the values of inter-correlation between two predictors (r_{12}), Friedman and Wall (2005) defines four regions to reflect the effects of multicollinearity: (R1) enhancement: with an increasing R^2 and $r_{12} < 0$; (R2) redundancy: with a decreasing R^2 and $0 < r_{12} < r'$; (R3) suppression: with an increasing R^2 and $r' < r_{12} < r''$; and (R4) enhancement: with an increasing R^2 and $r'' < r_{12}$, where the critical values r' and r'' define the three different effects of multicollinearity.

Survey Data Analysis

A sample of 2,325 (53% of males) Taiwanese individuals selected from the 2011 Panel Study of Family Dynamics (PSFD) is used to demonstrate the performances of the index statistics of effect sizes in predicting salary difference. Seven predictors implied by the human capital theory are selected: gender, age, marital status, number of kids, years on the job, weekly working hours, and years of formal education.

All index as well as the RIW and the D_g coefficient are computed by R software (R Development Core Team, 2014) and the 95% confidence intervals for statistical inference are constructed by bootstrapping with bias corrected accelerated (BCa) method (Canty and Ripley, 2014).

3. Findings

The simulation results show that without multicollinearity, all the index statistics can reflect the relative importance of the Predictors. When multicollinearity presents, however, only the RIW and the D_g coefficient can consistently indicate the relative importance of the predictors. Index such as the product coefficients fail to reflect the expected order of importance due to the inconsistent directions of the correlation coefficients and the regression coefficients.

The results from the survey data reveal that, regardless of the use of the index statistics, the years of formal education is the strongest predictor of salary. However, due to multicollinearity, different statistics indicate the importance of the predictors in different ways. Similar to the results from the simulation study, both the RWA and the DA show a stable function for evaluating the relative importance of the predictors. In particular, the DA has the advantage of flexible procedures for evaluating the different facets of dominance of the predictors.

4. Research Implications

This paper demonstrates the substantive differences of several index statistics for evaluating the relative importance of predictors in multiple regressions. Several implications can be mentioned. First of all, applications of regression analysis have to consider both the statistical significance and the practical significance of the overall model (Cohen et al., 2003; Pedhazur, 1997). A significant R^2 has to be established to support a regression model, and then the explanations of individual predictors can follow. Secondly, researchers have to clarify the purpose of the index statistics for evaluating the individual predictors or the relative importance (Budescu, 1993; Johnson, 2000; Johnson and LeBreton, 2004). The former could be made by many traditional correlation and/or regression coefficients. The latter, however, can only be done by a limited set of statistics, namely the RIW and the D_g coefficient. This is particularly true in the presence of multicollinearity.

Furthermore, in addition to the technical aspects, the mechanisms behind the predictors and the model deserve more attention. For example, the complex relations among the predictors may reflect not only the confounding effects of predictors, but also the possibilities of causal impact or interaction existing among the variables. Researchers have to be aware of the effects in terms of the mediation as well as the moderation and then incorporate them into the empirical examinations (Baron and Kenny, 1986; Hayes, 2013).

Finally, the high correlation between the predictors may be due to the fact that the two predictors are almost the same, a situation where there is lack of discriminant validity instead of the confounding effect among different predictors (Hair et al., 2006; Nunnally and Bernstein, 1994). In this case, removing one of the highly correlated predictors or combining the similar variables into a single predictor may be a better solution.

5. Contributions

Rather than simply relying on hypothesis testing and interpretations of regression coefficients, this paper presents a comprehensive review on several effect size index of regression models. Two recently proposed strategies for evaluating the relative importance of predictors, the RWA and the DA, are introduced along with a list of traditional statistics such as the correlation coefficient, the beta coefficient, the structure coefficient, and the product measures. The major contribution is to examine the impacts of multicollinearity, including the enhancement, suppression, and redundancy effects, on the evaluation of the effect sizes and several statistics of relative importance of predictors. The results from the simulation and empirical study support that the statistics based on the RWA and the DA are recommended for evaluating the relative importance of predictors.

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附錄

```
#SIMULATION DATA BASED ON Case2
library(MASS)
library(corpcor)
covm<-c(1.00, 0.60, 0.40, 0.20, 0.00,
        0.60, 1.00, 0.90, 0.40, 0.00,
        0.40, 0.90, 1.00, 0.40, 0.00,
        0.20, 0.40, 0.40, 1.00, 0.00,
        0.00, 0.00, 0.00, 0.00, 1.00)
covm<-matrix(covm,5,5)
varlist<-c("Y","X1","X2","X3", "X4")
dimnames(covm)<-list(varlist,varlist)
simudata<-mvrnorm(n=1000,rep(0,5),covm,empirical=TRUE)
simudata<-data.frame(simudata)

#regression function lm in R to create lm.out
library(yhat)
library(miscTools)
lm.out<-lm(Y~X1+X2+X3+X4,data=simudata)
regrOut<-calc.yhat(lm.out)

#bootstrapped the results produced from calc.yhat
library(boot)
boot.out<-boot(simudata,boot.yhat,1000,lmOut=lm.out, regrout0=regrOut)

#summary statistics of the bootstrap data
result<-booteval.yhat(regrOut,bty= "perc",boot.out)
```

作者簡介

邱皓政

　　美國南加州大學心理計量學博士，國立臺灣師範大學企業管理學系教授兼副總務長，研究興趣為心理計量與統計方法、多變量分析技術、測驗編製與量表發展、甄選與評量工具開發與應用等議題。教學領域為統計學、研究方法、組織行為與人力資源管理。曾擔任臺灣心理學會秘書長、中國測驗學會常務理事、臺灣統計方法學學會理事長與監事、國家教育研究院 TASA 推動委員等職。著有結構方程模式、多層次模式方法論、潛在類別模式等專書，論文多發表於臺大管理論叢、中華心理學刊、管理學報、教育科學研究期刊、測驗學報、教育與心理研究等期刊。

以實質選擇權觀點探討探索性與利用性活動對公司績效之影響：中介效果模型

The Real Options Perspective on Exploration, Exploitation, and Firm Performance: Test of a Mediation Model

趙雨潔 / 國立屏東科技大學企業管理學系助理教授
Yu-Chieh Chao, Assistant Professor, Department of Business Administration, National Pingtung University of Science and Technology

鄭鈞云 / 東吳大學企業管理學系助理教授
Chun-Yun Cheng, Assistant Professor, Department of Business Administration, Soochow University

湯明哲 / 國立臺灣大學國際企業學系教授
Ming-Je Tang, Professor, Department of International Business, National Taiwan University

黃逸平 / 國立臺灣大學國際企業學系博士候選人
Yi-Ping Huang, Ph.D. Candidate, Department of International Business, National Taiwan University

摘 要

過去文獻認為公司必須平衡探索性與利用性活動以達到最佳績效，然而對於如何「平衡」這兩類本質上存在矛盾關係之活動仍未有定論。截至目前為止，探討探索性、利用性活動與公司績效關係之實證研究仍十分稀少。本研究採用實質選擇權觀點，論述當公司面對不確定的環境時，探索性活動可視為替公司創造實質選擇權，而利用性活動則視為執行實質選擇權。實質選擇權帶給公司探索未來的機會，但未必會對公司績效有直接且正面的影響。惟有當執行實質選擇權時，才能將機會轉化為實質效益，提升公司績效。本研究以美國半導體公司 25 年的實證資料，檢視不確定性對利用性與探索性活動之影響，並探討利用性活動對於探索性活動與公司績效的中介效果。本研究採用創新的延遲結構 (Lag Structure) 模型，以在衡量探索性活動對公司績效之影響時，將時間延遲因素納入模型中考量。本研究發現：(1) 不確定性對探索性活動具正向顯著影響；(2) 利用性活動對於探索性活動與公司績效存在完全中介效果。此實證結果支持以實質選擇權觀點論述探索性與利用性活動對公司績效之影響。

【關鍵字】探索性、利用性、實質選擇權、公司績效

Abstract

Theoretical debate on how firms can balance exploration and exploitation activities to achieve better performance remains inconclusive, and very few empirical studies offer guidance on how to delineate contradictory theoretical debates. We adopted a real option perspective in viewing exploration as creating real options and exploitation as executing those options. In the face of uncertainty, holding real options can bring firms future opportunities but may not lead to superior performance. Firm performance can be enhanced only if firms execute these real options. Using 25 years of data on semiconductor firms in the United States, this study examines the influence of uncertainty on exploration and exploitation and the mediating effect of exploitation on the relationship between exploration and firm performance. This study adopts a novel lag structure model to explicitly consider the time-lag factor in measuring the effects of exploration on firm performance. This study finds that (1) uncertainty is positively related to exploration; (2) exploitation mediates the relationship between exploration and firm performance. The results support the real-options perspective in elaborating exploration, exploitation, and firm performance.

【Keywords】 exploration, exploitation, real options perspective, firm performance

1. Introduction

Since the seminar discussion of March (1991) on "exploring new possibilities" and "exploiting old certainties" as two distinct adaptive mechanisms for organizations, a substantial body of research has advanced the typology in areas such as organizational learning (Levinthal and March, 1993; Rosenkopf and Nerkar, 2001), organizational ecology (Burgelman, 2002), technological innovation (Benner and Tushman, 2002, 2003), acquisitions (Vermeulen and Barkema, 2001), and alliances (Vermeulen and Barkema, 2001; Lavie and Rosenkopf, 2006). From a strategic management viewpoint, exploration and exploitation are two different mechanisms for improving a firm's performance. Exploration provides opportunities for future growth, but it also creates more uncertainties about returns. Exploitation helps firms realize instant gains, but it can lead to a "competence trap" (Levinthal and March, 1993). The danger of overemphasizing either approach needs to be noted while managing firm performance (Vermeulen and Barkema, 2001; He and Wong, 2004; Rothaermel and Deeds, 2004; Lavie and Rosenkopf, 2006).

March (1991) argues that balancing the trade-off between exploration and exploitation is critical to a firm's survival and prosperity. However, the above mentioned fundamental discrepancy between exploration and exploitation can create tension as the firm tries to coordinate the two activities simultaneously to enhance firm performance. For example, although an organic organization fosters exploration, it discourages the development of routines for refining existing competencies to gain efficiency and effectiveness. Likewise, the organizational inertia (Hannan and Freeman, 1984) that promotes exploitation may hinder the generation of new ideas necessary to capture future opportunities. Although numerous efforts have been put into this issue, how this balance can be maintained to generate profits has remained largely untested (He and Wong, 2004; Uotila, Maula, Keil, and Zahra, 2009).

Some studies have addressed this issue empirically using different operational definitions of exploration and exploitation. One stream of literature modeled exploration and exploitation as orthogonal activities that positively interact (Katila and Ahuja, 2002; He and Wong, 2004; Jansen, Van den Bosch, and Volberda, 2006) while the other line of research has assumed these two activities as two ends of a continuum that crowd out each other (Uotila et al., 2009). The controversy comes mainly from the focus of research. When a study assumes that the resources needed to pursue exploration and exploitation are abundant (e.g., knowledge in Nerkar (2003) work), or when it aims to analyze exploration and exploitation in two different domains (e.g., forming alliances with new partners versus

forming alliances with existing partners in Beckman, Haunschild, and Phillips's (2004) research), the relationship between exploration and exploitation can be orthogonal (Gupta, Smith, and Shalley, 2006). Given that this study focuses on how a firm, in the face of uncertainty, balances exploration and exploitation in two different function domains y— R&D and capital investments to earn rents, this study adopts an orthogonal relationship between exploration and exploitation and uses the firm as the unit of analysis.

The primary objectives of this study are twofold. First, we empirically investigate whether uncertainty influences exploration and exploitation. Second, we choose the semiconductor industry as our research context involving high uncertainty which enables us to elucidate how firms allocate resources for exploratory and exploitative activities to pursue superior performance. In contrast to previous research that focused exclusively on March's (1991) reasoning to postulate the relationship between exploration, exploitation, and firm performance; we consider that real options reasoning can complement the classical arguments and provide a more solid theoretical foundation for understanding exploration and exploitation.

A real options approach addresses sequential decision making under conditions of uncertainty and provides an appropriate theoretical foundation for investigating how a firm allocates resources between exploration and exploitation for the purpose of enhancing returns in the face of uncertainty. This approach provides insights into the relationship between exploration and exploitation and their effects on a firm's performance. Drawing on real options reasoning, we suggest that uncertainty positively impacts exploration and exploitation serves as a mediator of the relationship between exploration and firm performance.

Our study fills four gaps in the exploration and exploitation literature. First, very little large-scale empirical research has been systematically conducted on examining the interactions between exploration and exploitation in firms (Holmqvist, 2004). Second, with very few exceptions (Benner and Tushman, 2002, 2003), few studies have explicitly dealt with the causal relationship between exploration and exploitation longitudinally (Uotila et al., 2009). Third, our research provides the first empirical test on whether firms employ real options reasoning to allocate exploratory and exploitative investments[1] under uncertainty. Fourth, although scholars have acknowledged the lag effects of exploration on performance,

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1 Exploration and exploratory investments are interchangeable while exploitation and exploitative investments are interchangeable in this study.

measuring these effects has been a challenging issue. We sought to meet this challenge by employing a novel lag-structure methodology to better capture the lag effects of exploration on firm performance.

The remainder of this paper is organized as follows. The first section briefly reviews the literature on the relationship between exploration and exploitation. The second section uses real options reasoning to reconceptualize the exploration-exploitation issue and proposes hypothesis based on this reasoning. The third section describes the test sample, research model and the measures used to test the hypotheses. In the fourth section we present the study results, suggest directions for future research and offer our conclusions.

2. Theory and Hypotheses

2.1 The Relationship between Exploration and Exploitation

Prior research modeled exploration and exploitation in different ways and proposed different perspectives for balancing these two activities. Some scholars modeled exploration and exploitation as orthogonal activities and advocated ambidexterity (Benner and Tushman, 2003) —pursuing exploration and exploitation simultaneously— as a way to strike a balance between exploration and exploitation (Tushman and O'Reilly, 1996). Others, however, recognized the difficulties in managing both at the same time and proposed an alternative-attention approach, such as crowd-out (Benner and Tushman, 2002) or positive feedback (Vermeulen and Barkema, 2001), as a better way to balance exploration and exploitation. This perspective assumes that exploration and exploitation are the two ends of a continuum.

According to Gupta et al. (2006), there are four reasons for this controversy: (1) the definitions and connotations for exploration and exploitation are unclear, (2) the nature of these two activities involves orthogonality versus continuity, (3) ambidexterity versus punctuated equilibrium perspectives, and (4) duality versus specialization. Three types of relationships exist between exploration and exploitation. These relationships can be categorized as: (a) a crowd-out relationship, (b) an alternative reducing approach, and (c) an alternative enhancing approach in terms of the study period and resource scarcity for synthesizing prior research. These alternatives are presented schematically in Table 1.

Table 1 The Relationship between Exploration and Exploitation

Study period Resource scarcity	Cross-sectional	Longitudinal
When resources are limited	(a) Crowd-out (e.g., Benner and Tushman, 2002; Uotila et al., 2009)	
When resources are abundant	(b) Ambidexterity (e.g., He and Wong, 2004; Lubatkin, Simsek, Ling, and Veiga, 2006)	(c) Alternative enhancing (e.g., Vermeulen and Barkema, 2001; Lavie and Rosenkopf, 2006)

A trade-off is necessary when the resources needed for exploration and exploitation are limited. This is what we meant by a crowd-out relationship. Using patents and ISO 9000 quality program certifications data in the paint and photography industry, Benner and Tushman (2002) found that exploitative innovation drove out explorative innovation, which provides a good example for a crowd-out relationship between exploration and exploitation. Uotila et al. (2009) employed a content analysis technique to measure the relative exploration versus exploitation orientation and found an inverted U-shaped relationship between the relative share of explorative orientation and firm performance.

When the resources relevant to exploration and exploitation are abundant, it is more likely that a firm can master ambidexterity. For example, using survey data from a sample of Malaysian firms, He and Wong (2004) demonstrated that the interaction between exploration and exploitation is positively related to a firm's performance. The work of Lubatkin et al. (2006) focused on the top management team's (TMT) role in pursuing ambidexterity in small-to-medium-sized firms (SMEs) and found a positive effect for ambidexterity on firm performance.

Advocates of the ambidexterity hypothesis have argued that a firm can alleviate the trade-off problem by dynamically balancing exploration and exploitation using a loosely-coupled organizational structure (Benner and Tushman, 2003). The implications of the ambidexterity hypothesis provide valuable insight into the organizational structure effects on exploration and exploitation.

The alternative enhancing perspective suggests that exploration and exploitation cyclically reinforce each other over time such that they do not compete for limited resources. For example, Holmqvist (2004) reasoned that more exploitation is more likely to lead to more exploration, and vice versa. Vermeulen and Barkema (2001) confirmed this mutual amplification effect of exploration (operationalized as acquisition) and exploitation (operationalized as Greenfield). Lavie and Rosenkopf (2006) found alliance formation to be

one way that exploration and exploitation can be balanced over time and over multiple domains.

The above discussion implies that the operationalization of exploration and exploitation depends on the resource characteristics and the study context. We used real options reasoning to elaborate the relationship between uncertainty, exploration, exploitation and firm performance to study how firms allocate resources under uncertainty.

2.2 Real Options Reasoning (ROR)

ROR applies the financial options concept to real assets or investment decisions. A financial option gives the owner the right, but not the obligation, to buy (call option) or sell (put option) a security at a given price on or before the expiration date. Analogously, an investment in a real option gives a firm the right, but not the obligation, to make further investments at a given time or defer them. Thus, a real option is commonly defined as "a limited commitment that creates future decision rights" (McGrath, Ferrier, and Mendelow, 2004).

Many strategy researchers have advocated ROR because its application gives the investor the managerial flexibility to address strategic issues in a highly uncertain environment, thus providing insights for good managerial decisions (McGrath, 1997, 1998, 1999; Kogut and Kulatilaka, 2001; Folta and Miller, 2002; Miller and Folta, 2002; McGrath and Nerkar, 2004). They suggested that an option-like initial investment has growth potential while avoiding substantial losses if the investment turns sour. This approach has also been referred to as the options lens (Bowman and Hurry, 1993), options thinking (Kogut and Kulatilaka, 1994), real-options logic (McGrath, 1997), and options reasoning (McGrath, 1999; Miller and Arikan, 2004). ROR is especially noticeable in sequential decision making under conditions of uncertainty. Given that investments in both the exploration and exploitation contexts involve the sequential allocation of resources, ROR explains the motivation that drives exploration and exploitation, as well as their relationship to each other and their performance implications.

In this paper, exploration and exploitation are conceptualized as two distinct resource allocation processes in two functional domains. Exploration or an exploratory investment is viewed as the creation of real options or what in financial reasoning is termed call options. Exploitation or an exploitative investment is conceptualized as "striking" these options.

2.3 Uncertainty, Exploration, and Exploitation

Previous research has shown that the real options perspective can be useful in understanding how firms can cope with exogenous uncertainties in their technological and market domains (Vassolo, Anand, and Folta, 2004). We propose the real options lens to reason how a firm allocates resources between exploration and exploitation for the purpose of enhancing performance under uncertainty. Although many scholars propose that organizations respond to uncertainty, what is meant by uncertainty seems to differ from study to study. This study defines uncertainties that underpin most others' definitions: Uncertainties are the difficulties firms have in predicting the future, which comes from incomplete knowledge (Beckman et al., 2004). According to Beckman et al. (2004), uncertainty is classified into two levels: market uncertainty and firm-specific uncertainty. Market uncertainty is external and is shared across a set of firms while firm-specific uncertainty is unique and internal to the firm. Given that this study has focused on a single industry — the semiconductor industry, uncertainty is identified mainly as firm-specific uncertainty (Beckman et al., 2004). Firms may face technical uncertainty, which is uncertainty about the likelihood of technical success and the costs associated with success (McGrath, 1997). Technical uncertainty is firm-specific to the extent that other firms have different capabilities and probabilities of success (Beckman et al., 2004). The U.S. semiconductor industry grows continuously but in a cyclical pattern with high volatility. In the face of uncertainty, firm capabilities to maintain high degrees of flexibility and innovation in order to constantly adjust to the rapid pace of change in the market are key factors for success. Firms attempt to reduce uncertainties by broadening their networks and by forming relationships with new partners, which is a form of exploration (Beckman et al., 2004). Likewise, to address this uncertainty, we argue that firms invest more in exploratory investment, somewhat implying a higher value for options created by exploratory investment under uncertainty. Thus, we hypothesize that:

Hypothesis 1:　Uncertainty is positively related to exploration while it has no effect on exploitation.

2.4 Exploration, Exploitation, and Firm's Performance

According to ROR, firms should not commit all of their resources at the outset. Instead, they should delay some of their investment decisions so they can take advantage of future uncertainty. Exploration can be regarded as "initial investments" through which a firm

converts existing resources into real options, thereby allowing them to realize future opportunities. Exploitation is defined as a process in which a firm waits to exercise its "options" until such time as the environmental conditions are more likely to generate a high rate of return. As such, exploration involves the creation of options that a firm can strike when there is less uncertainty and the environment is more favorable (Kogut and Kulatilaka, 2001). Under such circumstances, the firm can choose to exercise those options that are "in the money" and allow the remainder to expire (McGrath and Nerkar, 2004). In other words, exploration offers firms more investment options early on, the benefits of which they can exploit later. Based on ROR, we propose the following hypothesis:

Hypothesis 2: Prior exploration has a positive effect on exploitation.

As in the case with financial options, the "exercise price" of a real option is the amount of money that should be invested to exploit a future opportunity. In the context of technology development, exercising a real option most often involves a capital expenditure for equipment and facilities as a way to realize the potential gains from the option. If conditions are clearly unfavorable, the firm may decide to stop its commitment to the opportunity created by the exploration and confine its losses to the initial irreversible investment, just as an investor might choose not to strike a financial option and lose only the cost of the option. However, holding these options per se cannot generate profits. To reap profits, the firm must make more commitments, that is, exercise some of its options. This commitment is viewed as exploitation and given the capital budgeting process of the firm, this exploitation should subsequently lead to better performance. Therefore, we propose the following hypothesis:

Hypothesis 3: Exploitation is positively related to firm performance.

Previous research has yielded mixed results on the relationship between exploration and performance. Some studies found a positive relationship between the two (Isobe, Makino, and Montgomery, 2004), whereas others found no consistent relationship but high variability in profits (March, 1991; He and Wong, 2004). According to ROR, firms that made investments to explore their opportunities are the ones most likely to seize an opportunity to grow. Previous exploration expands the selection pool for later exploitation and also improves a firm's "absorptive capability" (Cohen and Levinthal, 1990) to fully exploit a favorable opportunity. Therefore, we argue that the more a firm engages in exploration, the more likely it is to apply its existing knowledge in creative ways that allow it to capitalize on new trends and increase its returns. Hence, we combined hypotheses 2 and 3 as follows:

Hypothesis 4: **Exploitation mediates the relationship between prior exploration and firm performance.**

3. Method

3.1 Data Sample

We chose firms in the semiconductor and related device industry in the United States (SIC 3674) for our sample. We chose this industry for two reasons. First, it exhibits high levels of both exploration and exploitation. For example, we learned from our field interviews with executives in the semiconductor industry that the reduction they achieved in the unit cost of their integrated circuits (ICs) is the main source of their competitive advantage. This was especially true for foundry and Dynamic Random Access Memory (DRAM) firms. Reducing the unit size of their wafers and the distance between circuit lines were two approaches they used to reduce the unit cost of their ICs. The investment in these two activities was huge[2] and irreversible. Therefore, most of the companies in this industry phase-in their investments, a ROR application that minimizes their investment risk early on. Second, the semiconductor industry experienced tremendous cyclicality during our sample period. This circumstance provides fertile ground for testing ROR because the uncertainty should increase the value of the options.

All of the financial data were taken from Standard & Poor's Compustat North America database. We initially collected 2,633 observations from 255 firms. We then eliminated firms with annual sales less than 10 million to mitigate small-firm bias. Because we wanted to study the effects over a relatively long period of time, we also eliminated firms with less than eight consecutive years of R&D expense data. To add uncertainty to our models, we collected monthly stock price data for each firm from the Center for Research in Security Price (CRSP) database. After this pruning, the final sample consisted of 526 observations from 63 firms.

Data on the ages of the firms (how long they had been in existence) were obtained by searching the Factiva news database and the firms' websites. Finally, we obtained shipment data for the worldwide semiconductor industry from 1976 to the present from the global Semiconductor Industry Association (SIA) billing report.

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2 The capital investment of Motorola Semiconductor Product Sector, for example, was $2.4 billion in 2000 (Motorola Inc., 2001).

3.2 Dependent and Independent Variables

Performance. Exploration and exploitation activities have been assumed to impact firm performance in different ways and over different time periods (Uotila et al., 2009). The influence of exploration on firm performance is far more distant while exploitation has a more instant impact, causing difficulties in measuring the effects of these two activities. We addressed this problem by employing a lag structure methodology to capture the long-run effects of prior exploration efforts. Employing a lag structure into our model allowed us to operationalize both short-term and long-term performance effects using a single account-based performance variable. We used return on assets (ROA) as the indicator of a firm's performance. We defined ROA as earnings before interest, depreciation, taxes and, amortization (EBIDTA), divided by total assets. This is the standard measure of operating performance in strategy research (Baliga, Moyer, and Rao, 1996; Zajac, Kraatz, and Bresser, 2000).

Exploration and Exploitation. Following previous researchers (Katila and Ahuja, 2002; He and Wong, 2004), we regarded exploration and exploitation as two distinct dimensions rather than ends of a continuum. Exploration was defined as exploratory investments which involved search, discovery, experimentation, and risk taking (March, 1991). Exploitation was characterized by exploitative investments regarding refinement, implementation, efficiency, and production (March, 1991). We used R&D intensity (R&D expenses divided by net sales) as the measure of exploration and capital intensity (capital expenditures (CAPEX) divided by fixed assets) to measure exploitation.

Some readers might consider that R&D and capital investments include both exploratory and exploitative activities, and may not be appropriate to measure exploration and exploitation respectively. As we focused on how firms allocate resources under uncertainty, we attempted to differentiate between exploration and exploitation by focusing on the amount of exploring new possibilities in different business functions to examine how exploration and exploitation can be balanced over domains within a firm. We admit that some types of exploratory investments such as local exploration (Rosenkopf and Nerkar, 2001) may skew quite close to exploitative activities and vice versa. However, given that our field interviews with executives in the semiconductor industry convinced us that R&D expenditures contain much more exploratory activities than do capital expenditures, we believe these two measures are distinguished in terms of exploratory nature.

For the following analysis, we defined "current exploration" as exploration in a given year. We defined "prior exploration," as exploration in the years preceding the current exploration.

Prior Exploration. Because of the semiconductor industry's technological continuity, we assumed that one firm's exploration in the sequence of investments would be dependent on what other firms were doing. We therefore defined prior exploration for this study as the *aggregation* of previous individual firms' exploratory investments. We applied a lag structure methodology to a longitudinal dataset to model prior exploration to determine how these prior explorations affected exploitation and performance.

Uncertainty. Given that this study focuses on a single industry—the semiconductor industry, uncertainty was identified mainly as firm-specific uncertainty (Beckman et al., 2004). Following Beckman et al. (2004), this study used the standardized monthly volatility of the focal firm's stock price to measure firm-specific uncertainty. The monthly volatility is calculated as the coefficient of variation for firm j's annual monthly stock closing price and was collected from the CRSP database.

$$\frac{\text{Standard Deviation (Firm's Monthly Closing Price, Year } i, \text{ Firm } j)}{\text{Average (Firm's Monthly Closing Price, Year } i, \text{ Firm } j)}$$

where $i = 1988, \ldots, 2005$

3.3 Control Variables

We included several control variables to account for industry and firm characteristics that could influence the relationships among exploration, exploitation and performance.

Size and age. Large firms tend to exhibit economies of scale (Sorenson, McEvily, Ren, and Roy, 2006). The firm age affect permits rapid adaptation to new technologies (Sørensen and Stuart, 2000). Thus, we added these two control variables to our regression analysis. We used the logarithm of net sales as our measure of a firm's size and we calculated its age by subtracting the founding year from the year to be analyzed.

Current ratio and debt/equity ratio leverage. The current ratio is defined as the ratio of current assets to current liabilities. The debt/equity ratio was defined as the long-term debt divided by total equity. These two ratios were used as the respective measures for the short-term and long-term financial resources available for allocation to exploration and exploitation.

Industry growth and concentration. Because an industry's growth and concentration have been found to be important control variables in studies of firms' performance, we included these variables in this study. Industry growth was defined as the yearly growth rate

of the global semiconductor billing value obtained from the SIA billing report. The Herfindahl Index was used to measure industry concentration. Estimated market share was calculated by dividing the firm's net sales by the summation of the net sales for all the firms within SIC 3674 for a given year. The Herfindahl Index was obtained by squaring and then summing the estimated market shares for all subject firms.

3.4 Analysis of Lag Structure

The effect of exploration on returns may have a lag structure that represents the effect of previous exploratory activities on current returns. This lag structure is not easy to define, but techniques have been developed to deal with it.

Lag structure was originally used to investigate the relationship between firm performance and prior R&D or marketing expenses. The idea was to model these expenses as the aggregation of expenses over successive periods of time. The aggregation is assumed to have a specific form and can be determined by one or more parameters. Along with other variables, this aggregated expense can then be modeled to predict performance. By minimizing the residual between performance and its predicted value in the model used for our study, the coefficients of each variable could be estimated and the distribution effect of prior exploration on performance could be determined (Ravenscraft and Scherer, 1982).

Although most of the literature assumed a constant rate of decline in the R&D influence on firm performance as the length of the lag increases, this study used a binomial log structure model (Ravenscraft and Scherer, 1982), which assumed a wide range of plausible alternative lag shapes such as a bell-shaped distribution in the aggregated prior R&D effect. This method was initially proposed by Che (1971) and Spitzer (1974) to investigate the effect of prior marketing expenses on performance. Later, Ravenscraft and Scherer (1982) adopted it to study the relationship between prior R&D expenses and performance. Following Ravenscraft and Scherer (1982), after ruling out a contemporary effect in year zero, we defined the aggregated prior exploration as:

$$Prior\ Exploration \equiv L^k(\frac{RD}{NetSales}) = \sum_{i=1}^{k} w_{i-1}(\frac{RD}{NetSales})_{t-i} \tag{1}$$

where k is the total lag period, and the weight w_i is defined as:

$$w_i = (\frac{k!}{(k-i)!i!})\lambda^i(1-\lambda)^{k-i} \tag{2}$$

where λ is the binomial parameter.

The regression model for performance (return on assets) can thus be stated as:

$$ROA_{it} = b_1 \, Exploitation + b_2 \, Prior \, Exploitation + b_3 \, Exploitation + b_4 \, Controls + \varepsilon \tag{3}$$

The introduction of the parameter λ added one degree of freedom to the model. By minimizing the sum of the squared residuals,[3] an optimal λ could be found. As a result, the distribution of W_i and the lag structure of *Prior Exploration* could be determined.

A multivariate linear regression procedure was then adopted. The model takes account of both time and firm-specific fixed effects to control for unobservable effects. Following Ravenscraft and Scherer (1982), we set $k = 8$,[4] i.e., the lag period was from t-8 to t-1.

4. Results

By minimizing the sum of the squared residuals in equation (3), the optimal value for λ was found to be 0.2680. Substituting λ into equation (2), we calculated the values for w_0 to w_7 as 0.0824, 0.2414, 0.3094, 0.2265, 0.1037, 0.0304, 0.0056 and 0.0006, respectively. The value for *prior exploration* was thus derived from equation (1).

This result presents a bell-shaped exploration distribution with more of the lag effect found between year 2 (weighted by w_1) and year 5 (weighted by w_4), suggesting that the time lag between the beginning of exploratory investments and the commercialization of such investments in the semiconductor industry was 2 to 5 years. This finding is consistent with evidence from prior studies as well as field experience. Previous research has found that for the two-digit SIC electrical and electronics industry (SIC 36), the lag period for having a major impact is about 3 to 5 years (Lev and Sougiannis, 1996). The semiconductor industry is one of the most technology-intensive of the SIC 36 industries. Thus, a relatively long lag period, such as the 3 to 5 years is to be expected. As predicted by the famous Moore's Law,

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3   The sum of squared residuals was calculated as $\sum_{i=1}^{k}\left(ROA_i - R\hat{O}A_i \right)^2$.

4   We also tested multivariate linear regression results for k = 6 and k = 7, these robustness tests produce consistent results; the sign and significance of variables were unchanged.

for decades, the semiconductor industry has needed approximately 3 years to transition to each new technological generation. Semiconductor companies usually invest significant resources in R&D for new technologies. This R&D occurs one or two generations before the technology commercialization.

Table 2 presents the descriptive statistics and correlation matrix for all variables. The covariates consistently have low correlations with one another and thus there is no serious multicollinearity problem. Prior exploration shows a high correlation with current exploration, $r = .68$, so we demean these two variables in the following analysis.

Using a fixed-effects panel regression, we examined the influence of uncertainty on exploration and exploitation. The results in Table 3 show that uncertainty is positively associated with exploration. Uncertainty has an insignificant effect on exploitation. Hypothesis 1 is supported. We ran a fixed-effects panel regression for exploitation on prior exploration to test Hypothesis 2 (see Table 4). Model 3 reports the regression with only control variables. Model 4 reports the full model. The results from Model 4 show that the prior exploration effect on exploitation is positive and significant ($p < .01$). Accordingly, Hypothesis 2 is supported.

Table 2 Means, Standard Deviations, and Correlations

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1. Firm Performance (ROA)	0.12	0.14										
2. Exploitation	0.13	0.09	0.42 **									
3. Current Exploration	0.16	0.16	-0.46 **	-0.08								
4. Prior Exploration	0.14	0.14	-0.32 **	-0.10	0.68 **							
5. Uncertainty	0.25	0.13	-0.15 **	-0.04	0.25 **	0.07						
6. Firm Size (log of sales)	5.64	1.75	0.41 **	0.26 **	-0.12 **	-0.09	-0.13 **					
7. Firm Age	27.71	12.97	0.10 *	-0.01	-0.23 **	-0.26 **	-0.05	0.22 **				
8. Current Ratio	4.11	4.00	-0.05	-0.04	0.18 **	0.16 **	-0.06	-0.14 **	-0.01			
9. Debt/Equity Ratio	0.31	1.02	-0.09 +	-0.09 +	0.12 **	0.37 **	0.03	-0.08 *	-0.06	-0.03		
10. Industry Growth	0.08	0.18	0.13 **	0.05	-0.09 *	0.04	0.01	0.01	-0.02	-0.06 +	0.01	
11. Industry Concentration	0.10	0.03	0.24 **	0.14 **	-0.37 **	-0.31 **	-0.27 **	-0.05	0.02	-0.27 **	0.09 **	0.11 **

Note1: +p < .10. *p < .05. **p < .01.

Note2: Prior Exploration shows a high correlation with current exploration, r = .68, so we demean these two variables in the following analysis.

TABLE 3 Multi-Variable Linear Regression with Fixed-Effect Dependent Variable:
Exploration/Exploitation

Dependent Variables: Exploration		Dependent Variables: Exploitation	
Variables	Model 1	Variables	Model 2
Uncertainty	0.0671**	Uncertainty	0.0257
	(0.0268)		(0.0297)
Exploitation	0.1062**	Prior Exploration	0.2097**
	(0.0422)		(0.0660)
Prior Exploration	-0.2812**	Exploration	0.1293**
	(0.0590)		(0.0514)
Firm Size (log of sales)	-0.0479**	Firm Size (log of sales)	0.0550**
	(0.0078)		(0.0086)
Firm Age	-0.0024	Firm Age	-0.0035
	(0.0023)		(0.0025)
Current Ratio	0.0019	Current Ratio	0.0003
	(0.0012)		(0.0013)
Debt/Equity Ratio	-0.0134**	Debt/Equity Ratio	-0.0140**
	(0.0039)		(0.0043)
Industry Growth	-0.0253	Industry Growth	0.0076
	(0.0160)		(0.0177)
Industry Concentration	0.1227	Industry Concentration	0.5404
	(0.3352)		(0.3690)
N	526	N	526
R^2 (Within)	0.2338	R^2 (Within)	0.1542
R^2 (Overall)	0.0014	R^2 (Overall)	0.0824

Note: $+p < .10$. $*p < .05$. $**p < .01$.

TABLE 4 Multi-Variable Linear Regression with Fixed-Effect Dependent Variable: Exploitation

Variables	Model 3	Model 4	Model 5
Prior Exploration		0.1757**	0.2097**
		(0.0650)	(0.0660)
Current Exploration			0.1293**
			(0.0514)
Uncertainty	0.0318	0.0349	0.0257
	(0.0299)	(0.0297)	(0.0297)
Firm Size (log of sales)	0.0479**	0.0495**	0.0550**
	(0.0084)	(0.0084)	(0.0086)
Firm Age	-0.0049+	-0.0039	-0.0035
	(0.0025)	(0.0025)	(0.0025)
Current Ratio	0.0009	0.0006	0.0003
	(0.0013)	(0.0013)	(0.0013)
Debt/Equity Ratio	-0.0122**	-0.0159**	-0.0140**
	(0.0040)	(0.0043)	(0.0043)
Industry Growth	0.0015	0.0044	0.0076
	(0.0178)	(0.0177)	(0.0177)
Industry Concentration	0.4978	0.5640	0.5404
	(0.3728)	(0.3711)	(0.3690)
N	526	526	526
R^2 (Within)	0.1287	0.1485	0.1542
R^2 (Overall)	0.0750	0.0831	0.0824

Note: $+p < .10$. $*p < .05$. $**p < .01$.

Table 5 shows the estimates from the fixed-effects panel regression analysis with the firm's performance as the dependent variable. Model 5 presents the results with the control variables added and thus serves as the base model. In Models 6, 7, and 8, we added the exploration and exploitation variables. The sign and significance of the exploitation coefficients is in line with expectation ($p < .01$). Thus, Hypothesis 3 that exploitation positively impacts firm performance is confirmed.

TABLE 5 Multi-Variable Linear Regression with Fixed-Effect Dependent Variable: Firm Performance (ROA)

Variables	Model 6	Model 7	Model 8	Model 9	Model 10
Prior Exploration		0.1573+		0.0922	-0.0006
		(0.0824)		(0.0795)	(0.0790)
Exploitation			0.3791**	0.3708**	0.4058**
			(0.0565)	(0.0569)	(0.0556)
Current Exploration					-0.3298**
					(0.0614)
Uncertainty	0.1011**	0.1039**	0.0891**	0.0910**	0.1131**
	(0.0377)	(0.0376)	(0.0360)	(0.0361)	(0.0353)
Firm Size (log of sales)	0.0596**	0.0610**	0.0414**	0.0427**	0.0269**
	(0.0106)	(0.0106)	(0.0105)	(0.0105)	(0.0106)
Firm Age	0.0038	0.0047	0.0056+	0.0061*	0.0053+
	(0.0032)	(0.0032)	(0.0030)	(0.0031)	(0.0030)
Current Ratio	0.0015	0.0012	0.0012	0.0010	0.0017
	(0.0017)	(0.0017)	(0.0016)	(0.0016)	(0.0016)
Debt/Equity Ratio	-0.0049	-0.0083	-0.0003	-0.0024	-0.0068
	(0.0051)	(0.0054)	(0.0049)	(0.0052)	(0.0052)
Industry Growth	0.0724**	0.0750**	0.0718**	0.0733**	0.0650**
	(0.0225)	(0.0225)	(0.0215)	(0.0215)	(0.0210)
Industry Concentration	1.6876**	1.7469**	1.4989**	1.5378**	1.5782**
	(0.4708)	(0.4705)	(0.4505)	(0.4516)	(0.4384)
N	526	526	526	526	526
R^2 *(Within)*	0.1222	0.1292	0.2013	0.2037	0.2514
R^2 *(Overall)*	0.2138	0.1836	0.2262	0.2065	0.2788

Note: +$p < .10$. *$p < .05$. **$p < .01$.

We introduced Models 9 and 10 to assess the mediating effect of exploitation on prior exploration and performance. According to Baron and Kenny (1986), exploitation can be considered a mediator if (a) prior exploration significantly predicts firm performance, (b) prior exploration significantly predicts exploitation, and (c) exploitation significantly predicts firm performance controlling for prior exploration. In Table 5, Model 7 shows that prior exploration has a positive effect on a firm's performance ($p < .10$). In Table 4, the coefficients in Models 4 and 5 support a positive prior exploration effect on exploitation ($p < .01$). Furthermore, in Table 5, Models 9 and 10 suggest that exploitation significantly and positively impacts a firm's performance with prior exploration controlled ($p < .01$). When exploitation is included in the prior exploration regression on firm performance with controls, the influence of prior exploration is insignificant; indicating a full mediation effect. Thus, the above results significantly support Hypothesis 4, that exploitation mediates the effect of prior exploration on performance.

5. Discussions, Limitations, and Conclusions

Balancing exploration and exploitation is an important strategy for firms to outperform others, yet not much empirical research clearly elucidates how a firm can do so to gain benefits. We posed two research questions for our study: (a) how does uncertainty influence exploration and exploitation, and (b) what was the relationship between exploration and exploitation and its effect on firm performance? Drawing on real options reasoning, we found that uncertainty is positively related to exploration and that exploitation was a mediator that fully mediated the relationship between prior exploration and firm performance.

This study finds that uncertainty is positively related to exploration while it poses an insignificant effect on exploitation. The empirical results suggest that firms invest more exploratory investments in the face of uncertainty, indirectly implying a higher value for options created by such investments under uncertainty.

Our findings suggest that exploitation plays a key role in materializes the outcomes of exploration and that exploration and exploitation are balanced over time to create value for firms. This result supports an alternative enhanced view (Vermeulen and Barkema, 2001; Lavie and Rosenkopf, 2006) that balances exploration and exploitation over time and over domains. Additionally, the result on the positive effect of prior exploration on exploitation highlights the role of path-dependency in technology management, echoing Cohen and Levinthal's (1994) statement that "fortune favors the prepared".

Although our results provide support for our arguments, some caution is warranted as we study just a single industry. Although we consider that the semiconductor industry is the best choice for revealing exploration and exploitation activities under uncertainty, our results might not be generalizable to other industries. For example, our binomial lag methodology identified an optimal exploration lag pattern on a firm's performance, yet one must be careful in applying this pattern to other industries.

Another limitation of this study is that we cannot match each case of exploitation with previous exploration because of the non-additive nature of exploration activities (Vassolo et al., 2004), that is, the benefits of these activities interact with subsequent exploitation to affect firm performance. Because the purpose of our study was to highlight the sequential decisions involving exploration and exploitation, matching specific instances of exploration and exploitation was not our major concern. Future research might use a different data structure (e.g., a patent database) to examine the influence of the quantity and quality of exploration on exploitation.

Furthermore, merely categorizing exploration as real options may not be consistent with the real options reasoning used in initial investment (Adner, 2007). However, we believe that conceptualizing exploitation as striking options somewhat resolves the concern for the "impossibility of proving failure" (Adner and Levinthal, 2004).

Despite these reservations, our study makes several theoretical and empirical contributions to our understanding of exploration and exploitation. First, we broadened the use of real options reasoning by integrating ROR with classical exploration-exploitation arguments (March, 1991). Second, we resolved the debate between the advocates of the crowd-out and alternative enhancing hypotheses on exploration and exploitation. By reconceptualizing exploration and exploitation as creating and striking options in two functional domains, we uncovered the relationship between exploration and exploitation and also the sequences for these two kinds of activity.

In addition, this study provides new empirical evidence on exploration and exploitation. Specifically, it provides empirical support for an alternative enhancing relationship in the context of R&D resources management. Few previous studies have provided direct empirical evidence for balancing these two activities, although the benefits of doing so are commonly recognized. Moreover, it should be kept in mind that investment decisions involving resource allocation drive the direction a firm takes in its development activities, and they influence the source of the returns. Based on longitudinal data in the semiconductor industry, our findings

supported the proposition that decision makers, explicitly or implicitly, appeal to ROR in making investment decisions under conditions of uncertainty.

Our results highlight the danger of short-sighted exploration. As shown in Model 10 in Table 5, current exploration has a negative impact on current performance; that is, it takes time to realize the benefits of current exploration. By cutting current exploration activities, a firm can increase its short-term profitability but suffer long-term returns. Therefore, firms must manage their exploration activities cautiously over time.

Finally, our study contributes to our understanding of the performance implications of exploration and exploitation under uncertainty. Performance is a function of exploitation, which is instrumental in translating prior exploration into returns. Although exploration, exploitation, and their strategy implications have been extensively studied conceptually, there have been surprisingly few empirical investigations of them (Isobe et al., 2004). The few exceptions have addressed the problem in terms of the ambidexterity hypothesis (He and Wong, 2004). Although with some limitations, our study provides valuable insight into the relationship between exploration, exploitation, and firm performance.

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作者簡介

＊趙雨潔

趙雨潔為國立臺灣大學國際企業學系策略管理組博士，目前任職於國立屏東科技大學企業管理學系助理教授，研究興趣為企業成長、企業併購、與策略創新等。

Yu-Chieh Chao is an Assistant Professor of the Department of Business Administration at National Pingtung University of Science and Technology. She received her Ph. D. in strategic management from National Taiwan University. Her research interests include: firm growth, mergers and acquisitions, and strategic innovation.

鄭鈞云

鄭鈞云為國立臺灣大學國際企業學系策略管理組博士，目前為東吳大學企管系助理教授，研究興趣為策略管理與組織理論。

Chun-Yun Cheng is an Assistant Professor at the Department of Business Administration, Soochow University. She received her Ph. D. in strategic management from National Taiwan University. Her research interests include strategic management and Organizatinal Theory.

湯明哲

湯明哲教授為美國麻省理工史隆管理學院 (MIT Sloan School) 策略管理博士，曾任教於美國伊利諾大學香檳校區 (University of Illinois at Urbana-Champaign)（1985 年～1995 年），並於 1991 年獲終身教職 (tenure)。1994 年任教香港科技大學，於 1995 年返國擔任長庚大學管理學院工管系系主任，1996 年轉赴臺大國企系任教並擔任臺大管理學院 EMBA 第一任執行長，進修推廣部主任，及副校長等職。並曾擔任聯發科技獨立董事。現擔任富邦金控獨立董事。研究專長為：(1) 產業分析，尤見長於競爭策略；(2) 進入國際市場之策略；(3) 科技與策略之互動；湯教授曾發表文章於 Management Science, Strategic Management Journal, Journal and Management Studies 等期刊。

Professor Ming-Je Tang received his Ph.D. in Strategy and Policy from Sloan School of Management, MIT in 1985. He subsequently taught and was tenured at University of Illinois at

Urbana-Champaign. He also served as Visiting Associate Professor at Hong Kong University of Science and Technology. In 1995, Professor Tang went back to Taiwan and became the department head of Industrial Management at Chang Gung University. In 1996, he joined the faculty of the Department of International Business, NTU, found the EMBA program, and served as Vice President of NTU. Professor Tang's research interests include industry analysis and competitive strategies, international entry strategies, and technology strategy. He has published in Management Science, Strategic Management Journal, Journal of Management Studies, and other international business and management journals.

黃逸平

黃逸平為國立臺灣大學國際企業學系策略管理組博士候選人，目前任職於電子時報國際中心資深分析師兼主任，研究興趣為市場／產業聚合現象及此聚合現象下之公司行為。

Yi-Ping Huang is currently a Ph. D. candidate of the department of Business Administration at National Taiwan University. He is Senior Analyst and Director at DIGITIMES. His research primarily focuses on Market/Industry convergence phenomenon and the related firm behavior.

經理人外部連結對新興產業內公司之表現影響

External Ties of Managers and Firm Performance in an Emerging Industry

陳寶蓮 / 國立清華大學科技管理研究所副教授
Pao-lien Chen, Associate Professor, Institute of Technology Management, National Tsing Hua University

摘 要

本文檢視經理人的外部連結對進入新興行業之廠商的表現差異影響。從 1983 年至 1998 年間進入美國手機通訊服務業公司的實證，本文得到以下發現。首先，經理人與產業協會之連結會正向調節經理人的產業內經驗對公司手機用戶成長的影響。但這種正向的調節作用會隨著產業年齡增長而下降。其次，經理人與同業競爭者之連結也會正向調節經理人的產業內經驗對公司手機用戶成長的影響，而且此正向調節作用不會隨產業年齡而改變。最後，經理人的產業外連結不具前述調節作用。

【關鍵字】社會資本、人力資本、進入表現

Abstract

This paper examines the impact of managerial ties on the performance difference among entrants in an emerging industry. Empirical findings from firms that entered the cellular-phone service industry between 1983 and 1998 suggest the following. First, managers' ties to an intra-industry association positively moderated the relationship between managers' intra-industry experience and an entrant's new subscribers at the early stage of the focal industry; however, this effect decreased as the industry aged. Second, managers' ties to intra-industry competitors positively moderated the relationship between managers' intra-industry experience and an entrant's new subscribers regardless of industry age. Finally, mangers' external ties to other firms outside the industry exhibited no moderating impact.

【Keywords】social capital, human capital, entry performance

1. Introduction

How do managers' ties to other organizations affect firm performance? Prior research has suggested that the social ties of individuals can be valuable to their organizations because the connections can facilitate access to more in-depth sources of information; improve information quality, relevance, and timeliness; increase the ability to get things down; and enhance solidarity and legitimacy (Stuart, Hoang, and Hybels, 1999; Adler and Kwon, 2002). Subsequently, these benefits of social ties may enhance an organization's competitive advantage.

However, studies examining the relationship between firm performance and social ties of founders or boards of directors have presented conflicting findings (Peng and Luo, 2000; Stam, Arzlanian, and Elfring, 2014). Moreover, relevant studies have largely emphasized the direct influence of social ties on firm performance, ignoring the role of social ties as a "facilitator" of both execution- and innovation-oriented task performance (Nahapiet and Ghoshal, 1998; Moran, 2005), and the importance of industry-specific knowledge in creating innovation by applying the external information, knowledge, and resources facilitated by social ties (Dakhli and De Clercq, 2004). More critically, there is still a lack of empirical support for the general belief that industry conditions determine the firm performance impact of social capital (Stam et al., 2014). Therefore, this paper proposes and tests a model that can explain the relationships among managerial resources, industry evolution, and firm performance.

Building on social capital and experience-based human capital studies, this paper suggests that firm performance in an emerging industry is directly affected by managers' intra-industry experience and that managers' ties to other organizations affect firm performance indirectly by providing the direction for utilizing managers' intra-industry experience. As Ocasio (1997) indicated, the external ties of managers direct managerial attention toward certain strategic threats or opportunities. We suggest that external ties determine the capability of managers to detect business opportunities and threats, subsequently guiding their intra-industry knowledge and influencing firm growth. Moreover, this paper proposes that the indirect benefit of managers' external ties decrease as the focal industry evolves because managers' external ties should align with the informational requirements of the firm's strategy to enhance organizational performance (Geletkanycz and Hambrick, 1997) and because the information source for innovative ideas would shift to areas more local to the firm (Gort and Klepper, 1982).

The proposed hypotheses are tested by examining firms that entered the U.S. cellular-

phone (cell-phone) service industry before 1999, covering industry activities before and after widespread cell-phone adoption. The industry is an ideal empirical setting because from its beginning in 1983, it has included (1) the frequent exit and entry of a group of heterogeneous firms on the supply side, (2) more than six changes in the technology standard of mobile telecommunications, and (3) a shift from primarily 35 to 50 year-old professional, managerial customers to the general public. Three types of managers' ties to other organizations are examined in this paper: ties to an intra-industry association, competitors, and firms outside the industry. Empirical findings reveal that managers' ties to the Cellular Telecommunications Industry Association (CTIA) and intra-industry competitors positively moderate the effect of their intra-industry experience on an entrant's new subscribers. However, the positive moderating effect of ties to the CTIA significantly decreased as the industry aged. In addition, managers' ties to firms outside the cell-phone service industry did not moderate the relationship between their intra-industry experience and an entrant's new subscribers.

This paper's results reveal that not all external ties of managers are valuable to firm performance in an emerging industry. Managers' ties to intra-industry associations and competitors are in general helpful to firms in finding opportunities or avoiding threats. However, the value of external ties to industry associations does not sustain in an emerging industry. The findings could guide managers to manage external ties strategically.

2. Literature Review on Social Capital

The source of social capital lies in the social relations within which the individual actor is located (Adler and Kwon, 2002). Like human capital, individuals' social capital is one productive resource of their organizations (Castanias and Helfat, 2001), and it influences the process of resource combination and exchange by governing the opportunity, motivation, and ability of social interaction between individuals and their contacts (Nahapiet and Ghoshal, 1998; Adler and Kwon, 2002). Generally, a prospective donor without network ties to the recipients, motivation to contribute, and requisite competences or resources would not be a source of social capital (Adler and Kwon, 2002).

Theoretically, the benefits of social capital to the actors, and subsequently to their organizations, include facilitating access to more in-depth sources of information, improving information quality, relevance, and timeliness, increasing the ability to get things down, and enhancing solidarity and legitimacy (Stuart et al., 1999; Adler and Kwon, 2002). Furthermore, the social capital of managers' ties to other organizations can strengthen

supplier relations (Uzzi, 1997) and interfirm learning (Kraatz, 1998). The external connections of founders, particularly founders of new ventures, enable them to identify new business opportunities, obtain resources at below market prices, and secure legitimacy from external stakeholders. However, social capital also entails costs and risks. For example, sometimes ties are too costly to maintain. In addition, strong solidarity with ingroup members may reduce the flow of new ideas into the group, causing inertia and blindness (Powell and Smith-Doerr, 1994; Gargiulo and Benassi, 1999).

To evaluate the potential benefits, costs, and risks associated with social capital, scholars often refer to the structural, relational, and cognitive dimensions of social capital. Essentially, the structure of social capital defines the structure of individuals' social interactions with others (Adler and Kwon, 2002). The relational dimension of social capital reflects the potential trust and trustworthiness between individuals within social interaction (Barney and Hansen, 1994; Uzzi, 1996). The cognitive dimension of social capital relates to the development of a shared vision and common values between the donor and recipient because of their similar backgrounds and resources (Portes and Sensenbrenner, 1993; Nahapiet and Ghoshal, 1998). Thus, the crucial external measures for an individual actor's social capital comprises tie strength, size, quality, density, and diversity, network centrality, and structural holes (Granovetter, 1973; Freeman, 1979; Burt, 1983, 1992).

However, our understanding of the relationship between managerial ties and firm performance is incomplete. The literature pays considerable attention to the firm performance impacts of board interlocks and the personal connections of founders. However, the empirical evidence of these studies are often contradictory (Peng and Luo, 2000; Stam et al., 2014). Moreover, past studies have emphasized the direct impact of social capital, overlooking how the synergy between social capital and human capital influences firm performance. Because social capital can be a "facilitator" of both execution- and innovation-oriented task performance (Nahapiet and Ghoshal, 1998; Moran, 2005), discussing the value of managers' social capital without jointly considering their managerial capability in implementing tasks could result in the problem of identification. More critically, we still lack empirical support for the assertion that the impact of social capital depends on industry conditions (Stam et al., 2014). Thus, this study focuses on managers and examines how the synergy between their social and human capital influences firm performance in an emerging industry. Thus, we first develop propositions describing how managers' social and human capital can jointly influence firm performance and then we develop hypotheses.

3. Propositions

Prior studies have suggested that managers contribute two types of capabilities that constitute firms' managerial capabilities and are particularly crucial to the economic rent generated by firms. The first is managers' industry capabilities, an essential type of human capital for managers that refers to the managerial skills and knowledge of the industry gained through industry experience rather than education (Castanias and Helfat, 2001; Kor, 2003; Kor and Leblebici, 2005). Managers obtain industry skills and knowledge through on-the-job training or learning within industry settings (Becker, 1964; Pennings, Lee, and Van Witteloostuijn, 1998; Van Den Bosch and Van Wijk, 2003; Castanias and Helfat, 2001; Adner and Helfat, 2003; Kor and Leblebici, 2005). These capabilities offer competitive advantages to firms because they are tacit, difficult to replicate (Castanias and Helfat, 2001), and contribute to effective management (Mintzberg, 1973). Because every industry has unique characteristics, capabilities developed in one industry might not be entirely transferable to others (Castanias and Helfat, 2001). Industry capabilities are further divided into intra- and extra-industry capabilities depending on whether the capabilities are accumulated within or outside the focal industry.

3.1 Intra-industry Capabilities

Intra-industry experience has been suggested as enabling managers to accumulate managerial and industrial skills and knowledge regarding customer needs, technological potential, and creating and serving markets in the focal industry. Empirical studies have reported that firms at which top managers or founders have intra-industry experience perform more competitively. For instance, the intra-industry work experience of managers is positively associated with firms' likelihood of survival in the accounting and legal services industries (Pennings et al., 1998; Kor and Leblebici, 2005). Similarly, findings from the disk-drive industry reveal that the survival rate of employee spin-outs are positively related to the capabilities of their founders' former employers within the same industry because of the ties and resources that founders inherited from their former employers (Agarwal, Echambadi, Franco, and Sarkar, 2004). Accordingly, the first proposition of this paper is as follows:

Proposition 1: Increases in the intra-industry capabilities of managers increase an entrant's intra-industry performance.

3.2 Synergy between Intra-Industry Capabilities and Environmental Scanning Capabilities

Environmental scanning capabilities reflect the ability of managers to scan for opportunities and threats to firms' current operations and are highly influenced by managers' social capital, particularly their ties to other organizations (Ocasio, 1997; Pennings et al., 1998; Gulati, Dialdin, and Wang, 2002; Williams and Mitchell, 2004). Studies on the nature of managerial work suggest that an essential part of managerial work is making and maintaining contacts and interaction outside the formal organizational chain of command, both at interorganizational and interpersonal levels (Mintzberg, 1973, 1975; Carroll and Teo, 1996). Thus, managers' ties to other organizations determine their environmental scanning capabilities.

However, managers require a high level of industry-specific knowledge and skills to recognize and realize the benefits of external opportunities in a specific industry. For external information and knowledge to be transferred to the recipient effectively, the recipient must have sufficient absorptive capacity, which depends on whether the recipient has related experience (Cohen and Levinthal, 1990). In addition, generating innovation from external information, knowledge, and resources facilitated by external ties requires intra-industry experience (Dakhli and De Clercq, 2004). Accordingly, the second proposition of this paper is as follows:

Proposition 2: The environmental scanning capability of managers moderates the relationship between their intra-industry capability and an entrant's intra-industry performance.

4. Hypothesis Development

4.1 Synergy between Intra-Industry Experience and Managers' External Ties

The external ties that managers make and maintain reportedly enable firms to manage ambiguity and uncertainty in an emerging industry (Pfeffer and Salancik, 1978; Aldrich, 1999; Aldrich and Baker, 2001; Lant, 2003) and reduce environmental dependency (Carroll and Teo, 1996). Moreover, the external ties of mangers can enable firms to access information, resources, markets, and technologies in a timely and reliable manner (Gulati, Nohria, and Zaheer, 2000), transfer knowledge directly, and combine complementary knowledge bases (Van Den Bosch, Van Wijk, and Volberda, 2006). Recent empirical findings have revealed that the business ties of managers can exert a direct impact on knowledge exchange and knowledge combination, indirectly influencing firm innovation in product and

process (Shu, Page, Gao, and Jiang, 2012).

More critically, external ties might direct managers' attention to aspects of an organization's environment (Ocasio, 1997) and enable access to certain external information (Gulati et al., 2002), subsequently promoting organizations' social learning of adaptive responses rather than other, less productive forms of interorganizational imitation (Kraatz, 1998). Furthermore, newly hired executives with prior exposure to different products and strategies affect the subsequent product-market entry decisions of the firm (Boeker, 1997). As Penrose (1959) suggested, different firms face different supply and demand conditions, and the profitability of investment in different directions is affected accordingly. Thus, a reasonable expectation is that the more external ties a top manager brings to a top management team (TMT), the more likely the TMT is to identify new market opportunities to utilize the members' intra-industry experience. Therefore, we posit the following:

Hypothesis 1: **The more external ties a TMT has, the more the TMT's intra-industry experience enhances the firm's intra-industry performance.**

4.2 Fit between External Ties of Managers and Industry Evolution

Previous studies have suggested the following aspects in which industries evolve. First, the uncertainty and ambiguity are high initially and decrease over time (Daft and Lengel, 1986; Tushman and Nadler, 1986; Aldrich, 1999; Murmann and Tushman, 2001; Lant, 2003). Second, the rate of innovation decreases over time as the cost of innovation increases and ultimately outweighs the economic rents generated (Gort and Klepper, 1982; Klepper and Simons, 2000). Third, competition moves from product innovation to process innovation (Abernathy and Utterback, 1978). Finally, the customer base changes from technology enthusiasts and early adopters to mainstream markets (Moore, 1999). Then, how would these changes affect the importance of the external ties of managers?

As suggested, a firm's resource dependence on the external environment often increases with the level of environmental uncertainty (Pfeffer and Salancik, 1978). In addition, the information sources for innovation have been suggested as moving from places that are more distant from the firms in the focal industry to within the firms (Gort and Klepper, 1982). Moreover, it has been observed that product innovation, as opposed to process innovation, is more externally oriented by the business ties of managers (Shu et al., 2012). Thus, as the industry ages, a firm's reliance on the external ties of managers should decline. This logic leads to the following hypothesis:

Hypothesis 2: The positive moderating effect of a TMT's external ties on the relationship between the TMT's intra-industry experience and the firm's intra-industry performance decreases as the industry ages.

5. Methodology

5.1 Empirical Setting and Sample

To test the proposed hypotheses, the current study used panel data on firm performance and TMT backgrounds from 1983 to 1998 in the U.S. cell-phone service industry. Mobile communications services began in the United States in 1983 when the U.S. Federal Communications Commission issued its first license for a mobile communications service and Ameritech Mobile Communications launched the first commercial cell-phone service in Chicago. The first technology innovation in the industry was the shift from analog to digital transmission. In Los Angeles on January 14, 1991, PacTel Cellular placed the first commercial digital cell-phone call using the new industry standard, according to a report by PR Newswire. Following the improvement in technology, the U.S. cell-phone industry had reached 10 million subscribers by the end of 1992, 10 times the number of subscribers in 1987, according to a 1987 CTIA report. At the end of 1998, the number of subscribers in the U.S. was 69,209,321.

This industry setting is appropriate for this study for the following reasons. First, the industry environment has evolved rapidly in technology, supply, and demand (Wickham, 1993). Second, the rapid entry and exit of firms in the industry was accelerated by a high number of mergers and acquisitions and changes in government regulations over the study period. Firms that entered the industry include both independent and corporate entrepreneurs, and were diverse in product and geographic scope. Finally, in addition to significant industry evolution, firms in the industry exhibit evolved capabilities by constantly adapting their technology, entering new geographic markets, and changing their organizational capabilities through hiring, internal restructuring, mergers, acquisitions, and alliances. Thus, testing the proposed hypotheses within the mobile communications service industry enables observing the sources of the initial capabilities of entrants and their adaptation as the focal industry evolves in technology, demand, and competition.

This paper examines only those firms that appear to have long-term ambitions in the business. At the early stage of the industry, numerous firms or individuals entered the industry through forming partnership solely to realize short-term gains from arbitrage. Hence, firms were classified as entrants to the industry if they exhibited a sufficient degree

of commitment to the industry and activities in conducting the core business. Therefore, to exclude parties seeking only arbitrage opportunities, an entrant was required to hold a majority of ownership in a mobile license and to have demonstrated activities in purchasing telecommunication equipment or providing mobile phone service. Using these criteria, the initial sample comprises 88 entrants to the industry, 13 of which are start-ups. Although the sample decreased to 64 after excluding firms without performance data, the market share represented by those 64 firms ranged from 87% to 100% between 1986 and 1998. Further excluding firms without data on TMTs in the focal year and without data on one-year lagged firm performance yielded 41 firms with 272 observations.

To identify TMT members, empirical studies have referred to, or defined TMTs in several fashions: CEO, all officers reporting to the CEO, all officers on the board, first-level officers, or titles of vice president or higher (Pitcher and Smith, 2001). In this study, managers that meet all the following criteria are included in TMTs: (1) people who make strategic decisions and are involved with the operations of the focal business, (2) people who have positions in the highest level of management or the second-highest tier, and (3) people whose job titles are vice president or higher.

5.2 Variables and Measurements

Intra-industry performance. The *intra-industry performance* variable is measured by the increase in cell-phone service subscribers of firm i from year t-1 to year t. The subscriber figure is a performance measurement that reflects the capabilities of TMTs appropriately for the following reasons. First, Oster (1999) suggests that for some innovations, network size affects profitability substantially, such as in the classic example of telephone systems. Second, the cost of switching to another service provider is low (e.g., the cost of a cell phone, activation fee, or penalty) and maintaining customers requires reliable day-to-day operation. The customers of firms with unreliable operations might be unable to place phone calls or may receive poor call quality and subsequently switch to the providers offered by competitors. Third, further increasing a firm's subscriber base requires top managers to seek opportunities inside and outside existing markets. Finally, a total subscriber is a more accurate performance measurement than market share in the context of industry evolution because a firm might be growing strongly even as the rapid growth of the entire market reduces its market share. Hence, using a firm's annual number of new cell-phone service subscribers as a performance measurement enables more robust empirical testing of the proposed hypotheses than other measurements provided. Furthermore, to control for the

effects of mergers and acquisitions (M&As) on subscriber bases, all subscribers obtained through M&As were excluded. We also controlled the total number of acquired firms whose main business area is classified as 4812 according to the Standard Industrial Classification Code.

Intra-industry ties of TMT. Two types of manager intra-industry ties were examined: ties to the CTIA and ties to other cell-phone service operators. TMT's ties to the CTIA represent the number of top managers who had been a member of the CTIA directorial board prior to the focal year. TMT's ties to other firms represent the number of industry firms at which each manager had worked as a top manager (vice president or higher).

Extra-industry ties of TMT. TMT's extra-industry ties represent the number of firms at which each manager had worked as a top manager (vice president or higher) in firms outside the cell-phone service industry.

Industry age. The industry age variable is measured by the number of years since the beginning of the cell-phone service industry in 1983.

Intra-industry experience addition of TMTs. The variable for the intra-industry experience addition of TMTs is measured by the increase in the average years that TMT members had worked in the mobile communications service industry as top managers from year t-1 to t.

Control variables. To control for the increase in firm subscribers because of the growth of the entire industry, *industry growth at t* was included. This variable measures the growth rate of cell-phone subscribers at the industry level in year t. To control for the impact of competition on firm performance, the four-firm concentration ratio in the industry, *CR4*, is used. To control for the increase in firm subscribers because of technological advancement, a dummy variable specifying the time period before a shift to digital technology—*predigital regime*, is used. Regarding time-invariant firm effects, the number of acquisitions that the focal firm completed in the focal year, *N of acquisitions at t*, is used to control for the increase in firm subscribers from acquisitions. In addition, *firm size at t*-1, which measures the number of subscribers of the focal firm at year t-1, and *Below Industry Median Firm Size*, which is a dummy variable specifying whether firm size is below the industry median at t-1, are included, according to the firm growth literature (Geroski, 2002). The number of managers in the TMT, *Size of TMT*, is included to control for the amount of human capital in the TMT (Hambrick and Mason, 1984). To control for potential systematic errors caused by missing executive background information, the number of top managers with missing information, # *Execs w/ missing info*, is included. Firm-level variables such as entry date and

pre-entry background information is not included in the estimation model because the fixed-effects model automatically controls the time-invariant firm effects. Table 1 presents a summary of the variables and their measurements.

Table 1 Variables and Measurements

Variables	Measurements
Intra-industry performance of firm i at t (Increases in sales)	= Addition in total number of subscribers for firm i from t-1 to t, excluding the subscribers obtained through acquisitions
Firm size at t-1	= Total number of subscribers for firm i at t-1
Growth of industry subscribers (t)	= Ln (industry subscribers at t divided by industry subscribers at t-1)
CR4	= Sum of market share of the top four firms in the industry of cellular phone services
N of acquisitions (t)	= Number of acquisitions firm i completed at t
Size of TMT	= Number of executives at firm i's TMT at t
# Execs w/ missing info	= Number of executives with missing information
Below industry median firm size	= 1 if firm subscribers at t-1 is below industry median
Focal year is before digital technology regime	= 1 if focal year is before 1991, and 0 otherwise
Industry age	= Total number of years the industry has existed = focal year-1983 + 1
Intra-industry experience addition of TMT at t	= Addition in the average year of cellular phone service industry experience of firm i's TMT members at year t
Intra-industry ties to industry associations-CTIA of TMT at t-1	= Total number of TMT members who had been a board member of CTIA prior to the focal year for firm i at year t-1
Intra-industry ties to other cell-phone operators of TMT at t-1	= Total number of other cellular phone service operators that all TMT members had been a top manager prior to entering firm i at year t-1
Extra-industry ties to other firms of TMT at t-1	= Total number of firms in other industries that TMT members had been a top manager prior to entering firm i at year t-1

5.3 Data Sources

Data on the sampling firms and their TMT compositions are obtained primarily from the following sources: Phillips Publishing Telephone Industry Directory, Mobile Communications Directory, Cellular/Mobile Communications Directory, Wireless Industry Directory, Telephone Industry Directory and Sourcebook, Telecom Factbook 1985-1988, Corporate Affiliations, firms' U.S. Securities and Exchange Commission (SEC) filings, and Moody's Unlisted OTC Manual, OTC Manual, and Industry Manual. To determine TMT

members' employment history, this study used companies' SEC filings and four industry magazines, namely–*Telephony, Cellular Business, Communications (Englewood)*, and *Mobile Phone News*, that reported the movement of managers within the industry during the study period. To supplement these sources, searches of *Dun & Brad street Corporate Management, LexisNexis*, and *Hoover's Online* were also performed.

5.4 Analysis

The hypotheses are tested using the fixed-effects model because it is considered a conservative test that can control for all constant, unobserved heterogeneity among firms (Greene, 2000). In addition, there is no justification for treating the individual effects as uncorrelated with the other regressors, as is assumed in the random-effects model (Greene, 2000). Moreover, the results from Hausman tests on specified regression models support the use of fixed effects, not random effects. The general form for estimation is as follows:

$$y_{it} = \alpha + X_{it} \cdot \beta + v_i + \varepsilon_{it} \tag{1}$$

where y_{it} is the increase in cell-phone subscribers for firm i from year t-1 to t, $v_i + \varepsilon_{it}$ is the residual that includes the regular error term and firm-specific component v_i. Note that a TMT's external ties in year t-1 interacted with the addition in a TMT's intra-industry experience for firm i from year t-1 to t. The reasons for such specification are that (1) the external ties at year t-1 further shape the "development of intra-industry experience from year t-1 to t" and (2) the future experience "Δ", rather than current experience, can be shaped.

6. RESULTS

6.1 Descriptive Statistics

The final data set comprises 41 firms and 272 firm-year observations. The corresponding descriptive statistics and correlation matrix for key variables are summarized in Tables 2 and 3. On average, the firms in the sample have 9.35 team members, 0.26 years addition in a TMT's cell-phone service industry experience, and 0.15 team members whose background information is missing. Although some correlations are high in Table 2, high correlations do not occur among the key explanatory variables. In addition, using panel data analysis can reduce the problem of multi-collinearity among variables (Hsiao, 2003).

6.2 External Ties

Table 4 presents the empirical results of hypothesis testing. The current study measured a TMT's environmental scanning capabilities by examining three types of external ties that top managers accumulate from their past work: (1) ties to the CTIA, (2) ties to other cell-phone service providers, and (3) ties to firms outside the industry. The results of Model 1 in Table 4 reveal that the simple effects of these external ties on firm subscriber increase are positive but non-significant.

6.3 Accounting for Industry Age

Model 2 in Table 4 included the interaction between a TMT's external ties and intra-industry experience addition to test Hypothesis 1, which predicts that the more external ties a TMT has, the greater the TMT's ability to convert intra-industry experience into intra-industry performance. The results of Model 2 in Table 4 reveal that the coefficient of the interaction between the TMT's external ties and intra-industry experiences addition is significantly negative for ties to the CTIA ($\gamma = -1.36$, $p < 0.01$), significantly positive for ties to other cell-phone service providers ($\gamma = 0.31$, $p < 0.01$), and positive but non-significant for ties to extra-industry firms ($\gamma = 0.01$). Thus, Hypothesis 1 is supported only for a TMT's ties to intra-industry competitors.

Table 2 Summary Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max
Intra-industry performance of firm *i* at *t*	1.97	3.80	-21.89	36.06
Firm size at *t*-1	6.28	11.42	0.003	59.64
Growth of industry subscribers (*t*)	0.37	0.12	0.22	0.70
CR4	0.47	0.06	0.39	0.58
N of acquisitions (*t*)	0.06	0.25	0	2
Size of TMT	9.35	5.69	1	32
# Execs w/ missing info	0.15	0.43	0	3
Below industry median firm size	0.48	0.50	0	1
Focal year is before digital technology regime	0.29	0.45	0	1
Industry age	10.92	3.47	4	16
Intra-industry experience addition of TMT at *t*	0.28	0.98	-4.9	4.37
Intra-industry ties to CTIA of TMT at *t*-1	1.08	0.81	0	5
Intra-industry ties to other cell-phone operators of TMT at *t*-1	1.28	3.81	0	32
Extra-industry ties to other firms of TMT at *t*-1	2.44	3.25	0	18

Table 3 Correlations Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Intra-industry performance of firm i at t	1.00													
(2) Firm size at t-1	0.60	1.00												
(3) Growth of industry subscribers (t)	-0.28	-0.42	1.00											
(4) CR4	-0.25	-0.36	0.49	1.00										
(5) N of acquisitions (t)	0.02	-0.04	-0.03	0.06	1.00									
(6) Size of TMT	0.23	0.32	-0.12	-0.07	-0.01	1.00								
(7) # Execs w/ missing info	0.03	0.03	-0.02	-0.04	-0.02	0.24	1.00							
(8) Below industry median firm size	-0.36	-0.47	0.07	0.06	0.01	-0.26	0.03	1.00						
(9) Focal year is before digital technology regime	-0.22	-0.30	0.79	0.13	-0.05	-0.13	0.00	0.06	1.00					
(10) Industry age	0.31	0.45	-0.94	-0.63	0.02	0.13	0.02	-0.08	-0.82	1.00				
(11) Intra-industry experience addition of TMT at t	0.11	-0.04	0.03	0.07	0.01	-0.04	-0.02	0.04	0.04	-0.06	1.00			
(12) Intra-industry ties to CTIA of TMT at t-1	0.22	0.36	-0.09	0.05	0.07	0.47	-0.06	-0.28	-0.13	0.08	-0.02	1.00		
(13) Intra-industry ties to other cell-phone operators of TMT at t-1	0.31	0.55	-0.24	-0.23	-0.04	0.48	-0.05	-0.21	-0.18	0.27	0.04	0.53	1.00	
(14) Extra-industry ties to other firms of TMT at t-1	0.17	0.19	-0.25	-0.17	-0.07	0.44	-0.16	-0.06	-0.22	0.26	0.05	0.38	0.53	1.00

As shown in Table 4, Model 3 included interaction among industry age, TMT external ties, and TMT intra-industry experience addition to test Hypothesis 2, which predicts a positive moderating effect of TMT external ties on the relationship between intra-industry experiences and that firm intra-industry performance decreases with industry age. The results of Model 3 reveal that the coefficient for the three-way interaction is significantly negative for ties to the CTIA ($\gamma = -0.45$, $p < 0.01$) and non-significant for ties to other cell-phone service providers and firms outside the focal industry. In addition, the coefficient for the two-way interaction between a TMT's ties to the CTIA and intra-industry experience addition is significantly positive ($\gamma = 4.49$, $p < 0.01$), supporting Hypothesis 1 at the emerging stage of the industry. To check the robustness of the observed effect of industry age in Model 3, we estimated the specification in Model 2 again by splitting the sample into two groups, one with an industry age lower than the mean industry age of the full sample and the other with a higher industry age than that of the full sample. Although not reported here, the results of the subsample analysis are consistent with the results of Model 3. Thus, Hypothesis 2 is supported for a TMT's ties to the CTIA, and Hypothesis 1 is further supported for a TMT's ties to CTIA at the emerging stage of the industry of cell-phone services.

In summary, Hypothesis 1 is generally supported but Hypothesis 2 is not for a TMT's ties to other cell-phone service providers. Graph 1 shows the marginal benefit of obtaining one addition tie to the intra-industry competitors. Hypothesis 1 is supported at the emerging stage of the focal industry for a TMT's ties to the CTIA. However, this positive moderating effect of ties to the CTIA gradually decreased with industry age and finally constrained firm performance, supporting Hypothesis 2. Hypotheses 1 and 2 are not supported for ties to extra-industry firms. Hence, support for Hypothesis 1 and 2 depends on the type of external ties that the TMT uses to scan the environment. The results from the fully specified model are presented in Model 4 in Table 4.

Table 4 The Relationships among Intra-Industry Experience, External Tie Type, Industry Age, and Intra-Industry Performance

Dependent variable Intra-industry performance of firm *i* at *t*	H.	(1)	(2)	(3)	(4)
Independent variables					
Firm size at *t*-1		0.13***	0.12***	0.16***	0.16***
		(0.04)	(0.04)	(0.04)	(0.04)
Growth of industry subscribers (*t*)		0.47	-1.05	1.28	1.84
		(5.99)	(5.68)	(5.51)	(5.45)
CR4		-9.53	-12.53	-8.56	-7.54
		(10.14)	(9.71)	(9.36)	(9.26)
N of acquisitions (*t*)		0.70	0.39	0.19	0.25
		(0.83)	(0.79)	(0.76)	(0.75)
Size of the TMT		-0.09	-0.09	-0.04	-0.04
		(0.08)	(0.08)	(0.07)	(0.07)
# Execs w/ missing info		0.68	0.31	0.35	0.36
		(0.60)	(0.57)	(0.55)	(0.54)
Below industry median firm size		0.43	0.83	0.31	0.35
		(0.75)	(0.71)	(0.69)	(0.68)
Focal year is before digital technology regime		-1.32	-1.78	-1.12	-1.18
		(1.65)	(1.59)	(1.52)	(1.51)
Industry age		-0.00	-0.10	-0.19	-0.20
		(0.44)	(0.42)	(0.42)	(0.41)
Intra-industry experience addition of TMT (*t*)		0.63***	1.66***	-4.99***	-5.16***
		(0.20)	(0.34)	(1.50)	(1.43)
Intra-industry ties to CTIA of TMT (*t*-1)		0.63	0.84**	-1.84	-1.45
		(0.42)	(0.41)	(1.25)	(1.20)
Intra-industry ties to other cell-phone operators of TMT (*t*-1)		0.02	-0.03	0.66	-0.20
		(0.21)	(0.20)	(0.79)	(0.19)
Extra-industry ties to other firms of TMT (*t*-1)		0.10	0.05	0.27	0.03
		(0.13)	(0.12)	(0.46)	(0.12)
Intra-industry experience addition of TMT (*t*)*					
Intra-industry ties to CTIA of TMT (*t*-1)	H1		-1.36***	4.49***	4.52***
			(0.28)	(1.38)	(1.24)
Intra-industry ties to other cell-phone operators of TMT (*t*-1)	H1		0.31***	0.21	0.36***
			(0.08)	(0.65)	(0.09)
Extra-industry ties to other firms of TMT (*t*-1)	H1		0.01	-0.03	-0.01
			(0.06)	(0.44)	(0.06)

Dependent variable Intra-industry performance of firm *i* at *t*	H.	(1)	(2)	(3)	(4)
Industry age* Intra-industry experience addition of TMT (*t*)*					
Intra-industry ties to CTIA of TMT(*t*-1)	H2			-0.45***	-0.45***
				(0.10)	(0.09)
Intra-industry ties to other cell-phone operators of TMT (*t*-1)	H2			0.02	
				(0.05)	
Extra-industry ties to other firms of TMT (*t*-1)	H2			0.00	
				(0.03)	
Industry age*					
Intra-industry ties to CTIA of TMT (*t*-1)				0.23**	0.20*
				(0.11)	(0.11)
Intra-industry ties to other cell-phone operators of TMT (*t*-1)				-0.07	
				(0.06)	
Extra-industry ties to other firms of TMT(*t*-1)				-0.02	
				(0.03)	
Intra-industry experience addition of TMT(*t*)				0.50***	0.51***
				(0.11)	(0.10)
Constant		5.18	8.20	6.34	5.65
		(11.28)	(10.80)	(10.43)	(10.34)
r2 o			0.32	0.31	0.418	0.437
r2 b			0.36	0.17	0.164	0.227
r2 w			0.31	0.39	0.468	0.463

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: (1) 41 firms and 272 firm-year observations, (2) fixed-effects estimation, (3) The unit for subscribers is in 100,000.

Marginal Increase in Subscribers
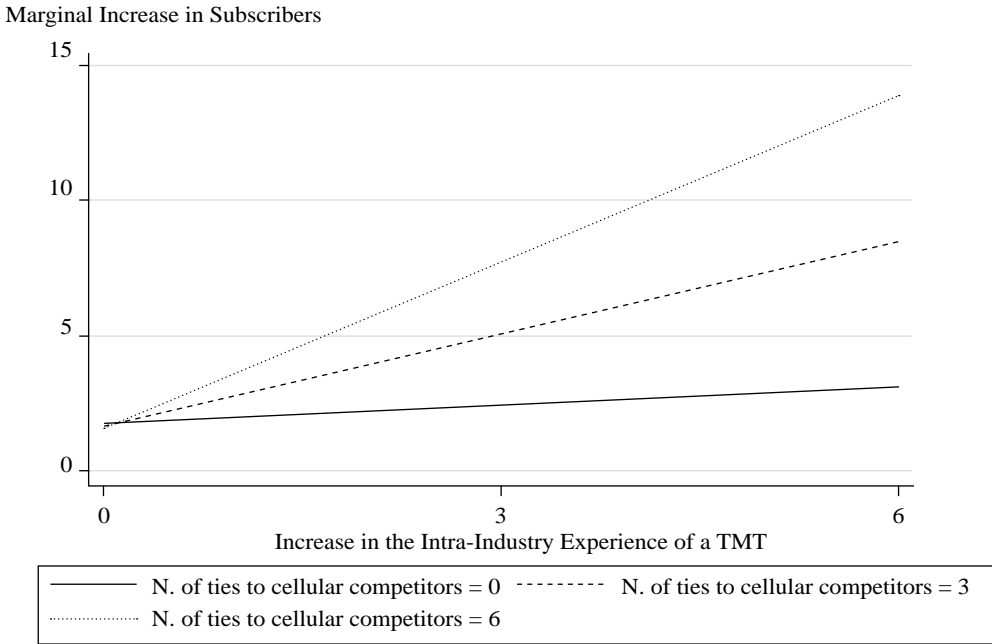
Graph 1 The Marginal Increase in Firm Subscribers with a One-Year Increase in a TMT's Intra-Industry Experience While Holding the Number of a TMT's Ties to Cellular Competitors at Difference Value

7. Conclusions

This paper reveals how managers' ties to other organizations affect firm performance in an emerging industry, namely the cell-phone service industry. Specifically, this paper focuses on the external ties that top managers accumulated through previous employment. In particular, this paper proposes that the more external ties managers have, the more the managers' intra-industry experience increases firm performance in the focal industry. However, this positive moderating effect of managers' external ties would decrease with industry age.

The empirical findings obtained by analyzing the information of 41 cell-phone service firms from 1983 to 1998 suggest the following. The greater the number of managers' ties to intra-industry competitors and an industry association, the more the managers' intra-industry experience increases firm subscribers. However, the previous positive moderating effect of managers' ties to the intra-industry association decreased significantly as the focal industry

aged. The observed conditioning effect of industry age is consistent with the historical development of digital standard competition: Time division multiple access, a digital standard endorsed by the CTIA, was not widely adopted. Cell-phone service providers with more ties to the CTIA were slower to adopt code division multiple access, a competing technology that later became the industry standard. Managers' ties to extra-industry firms had no direct or moderating impact on firm subscriber increase.

The results of this study suggest that being able to scan the environment through top managers' relationships with competitors and an industry association is crucial to firm performance in the focal industry. However, as the industry structure develops, the managerial capabilities of scanning the environment through the lens of industry associations become less critical to firm performance. This finding suggests that for earlier entrants, active involvement in the focal industry association is essential to performance. For entrants to the focal industry at any time, managerial relationships with competitors are always crucial to firm performance in the focal industry.

On the basis of studying a TMT's environmental scanning capabilities in the context of industry evolution, this paper contributes to the theoretical and empirical understanding of social capital, demonstrating the role of social capital as a "facilitator" of task performance (Nahapiet and Ghoshal, 1998; Moran, 2005) and showing that various "types" of external ties affect firm performance differently. Furthermore, this paper identifies industry evolution as one industry condition under which the benefits of external ties could diminish and provides empirical support for this (Stam et al., 2014). This paper indicates that firms can and must adjust their environmental capabilities by managing their managerial talents in response to changes in the industry environment post entry, to guide practitioners in determining whom and when to hire or promote to the TMT according to the industry life stage.

However, we must be careful in interpreting the results presented in the paper, which are based on observations in one industry that is technology-related and has evolved rapidly. The same results might not be derived from industries that are static or non-technology-related. In addition, the current study did not consider the magnitude or strength of external ties because they were measured by counting the total TMT member ties. Furthermore, the study did not examine all firms entering the mobile communications service industry because of the problem of missing cellular licensees' background information, entrants' TMTs, and subscriber numbers. However, this study included most early entrants to the industry.

Although this paper focuses on managerial capabilities in environmental scanning and industry evolution, additional research in the following directions is necessary to further understand the characteristics of managerial resources that are valuable to firms and how to convert managerial resources into productive managerial services as an industry evolves. This paper directly connects managerial capabilities in environmental scanning and firm performance, ignoring the heterogeneity of firm strategies that managers implemented. The same set of managerial capabilities might result in different strategies because there are more than one means to the same end. If heterogenic strategies among firms are observed, do heterogenic managerial capabilities contribute to the phenomenon? In addition, it is crucial to determine how the design of corporate governance structure moderates the effect of managerial capabilities on firm performance and whether the structure should be adjusted according to the industry.

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作者簡介

陳寶蓮

　　美國伊利諾大學香檳分校商學院策略管理博士，現為國立清華大學科技管理研究所副教授。論文曾發表於 Strategic Management Journal 與 International Business Review 學術期刊。目前研究興趣包含組織變革、新創事業高階人才策略管理以及產業演化等議題。實證研究對象包含美國通訊手機服務廠商，臺灣半導體新創公司以及中國科技新創公司。

　　Pao-Lien Chen is currently associate Professor of the Institute of Technology Management, National Tsing Hua University, Taiwan. Her works have appeared in Strategic Management Journal and International Business Review. Her current research focuses on strategic human capital, organizational change and industry evolution. Industrial contexts include the cellular phone service operators in the U.S, semiconductor startups in Taiwan, and the technology-related startups in China.

* 　E-mail: chenpl@mx.nthu.edu.tw

併購與策略聯盟在公司理財文獻之回顧與展望：亞洲市場之研究

Review of M&A and Joint Ventures in the Field of Corporate Finance: Asia as the Case Study

翁鶯娟 / 國立高雄應用科技大學企業管理系副教授

Ying-Jiuan Wong, Associate Professor, Department of Business Administration, National Kaohsiung University of Applied Sciences

張紹基 / 國立成功大學國際企業研究所教授

Shao-Chi Chang, Professor, Institute of International Business, National Cheng Kung University

摘 要

企業需藉由不同投資決策，以達成追求成長與永續經營等目的。當內部成長例如創新投資和資本投資等方式受限，無法達到成長目的時，併購、權益性策略聯盟如合資，或非權益性策略聯盟等外部成長方式遂成為組織達到擴張的重要方式。本文主要聚焦於公司外部成長之投資決策，回顧 2000~2015 間以亞洲市場資料為樣本，並發表於 TSSCI 或 A 級 SSCI 財務期刊中關於併購、合資與策略聯盟的文獻，依文獻之研究方向分為併購以及策略聯盟二個議題，系統性整理與分析各議題的發展與成果。此外，台灣市場具有家族企業普遍、網絡關係密切的產業供應鏈和集團企業等特性，這些特性提供台灣學者未來發展以台灣樣本為基礎之併購與策略聯盟研究的良好利基。本文希望透過系統性的整理分析，進而指出以台灣資料特性為樣本以及未來可能之研究方向，提供予後續研究者參考。

【關鍵字】併購、策略聯盟、合資、公司理財

Abstract

A firm needs to engage in various corporate investments in order to grow and ensure sustainable operations. When opportunities for internal growth (innovation investment or capital investment) are limited and financial goals are not achieved, a firm may then turn to external growth methods (M&A, equity-based alliances such as joint ventures, and non-equity-based alliances) to achieve its growth objective. This study focuses on external growth strategies by revisiting the relevant literature that sampled data from the Asian market, and was published in TSSCI or A Tier SSCI financial journals from 2000 to 2015. Journals that touched upon M&A, joint ventures and strategic alliances were targeted. Following the research format within these journal articles, topics were then divided into two categories: M&A and alliances. Additionally, Taiwanese companies have a prevalence of family businesses, supply chains with closed networks and business groups. These unique characteristics of Taiwanese companies give scholars an opportunity to develop research focused on M&A and alliances. Taiwanese companies provide good data on niche acquisitions and alliances for researchers to examine. This study, through a systematic analysis, sheds light on potential future research topics and studies related to M&A and alliances based on data collected in Taiwan.

【Keywords】M&A, alliance, joint venture, corporate finance

壹、前言

企業需藉由不同投資決策，以取得技術與資源，擴充營運與市場規模，分散公司營運風險，達到追求成長與永續經營等目的。企業追求成長的方式可分為內部與外部成長策略，內部成長例如創新投資（研發支出／專利）或資本投資，外部成長策略則藉由不同個體公司間之併購、合資或策略聯盟等來達成企業擴張之目的。內部成長策略未涉及組織間正式化的契約，所以不會因股權結構的改變，威脅到經營者的控制權；外部成長策略則包含策略聯盟與併購，策略聯盟依其所牽涉權益資本的投入與控制程度，分為非權益性合約式的策略聯盟，以及權益性的合資，非權益性策略聯盟的控制性相對於權益性的合資低。併購則因收購目標公司大部份股權，需投入更多資源取得目標公司。一般而言，併購的交易成本與涉入程度均較合資或合約式策略聯盟更高（林財源與程運瑤，2012；Preece, 1995; Yin and Shanley, 2008）。

在公司無法單獨藉由內部成長策略達到成長需求時，外部成長方式常成為管理者紓解內部成長機會限制的重要方式 (King, Dalton, Daily, and Covin, 2004; Slywotzky and Wise, 2002)。尤其是併購，從二十世紀初迄今，已歷經六次完整的併購熱潮。根據 Thompson Financial Securities Data Company 資料，1992 ～ 2011 全球平均每年併購交易金額約為 2.7 兆美元，其中約有百分之五十的交易金額涉及美國企業。雖然，1998 至 2000 間完成的併購交易約 4 兆美元，2007 更高達 4.4 兆美元，然而，2015 全球併購交易額甚至已超過 2007 的歷史新高，接近約 5 兆美元的金額 (Lam, 2015; Shimizu, Hitt, Vaidyanath, and Pisano, 2004)。

併購因常涉及龐大的交易數量與金額，影響併購因素也相當複雜，不僅在實務上高度影響公司的投資策略與價值，在學術上亦吸引許多學者投入研究，並發展一系列理論與假說探討併購的相關因素。再者，因近年來已有許多國內、外文獻針對策略聯盟與併購等投資決策進行研究，並完整回顧與分析相關議題的文獻（Krug, Wright, and Kroll, 2014; 林財源與程運瑤，2012）。為避免與現有文獻重複，使得文獻回顧的主題過於龐大與失焦，本文主要聚焦於以亞洲資料為樣本的併購、合資與策略聯盟等外部成長方式文獻，並將相關研究歸納為併購與策略聯盟二個主題。此外，併購議題因以亞洲為樣本的文獻較多，故本文在併購部分將依據以往回顧文獻的討論分類，針對併購績效與影響績效因素進行文獻回顧，而策略聯盟則分別以台灣市場與亞洲市場研究為討論主軸。

由於台灣主要的組織型態為家族企業和集團企業，公司治理也存在對投資人保護較差，家族控制公司營運，股權高度集中於控制股東等問題，本文希冀藉由系統性文獻整理，輔以台灣家族、集團企業和公司治理較弱等市場特性，提出屬於台灣市場獨特性的可能研究議題，以供後續研究者參考。

　　本研究所涵括之投資活動學術文章，主要為發表於 2000 ～ 2015 間，以亞洲國家資料包含東亞（台灣、大陸、香港、澳門、日本、南韓），與東南亞（新加坡、泰國、馬來西亞、印尼、馬來西亞、緬甸、菲律賓、與越南）等國家，並發表於 TSSCI 和科技部財務學門國際期刊分級排序計畫中之 A 級 SSCI 財務期刊中之研究。本文後續各節內容如下：第二節進行併購文獻回顧；第三節回顧策略聯盟文獻；最後，第四節則為結論。

貳、併購

　　併購是企業外部成長的重大投資方式，企業利用併購以達成營運綜效、進入新市場、多角化，取得創新資源、垂直或水平整合、減緩過剩產能及全球化，或是追求管理者個人私利等目的。由彙整之文獻資料可發現近期併購研究依其研究的層級，分別以各類理論與觀點討論併購相關議題。例如，個別層級研究（交易特性或管理者特性），部分學者以綜效理論、組織學習、資源基礎理論討論相關或非相關併購（曾真真，2010a；曾真真與何雍慶，2005；陳安琳、湯惠雯與許銘峻，2000），或者是以代理理論探討併購支付方式對績效影響的議題（王祝三、周德瑋與陳弘榮，2006），也有學者以行為財務／高層理論研究管理者過度自信與特性對併購的影響（Lin, Michayluk, Oppenheimer, and Reid, 2008; 許培基、葉銀華、邱琦倫與王宛婷，2013），亦有文獻使用網絡理論探討 CEO 在公司中的網絡核心程度與併購間的關係 (El-Khatib, Fogel, and Jandik, 2015)。公司層級的研究除了以綜效理論為論述基礎外，尚有許多研究以資源基礎理論、組織學習、代理理論探討公司內部特性，例如公司所擁有之策略性資源、研發存量、併購經驗或知識移轉能力對併購產生的影響（曾真真與何雍慶，2005；邱奕嘉與曾為國，2014），而公司外部特性則主要以網絡／關係理論為論述依據，探討公司的銀行或政治與公司間網絡關係如何影響併購行為與績效 (Chong, Liu, and Tan, 2006; Zhou, Guo, Hua, and Doukas, 2015; Ishii and Xuan, 2014)。在公司治理的部分則有學者以代理理論或是由公司治理觀點研究機構法人、公司治理良莠程度、股權／董事會結構，或是以投資者保護觀點與企業社會責任探討其對併購所產生的影響（陳振遠、王健聰與洪世偉，2013；Deng, Kang, and Low, 2013）。產業層級研究則以市場力、併購熱潮、羊群效應、政治熱期，或組織生態觀點中之環境豐厚性與環境動態性為理論觀點（Duchin and Schmidt, 2013; Zhou et al., 2015; 邱奕嘉與曾為國，2014）。此外，亦有部分研究以多國樣本討論國家層級因素，例如法制或文化差異與併購間之關係為何 (Wang and Wang, 2012)，也有學者以行為財務觀點探討不同國家的投資人或管理者如何影響併購的相關議題 (Ferris, Jayaraman, and Sabherwal, 2013)。而跨國併購亦因涉及國家層級差異，以往除了以交易成本或折衷理論為主要論述基礎，討論進入地主國模式與價值創造等議題外 (Shimizu et al., 2004)，目前也有研究以法令

與聲譽約束假說，或文化／法制差異觀點探討跨國購併對主併公司的影響 (Ghosh and He, 2015; Ahern, Daminelli, and Fracassi, 2015)。

以往併購研究除了以單一或綜合多重理論討論併購議題外，也分別針對併購績效、影響併購因素與跨國併購，進行文獻分析與回顧 (Haleblian, Devers, McNamara, Carpenter, and Davison, 2009; Shimizu et al., 2004; Butler, Perryman, and Ranft, 2012; Ismail, Abdou, and Annis, 2011; King et al., 2004; Krug et al., 2014; Meglio and Risberg, 2011; Tuch and O'Sullivan, 2007)。在績效方面，相關回顧文獻指出併購除影響企業的財務（長、短期股價及會計績效）與營運績效（創新、市場與生產力績效）外，亦會影響公司利害關係人、支付溢價及管理階層的異動。在影響因子方面，則聚焦於交易、管理者、公司、環境與國家特性等因素進行探討。此外，跨國併購因牽涉到母國與地主國間公司治理、體制或文化的差異，所以跨國併購也將國家層級因素納入討論範圍。

為了彙整並回顧以亞洲資料為樣本之併購研究，本節將依循以往併購文獻回顧的架構，分別依併購對財務、創新與其他績效的影響，個別、公司、產業與國家層級影響併購之因素，以及跨國併購等議題進行文獻回顧，並整理不同層級研究的文獻所引用之相關理論（請參閱附錄表1），希冀能利用台灣樣本的獨特性，發展出新的研究議題與研究方向。

一、併購對績效的影響
（一）對財務績效的影響

以往購併文獻指出，企業除透過併購獲取公司所需資源，藉以提升營運效率以及增加公司獲利能力外，併購活動也潛藏著經理人攫取個人私利的代理問題，並進而影響公司併購後的經營績效。

在台灣樣本方面，併購對於財務績效影響的研究，陳妙玲與陳欣瑜 (2010) 發現金融控股公司購併後業務多角化未因規模經濟和範疇經濟的影響而產生成本上的綜效，購併後變動成本率反而向上揚升而降低併後營運績效，且併後也未因市場力量上升而增加市場效益，反而負向影響市場表現並降低營運績效。黃志仁與溫宜豪 (2008) 實證結果也指出母公司合併子公司後並未產生營運、市場與財務上綜效，故母公司產生負向短期異常報酬，宣告後一年也未呈現顯著的長期異常報酬。陳安琳等 (2000) 研究發現併購宣告具有顯著正向的短期累計異常報酬。王祝三等 (2006) 也發現主併公司之併購活動宣告前後一日之短期股東財富顯著為正，但宣告前後二十日之累計異常報酬卻不顯著，然而，金融業在此宣告期間則具有正向短期異常報酬。

在其他亞洲國家樣本部分，Zhou et al. (2015) 的研究則探討大陸國有及私有企業併購對併後長、短期績效的影響，該研究發現當目標公司為國有企業時，大陸民營主併公司相對於國有主併公司有更高的短期異常報酬，然而，國有主併公司的長期股票

報酬與營運績效均優於民營企業。Higgins and Beckman (2006) 的研究則指出因公司政策與跨國環境間調和的複雜程度高，日本企業在併購法規鬆綁前，主併公司不論進行國內或跨國併購均無顯著短期異常報酬，即使在法規鬆綁後，也只有在併購國內目標公司時才具有正向短期異常報酬。Higgins (2013) 卻發現日本主併公司並未因併購而獲得長、短期股票報酬與營運績效。Chong et al. (2006) 檢測強制性銀行合併對股東財富的影響，該研究顯示強制性銀行合併減損經濟價值具負向短期異常報酬，此外，主併銀行在犧牲目標銀行的利益下獲取併購利得，該結果與以往自願合併的研究結論不同－目標公司在犧牲主併公司的利益下獲取併購利益，且對整體併購價值並無影響。

亞洲樣本研究在財務績效之實證結果，除王祝三等 (2006) 研究中的金融產業，Higgins and Beckman (2006) 法規鬆綁後之日本國內併購，以及陳安琳等 (2000) 和 Zhou et al. (2015) 的實證結果發現併購具正向宣告效果，其他研究結果均大致符合主併公司無法藉由併購增加公司長、短期價值和營運綜效之研究結論 (King et al., 2004; Netter, Stegemoller, and Wintoki, 2011; Berger, 2003)。王祝三等 (2006) 的研究僅金融產業有正向報酬應與台灣金融產業推動金融改革，以及推動金融機構合併特性有關。陳安琳等 (2000) 的研究結果可能是因為市場認為台灣的企業在市場狹小與技術缺乏情況下，進行併購可以增加企業的競爭力。然而，Zhou et al. (2015) 的正面宣告效果則主要受到主併公司股權結構與是否併購國有企業所影響。

（二）對創新績效的影響

過去相關研究指出，在技術快速變動的環境下，廠商除了透過投入內部研發資源取得技術外，技術併購亦是廠商用以發展創新能力的重要替代策略 (Hussinger, 2010)。技術併購係指主併公司透過併購目標企業以取得目標公司的技術資源，藉以提升主併公司的研發與創新能力，然而，技術併購的成功與否，端視主併公司是否在併購過程中取得如專利等創新能力而定 (Ahuja and Katila, 2001; Poon and MacPherson, 2005)。

在台灣樣本方面，併購對創新績效影響的研究，邱奕嘉與曾為國 (2014) 的研究結果顯示，技術相關程度與併購後研發績效間呈現倒 U 型關係；組織吸收能力正向強化技術相關與併購後研發績效間的關係；但組織外部環境的豐厚性及動態性弱化此關係的結論與以往研究並不一致 (Teece, Pisano, and Shuen, 1997)。然而，曾真真 (2010b) 的研究發現同業併購對併後創新績效產生負面影響的結果符合降低競爭的論點，亦即併購後因競爭壓力下跌，降低企業投入創新的誘因 (Ernst and Vitt, 2000)；該研究也指出跨國的同業併購有利於併後創新績效，符合區位特性可以挹注主併公司互補性資源與知識之主張 (Bertrand and Zuniga, 2006)，而且主併公司國際化程度愈高，槓桿海外知識的能力越強，跨國購併的創新績效也越好；主併公司的知識基礎愈高，也愈能順利地吸收外來知識，提升併購創新的績效。曾真真 (2008) 實證則發現合併後主併公司之研發投入及創新績效顯著增加；此外，主併公司之研發存量正向影響併購績效的結果

與以往研究結論一致；雖然目標公司的研發存量與併購績效間的關係為不顯著，但卻符合目標公司知識移轉至主併公司之效果不顯著的研究結果 (Capron and Pistre, 2002)；主併公司與目標公司之技術相似性負向調節研發存量與併購績效間關係也符合競爭降低的論點。陳玉麟 (2011) 針對內外部創新機會及能力的配合，探討外部的開放性創新模式例如併購是否可以促進企業的創新績效。該研究指出當知識難以模仿時，併購讓企業得以運用有限的資源，提升本身的學習機會，對企業創新績效的助益較大，其實證結果確實顯示併購對於專利的產出有正向顯著的影響。

目前技術併購對創新績效影響的文獻，主要聚焦於技術的互補性與相關性 (Cloodt, Hagedoorn, and Van Kranenburg, 2006)，技術的複雜程度 (Brusoni, Prencipe, and Pavitt, 2001)，目標公司知識基礎規模 (Ahuja and Katila, 2001; Phillips and Zhdanov, 2013)，主併公司的資源整合、財務與研發能力 (Puranam, Singh, and Zollo, 2006; Le, Park, and Kroll, 2014)，以及主併公司併購經驗、併購時機 (Puranam and Srikanth, 2007)，公司特性如公司規模、行業 (Danzon, Epstein, and Nicholson, 2007; Hussinger, 2010)。此外，亦有專文反向討論創新活動是否引發公司間併購的議題，例如，基於知識蔓延或目標公司的創新資源是否引發主併公司併購動機 (Bena and Li, 2014; Phillips and Zhdanov, 2013)。然而，以台灣為樣本的文獻則集中於討論技術相關性、國際化程度與主併公司資源整合或研發存量對創新績效影響等議題，近期發表於 TSSCI 或 A 級 SSCI 財務期刊中，並利用其他亞洲國家為樣本對創新績效影響的併購文獻則較少見。

（三）對其他併購績效的影響

企業進行併購除了影響公司的長、短期財務或創新績效外，也會影響併購活動中的支付溢價、高階經理人異動、債權人、競爭對手與行銷的績效，以及後續的併購行為（併購對非財務績效影響相關的議題請參閱圖 1）。

例如，支付溢價的研究發現併購之防禦程度或措施，董事會經驗或網絡、股東結構、公司特性與印象管理，均是影響併購溢價程度的重要因素 (Dimopoulos and Sacchetto, 2014; Offenberg and Pirinsky, 2015; Huang, Jiang, Lie, and Yang, 2014; Uysal, 2011; Beckman and Haunschild, 2002; Fu, Lin, and Officer, 2013; Devos, Elliott, and Karim, 2013; Francoeur, Ben Amar, and Rakoto, 2012; Ahern and Sosyura, 2014)；併購對高階經理人異動的研究主要聚焦於董事及高階團隊的網絡／關係如何影響併後經理人的異動 (Ishii and Xuan, 2014)；對債權人的影響部分則探討避險基金的維權行動、知情交易者或經理人持有債權的程度如何影響主併與目標公司的債券價值 (Klein and Zur, 2011; Kedia and Zhou, 2014; Phan, 2014)；亦有研究探討併購方式是否影響產業內對手公司的競爭能力 (Offenberg and Pirinsky, 2015)，以及討論併購如何影響公司的行銷支出 (Fee, Hadlock, and Pierce, 2013)。此一系列的研究中，對於債權人影響部分均聚焦於已開發國家資料，較少研究討論新興市場的樣本，亦僅有少數文獻探討併購對於行銷費用所帶來的影響。
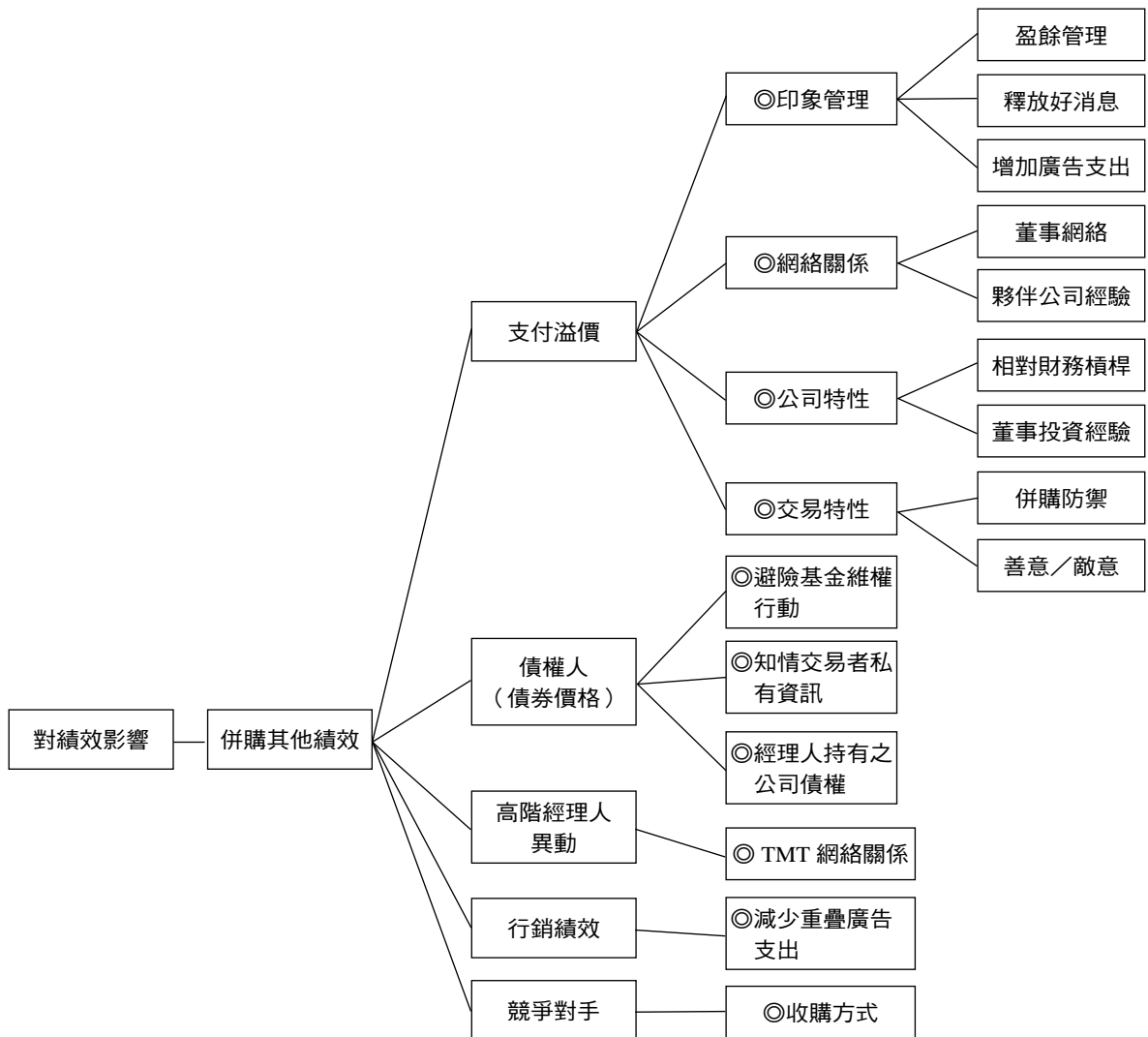
圖 1 近期影響併購其他績效之相關研究議題

在台灣樣本方面，併購對其他績效影響的研究中，近期僅見曾真真 (2010a) 討論經驗學習、替代性學習對再併購機率的影響，其研究結果指出同業從事併購經驗，以及企業以往成功的併購經驗與後續併購機率呈倒 U 型關係。許培基等 (2013) 則發現主併公司經理人過度自信正向影響併購的機率，但目標公司經理人過度自信則負向影響併購完成的機會。而以亞洲樣本為主的研究，在此議題則較少見。

二、影響併購績效因素

雖然企業進行併購希冀達成創造價值的目的，但是以往許多研究發現主併公司並未因併購而獲益，故而許多學者進一步探討影響主併公司獲取利益的重要因素。相關研究顯示，併購宣告效果受到許多因素，例如個別研究層級之交易特性（支付方式、相關／非相關、善意／敵意、單一或多個購併者、併購公司規模比、反收購措施），與管理者特性，公司研究層級之內／外部公司特性（併購經驗、股權市值、財務結構、網絡關係），或公司治理（股權或董事會結構、企業社會責任），環境特性，以及國家層級之跨國因素所影響，並進而產生不同的併購結果。以下將整理並回顧亞洲樣本文獻之併購績效影響因素（各研究層級之影響因素請參閱圖 2）。

（一）交易特性

在台灣樣本方面，併購交易特性對併購報酬的影響，王祝三等 (2006) 的研究中僅發現金融產業換股併購與現金併購具宣告效果，不論是換股或現金併購，在宣告前後一日均存在顯著正向異常報酬，但在較長之事件期間二者均無顯著之股價反應。此結果與多數文獻結論－換股併購不利於異常報酬，而現金則有利於長期與短期併購績效的研究結果不同 (Dong, Hirshleifer, Richardson, and Teoh, 2005)。該研究與國外文獻不一致應與產業特性有關，例如，Chatterjee and Kuenzi (2001) 指出高科技公司換股併購增加公司價值，是因企業將換股併購視為激勵手段，而非傳達主併公司股票價值被高估的訊息。就整體產業而言，換股併購市場報酬高於現金併購，可能是因為台灣大多數公司為家族企業，因家族企業以傾向保住控制權為主要考量，所以主併公司不願利用股權進行購併，目標公司也因不願意喪失控制權而要求較高併購價金的特性所導致 (Gomez-Mejia, Haynes, Nunez-Nickel, Jacobson, and Moyano-Fuentes, 2007)。此外，陳安琳等 (2000) 研究發現相關併購無顯著短期異常報酬，但非相關併購在宣告日則有顯著的正向短期異常報酬。曾真真與何雍慶 (2005) 研究結果亦發現異業整合之併購活動正向影響併購短期異常報酬。黃志仁與溫宜豪 (2008) 則發現將子公司併入母公司的事件中，母公司合併前營運績效較差時併購宣告報酬為負；母子公司為非相關產業，或母子公司為非電子產業則會有更負向的異常報酬；如果併購宣告中說明併購改善財務透明度，反而讓投資人對母公司財務透明度產生疑慮，不利於宣告報酬。

跨國購併
＊法制／文化差異
◎民族主義
＊法人機構
＊外溢效果
＊人力發展
＊國家聲望

國家特性
＊跨國上市／併購
＊過度自信
＊法制／文化差異

環境特性
＊環境豐厚性、動態性
＊政治環境／政府干預
◎羊群效應

公司特性
＊財務／股權特性
＊產業／技術相關性
＊國際化程度
＊知識／研發存量
＊公司間網絡
＊銀行／政治關係
＊購併／策略聯盟經驗

公司治理
＊機構投資者
＊公司治理指數
◎社會責任
◎高階團隊結構／關係
◎私募基金勾結

交易特性
◎相對規模
◎善意／敵意／併購防禦
＊相關／非相關
＊支付方式

管理者特性
＊過度自信
◎年紀／性別
◎ CEO 網絡核心程度

對績效影響 — 財務／創新績效

註：＊為近期亞洲樣本文獻探討之議題
　　◎為近期非亞洲樣本文獻探討之議題
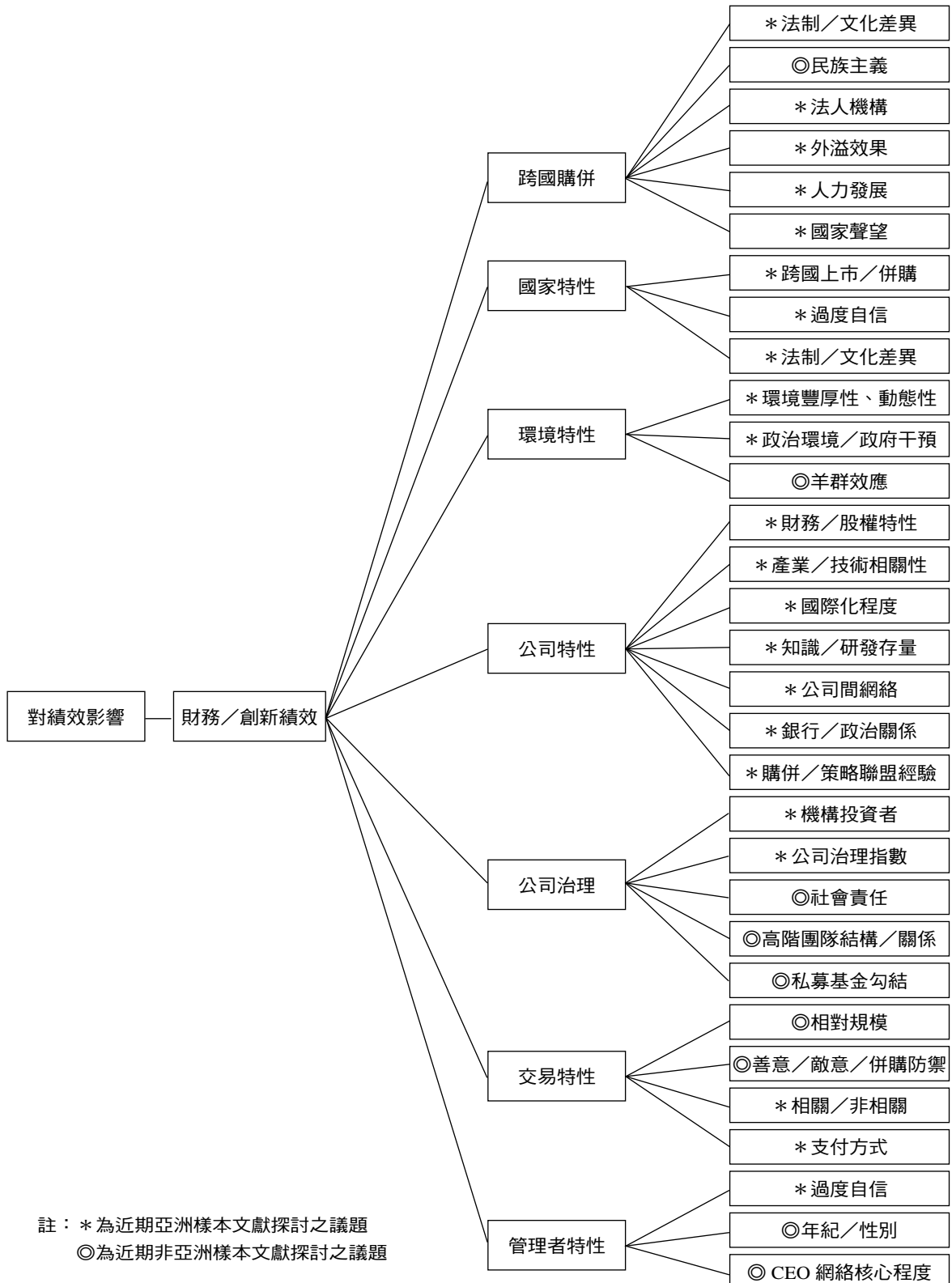
圖 2 近期影響併購財務與創新績效因素之研究

在亞洲其他國家樣本方面的研究，Claessens, Djankov, Fan, and Lang (2003) 探討不同型態的合併如何影響公司績效，研究顯示不同的企業合併型態對績效的影響具系統性差異。垂直相關與互補性多角化均正向影響多部門公司的長（短）期財務績效，但互補性多角化的正面影響比垂直相關的影響更大。除日本公司外，亞洲國家所進行之垂直整合的長（短）期績效均較低，但互補性多角化公司之長（短）期績效則均為正向；相較於互補性多角化，亞洲國家較難藉由垂直整合增加生產力。Bae, Kwon, and Lee (2011) 則探討韓國集團企業多角化對公司價值的影響。該研究發現韓國集團企業的非相關多角化減損公司的價值。雖無證據顯示相關多角化增加公司價值，但集團企業增強相關多角化對公司價值的正向影響，此結果支持企業集團的特性，例如強健的內部資本市場，讓集團企業享有相關多角化的綜效利益。

（二）管理者特性

高階經理人為公司重大投資的主要決策者，再加上購併所涉及的金額相當龐大，除了經理人的獎酬外，經理人的特性或個人特質均會影響併購決策。

在台灣為樣本的研究中，許培基等 (2013) 發現經理人過度自信不但減損主併公司長期及短期報酬，並且因其支付較高併購溢酬，完成併購機率較高；此外，該研究指出良好的公司治理機制可以監控過度自信經理人，使其降低進行價值破壞的併購活動。

在其他亞洲國家樣本方面，Lin et al. (2008) 指出日本高過度自信的主併公司具負向的異常報酬，而低過度自信主併公司則有正向的異常報酬，該研究結果與過度自信假說一致，過度自信經理人從事價值減損併購活動。Ferris et al. (2013) 的研究也發現過度自信減損併購活動的價值，而且過度自信是跨國現象。許培基等 (2013)，Ferris et al. (2013) 及 Lin et al. (2008) 的研究結果均與 Malmendier and Tate (2008) 的研究結果一致，管理者過度自信減損主併公司股東的價值。

（三）公司特性

除了個別層級因素影響併購績效外，公司層級因素，例如公司內部特性與外部特性均對併購績效產生重要影響。

在台灣樣本方面，王祝三等 (2006) 研究發現公司內部特性例如現金支付能力、市價對帳面價值比、內部人持股比率等，均對併購支付方式有顯著影響，但相對資產規模則不具解釋力；此外，金融產業較一般產業偏好採取換股併購。

在其他亞洲國家樣本部分，則主要聚焦於公司的外部特性，例如連結關係如何影響併購績效。Zhou et al. (2015) 指出具政治連結的國有主併公司，因政府干預的利益超過國有企業的無效率，所以享有正向的異常報酬；然而，當私有公司併購國有企業時，因成本的無效率超過政治連結所帶來的利益，所以併購產生負面的長期營運績效。Higgins (2013) 研究結果顯示銀行關係在合併時扮演利益衝突的角色，銀行關係密切之主併公司的併購損失高於銀行關係弱的主併公司。Chong et al. (2006) 則發現馬來西亞

銀行在進行強制性合併時，安華連結對併購價值產生負面影響；然而，巫統連結則無顯著影響銀行合併的價值，此研究結果顯示親信效果 (Cronyism) 與馬來西亞強制性銀行合併的負面影響有關。

（四）公司治理

公司治理文獻指出，經理人缺乏嚴密監控時，會為獲取私人利益而做出損害股東的決策，而良好的公司治理，則可監督並約束經理人自利行為。

在台灣樣本方面，陳振遠等 (2013) 的研究結果發現公司治理較差的企業在併購宣告前即已出現嚴重的資訊洩漏現象，而公司治理較佳的企業不但可以減緩資訊洩漏的問題，也具有較高的短期異常報酬；公司治理良好的企業，在併購宣告後出現正面異常報酬，顯示好的公司治理有助於提升企業併後之經營績效 (Masulis, Wang, and Xie, 2007)。然而，王祝三等 (2006) 卻指出外部機構法人持股與企業併購支付方式無關的結果則與國外發現不相符，但此一結果卻符合台灣公司治理未若歐美先進國家完善之現象。陳曉蓉 (2010) 的研究結果發現在資訊不對稱情況下，機構投資者難以發揮監督功能，故當機構投資人持股率越高時，銀行併購活動越多；經理人持股率越低時，銀行併購活動也會跟著增加。

在其他亞洲國家樣本部分，Bae, Kang, and Kim (2002) 檢測韓國企業集團是否受益於併購，與控制股東是否藉由併購攫取集團中其他公司價值以增加私人財富。研究發現集團企業主併公司短期異常報酬較非集團企業低；具控制股東的公司，可經由集團其他因併購而增加價值的企業中獲益，該研究結果符合利益輸送假設。Lin and Su (2008) 檢測大陸上市公司產業多角化與公司價值間關係，研究發現多部門公司的 Tobin's q 顯著高於單一部門公司；政府控制多部門公司之 Tobin's q 低於非政府控制的多部門公司。該研究支持多角化的政治成本假說。此外，在成長產業中，具高績效的非政府控制公司比較會進行多角化活動。

Zhou, Li, and Svejnar (2011) 則探討 1997 金融風暴前後，泰國家族企業，國內機構投資人與外國公司如何以撤資或併購方式重組公司的事業組合。研究顯示金融風暴後，外國公司重組活動受金融風暴影響較本國公司小；家族企業與國內機構投資者的撤資行為並無不同；本國公司在金融風暴時雖顯著減少併購新公司，但亦未增加撤資次要部門的行為，以聚焦公司的營運或取得現金。該研究指出在金融風暴的不確定性下，本國公司，特別是集團企業或大型企業投資的子公司，較能避免甩賣行為並維持核心資產，其研究結果並未支持重聚焦、代理問題或財務限制假說。

（五）環境特性

以往研究指出併購熱潮的產生主要是受產業的衝擊、股票市值高估，或是新證券發行熱潮所影響，所以併購活動會產生時間與產業的群聚現象 (Shleifer and Vishny, 2003; Rau and Stouraitis, 2011; Duchin and Schmidt, 2013)。然而，在併購熱潮中，因代

理問題與羊群效應的影響，常導致併購的決策品質、併購績效與公司治理均較差。此外，也有學者發現併購熱潮中先驅者的績效為正，而熱潮後期的併購，投資者則給予較差的評價 (McNamara, Haleblian, and Dykes, 2008)。

在台灣樣本研究部分，邱奕嘉與曾為國 (2014) 討論環境豐厚性與環境動態性對併購的影響，環境的豐厚性指一個產業是否具有成長性，而環境動態性則為公司外部環境的動盪以及不確定性程度，其研究結果發現環境豐厚性與環境動態性弱化技術相關程度與併後研發績效。

在亞洲其他國家樣本的文獻部分，Zhou et al. (2015) 的研究則探討政治熱期對併購績效的影響，該研究提出政府對併購干預的程度在政治熱期期間會更顯著，主要原因為大陸的產業政策、企業法令和國營企業經理人提名等重要決策，大部分均於政治熱期中，亦即在全國人民大會舉行前後一個月內通過並宣告，其研究結果顯示於政治熱期期間，國有企業進行的併購活動的短期與長期股票績效均優於私有企業。Duchin and Schmidt (2013) 則以羊群效應為理論依據，發現在熱潮中所進行的併購，其長期績效與公司治理均較差。

（六）國家特性

在國家層級因素的影響部分，台灣因投資者保護與公司治理程度相對於其他已開發國家弱，因此，台灣樣本也常被納入跨國樣本分析的一部分。

在台灣樣本方面，Rossi and Volpin (2004) 檢測各國法制差異對併購的影響，該研究結果發現在會計標準與投資者保護較佳的國家有較多的併購、敵意收購與股權收購，以及較高的併購溢價，但跨國併購活動則較少。Kim (2012) 的研究探討投資者保護如何影響併購方式，以及併後的控制機制，其研究結果發現投資者保護較佳的國家，公司傾向於使用股權進行併購，而投資者保護較弱的國家，企業則傾向於使用現金交易；此外，在普通法系國家，多重併購導致股權稀釋，特別是在美國稀釋情況更為嚴重，但大陸法系國家則無此現象；大陸法系國家中，進行連續併購的公司傾向於建立金字塔型的控制結構，然而，在普通法系國家此現象則相對較弱。Kim and Lu (2013) 檢測 26 個國家公司治理改革是否改變投資者保護並影響公司投資決策，以及是否影響國外主併公司在新興市場中傾向選擇績效較好的目標公司進行併購。該研究認為因為在新興市場中投資者保護相對於主併公司國家弱，所以外國主併公司會傾向選擇績效好的目標公司，故主、被併公司國家投資者保護強度的差距與選擇好公司投資的程度呈正向關係。此外，目標公司（主併公司）國家進行公司治理改革，強化投資者保護時，投資者保護強度的差距降低（上升），主併公司選擇好公司投資的傾向會被降低（增強）。Ghosh and He (2015) 研究 42 個國家的樣本，發現來自投資者保護較弱的國家，公司在美國跨國上市後會有較多的併購活動、較佳的併購決策，與較高的短期異常報酬與營運績效。

在其他亞洲國家樣本方面，Ferris et al. (2013) 的研究發現經理人過度自信正向影響併購的次數、非相關併購的頻率與現金併購的傾向；過度自信是跨國的現象，而且過度自信在鼓勵個人主義的基督教國家更為普遍。Wang and Wang (2012) 檢測地主國經濟自由度對外國創投及其經營績效的影響，研究結果顯示國家經濟自由度是影響創投績效的重要因素。在經濟自由度越高的國家，外國創投公司較能成功地藉由 IPO 或併購退出投資標的，外國的創投公司也較傾向短期投資目標公司。Claessens et al. (2003) 的研究發現開發程度越高的國家，垂直整合的長、短利益率與市場價值越高；開發程度較低的國家，互補性多角化的短期利益率較高，然而，長期而言，開發程度較高的國家較能受益於互補性多角化。其研究結果顯示開發程度越高國家，因學習對象較多，所以可以經由快速學習改善多角化績效，支持邊做邊學假說。該研究結果亦與資本配置不當假說觀點一致，亦即開發程度高的國家，因其市場監控資產配置的效率高於開發程度較低的國家，所以開發程度較高的國家，公司資產誤配問題較小。

（七）其他影響併購績效因素

除了個別、公司、環境與國家層級影響因素外，也有一些文獻探討其他因素對併購績效的影響。例如，Kot (2011) 討論香港公司更名如何影響股價與長期績效，研究結果顯示投資者正向回應因購併、重整或事業形態變動而產生之公司更名，但如果是因澄清或聲譽理由而改變公司名稱時，股價則無顯著之回應。該研究亦發現公司更名只影響短期股價，但卻並未影響宣告公司之長期股價與營運績效。Danbolt, Siganos, and Vagenas-Nanos (2015) 則以 17 個國家臉書更新狀態作為每日投資者情緒的代理變數，討論投資者情緒是否影響併購報酬，其研究發現投資者情緒與主併公司短期異常報酬呈正向關係；大股東持股較低、併購標的為美國上市或相對規模較大的公司，均會增強投資者情緒與主併公司異常報酬間的正向關係。

三、跨國購併

跨國併購是企業進行全球化的重要策略選項，與單一國家中的併購研究類似，跨國購併除了牽涉併後績效與影響因素等議題外，也牽涉母國與地主國間因交易成本衍生之進入模式選擇，以及國家文化與體制差異所產生之外來者劣勢 (Liability of Foreignness) 與雙層文化交流 (Double-layered Acculturation) 等阻礙企業在跨國購併中獲取新知識與能力的問題 (Shimizu et al., 2004)。

在台灣樣本方面的研究，陳安琳等 (2000) 發現僅有跨國購併具有顯著正向的短期異常報酬，國內併購則無此現象，該實證結果顯示主併公司股東視跨國購併為利多消息。雖然，此研究結果與國外結論一致，企業藉由跨國併購取得市場與技術以增加企業的競爭力 (Markides and Ittner, 1994; Morck and Yeung, 1992)，但該研究並未再進一步區分目標公司的來源國所產生的影響。

　　近期文獻除了探討台灣企業進行跨國併購對績效的影響外，亦有許多研究將台灣樣本納入比較多個國家跨國併購樣本的一部分。例如，Rossi and Volpin (2004) 指出在跨國併購交易中，目標公司通常來自投資者保護相對較弱的國家，跨國併購可以讓目標公司引進主併公司的治理機制，故當主併公司具較佳的公司治理與會計標準時，其併購活動較活躍，此研究結果顯示，跨國併購扮演改善目標公司投資者保護的治理機制，符合公司治理趨同觀點 (Convergence in Corporate Governance)。Bris and Cabolis (2008) 的研究認為 100% 股權收購之跨國目標公司被視為等同於主併公司國家的企業，目標公司併後須受主併公司國家公司治理系統的管制，因此，跨國購併提供檢測公司治理改變對公司價值影響的妥適性。該研究發現，主併公司來自投資者保護與會計標準越好的國家時，其所進行之跨國併購的短期異常報酬越高。Chari, Ouimet, and Tesar (2010) 指出當已開發國家之多國企業併購新興市場公司的多數股權時，主併公司具正向顯著三日短期異常報酬；而且，當主、被併公司制度環境差異越大，主併公司的異常報酬越高；然而，只有在目標公司被控制時，才能綑綁至主併公司的國家法制制度，並替股東創造價值；此外，當開發中國家的契約環境越弱，以及無形資產越高的產業，其股價上揚的幅度越高。Siegel, Licht, and Schwartz (2011) 的研究發現平等主義相對較低的國家（如台灣）負向影響跨國併購。Ahern et al. (2015) 也發現文化差距越大時跨國購併愈少，併購異常報酬也較低。Hwang (2011) 的研究則討論國家聲望對跨國併購的影響，該研究發現國家聲望正向影響美國主併公司在該國所進行的跨國併購活動。

　　在其他亞洲國家樣本方面，Guo, Keown, and Sen (2001) 探討投資人對美、日二國公司進行雙邊跨國併購與合資宣告時的反應。該研究發現美國與日本公司之併購與合資宣告均具有正向短期異常報酬；美國公司聚焦事件的短期異常報酬較非聚焦事件高。雖然，整體而言日本公司宣告事件的短期異常報酬為正向，但聚焦事件的短期異常報酬為非顯著負向，而非聚焦事件則有顯著正向短期異常報酬；如進一步檢測非聚焦事件，發現只有集團企業的宣告才有顯著正向短期異常報酬。該研究結果顯示日本集團企業可抵消公司多角化所增加的資訊成本，並抑制公司投資於績效差的子公司。

　　Burns, Francis, and Hasan (2007) 指出主併公司來自投資者保護較差的國家時，即使在美國跨國上市後仍然較少使用股權交換方式併購美國的目標公司，此結果隱含美國證券交易委員會的監控無法完全補償公司來自投資者保護較差國家的劣勢。Ferreira, Massa, and Matos (2010) 則檢測機構投資者在跨國併購時所扮演的角色，其研究發現外國機構投資者持股比例正向影響跨國併購的密度、交易與成功的機率，並傾向收購目標公司所有股權；此外，法制環境較弱與開發程度較低的國家，增強國外法人持股與跨國併購間的正向關係，該研究結果符合外國機構投資者扮演跨國公司控制市場促進者的假說。Focarelli and Pozzolo (2001) 的研究探討促使銀行拓展海外併購的因素，該論文的研究結果發現，銀行業因資訊不對稱問題與法令限制較製造業高，所以跨國併

購在銀行產業較不常見；此外，持有跨國股權的銀行，通常也是效率較高、獲利性高，以及已開發國家的大型銀行。Jeon, Olivero, and Wu (2011) 的研究探討外國銀行進入地主國時，是否影響新興市場地主國銀行產業的競爭程度，其研究結果指出外國銀行進入地主國所產生的外溢效果，使得地主國銀行產業競爭程度加劇；而且當效率高的外國銀行進入產業集中程度低的地主國時，外溢效果更強；該研究也發現，以新設投資為進入模式的外溢效果高於併購地主國銀行的外溢效果。Owen and Yawson (2010) 的研究則是討論美國公司進行跨國併購時地主國人力資源發展所扮演的角色，該研究結果發現美國公司傾向在人力資源發展程度高的國家進行併購，跨國併購與地主國人力發展指標呈正向關係，該研究說明為何資本較少由已開發經濟體流向開發中經濟體。

四、其他併購議題

併購文獻中也有一些研究利用數量方法檢測併購的時點，分析併購的效益，或是討論併後組織型態是否影響軟性資訊的取得。

在台灣樣本方面，李國榮、廖四郎與徐守德 (2006) 以實質選擇權討論合併、股票收購與現金收購等三種形式下的最適併購決策問題，該研究發現規模經濟、績效改善、市場佔有率增加皆會降低併購門檻，並加速併購活動；此外，併購型態會影響併購雙方的併購報酬與時點，其中現金收購發生的時點將晚於合併與股票收購。陳永琦 (2006) 則納入不完全競爭市場與成本結構差異的因素，運用厚邊界法與聯立方程式進行樣本分組及估計成本函數，模擬在不完全競爭市場下銀行進行合併的成本節省效益，其研究結果顯示，合併綜效並非自動產生，銀行業在進行合併時，應考量成本結構與經營技術，篩選合適的合併對象，才能透過模仿學習與較佳的經營技術達到降低成本的效能，以及達成合併綜效的目的。

在亞洲其他國家樣本方面的研究，Ogura and Uchida (2014) 的研究則檢測銀行合併對銀行取得債務人軟性資訊的影響，其研究結果發現小型銀行的合併負面影響債務人軟性資訊的取得，然而對大型銀行的合併則無影響；該研究結果也發現小型銀行的合併增加組織複雜程度，而非降低併購後成本，故合併顯著負面影響小型銀行軟性資訊的取得，此研究結果符合組織理論的觀點，簡單與扁平化組織在取得與處理軟性資訊時較具相對優勢。林孝倫與卓佳慶 (2014) 則以資料包絡法與麥氏生產力指數，探討中國會計師事務所是否可以利用合併方式以提升經營效率。研究結果顯示，相較於未進行合併的事務所，曾進行合併之事務所的經營效率顯著提升。

本研究回顧並彙整近期併購相關論文後發現（請參閱圖 2），在個別層級文獻部分，交易特性相關研究主要探討支付方式、相關／非相關、善意／敵意、併購防禦、相對規模等因素的影響。在管理者特性部分則聚焦於過度自信、CEO 的網絡核心程度，或年紀／性別對併購的影響（Kolasinski and Li, 2013; El-Khatib et al., 2015; Yim,

2013; Huang and Kisgen, 2013; Custódio and Metzger, 2013; 王淑芬與黃昭華，2010）。在公司層級部分探討公司內部特性如行銷與研發之策略性資源、知識存量、組織學習能力、併購經驗 (Garfinkel and Hankins, 2011; Gormley and Matsa, 2011; Uysal, 2011; Akbulut, 2013; Haleblian, Kim, and Rajagopalan, 2006; Vanhaverbeke, Duysters, and Noorderhaven, 2002; Humphery-Jenner and Powell, 2014)，與公司外部特性如政治關係、銀行關係與公司間網絡／關係 (Ishii and Xuan, 2014; Renneboog and Zhao, 2014; Cai and Sevilir, 2012)，或公司治理機制如法人機構、公司治理良窳、股權／董事會結構、經理人與董事會關係、企業社會責任等議題 (Deng et al., 2013; Levi, Li, and Zhang, 2014; Schmidt, 2015; Landier, Sauvagnat, Sraer, and Thesmar, 2012; Kolasinski and Li, 2013)。在環境特性部份聚焦於探討環境豐厚性、環境動態性、政治熱期或羊群效應對併購的影響 (Rau and Stouraitis, 2011; Duchin and Schmidt, 2013; McNamara et al., 2008)。在國家特性部分主要討論不同國家的法制或文化的差異對併購產生的影響。跨國併購的議題則更多元化，法制／文化差異、跨國上市、國家聲望、機構投資人角色、競爭程度與人力發展程度如何影響併購均為此系列研究討論的議題 (Karolyi and Taboada, 2015; Serdar and Erel, 2013)。

　　此外，回顧近期併購研究可見許多個別或公司層級文獻均聚焦於探討網絡／關係對併購的影響。在管理者特性方面，部分文獻討論公司內部網絡關係，如 CEO 與董事會間網絡或 CEO 與高階團隊間網絡如何影響併購結果，例如，El-Khatib et al. (2015) 探討 CEO 的網絡核心程度對併購的影響，該研究發現 CEO 的網絡核心程度越高時，其所擁有的權力越大，攫取個人私利的機會也越高，所以高網絡核心的 CEO 不僅併購的次數較多，併購的價值也較低。除了公司內部網絡會影響併購績效外，公司間的網絡／關係如高階團隊的網絡，也是影響公司併購決策以及績效的重要因素。例如，Ishii and Xuan (2014) 指出主、被併公司間高層的網絡關係越密切，主併公司越容易出現過度信任、趨向熟悉、社會從眾與團體迷失等現象，故而當公司間高層網絡的關係越密切時，不但併購決策品質越差，併購的價值也越低。Renneboog and Zhao (2014) 的研究也發現當主、被併公司有相同的董事時，併購較容易成功，目標公司也傾向願意接受股權併購；具董事連結之目標公司的董事有較高機會留任於併後公司；但具網絡關係的宣告報酬相較於不具網絡關係的宣告報酬並無顯著的差異。然而，Cai and Sevilir (2012) 指出主併與目標公司如具有相同的董事，則主併公司支付的併購溢價相對較低；當主、被併公司均在第三方公司有董事席次時，主併公司可享有較高的宣告報酬與併後的營運績效，所以網絡關係可替主併公司創造併購價值。在公司治理部分，亦有專文討論網絡／關係對併購的影響，例如，Schmidt (2015) 的實證顯示當公司需要董事會提供建議的功能時，如果經理人與董事會成員間有較好的關係時，併購的異常報酬較高；然而，當公司需要董事會監督時，如果經理人與董事成員關係友好則併購的異常報酬較低。

五、未來研究方向

綜觀併購文獻，近期研究較少探討高階團隊中過度自信，或跨國高階團隊的差異如何影響併購。尤其是在網絡／關係的併購文獻中也較少見到探討供應鏈、集團企業或家族企業如何影響高階經理人的異動與併購績效的相關研究。台灣公司以家族企業和企業集團為主要組織型態，台灣市場也存在對投資人保護較差，家族控制公司營運，股權高度集中於控制股東，與利用交叉持股或金字塔結構方式控制股權等公司治理較弱問題 (Yeh and Woidtke, 2005)。本研究在回顧近期併購文獻後，希冀利用台灣資料的特殊性，提出屬台灣市場獨特性的可能研究議題，以供後續研究者參考。

首先，以往關於併後經理人異動的研究較少聚焦於主、被併公司是否為家族或集團企業。台灣企業集團的形成除了考量內部資本市場或降低供應鏈中不確定性等因素外，基本上也包含家族成員成長後因分房所形成的需求 (Luo and Chung, 2005; Wong, 1985)。尤其是近年來家族企業邁向接班高峰期，繼承問題也成為研究關注的焦點。家族企業的接班主要以維持家族的社會情感財富，例如永續經營並掌控企業，或者是寬待家族成員為考量 (Lubatkin, Schulze, Ling, and Dino, 2005)，然而，不論是以血緣傳遞的繼任方式以確保家族對企業的控制能力，抑或是家族的分房需求，均可能產生謀取家族成員職務私利的問題。因此，家族企業或家族控制集團企業併購後經理人的異動可能有別於非家族公司。例如，主併公司如為家族所控制，基於分房需求或寬待家族成員的影響，主併公司可能傾向派任家族成員接管被併公司；反之，如果目標公司為家族企業，可能在併購過程中要求讓家族成員留任做為同意被收購的條件，此舉將使併購績效高度受到家族成員的影響。後續研究可針對牽涉家族企業的併購活動，探討家族企業如何影響併後經理人的異動及對其對併後績效的影響。此外，集團公司在經營策略與決策上常因成員間的緊密關係而彼此相互影響，後續研究亦可討論家族集團企業併購後，家族經理人的異動如何進一步影響集團內其他分子公司的績效變動。

其次，經理人傾向關注高投資總額且具重大不確定性的創新投資，所以高階經營團隊的特性通常密切影響企業的投資決策。目前關於技術併購的文獻雖有探討公司或個人層級因素對併後創新績效的影響，例如技術多角化／專業化，或是經理人特質例如過度自信如何影響創新績效，但較少研究探討家族企業經理人特性對併購後創新績效的影響。相對於專業經理人，家族企業經理人在家族社會情感財富影響下，技術併購的決策可能傾向以對家族控制權或財富影響最小為主要考量，未來研究可根據高層理論與家族企業的觀點，分析在家族企業的治理下，高階經營團隊技術併購的傾向及其對併後創新績效的影響為何。

此外，併購文獻指出高階團隊網絡關係亦是影響併購結果與績效的重要因素，然而集團企業或供應鏈間的網絡關係也可能影響併購績效。例如，垂直整合讓供應鏈中個別廠商得以發展其專門的技術，供應鏈體系中成員則利用合作的方式來提高創新能

力 (Shera and Yang, 2005)。再者，集團企業內的公司因交互持股或董事連結所產生之緊密且互信的關係，使得集團內成員得以彼此交換技術與市場的資訊 (Hitt, Lee, and Yucel, 2002; Luo and Chung, 2005)。如果供應鏈或集團內公司因進行併購而產生技術能力的改變，在緊密關係的連結下，網絡中其他公司的創新績效預期也將受到影響。近期也有部分文獻開始探討網絡成員或公司過去的併購經驗如何影響併購行為 (Argote and Miron-Spektor, 2011; Kim and Miner, 2007)，後續研究可探討網絡中公司進行併購或是網絡中成員的併購經驗，如何影響供應鏈或集團中其他網絡成員的創新績效。

再者，技術併購對競爭對手的影響目前研究仍較少著墨，雖有研究指出主併公司在進行併購時因需專注於完成併購交易，以及併後財務上的限制使得主併公司降低對創新的承諾，產業中對手傾向在此時點增加技術探索的廣度，因如投資未達到預期目標時，在主併公司於併後減少創新投入的情況下，對手公司所受到的影響也會較小 (Valentini, 2015)。但不同的組織型態對競爭者產生的影響可能有所差異，後續研究可進一步探討購併如何影響家族企業或集團網絡關係外其他競爭者的創新績效。

參、策略聯盟

相對於併購的相關文獻，在財務領域中過去針對亞洲企業的策略聯盟研究明顯少很多。不同於併購上的完全股權擁有，在策略聯盟中合作夥伴通常只投資部份股權，或是完全不涉入股權。有股權參與的企業間合作通常指的是合資 (Joint Venture)。完全不涉及股權投資通常稱為合約式策略聯盟 (Contract Alliance)。合資通常涉及兩位或兩位以上的股權投資人，創立新的企業由出資人共同管理。合約式的聯盟只針對特定目的進行合作。為了區別，本研究將合約式聯盟通稱為策略聯盟，以別於有股權涉入的合資。

合資與策略聯盟都屬於不完全合約的範疇。由於在合作的當時並無法將所有未來可能發生的情形完全註明在合約中，可能產生套牢 (Hold-up) 問題 (Mody, 1993)。聯盟夥伴也可能預期到不完全合約的問題，因此在合作的過程中出現傷害聯盟夥伴的投機性行為（陳一如，2010；賴蓉禾，2011；Das, Sen, and Sengupta, 1998; Allen and Phillips, 2000），因此產生策聯盟合作機制的管理及監督成本，這在 Williamson (1975, 1979, 1989) 探討的交易成本理論的系列研究中有清楚詳細的討論（林欣美，2007；吳菊華與胡聯國，2009）。後來有許多研究也針對交易成本理論有不同方面的討論。

由於合資及策略聯盟牽涉到不完全合約的機制，廠商在合作的過程中會經歷許多模糊的地帶，可能利益會被剝奪，因此治理本身自然是一個重點。過去許多研究都在談公司治理在聯盟中的重要性，信任的建立，夥伴的選擇如何影響策略聯盟及合資的績效（賴蓉禾、陳一如與陳麗宇，2014；Ang, Cheng, and Wu, 2015; Owen and Yawson, 2013）。在財務文獻中，許多的研究將合資及策略聯盟視為重要的投資決策，檢測其宣告時的異常報酬，以及影響宣告效果的決定因子。

一、以亞洲市場為樣本之研究

在台灣樣本方面，台灣學者在合資及策略聯盟的研究上大多著墨在實證上的檢測，進行理論探討的研究較少。張美玲、孫瑞霙與王國樑 (2002) 是少數的例外。此論文強調既有策略聯盟之文獻多採用交易成本或是資源基礎理論的觀點來解釋策略聯盟存在的原因、動機及特性。他們則試圖將動態觀點引入策略聯盟的文獻中。論文中強調廠商為因應產業環境變化，在現有知識資源不足且無法透過市場交易獲取情況下，隨著時間經過與產業環境變化，策略聯盟的組成份子亦會隨著改變。本研究引用三家台灣電子廠商的個案研究驗證動態觀點的理論基礎。另一篇理論的論文是林欣美 (2007)，作者以台灣半導體業為研究對象，探討策略聯盟中交易成本理論與網路鑲嵌理論中，如何互相互補式地解釋半導體產業中策略聯盟的行為。過去的研究多認為交易成本及網路鑲嵌理論彼此互為替代性地解釋策略聯盟的管理機制；但此論文以半導體產業的實際例子提出交易成本及網路鑲嵌理論亦可能成為互補性的解釋理論，此研究的特點為以台灣的產業特性，重新審視策略聯盟之後的機制管理理論。

在合資的議題上，吳菊華與胡聯國 (2009) 是少數在不完全合約議題上尋求發展的理論模式研究。其論文提出理論模型來探討在不完全合約的情境之下，企業在進行垂直整合時，採取併購或合資不同的整合方式對社會效率及福利造成的可能影響。

利用不完全合約的特性，陳世傑、李文瑞、洪廣朋、陳律睿與蔡明叡 (2006) 探討聯盟夥伴間的溝通是可以增進合作績效。此研究專門探討網際網路的運用是否能有效幫助聯盟夥伴之間的溝通，增進知識／技術上的吸收及擴散，進而增進聯盟的績效。研究以問卷方式進行，實證結果顯示網路的運用對聯盟績效有重要的幫助。

陳一如 (2010) 將公司組織特性及董事會功能連接到策略聯盟的宣告績效。在這個議題上主要把策略聯盟當成投資活動，藉以探討多角化公司進行策略聯盟是否有更好的股市評價，同時也研究董事會組成的影響。實證結果和文獻過去的發現一致，雖然多角化公司進行策略聯盟時也有正向的股市宣告效果，但其財富效果比非多角化公司略低。獨立或外部董事比例對策略聯盟的宣告效果具有正向的影響，而董事長兼任總經理時則具負向影響。

賴蓉禾 (2011) 探討參與聯盟企業本身之公司治理健全度可否作為聯盟夥伴可信任程度的衡量指標。研究之實證結果發現公司治理健全度可正向增進夥伴的聯盟利益，而當聯盟參與公司的治理健全度愈高時，整體策略聯盟績效愈佳，上述實證結果在台灣與美國樣本均顯著成立，顯示利害關係人理論在不同環境中均具有重要意涵。

賴蓉禾等 (2014) 嘗試了解董事會功能如何影響合資績效。論文中強調合資可能產生經理人為了個人私利所衍生的代理問題，因此運作良好的董事會在此代理問題上可以扮演監督。除此之外，合資亦牽涉尋找合適的聯盟夥伴的過程，董事會也可以扮演良好的諮詢角色。因此運作良好的董事會對合資績效應該有正向的幫助。實證結果顯

示，在合資宣告的市場反應上，股票市場對於董事會的大小及獨立性並不顯著重視，比較重視的是董事會成員是否有合資經驗以及董事會是否頻繁地召開。

陳燕錫與陳瓊燕 (2014) 探討會計師事務所與管理顧問公司的策略聯盟。由於會計師事務所與管理顧問公司的業務有相關的區域，但因為事務性質的關係，使得會計師事務所不合適同時經營管理顧問公司，也因此有了策略聯盟的空間。實證結果顯示與管理顧問公司聯盟的會計師事務所展現比較佳的績效表現。

在策略聯盟議題上利用台灣資料發表在國際期刊上的文獻相當有限。早期有 Chang and Chen (2002) 利用台灣合資的股票市場宣告結果，探討影響合資績效的決定因素。由於當時文獻主要都是集中於美國的資料，缺乏其他的國際證據。因此，此論文之主要貢獻在於提供非美國的實證結果，幫助了解合資在資本市場上的評價機制。同時此論文也將文獻中的相關理論做有系統的整理。實證結果顯示平均而言，台灣企業的合資宣告減損企業價值。宣告的異常報酬和成長機會、投資金額呈現正向相關。結果也顯示非相關產業的公司進行合資會有比較好的宣告異常報酬。

在亞洲其他國家樣本方面，策略聯盟發表在優秀國際期刊上的數量雖然相對較少，但仍有學者持續投入相關研究中。Chiou and White (2005) 探討策略聯盟形成對股東財富效果的影響。這個議題過去用美國資料已經探討過，但與以往的文獻不同在於此篇論文專注於金融機構間的策略聯盟，在以往文獻中金融機構大多被剔除於樣本之外。研究利用日本 1990 晚期的數據，研究不同類型的金融機構聯盟是否會導致不同的股票市場反應。結果發現策略聯盟平均而言提升了合夥企業的價值，較小的合作夥伴有較大的異常報酬。不同於以往文獻的證據是本論文發現跨集團的策略聯盟會比集團內的聯盟產生較高的市場價值。

Chang, Chen, and Lai (2008) 探討日本與美國企業宣布策略聯盟的價值創造影響。此研究將過去文獻中國內策略聯盟的方向延伸到國際策略聯盟的領域之中。研究結果發現平均而言，美國與日本策略聯盟的形成對於聯盟夥伴有顯著正向的財富效果。證據也顯示在策略聯盟中公司規模相對較小、有較高的成長機會的企業可能獲得較大的異常報酬。在長期績效上，國際聯盟夥伴企業在聯盟宣告後的三年內的經營表現有顯著的提升。

Owen and Yawson (2013) 探討資訊不對稱下如何影響跨國策略聯盟的形成。此篇論文建構變數來衡量資訊成本。研究顯示資訊成本和跨國聯盟的形成之間呈現負相關， 但這個效果和企業的上市狀態有關。如果聯盟夥伴是上市公司的話，策略聯盟頻率和夥伴所在國的股票市場發展程度有重要關係，卻和該公司的資訊成本高低無關；如果聯盟夥伴是未上市公司的話，資訊成本則有重要影響。

Lee, Cho, Cheong, and Kim (2013) 利用韓國資料來檢測策略聯盟宣告的財富效果。這個題目其實並不是新議題，因為在 Chan, Kensinger, Keown, and Martin (1997) 及 Das

et al. (1998) 已經探討過類似的議題，只不過過去研究多是針對美國資料作探討，本篇論文則探討開發中國家公司的策略聯盟策略和已開發國家的不同。實證結果發現策略聯盟宣告能夠帶來正向的價值創造，這是和過去研究相同的結果；比較不同的是此研究發現價值創造的主要是行銷型的聯盟，而非之前發現的科技型策略聯盟。此論文也發現在行銷聯盟中，和海外夥伴的行銷聯盟，特別是來自 G7 國家的聯盟夥伴，比國內的策略聯盟創造更多的價值。

在合資文獻中也有以亞洲資料發表在知名國際期刊上的文獻。Chen, Ho, Lee, and Yeo (2000) 將 Jensen (1986) 的自由現金假說，以及企業成長機會假說應用到國際合資的議題上。樣本利用新加坡公司的資料檢測了此一假說在國際合資績效上的解釋能力。實證結果顯示自由現金並無法解釋國際合資的宣告報酬，這和併購文獻上的發現有所不同。但成長機會假說則受到顯著的支持。

文獻上大多只研究合資創立的財富效果，但 Mantecon and Chatfield (2007) 指出許多的合資案可能只是階段式的合作，終極目標是合併或購併，合資目的在於解決資訊不對稱性的成本，因此合資終結的方式會影響合資的價值創造，故此研究將焦點轉移到合資資產處份方式的股價反應。藉由 1985 至 2003 年合資的樣本資料，研究結果顯示合資解散時，如果合資企業的資產能納入合資夥伴公司內部時，合資案會創造出正向價值，尤其是當合資企業被一個夥伴公司完全購併時可創造最大價值。如果合資資產是出售給外部非夥伴企業，合資的價值創造就不顯著。

Ushijima (2010) 研究日本企業的部份合併績效對股東財富的影響。傳統上的合資文獻通常針對的是合資夥伴出資創立一家新公司，但此研究中部份合併指的是兩個或以上的企業將位於自己公司中在相同產業的資產合併成為一家新公司，而這種部分合併的情況現象在西方經濟體較少發生，這也是此研究的特殊之處。實證結果顯示部分合併通常是企業面臨營運不良所選擇的結果；合併夥伴公司不論規模大小皆有正向顯著的異常報酬，在部份合併之後股權通常會在聯盟夥伴之間轉換。

Ang et al. (2015) 探討企業在跨國投資時，當地廠商的可靠性如何影響投資決策。研究利用中國資料進行探索，並且試圖衡量企業的可信任程度。結果發現外國企業傾向投資在當地員工與廠商較可信賴的地區，也較可能與當地企業建立合資關係以及進行更多的研發投資。這篇研究的不同點在於探討合資中最重要的夥伴信任問題，並能夠直接量化信任程度。

二、未來研究方向

在策略聯盟及合資上的文獻，利用台灣資料發表在國外優質期刊的比例仍舊不高。本研究認為如要發表在優秀的期刊，可能必須強調台灣環境的獨特性，否則不易彰顯研究的貢獻度。可能的方向之一是集團企業，這是台灣相對於西方企業比較特殊

的組織。 集團內企業可能互相持股，相互間有密切的商業交易，因此會受到其他集團內企業策略的影響。在這個議題上未來的研究方向可能包含：集團內成員與集團外的企業進行策略聯盟時，新創的連結將如何影響集團內的其他廠商？如何對集團夥伴產生優缺點？集團特性的不同如何影響策略聯盟對集團內其他企業的價值創造的效果，例如：集團內的股權結構、產業分布、企業在集團內的地位等。

第二個台灣產業具有的特色是在一些特殊的產業中具有完整的上、下游產業鏈的結構，例如半導體及自行車業。這樣的特性在全世界其他市場上是不多見的。未來的研究或許可以利用這個特性來探討當產業鏈中的企業進行合資及策略聯盟時，如何對其他產業鏈中的企業，以及整個產業鏈產生影響。策略聯盟如何影響產業鏈與產業鏈之間的競爭以及企業價值創造。

另外一個可能的研究方向是了解透過策略聯盟接觸到其他的企業夥伴，如何為企業本身帶來改變。例如如果聯盟夥伴的公司治理制度完善，是否也可能正向改變其聯盟合作的夥伴公司；或者跟知名公司進行策略聯盟，是否會增加企業本身分析師報導程度，影響股票交易量，或者能夠吸引更多的機構投資人的資金投入。這些都是重要但很少在公司理財領域中討論到的議題。

最後，近來管理學上的文獻已經有許多研究開始由討論單一策略聯盟事件進展到討論聯盟組合 (Alliance Portfolio)。由於企業藉由策略聯盟來面對市場快速變遷、科技快速進步，並且發展競爭優勢的趨勢越來越重要，企業常不只面對單一的聯盟夥伴，而是同時面對許多不同的聯盟夥伴，進行各種不同目的的合作，形成了聯盟組合。如何管理聯盟組合也就成為一個重要議題 (Lavie, 2007; Wassmer, 2010; Majchrzak, Jarvenpaa, and Bagherzadeh, 2015)。但聯盟組合的相關議題在財務的文獻當中仍然很少被探討。

肆、結論

本文主要回顧 TSSCI 和科技部財務學門 A 級 SSCI 財務期刊中以亞洲區域為樣本之併購、合資與策略聯盟等外部成長策略議題的研究，將現有文獻分為併購和策略聯盟二大主題，系統性歸納整理現有的亞洲樣本文獻。

雖然，亞洲非為主要併購交易國家，但自 1990 起併購亦成為這些國家公司重要的投資方式 (Martynova and Renneboog, 2008)，然而，亞洲各國因經濟發展與資訊透明度各異，新興亞洲市場的資料庫尚未臻完善，故本研究回顧亞洲地區文獻時，發現大部分研究集中在台灣，以及日本、韓國等幾個經濟發展與資訊透明度較高，資訊取得較容易的國家 (Mody and Negishi, 2001; Chen, Huang, and Chen, 2009; Wright, Filatotchev, Hoskisson, and Peng, 2005)。此外，大陸公司由於經濟的發展與政府政策的

支持，近年來也逐漸成為亞洲地區對外投資的重要參與者 (Deng, 2007)，因而本文回顧之文獻近期亦見以大陸為樣本的研究。

再者，亞洲各國因法制系統、資本市場效率與投資者保護的良莠也存有許多差異，是以影響亞洲國家公司外部投資策略的因素也因法制環境而有所不同。例如，與政府的關係網絡在馬來西亞（安華／巫統連結），與大陸（國有公司與政府的關係）被視為影響併購的重要因素 (Chong et al., 2006; Zhou et al., 2015)。而且，新興亞洲市場因其經濟規模與範疇相對較小，所以亞洲國家樣本也較常見到被納為相關研究中跨國樣本的一部分，這些研究的主要議題大多為比較各國法制差異或公司治理改革如何影響外部成長投資決策 (Kim and Lu, 2013; Owen and Yawson, 2013)。

最後，台灣市場具有許多特殊性，例如公司治理較弱，股權結構集中，家族企業普遍，與網絡關係密切的產業供應鏈和集團企業等，這些特性均提供台灣併購和策略聯盟研究學者，未來進一步發展以台灣資料為研究樣本之良好利基。本研究希望透過系統性的整理分析亞洲地區文獻，輔以台灣市場特性，並配合國外文獻發展與相關研究的進程，可以提供國內學者未來探討此一領域可能的研究方向。

Review of M&A and Joint Ventures in the Field of Corporate Finance: Asia as the Case Study

Ying-Jiuan Wong, Associate Professor, Department of Business Administration, National Kaohsiung University of Applied Sciences

Shao-Chi Chang, Professor, Institute of International Business, National Cheng Kung University

1. Introduction

A firm needs to engage in various corporate investments in order to grow and ensure sustainable operations. Internal (i.e., innovation investment or capital investment) as well as external growth activities (i.e., M&A, equity-based alliances such as joint ventures, and non-equity-based alliances) are important approaches for a company to achieve growth. When internal growth opportunities are limited, firms then turn to external growth methods to achieve their growth objective (King et al., 2004; Slywotzky and Wise, 2002). This study focuses on external growth strategies by revisiting literature that sampled data from the Asian market and were published in TSSCI or A Tier SSCI financial journals from 2000 to 2015. The research related to M&A, joint ventures and strategic alliances were then categorized into two topics: M&A and strategic alliances.

This paper is organized as follows. A review of M&A is provided in Section 2. Section 3 offers a review of strategic alliances. The directions of future research regarding M&A and alliance are discussed at the end of Sections 2 and 3. Finally, conclusions are presented in Section 4.

2. Review of Mergers and Acquisitions

M&A is an important external growth method for a firm to achieve objectives such as: synergy, resource acquisition, diversification, vertical/horizantial integration, globalization and managers' self-interest. Extant research has applied various theories to discuss M&A-related topics according to different levels as follows:

1. Individual level: At the individual level (e.g., deals or managers), scholars apply the perspective of synergy overconfidence, network and agency theory.
2. Corporation level: At the corporation level (e.g., internal and external characteristics of a firm, or corporate governance), scholars adopt the perspective of network/guanxi, organizational learning or corporate governance and a resource-based view.

3. Industry level: At the industry level, scholars use the perspectives of M&A wave, herd behavior, hot political periods, environmental munificence and dynamism or market power.

4. Country level: At the country level, scholars quote the perspectives of institutional or cultural difference or behavioral finance.

A summary of the topics and theories related to M&A please refers to Figures 1 and 2 as well as Table 1.

The summary of M&A literature shows that little research has investigated how TMT overconfidence or transnational TMT affects M&A. In particular, few M&A studies related to network/guanxi discuss how supply chains, business groups or family firms influence post-TMT turnover and performance. Both business groups and family firms have the unique attribute of closed networks, and are prevalent in Taiwan. A Taiwanese sample set also involves the characteristics of weak investor protection, family control, concentrated ownership held by the controlling shareholders, and cross holding within the business group. After reviewing extant M&A literature, we suggested several potential issues for future research regarding M&A by using the unique characteristics of the Taiwanese samples.

First, little previous research related to M&A and TMT turnover has focused on family firms or business groups on their investigations. Embedded with unique family effects and networks, family businesses have the incentive to be generous to their children by providing them with job security (Luo and Chung, 2005; Wong, 1985). Future research could visit the issue regarding how the family effect influences post TMT turnover and thus M&A performance.

Second, the closed relationships among the firms within the business group have a great effect on the strategic decision of group members. Future research may investigate how family business groups affect the turnover of family managers after M&A, and subsequently the post-M&A performance of the other subsidiaries within the group.

Third, based on the perspectives of the upper echelon and family effect, future studies may discuss the orientation of technical M&A, as well as the post-performance, under family control and governance. Finally, different types of organizational forms may have various impacts on their rivals. Future research may further discuss how M&As by business groups (Supply Chains) affect their rivals' innovative performance within, as well as outside, the business group (Supply Chain), and how M&As in a family firm affect its rivals' innovative performance.

3. Review of Strategic Alliance

As opposed to the M&As, in which the acquirer invests in the majority of equity shares of the target firm, strategic alliances generally involve only part of (e.g., joint venture), or none of the shareholding (e.g., contract alliances) in an alliance. In order to distinguish ownership-based and non-ownership-based alliances; in this study and section, ownership-based alliances refer to joint ventures, while non-ownership-based alliances refer to strategic alliances. Compared to M&A literature, previous studies regarding strategic alliances by using Asian data are relatively fewer.

Because both joint ventures and alliances involve the problem of incomplete contracts, the partners may engage in opportunistic behavior, and thus face the hold-up problem as well as the potential monitoring costs when an alliance is forming (Chen, 2010; Lai, 2011; Wu and Hu, 2009). Corporate governance and trust are critical issues in the research on strategic alliances (Lai et al., 2014; Ang et al., 2015). Table 2 offers a summary of the topics and theories regarding strategic alliance.

As shown in Table 2, few studies on joint venture and contract alliances using Taiwan data have been published in the top-tier journals. The potential opportunity to publish research in the top-tier journals, while adopting Taiwanese samples, needs to emphasize the unique attributes of Taiwan data.

The issue related to alliances associated with business groups may be a possible problem as business groups are a specific organizational form in Taiwan. Cross holdings, as well as closed business relationships, among group members have a great effect on the firms' strategies within the groups. The first potential issue related to business groups involves how a firm within the business group that forms an alliance with a company outside the business group affects the other firms belonging to the business group. What are the disadvantages and advantages of this new alliance relationship to the other firms within the group? How do the attributes of different business groups, such as the ownership structure or a firm's status within a group, affect value creation on the part of the group members?

Second, in Taiwan, supply chains with a completely integrated up and down stream of industries present a specific attribute for Taiwanese data. Future research may investigate how alliances affect the firms belonging to the other supply chains in the industry, and the value of a supply chain, or how alliances influence the competition and value creation of a firm among the supply chains.

The third potential issue is to investigate how alliances with a famous firm change a focal firm's corporate governance, the degree of analyst following, the volumes of stock trading, or an increase in institutional investment. Finally, extant research in management has switched the focus from a single alliance to the alliance portfolio. An increasing number of firms deal with a dynamic market as well as rapid technical changes, and develop competitive advantages by adopting various alliances. While a firm has to face multiple alliances, little extant research has focused on this issue. Future research may further investigate how a firm manages its alliance portfolio (Lavie, 2007; Wassmer, 2010; Majchrzak et al., 2015).

4. Conclusions

This study reviewed the literature on external growth strategies, including M&A, joint ventures and strategic alliances. Moreover, we pointed out the characteristics of the Taiwanese sample, such as weak investor protection, concentrated ownership, a prevalence of family businesses, supply chains with closed networks and business groups. The attributes of the Taiwan market provide scholars with good opportunities to study niche acquisitions and alliances. Through systematic analysis, this study sheds light on potential future research topics related to M&A and alliances based on data collected in Taiwan.

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附 錄

表 1 以亞洲資料為樣本之併購文獻

期刊	作者	主題	理論依據	台灣	大陸	香港	日本	韓國	新加坡	東南亞	跨國樣本
交大管理學報	黃志仁與溫宜豪 (2008)	合併子公司之合併綜效與市場反應	綜效理論	v							
亞太管理評論	陳安琳等 (2000)	企業購併對主併公司股東財富的影響	綜效理論 市場力理論 代理理論	v							
亞太管理評論	Ström and Nakamura (2014)	中國企業併購日本公司的動機和模式	資源基礎理論		v						
財務金融學刊	李國榮等 (2006)	不確定下之最適購併決策分析	綜效理論	v							
管理與系統	曾真真 (2010b)	範疇擴張、區位擴張與創新績效	吸收能力觀點	v							
管理與系統	邱奕嘉與曾為國 (2014)	技術相關程度對技術併購影響	資源基礎理論 組織學習理論	v							
管理評論	曾真真與何雍慶 (2005)	資源槓桿、取得互補性資源，與經驗學習購併對併購決策與績效的影響	資源基礎觀點 動態能力觀點	v							
管理評論	曾真真 (2008)	M&A 與 R&D：研發存量、技術相似性與併購績效之關係	組織學習理論 資源基礎理論	v							
管理評論	陳曉蓉 (2010)	影響銀行分行活動之決定因素	代理理論 資訊不對稱假說	v							
管理學報	曾真真 (2010a)	經驗學習、替代性學習對再併購機率的影響	組織學習理論	v							

期刊	作者	主題	理論依據	台灣	大陸	香港	日本	韓國	新加坡	東南亞	跨國樣本
管理學報	陳振遠等 (2013)	公司治理與併購資訊洩露	代理理論	v							
證券發展季刊	王祝三等 (2006)	企業併購支付方式決定因素與股股價反應	資訊不對稱假說	v							
證券發展季刊	許培基等 (2013)	管理者過度自信完成購併購併後績效	代理理論	v							
臺大管理論叢	陳永琦 (2006)	不完全競爭市場下銀行進行合併的效益	綜效理論	v							
臺大管理論叢	陳妙玲與陳欣瑜 (2010)	金融控股公司購併後業務多角化對財務績效之影響	綜效理論	v							
臺大管理論叢	陳玉麟 (2011)	外部創新模式對創新績效的影響	組織學習 吸收能力觀點	v							
臺大管理論叢	林孝倫與卓佳慶 (2014)	會計師事務所合併對經營效率的影響	綜效理論		v						
Journal of Finance	Bae et al. (2002)	韓國企業集團是否受益於併購	利益輸送假設					v			
Journal of Financial Economics	Rossi and Volpin (2004)	會計標準與投資者保護對併購活動的影響	法制差異觀點－投資者保護 公司治理趨同觀點	v							v
Journal of Financial Economics	Hwang (2011)	國家的聲望對跨國併購活動的影響	聲望假說	v							v
Journal of Financial Economics	Siegel et al. (2011)	平等主義對跨國併購的影響	文化差異觀點	v							v

期刊	作者	主題	理論依據	台灣	大陸	香港	日本	韓國	新加坡	東南亞	跨國樣本
Journal of Financial Economics	Ahern et al. (2015)	員工文化價值對併購績效影響	文化差異觀點								✓
Review of Financial Studies	Bris and Cabolis (2008)	投資者保護與會計標準對跨國併購溢價的影響	代理理論 法制差異觀點— 投資者保護	✓							✓
Review of Financial Studies	Chari et al. (2010)	已開發國家企業併購新興市場公司對主併公司異常報酬的影響	契約理論	✓							✓
Review of Financial Studies	Ferreira et al. (2010)	機構投資人對跨國併購的影響	資訊不對稱假說 機構投資者促進假說								✓
Journal of Financial and Quantitative Analysis	Ferris et al. (2013)	經理人過度自信對國際併購的影響	過度自信假說 文化差異觀點								✓
Journal of Corporate Finance	Bris, Brisley, and Cabolis (2008)	跨國併購後公司治理變動對公司價值的影響	法制差異觀點— 公司治理機制								✓
Journal of Corporate Finance	Danbolt et al. (2015)	投資者情緒對主併公司異常報酬的影響	行為財務—非理性投資者								✓
Journal of Corporate Finance	Kim and Lu (2013)	公司治理改革是否改變投資者保護以及影響公司投資決策	法治差異觀點— 公司治理 投資者保護								✓

期刊	作者	主題	理論依據	台灣	大陸	香港	日本	韓國	新加坡	東南亞	跨國樣本
Journal of Corporate Finance	Lin and Su (2008)	新興市場中部份私有股權控制公司多角化對公司價值的影響	多角化政治成本假說		∨						
Journal of Corporate Finance	Zhou et al. (2011)	金融風暴前後，不同股權結構的公司之事業重組	重聚焦假說 代理問題							泰國	
Journal of Banking & Finance	Focarelli and Pozzolo (2001)	銀行業進行海外併購的因素	資訊不對稱假說 優勢能力觀點 法制差異觀點								∨
Journal of Banking & Finance	Chong et al. (2006)	銀行強制性合併對股東財富的影響	政治連結觀點 親信效果							馬來西亞	
Journal of Banking & Finance	Burns et al. (2007)	跨國上市對併購方式的影響	約束假說								∨
Journal of Banking & Finance	Jeon et al. (2011)	外國銀行進入新興市場國家對地主國銀行產業競爭程度的影響	外溢效果								∨
Financial Management	Kim (2012)	投資者保護對併購方式與併購後控制機制的影響	控制股東代理問法制差異觀點—投資者保護	∨							∨
Financial Management	Ghosh and He (2015)	跨國上市投資者保護改善，對公司投資決策與公司價值的影響	約束假說	∨							∨
Journal of Empirical Finance	Owen and Yawson (2010)	美國公司進行跨國併購與該國人力發展的關係	盧卡斯矛盾 (Lucas Paradox)								∨

期刊	作者	主題	理論依據	台灣	大陸	香港	日本	韓國	新加坡	東南亞	跨國樣本
Journal of Empirical Finance	Wang and Wang (2012)	地主國經濟自由度對外國創投及其經營績效的影響	法制差異觀點								v
European Financial Management	Zhou et al. (2015)	大陸國有及私有企業併購對併後長、短期績效的影響	代理理論		v						
Journal of Financial Services Research	Ogura and Uchida (2014)	銀行合併對取得債務人軟性資訊的影響	扁平化組織觀點				v				
Pacific-Basin Finance Journal	Guo et al. (2001)	美日公司對於兩國間國際併購與資訊告的回應	集團企業監控假說				v				
Pacific-Basin Finance Journal	Claessens et al. (2003)	多角化公司事業部門的垂直相關與互補性多角化趨勢	邊做邊學假說 資本錯誤配置假說								v
Pacific-Basin Finance Journal	Higgins and Beckman (2006)	併購標的對主併公司股東財富的影響	多角化折價假說				v				
Pacific-Basin Finance Journal	Lin et al. (2008)	過度自信對併購的影響	自滿假說				v				
Pacific-Basin Finance Journal	Kot (2011)	購併、重整或事業形態變動後企業更名對股價與長期績效的影響	訊號發射假說			v					
Pacific-Basin Finance Journal	Bae et al. (2011)	集團企業多角化對公司價值的影響	多角化折價理論					v			
Pacific-Basin Finance Journal	Higgins (2013)	主併公司往來銀行關係與併購利益間之關係	利益衝突假說				v				

表 2 以亞洲資料為樣本之策略聯盟文獻

期刊	作者	主題	理論依據	台灣	大陸	香港	日本	韓國	新加坡	東南亞	跨國樣本
文大管理學報	陳世傑等 (2006)	網際網路之運用與溝通對技術移轉及聯盟績效的影響	聯盟治理機制	v							
財務金融學刊	吳菊華與胡聯國 (2009)	垂直整合下合資併購之策略選擇	不完全合約	v							
管理評論	林欣美 (2007)	交易成本及網路鑲嵌對策略聯盟的影響	交易成本 網路鑲嵌	v							
管理評論	張美玲等 (2002)	環境動態性如何影響策略聯盟的形成	交易成本 資源基礎	v							
管理評論	陳一如 (2010)	企業組織型式與董事會結構對策略聯盟財富效果之影響	不完全合約 公司治理	v							
組織與管理	賴蓉禾 (2011)	公司治理、夥伴選擇與策略聯盟績效	不完全合約 公司治理	v							
臺大管理論叢	賴蓉禾等 (2014)	董事會特徵與企業合資之財富效果	公司治理 財富創造	v							
Journal of Banking & Finance	Chiou and White (2005)	策略聯盟形成對股東財富效果的影響	綜效、價值創造				v				
Journal of Banking & Finance	Owen and Yawson (2013)	資訊成本對跨國聯盟的形成的影響	資訊不對稱假說								v
Journal of Empirical Finance	Lee et al. (2013)	策略聯盟宣告的財富效果	綜效、價值創造					v			
Journal of Banking & Finance	Chen et al. (2000)	成長機會與自由現金流量對合資價值的影響	自由現金假說 成長機會假說						v		

期刊	作者	主題	理論依據	台灣	大陸	香港	日本	韓國	新加坡	東南亞	跨國樣本
Journal of Banking & Finance	Mantecon and Chatfield (2007)	合資資產的處份方式對股價的影響	資訊不對稱假說				v				v
Journal of Banking & Finance	Ushijima (2010)	部份合併績效對股東財富的影響	綜效觀點				v				
Journal of Business Finance & Accounting	Chang and Chen (2002)	影響合資績效的因素	投資機會 綜效觀點	v							
Journal of Financial and Quantitative Analysis	Ang et al. (2015)	當地廠商的可靠性如何影響跨國投資決策	信任觀點								v
Financial Management	Chang et al. (2008)	日本與美國企業宣布非股權策略聯盟對價值創造的影響	綜效、價值創造				v				v

作者簡介

* 翁鶯娟 [1]

國立成功大學企管博士，現為國立高雄應用科技大學企業管理系副教授。研究領域為公司理財、公司治理與家族企業，其學術論文曾發表於國內、外之學術期刊中。

Ying-Jiuan Wong is an Associate Professor at the Department of Business Administration, National Kaohsiung University of Applied Sciences. She received her Ph.D. from the Department of Business Administration, National Cheng Kung University. Her main research interests are corporate finance, corporate governance and family business. Her research papers have been published in international and domestic academic journals.

張紹基

美國紐約州立大學水牛城校區管理經濟及財務博士，現為國立成功大學國際企業研究所教授。研究領域為公司理財與股東價值，其學術論文曾發表於國內、外之學術期刊中。

Shao-Chi Chang is a Professor at the Institute of International Business, National Cheng Kung University. He received his Ph.D. from the State University of New York, Buffalo, U.S.A. His main research interests include corporate finance and shareholder value. His research papers have been published in international and domestic academic journals.

我國資訊科技採納與導入文獻回顧之趨勢分析 (2000-2015)

A Literature Review of the Information Technology Adoption, Implementation, and Related Themes in Information Systems Research in Taiwan (2000-2015)

歐陽瑜 / 銘傳大學國際學院新聞與大眾傳播學程助理教授
Shirley Ou Yang, Assistant Professor, Journalism and Mass Communication Program, International College, Ming Chuan University

許瑋元 / 同濟大學管理科學與工程系教授
Carol Hsu, Professor, Department of Management Science and Engineering, Tongji University

摘 要

本研究回顧自 2000-2015 年國內資訊科技採納與導入主題之文獻。總計針對有六份國內與研究主題高度關聯的頂尖資管與電子商務期刊進行研究。在本研究篩選出的 82 篇相關論文中，根據理論、研究方法、分析單元與研究主題進行分析。研究結果發現，國內資訊科技採納與導入主題之研究在理論採用、研究方法、與分析單元等面相上，都受到科技接受模式研究典範的影響與限制，以個人層次的問卷調查研究佔極大多數，欠缺多樣性。本研究透過國際期刊的趨勢比較，提供未來國內資訊科技採納與導入後續研究建議，呼籲國內研究者應著眼於科技的、制度性的與歷史的脈絡因素，來豐富我們對科技創新之採納與導入的了解，同時建議未來研究需要有在個人、組織與產業等不同層次進行多層次、相互連結的分析。

【關鍵字】科技採納與導入、科技接受模式、科技創新、文獻回顧

Abstract

This paper reviews the IS adoption and implementation literature for the period of 2000-2015.More specifically the top six Taiwanese journals on the information system, management and e-commerce topics were examined. In total 82 articles were analyzed in terms of theories, research methods, unit of analysis, and research topics. Our research found that Technology Acceptance Model has been the mainstream theory during the past 15 years in the Taiwanese IS journal. The individual level research, using survey method were appeared the most. We argued that the IS adoption and implementation literature in Taiwan in terms of the theories, methods, and units of analysis are considerably affected and narrowed the scope by TAM, lacking of diversity and contextual concern. We further compare our finding with the trend of international IS scholarship, and offer implications for future research directions on IS adoption and implementation, scholars to publish multiple, complementary levels of analysis across individual, organizations, and industries. Macro level study considering the variety of IT innovations and the intersection among different levels of IS adoption, implementation and user is also important.

【Keywords】IS adoption and implementation, technology acceptance model, IT innovation, literature review

壹、前言

　　資訊科技創新、採納與導入的研究主題，在過去三十年資訊管理研究領域中，有長足的發展與累積。資管學界最重要的國際資訊管理會議 (International Conference of Information Systems; ICIS) 自 1983 年以來，便持續地將「科技的導入與使用 (IS Implementation and Use)」作為徵求論文的主要研究議題之一，這些論文的發表不但紀錄了隨著時代的演進，資訊科技系統如何協助並改變個人工作與組織流程創新歷程，也提供了不同的理論架構，協助管理者理解資訊系統導入的問題，以及其複雜的組織情境脈絡因素。

　　在這些「科技採納與導入」的研究潮流中，奠基於認知心理學的科技接受模式 (Technology Acceptance Model; TAM) 無疑是最廣為資訊管理學者接受的，在科技採納與導入研究中，有相當高比例的研究都以此理論為基礎 (King and He, 2006; Schepers and Wetzels, 2007; Venkatesh, Davis, and Morris, 2007)。而在資訊管理協會期刊 (Journal of AIS) 2007 年更出版專刊，專門討論科技接受模式的過去與未來發展 (Benbasat and Barki, 2007)。這些回顧無不肯定科技接受模式在形成常態化的研究典範，協助資訊管理學者聚焦於研究資訊科技導入組織早期，資訊科技的使用與接受情境之各類型議題。透過提出研究問題，導引研究者尋找個人與組織接受或拒絕科技創新的答案。

　　然而，近年來主流科技接受模式衍伸的相關研究已近飽和的狀態，許多研究者開始檢討，受該模式影響的相關研究似乎只在作重覆性的研究，無法實質達到理論上的突破（Venkatesh et al., 2007; Silva, 2007；洪新原、梁定澎與張嘉銘，2005）。許多研究者開始質疑「科技採納與導入」研究潮流中是否已經死去？此研究主題是否還能有更多理論突破的可能性？近廿年來企業環境因網路科技與全球化風潮，深深影響了企業組織管理運作的方式，在科技採納與導入的議題是否還僅止於組織內的導入？這些研究議題正是激發本研究的主要動機。

　　本研究的目的是要檢視我國的「科技採納與導入」的研究潮流過去十五年間的發展，與其受到科技接受模式研究典範的影響。透過從國內主要資訊管理與組織期刊的文獻回顧，我們想要回答兩個研究問題：（一）對於「科技採納與導入」主題的探索，我國資訊管理學界在過去的回應與累積為何？採用了哪些理論與方法？在哪些研究層次上，探討了哪些研究主題？（二）國內對於「科技採納與導入」主題的知識累積與國際間相關主題的發展趨勢有何異同？國際間對此一主題累積的反思與知識資產，有哪些可以值得國內未來相關研究發展借鏡的？為了回答上述的回題，本研究回顧了國內六份頂尖資管與電子商務期刊中，在 2000-2015 年間有關科技採納與導入主題，總計共 82 篇論文。

　　本文組織的方式如下：第二節是文獻探討，我們嘗試從歷史角度回顧國際間的科技採納與導入的研究趨勢與發展；第三節介紹本研究的研究範圍與方法；接下來說明

研究結果與討論；最後一部分則為本研究的結論，也對未來國內「科技採納與導入」後續理論、研究方向、主題等方向提出建議。

貳、文獻探討：科技採納與導入的研究趨勢

在資訊管理領域中，以「科技的採納與導入 (Adoption and Implementation of New Information Technology)」的研究一直隨著資管學域的發展佔據重要的位置。從早期將管理資訊系統視作為一種人機整合系統，以資訊協助組織例行的作業、管理與決策活動 (Davis, 1986)；繼而延伸到科技導入組織時所面臨的抗拒與失敗的議題 (Markus, 1983)；直到 90 年代科技發展與使用、人的決策與組織設計三者之間的互動與影響，漸成為研究的焦點 (Orlikowski, 1992)。此研究議題隨著科技發展，在不同時空背景下研究重心雖有變異，但一直是推進資訊管理學門知識領域，帶動相關學術思潮與研究的重要議題。

資管領域的資深學者為整合「科技的採納與導入」過去大量的學術研究成果已有一系列的努力，Chin and Marcolin (2001) 對科技導入與傳散研究所做的文獻回顧；Journal of the Association for Information Systems 2007 年也出版了一期特刊專門介紹「科技的採納與導入」議題中最具影響力、也最常被引用的理論科技接受模型 (Technology Acceptance Model; TAM) 與其相關的實證研究文獻回顧；資管學界最重要的國際資訊管理會議 (ICIS)，則自 1983 年以來，一直持續以「科技的採納與導入」為主要研究議題，也帶動大量相關學術研究與論文發表。奠基這上述的研究成果之上，本研究嘗試從歷史的角度，回顧相關研究的發展趨勢與重要關鍵，歸納整理如下，作為下一階段拓寬與深化相關研究議題方向之借鏡。

資管領域中，此研究主題自 70 年代起開始逐漸蓬勃發展，至今已超過 40 個年頭，大致而言，歷經了三個不同階段。隨著不同時代的科技進步所帶來的新興問題，這些沿革在不同階段就發展成新興的研究重點：從早期聚焦在「執行與實作的議題」(1965-1980s)、中期集中在以「科技接受模式」為主流的研究與其他發展中的學術支流 (1990-2000)、到晚近 2000 年迄今則逐漸以更多元的創新研究為主軸，在分析單元與研究方法上，都呈現出豐富與多元的面貌。

1960 年代由於個人電腦興起，企業開始採用電腦快速精準的運作能力，來支援所有例行活動，作為其重要的競爭價值。在這個時期，組織開始重視資訊科技可能帶來的策略價值，例如運用資訊科技統計產品銷售量、或是建置會計資訊系統等。因此，早期的科技採納與接受的研究 (1965-1980s) 主要關切的主題即是，企業如何運用資訊科技進行創新與變革。由於當時有許多組織在導入資訊系統時，都遭遇到困難或是失敗，主要的議題是組織導入資訊科技的方法。因此，在第一個階段的研究重心是在研究「執行與實作的議題 (Implementation Problems)」，探索這些問題有哪些來源與特性，以及應當要如何解決。

這些「執行與實作議題」研究潮流，主要是奠基於管理科學領域。早期 Churchman and Schainblatt (1965) 研究在組織環境執行其模型的難題；Swanson (1974) 研究管理者對於資訊科技的解讀影響他們對管理資訊系統任意地運用；Lucas (1975, 1978) 解釋資訊系統為何會失敗，以及對執行與實作模型的實證研究；Zmud and Cox (1979) 則提出一種執行與實作的途徑，提出一旦系統開始營運，就會產生實質的改變。早期這一系列「執行與實作議題」的研究潮流，主要是以管理科學的角度，探討實作的模型與步驟，在科技導入組織的過程中，既有模型何以不適用而失敗。這些從管理科學探討「科技採納與導入」研究，為資訊管理領域研究注入了與組織相關、人的科技使用與的執行的難題。自 80 年代 ICIS 每年一度科技採納與擴散議題的學術論壇，更將不同的議題聚焦在科技採納與擴散的主題框架下，有多元的開展，為日後理論與實證研究的發展奠定基礎。

「執行與實作議題」的研究潮流在 80 年代蔚為風潮，包括 Swanson (1988)、Lucas, Ginzberg, and Schultz (1990) 都提出了「執行之難題 (Implementation Puzzle)」、「執行作為設計與使用間的橋樑」、「執行與實作之結構化模型」等若干不同的觀點，不但整合並延伸了早期的作品，並且將個人使用者與管理模型的「執行與實作議題」加以連結起來。而 Zmud (1982, 1983, 1984) 的一系列研究則將注意力轉向在資訊科技環境中的創新與擴散，Kwon and Zmud (1987) 指出創新角度可以將現有「執行與實作議題」的片斷的模式統整起來。另外，Markus (1983) 也提出了對管理資訊系統導入與組織政治和權力的關係、組織抗拒理論的探討，雖然這些議題在當時執行與實作議題中算是相當少數，但是卻對後續的資訊科技導入與組織的議題帶來深遠的影響。

到了 90 年代，個人電腦普及化、電子商務的逐漸發展，第二階段的科技採納與接受研究不再著眼於組織面、管理面，而逐漸轉向個人層面，科技接受模式 (TAM) 蔚為主流研究議題。在 80 年代末 Davis 與其同儕 (Davis, 1989; Davis, Bagozzi, and Warshaw, 1989) 最早提出科技接受模型，對於解釋個人的意圖如何影響新資訊科技的採納與使用提出了完整且化約的理論基礎。由於科技接受模式為研究個人層次上的科技採納與使用行為，提供了一個健全可以測量的工具：將個人意圖化約成兩組重要的變項－有用性 (Perceived Usefulness) 與易用性 (Perceived Ease of Use)，引起了分析單元 (Unit of Analysis) 以個人層次的科技採納與接受研究大量擴增。然而，在這個學術潮流下，較少提供新興科技如何執行與實作的管理意涵，這股研究潮流甚至也影響後續的「執行與實作議題」趨向大量的調查研究。

90 年代除了科技接受模型研究潮流的發展之外，另有若干重要且多元研究潮流分頭並進。從管理科學的角度而言，若干學者發現不再能以制式的管理科學方法直接將資訊系統導入組織，根據不同的議題，會影響不同的導入結果。例如：Cooper and Zmud (1989, 1990) 用創新理論將原有的「執行與實作議題」重新定位，從組織層次的

分析單元來看這個議題，同時提出了科技挹注 (Infusion) 的概念來補充原有的科技擴散 (Diffusion) 概念。Swanson (1994) 則提出了資訊系統創新的三核心柱石的模式，將創新類型與組織的採納與擴散區分開來。Swanson and Ramiller (1997) 提出了組織願景的概念來談一種主流的資訊科技系統（例如 ERP）在不同組織間的擴散，組織願景的概念給創新研究中的制度性環境注入了新的視角。Lucas 與他的同儕 (Kambil, Kamis, Koufaris, and Lucas, 2000; Lucas and Spitler, 2000) 重新檢視了在網路科技與更新的網路架構下執行與實作的挑戰。

這些組織面向的科技採納與導入的研究，也從過去實證取向的線性觀點，進一步轉向理解科技與組織並非獨立的個體，科技鑲嵌於組織與其制度性安排、考慮科技導入與組織中各種內外環境因素與動態關係的質性研究逐漸出現在「科技採納與導入」研究議題中，深化對科技與組織互動的理解。Orlikowski (1992) 科技與人互動關係雙重性模式 (Duality of Technology) 都是這個時期的經典之作。

至於從 90 年代持續發展的個人層級的研究，仍圍繞著科技接受模式研究為主軸，持續關注採用行為的相關研究。例如：Davis (1989) 研究資訊科技的認知有用性、認知易用性與使用者接受間的關係；Chau (1996), Chau and Hu (2001) 將科技接受模式應用在系統開發者；醫生等不同使用者 Koufaris (2003) 將科技接受模式，結合心流理論應用在研究網路消費者行為等。

至於較晚近的科技採納與接受研究（2000 年迄今），隨著網路科技的發展與虛實整合策略規畫、上下聯盟合作的新典範發展等，無論在研究主題、研究方法與分析單元上，又從個人層次的量化研究，朝向組織層次、產業層次研究更多元的發展。此外，用策略角度看組織外環境對科技接受與導入的影響，也成為新興研究方向。首先，Swanson, Ramiller 與其同儕繼續從制度理論的角度來探討科技採納與接受的主題。除了繼續發展組織願景的不同生涯路徑 (Ramiller and Swanson, 2003)、在資訊創新中組織的注意 (Mindfulness) 與不注意 (Mindlessness) (Swanson and Ramiller, 2004)、以及透過訴求制度性的創業家精神，例如：市場研究者、顧問、企業、工商協會新聞、廣告業者、作家與會議組織單位，共同在社群中啟動組織願景 (Wang and Swanson, 2007)。

另外，「科技採納與接受」多元的研究議題中，也發展出一支探討資訊科技的商業價值與企業流程改造 (Business Process Reengineering) 的研究潮流。Zmud 與他的同儕近年的科技創新研究主要聚焦於多重層次的採納後行為 (Post-adoptive Behavior)。這些研究者主要關懷的議題是：在組織中導入資訊科技後，企業究竟要做哪些對的事，才能讓科技的功能充分協助增加企業的價值 (Saga and Zmud, 1994; Jasperson, Carter, and Zmud, 2005; Sherif, Zmud, and Browne, 2006)？同時這些研究也呈現出以組織層次以及混合層次研究為關懷的重點，並使用注重脈絡與更多元的研究方法。

此外，晚近的研究中，更擴展視野關注社會、外環境因素，也被視為科技接受與

導入所鑲嵌的脈絡。例如：Lucas 則走出個人與組織層次的研究，進一步嘗試產業層次的研究，研究不同產業採納資訊科技系統對該產業的影響，例如：航空業 (Duliba, Kauffman, and Lucas, 2001)、零售代理業 (Bakos, Lucas, Oh, Simon, Viswanathan, and Weber, 2005)；以及資訊科技如何促成組織、市場與產業的轉型。當組織在實作中採取新的商業模式後，如何對於經濟帶來戲劇性的改變，而這些改變又讓競爭者繼續科技創新，用更新的商業模式來持續營運生存；而 Orlikowski (2002) 則提供了科技並非獨立於組織之外的實體，需要正視組織流程文化與實踐致知 (Knowing in Practice) 的觀點。

整體而言，儘管自 70 年代迄今，國際間的「科技的採納與導入」研究隨著時代與科技進上有不同的面貌，就理論的角度而言，「科技接受模式」是這個領域中最常被引用的理論，對資管領域具有相當大的影響性 (Venkatesh et al., 2007)，而晚近科技與組織的互動性與鑲嵌性，科技導入的非理性因素，例如：制度性理論、組織願景理論、實踐理論、社會資本、企業策略伙伴、工作系統理論等都是跳脫單一心理取向的理論視角。在研究方法方面，由於「科技接受模式」長期是國際主題的主流，問卷調查法佔這四十年「科技的採納與導入」的大宗，但注重脈絡質性研究（例如：個案研究、次級資料分析）、多元的研究方法，例如：數學模式、實驗法等也仍互有出現；在研究主題方面，國際間「科技的採納與導入」研究中，隨著國際會議對相關主題的不斷反思，逐漸從過去將「科技接受」有用性與易用性主題定為一尊的方向，逐漸轉向公司套裝解決方案或企業組織內部應用（ERP、SCM 和 CRM 系統）、高度競爭市場對於資訊系統之發展、導入、調適與應用之快速策略等主題。此外，也有越來越多跨組織間價值網絡、新興社交網路科技平台，也增加了「科技的採納與導入」研究的複雜性、與寬廣度。而在分析單元方面，從過去以個人層次研究為主軸的分析單元，也漸漸轉向以組織層次以及混合層次研究。

參、研究方法

一、研究範圍

本研究的論文是科技採納與導入主題為主要研究範圍，在 2001-2015 年國內共六份頂尖資管與電子商務期刊中，有關科技接受與採納主題共 82 篇論文。就研究方法而言，本研究採取三個步驟：(1) 訂定評估標準－決定哪些類型研究應納入本研究分析；(2) 發展文獻蒐尋的策略；(3) 訂定分析架構－作為不同類型研究歸類編碼的準據。

首先，在論文出處的評估標準方面，我們根據科技部 102 年人文與社會科學期刊評比報告之研究結果（陳世哲、李昇暾、林修葳、洪世章、張錦特、葉仕國、盧瑞芬與謝依靜，2004）為依據。在管理學門類十一份評比為 A 級的期刊中，排除五份與資訊管理主題無關的期刊，挑選出中山管理評論、臺大管理論叢、資訊管理學報、管理學報、管理評論、組織與管理以及電子商務學報等六份與資訊採納與導入高度關聯的

A 級期刊，作為樣本抽選的母體。這些學術期刊均是國內管理學域中具有代表性，較常出現資訊管理相關研究的學術論壇。其中因組織與管理期刊自 2008 年才開始發行，因此資料蒐集時間則由該論文開始發行起。

其次，在文獻搜尋策略方面，我們首先透過「科技接受」、「創新擴散」、「科技導入」等相關關鍵字與標題在大學圖書館資料庫中進行關鍵字蒐尋。這些學術期刊都運用 CEPS 中文電子期刊資訊庫暨平台服務。其次，再經由瀏覽所有 2010-2015 上述期刊文獻之篇名、摘要與關鍵字，再次過濾篩選出與科技導入與擴散主題相關之學術文獻，共 82 篇。分別將每篇論文依主題、理論、研究方法、分析單元作編碼分類。表 1 顯示各期刊論文的收集期間與篇數。

表 1 本研究蒐集的各期刊論文與篇數

期刊	本研究收集區間	文章數	百分比	論文總數
資訊管理學報	2000~2015	34	6.94%	490
管理學報	2000~2015	4	0.79%	507
電子商務學報	2000~2014	29	8.08%	359
中山管理評論	2000~2014	6	1.45%	413
臺大管理論叢	2000~2014	6	1.83%	327
管理評論	2000~2015	2	0.60%	333
組織與管理	2008~2014	1	1.89%	53

而在分析架構方面，我們則根據 Laudan (1984) 所提出的科學的網狀模型 (Reticulated Model of Science)，其中包括：理論、方法與研究主題（目的）為分析架構。理論的應用與適當的研究方法的使用，都被視為任何一項研究最重要與基本的特性。Laudan 指出，理論必須與研究目的和研究方法能協調配合；至於研究方法的分類，我們則採用 Galliers (1992) 包括有實驗法、問卷調查、個案研究、理論驗證、主觀性論述、對未來研究之預期、模擬與行動研究等類別。另外，在研究主題方面，有兩種方法可以形成研究主題：第一種方法是，讓已出版的論文自己說話，亦即分析文獻時避免運用既定的分類系統，採用類似紮根理論所採用的理論分類途徑；另一種方法則是採用一種既定的架構或是分類系統。由於既定的架構或分類系統往往難以反映相關領域的真實研究。本研究採取讓論文主題自己說話的途徑，再用歸納法整合出相關聯性類別，賦予主題名稱。

對於這些 82 篇論文，我們採取如下的分析方法：首先，將每一篇研究根據其論文出處，依據年份加以分類整理；其次檢視每一篇論文並辨識其下列相關資訊：探討之科技主題類型、研究方法、使用的理論、在本研究中使用的自變數、依變數與控制變數、研究的分析單元（個人、組織、產業）。

肆、研究結果

一、科技採納與導入文獻使用的「理論」趨勢

根據分析結果，在 82 篇「科技採納與導入」主題的論文中，總計運用了 32 種不同的理論，其中出現數量最多理論類型就是「科技接受模式」，幾乎半數的論文都採用此一理論 (48%)；其次則是「創新擴散理論」(13%)；而「計畫行為模式」(9%) 則分屬前三位最常出現的理論，見圖 1。也就是說，在所有出現的理論中，有多達 28 種理論都只出現 1-3 次不等。這項結果顯示，國內「科技採納與導入」的研究中，與國外研究趨勢相類似，在過去十五年間也是以「科技接受模式」為最主流理論，論文發表集中在這個理論。
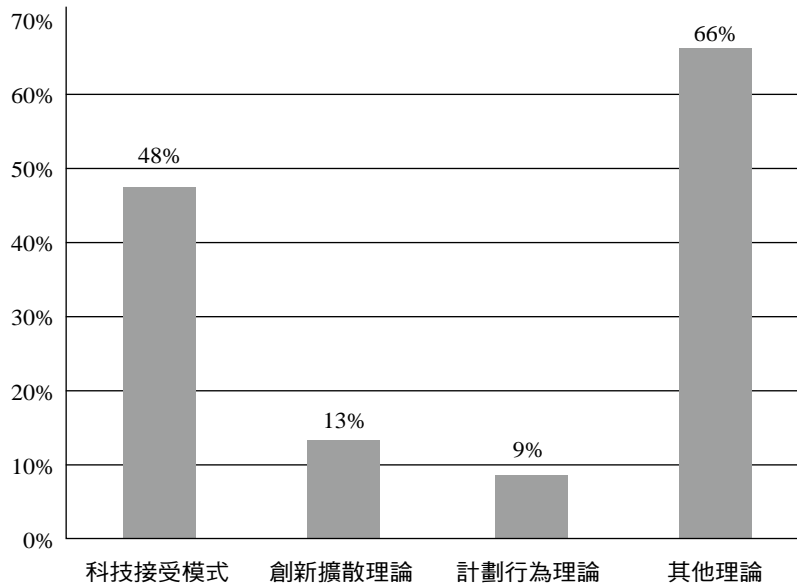
圖 1 我國科技採用與導入研究最常採用的理論 (N = 82)

若依據時間趨勢分析，研究結果發現，近十年來國內「科技採納與導入」主題論文數量有明顯的增加，但理論運用上卻有更集中的趨勢，2000-2004「科技接受模式」、「創新擴散理論」、「計劃行為理論」三種最常出現的理論的總和，僅佔各種類型理論運用的 39%、但 2005-2009、2010-2015 這三種理論的出現都佔各出現種理論的半數以上 (56.5%、51.1%)，顯示國內在理論運用上，有集中化而非多元化的趨勢。其中在過去十五年中出現比例最高的「科技接受模式」的數量以 2005-2009 為高峰，佔所有出現理論的四成左右 (39.1%)；2010-2015 則有微幅下降的趨勢 (34.0%)。至於「創新擴散理論」的論文在 2000-2004 此領域的研究中僅出現一篇，2005-2009 與 2010-2015 則在所有出現理論中各出現約 11%，維持在一定的數量，見圖 2。
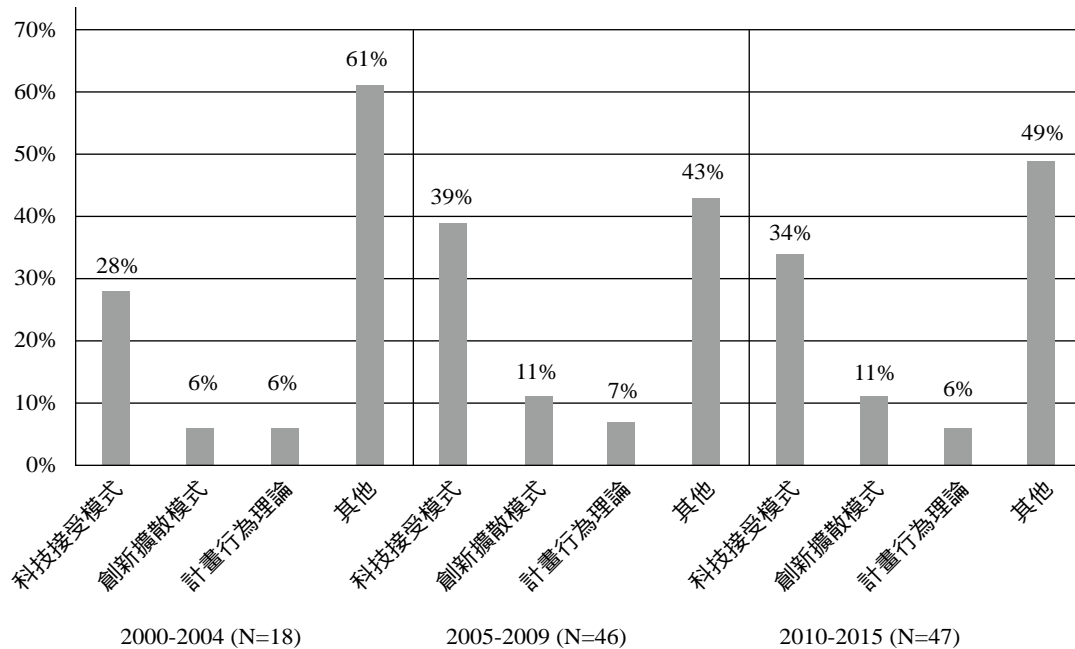
圖 2 我國科技採用與導入最常出現理論的時間趨勢分析

　　重複出現的理論，除了「科技接受模式」、「創新擴散理論」、「計劃行為理論」三種最常出現的理論之外，任務科技適配模型 (6)、科技接受與使用之統合理論 (UTAUT) (5)、理性行為理論 (3)、期望確認理論 (3)、制度理論 (3)、承諾信任理論 (2)、社會認知理論 (2)、交易成本理論 (2)、資訊管理理論 (2)、動機理論、和自我認同理論 (2)[1]，此外，另有媒體豐富理論等 17 種理論都僅出現一次。顯見理論採用集中與分散的情形成兩極化的趨勢，大量集中於少數理論，至於其他的理論使用上又相當分歧。

二、科技採納與導入文獻使用的「研究方法」趨勢

　　而在研究方法方面，在 82 篇論文中，最常使用的研究方法類型是問卷調查法，總計有 66 篇 (80%)、而個案研究居次有 10 篇 (12%)、其他的研究方法類型，例如次級資料分析、混合方法、質性分類統計、後設分析法等均只有零星的出現。顯見就研究方法而言，此領域的研究也是集中在以量化研究為主流，至於詮釋取向研究、批判研究等不同研究取向的比例則為數有限，見圖 3。

1　　括弧內為曾經出現次數。
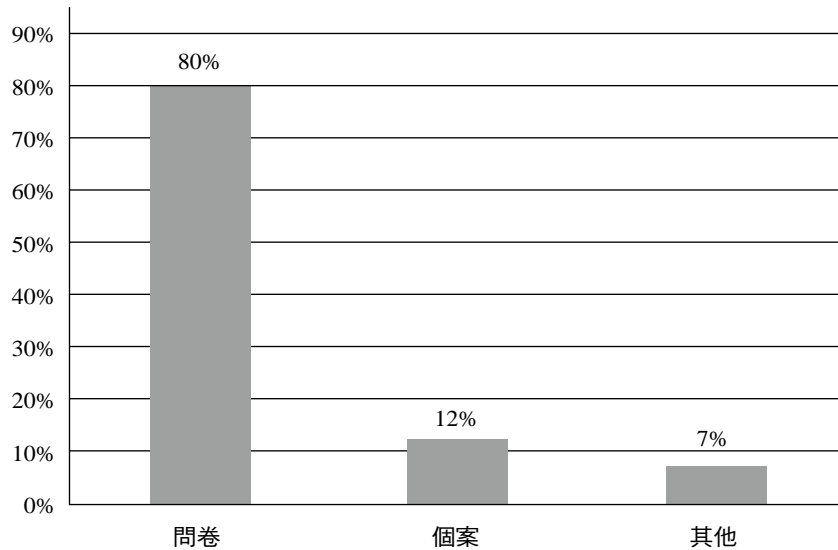
圖 3 我國科技採納與導入研究最常採用的研究方法 (N = 82)

　　從時間趨勢來看，研究結果顯示，研究方法的類型並未隨著領域發展時間，呈現更多元化的現象。相反的，隨著時間趨勢反而更加集中於實證主義取向的問卷調查法的現象，2000-2004 (75%)、2005-2009 (79%)、2010-2015 (83%)；至於個案研究的比例，雖然數量遠不如問調查法，但也維持一定比例 2000-2004 (17%)、2005-2009 (9%)、2010-2015 (14%)，在 2005-2009 年間稍微減少，但 2010-2015 又恢復到 2000-2004 年間類似的比例，差異不大；國內「科技採納與導入」的研究使用的研究方法，高度集中在前兩種類型的研究。至於其他類型的研究方法，在過去十五年間僅出現四篇，而在最近五年甚至完全未出現不同類型的研究方法，顯示對於其他研究方法的應用，仍有更大的發展空間。

　　若是以最常出現的理論與所使用的研究方法進行交叉分析，則發現四種最常出現的理論，有高達九成以上都是採用量化問卷調查方法：科技接受模型 (94.6%)、創新擴散理論 (90%)、計劃行為理論 (100%)、任務科技適配模型 (100%)。除了科技接受模型有極少數的個案研究 (2.7%) 之外，其餘這些高出現率理論都沒有使用個案研究。顯見「科技採納與導入」主題的論文高度集中以幾種常見理論與問卷調查方法，缺乏多元性，見圖 5。
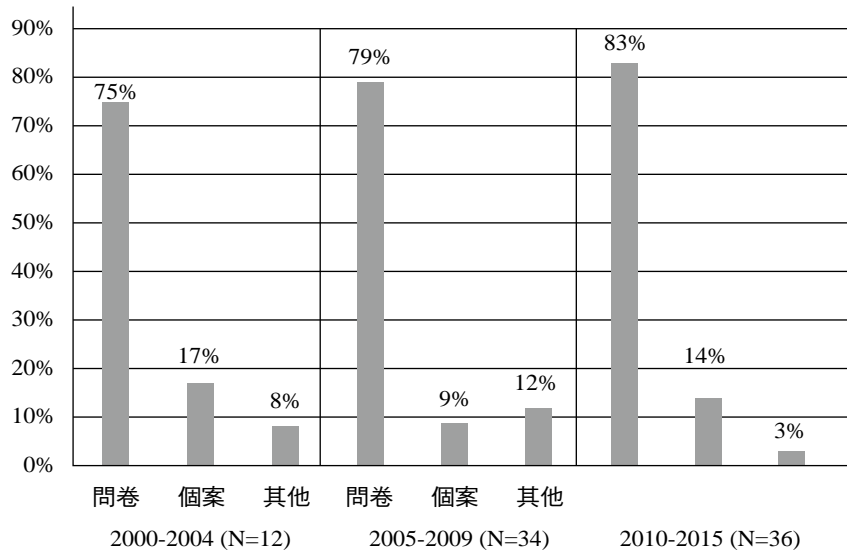
圖 4 我國科技採納與導入最常出現研究方法的時間趨勢分析
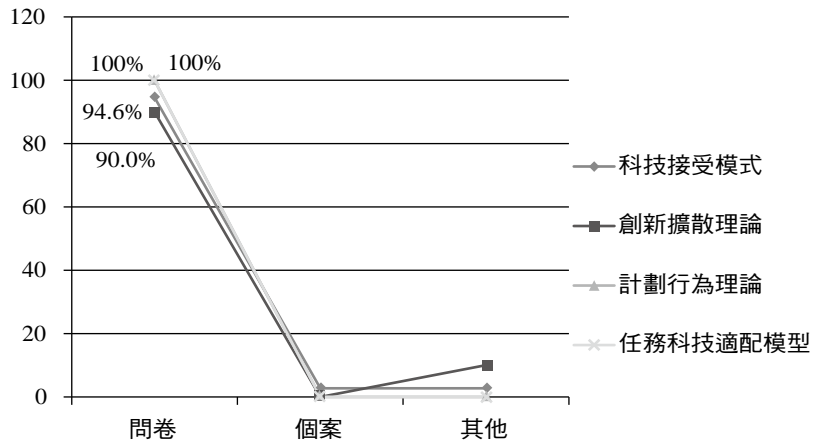
圖 5 我國科技採納與導入研究最常採用理論與其研究方法交叉分析 (N = 82)

三、科技採納與導入文獻使用的「分析單元」

　　從文獻所採用的分析單元角度來看，本研究也發現，在所有科技採納與導入的研究論文中，有高達 68% 採用「個人」為研究的分析單元，以「組織」為分析單元的研究只佔 28%，以產業為分析單元的研究則約佔 1%，另外多層次研究則佔 2%。
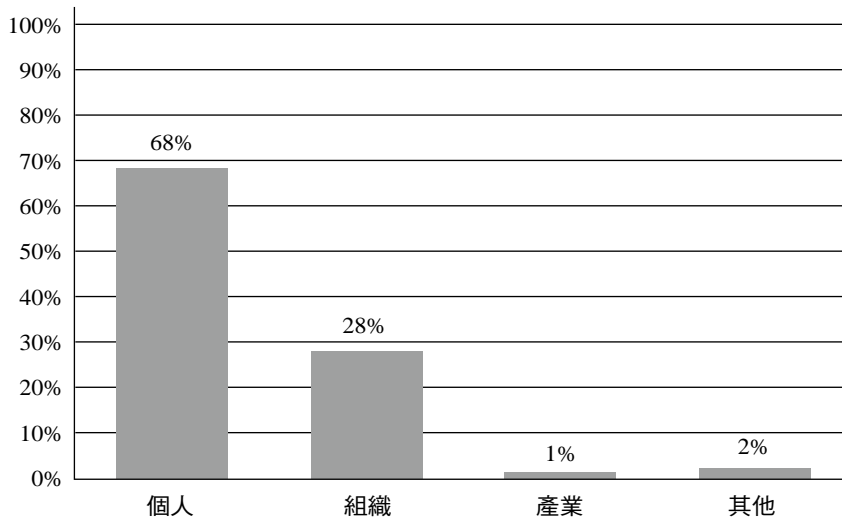
圖 6 我國科技採納與導入研究最常採用的分析單元 (N = 82)

　　而從時間趨勢來看，以「組織」為分析單元 (58%) 的研究在 2000-2004 年曾經是研究主流的分析單元，接近有六成的「科技採納與導入」研究都以「組織」為分析單元，超過以「個人」的研究單元 (42%)。但是以「組織」為分析單元的研究在 2000 年後就明顯下滑到僅佔 21% 到 25%；而以「個人」研究單元的研究數量大量增加，在過去十五年間，科技採納與導入的研究論文中，都約有七成以上是以「個人」為研究單元，2005-2009 (74%)、2010-2015 (72%)，至於產業層級的研究則是寥寥無幾，只有 2005-2009 (3%)。
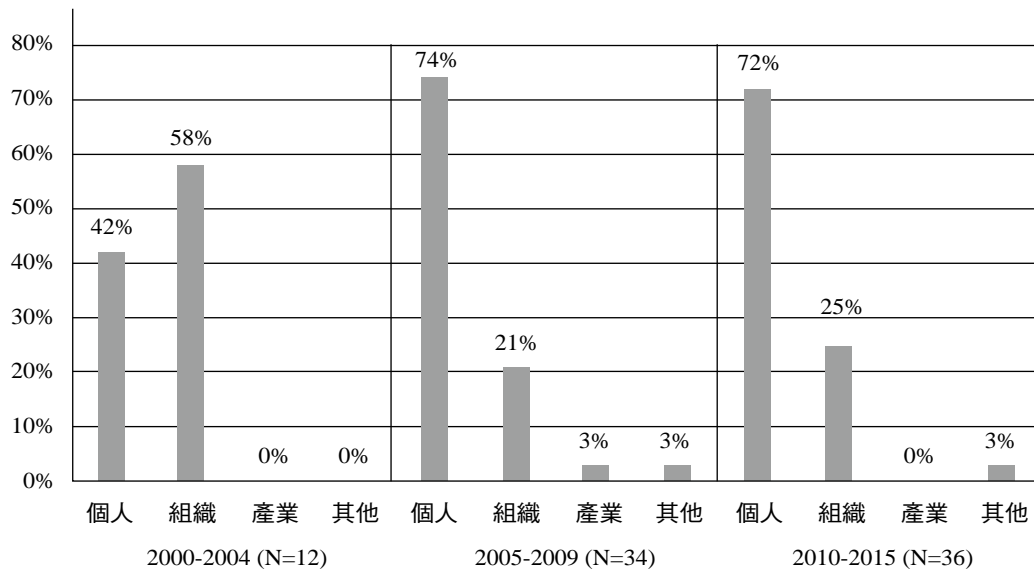
圖 7 我國科技採納與導入最常出現分析單位的時間趨勢分析

四、科技採納與導入文獻中呈現的「主題」趨勢

在研究主題方面，本研究依照所有論文中出現的科技類別，以歸納法加以編碼歸類後，共出現三大類型的主題，其中出現最多的主題是網路電子商務 (59%)，常見的相關主題包括：網路銀行、購物網站、線上學習、部落格、社交網站等；出現比例第二的主題則是傳統組織的管理資訊系統，佔所有論文總數的 26%，常見的相關主題包括 ERP、資訊系統、知識管理系統、E 化科技等；而第三種常見的主題是行動商務主題，佔所有論文總數的 12%，常見的相關主題包括行動商務、行動服務、手機 APP 等，見表 2。

若根據時間趨勢來看，出現比例最高的網路電子商務議題，在過去十五年間有持續微幅成長的趨勢，2000-2004 (50.0%)、2005-2009 (58.8%)、2010-2015 (61.1%)；而在行動商務的主題上，近十年持續成長，從 2000-2004 尚未出現類似主題 (0.0%)、到 2005-2009 (8.8%)、2010-2015 (19.4%) 相關研究倍數成長，顯見行動商務主題為一持續勃勃發展中的熱門議題；到於傳統組織管理資訊系統主題方面，過去十五年隨著電子商務與行動商務主題的研究增加，則有漸趨減少之勢，2000-2004 (33.3%)、2005-2009 (29.4%)，特別是近五年來下滑更為明顯，到 2010-2015 (19.4%) 出現的比例，已與新興的行動商務主題比例不相上下。

表 2 「科技採納與導入」研究主題類別

主題分類	相關議題
傳統組織 MIS	ERP、雲端 ERP、資訊系統、知識管理系統、醫療知識系統、公用事業 e 化科技、e 化系統、供應鏈系統、EDI、銷售預測、作業基礎成本管理、協同商務技術
行動商務	行動服務、行動英語學習、行動網際網路、行動廣告、手機 app、行動護理站
網路電子商務	數位學習、網路銀行、部落格、虛擬社群、線上購物、商業網站、購物網站、電子書閱讀器、網路報稅系統、語音留言板、Wiki、線上投保、即時交通資訊系統、電子銀行技術、web2.0、影音網站、跨組織金融資訊系統、國家創新系統、衛星派遣系統
其他	資訊科技採納、MP3 隨身聽、電腦軟體使用者界面、WAP 無線應用通訊協定
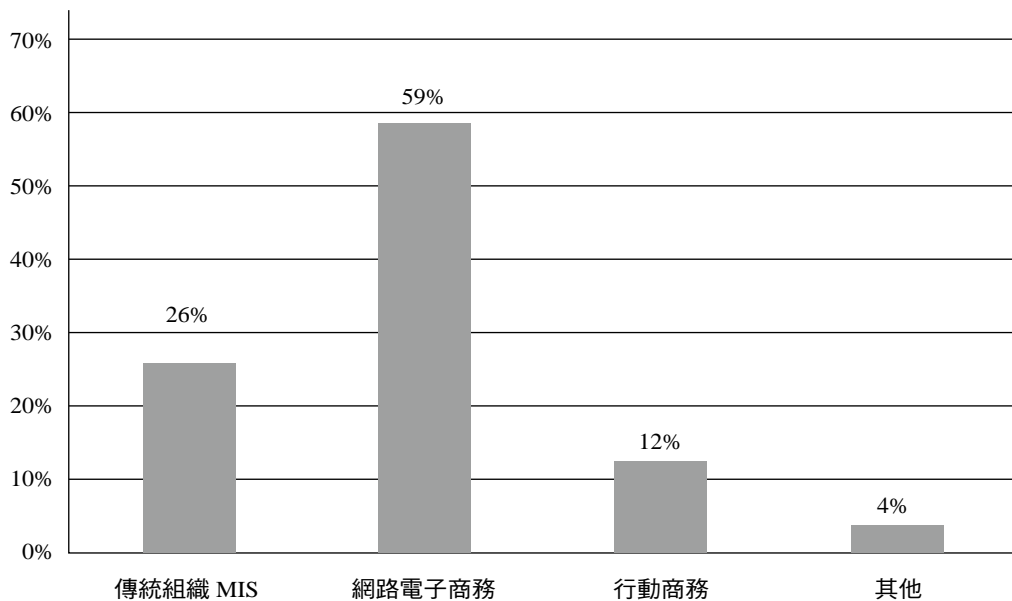
圖 8 我國科技採納與導入研究最常採用的主題 (N = 82)
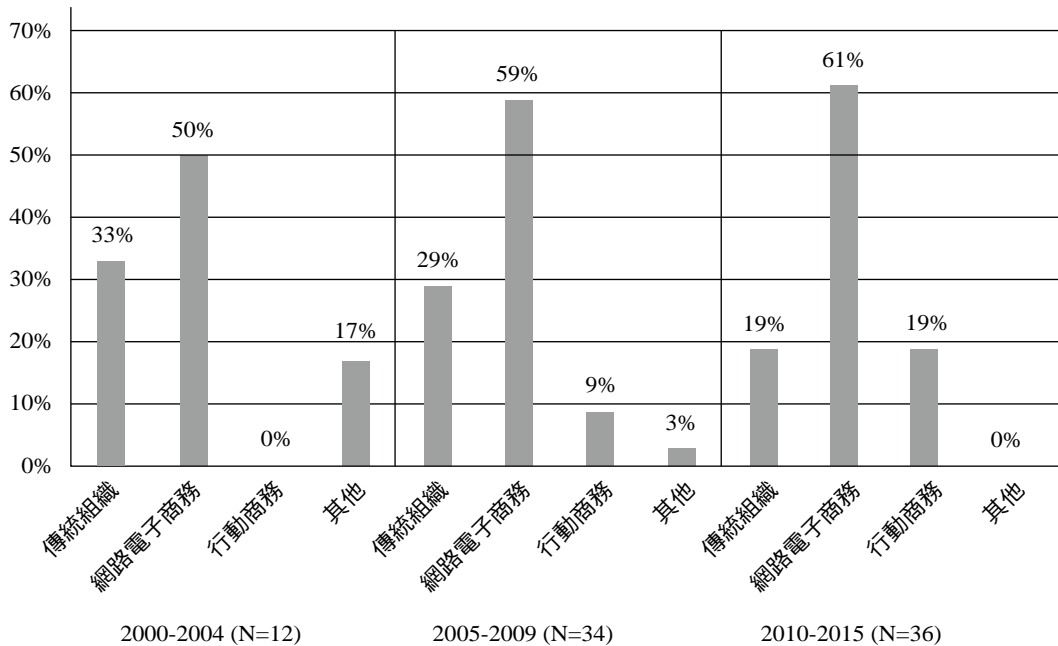
圖 9 我國科技採納與導入最常出現主題的時間趨勢分析

若是以最常出現的研究主題與研究方法進行交叉分析，則發現最常出現的三種研究主題傳統組織 MIS (77.2%)、網路電子商務 (88.9%)、行動商務 (100%)，無論哪一種常見主題，都高度集中在問卷調查法。傳統組織 MIS 與其他主題採用個案研究與其他研究方法的比例，略高於較行動商務與網絡電子商務主題。
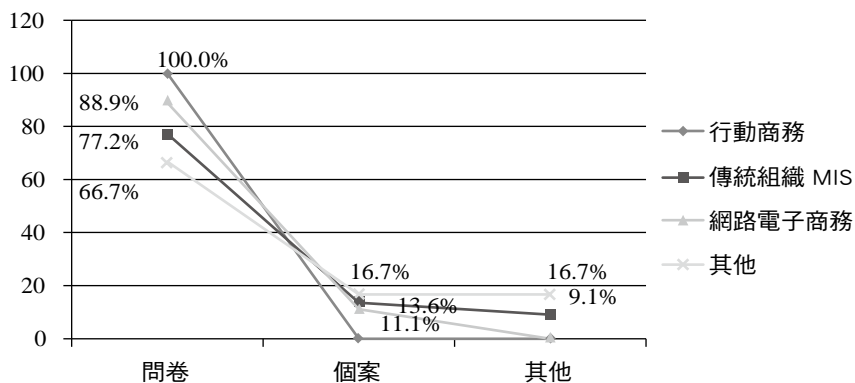
圖 10 我國科技採納與導入研究最常採用主題與研究方法交叉分析 (N = 82)

伍、研究討論

一、理論

在本研究回顧的 82 篇論文，共運用了 32 種不同的的理論，然而這十五年來的相關研究，有高達六成集中在運用「科技接受模式」、「創新擴散理論」兩種理論，「科技接受模式」這一項理論更高達近五成。這項結果一方面說明了，國內此主題的論文集中在少數主流理論的傾向，另一方面也顯示出，其餘探索不同的理論解釋科技採納現象的研究都相當分散，以零星、單篇的論文為主，沒有整合建構更有累積性的研究成果。

本研究結果與洪新原等 (2005) 的科技彙總研究結果非常類似，他們指出，科技接受模式在十多年的發展之後，多數的研究只在增加模式的不同構面，但對於詮釋預測使用者對資訊技術接受問題的詮釋力卻沒有增加，建議需留意採用科技接受模式的限制性。距離洪新原等一文又過了十年，儘管新興網路科技發展日新月益，科技環境已越來越複雜。科技接受模式在過去十五年仍是中流砥柱。但是在愈形複雜的科技環境中，組織制度性安排、行動者、與科技間的互動較過去更加動態性與去邊界，單一的科技接受模式是否仍能解釋這樣的複雜層面？對於使用者界面趨向多屏、多元的快速發展，今日的「科技採納與導入」議題所需關注的角度，應遠較過去的「科技採納與導入」有更高的複雜性。

個人層次的科技接受模式自從 80 年代 Davis (1989)、Davis et al. (1989) 所提出的科技接受模式，將個人採用創新資訊科技簡化，成使用者主觀認知的有用性 (Usefulness) 和易用性 (Ease of Use) 等兩個主要變數後，成為國際期刊中科技創新與採納的核心研究焦點 (Venkatesh et al., 2007)。資訊管理與相關的領域至少有超過千篇論文引用過 Davis (1989)、Davis et al. (1989) 這兩篇文獻，引起科技接受模式研究的爆炸性成長。

Silva (2007) 更進一步指出，科技接受模式已經成為一種常態科學的理論中心，有大量的文獻是透過應用科技接受模式進行修正與調整。研究典範同時也包括了建構研究工具、方法與技術。當科技接受模式形成了一個典範來引導資管學者研究各種類型的資訊系統使用與接受的情境，也提供了若干方式來型塑研究問題、了解並解決這些問題。Silva (2007) 指出這代表有相當高比例的資管研究學者是在科技接受模式和其方法論的基礎上接受訓練。由於科技接受模式提供了一套理論模型、資料蒐集工具與正確的統計組合。接受到這樣裝備的博士班學生，特別是在北美以科技接受模式為研究主流的環境中接受訓練，難免便繼續社會化這個模式的內涵、資料蒐集工具與配套的統計技術。

我們的研究結果也印證了 Silva (2007) 對此研究學域的反省。最常出現的理論與研究方法進行交叉分析結果發現（見圖 5），有高達九成以上的包括科技接受模式在內的前四種理論都均是以問卷調查進行研究。這顯示出主流研究典範的確帶來研究工

具、方法與技術的同型性 (Isomorphism)，並從西方「科技採納與導入」學域社會化，擴散到國內「科技採納與導入」學域。

若是從「科技採納與導入」文獻所採用的理論來源來看，國內的相關研究所引用的理論除了資訊管理領域的原生理論之外，也大量結合商業、管理、經濟學途徑與心理學途徑理論，和少部分的組織學、社會學途徑。這項結果印證了 Silva (2007) 的反省，主流典範形成了一個理論、方法與技術的配套組合。由於科技接受模式是探討個人心理接受的概念，因此有大量理論修正與延伸是結合其他心理學途徑研究的理論，而組織、社會學途徑的相關研究則明顯較少。

這種同型性大量集中少數理論的可能性還包括：首先，我國資訊管理科系自 1980 年初開始設立，1990 年開始有首屆資管年會暨學術研討會，與發展於 80 年、茁壯於 90 年的科技接受模式可以說是同步成長，因此，亟欲與國際研究潮流接軌的國內「科技採納與導入」研究，也大幅引進此模式，形成風潮。此一趨勢反映在本研究結果上，直到廿年後的今天仍極具有影響力；其次，國內資管學域形成之初是因應「新資訊科技的引進」與「應用的需要」，因此，有相當高比例的資訊科技背景的教授加入資訊系所，進行技術導向的研究（梁定澎與陳灯能，2005），這些學術人才以北美為養成腹地的比例甚高，因此，對於科技接受模式模式研究典範也有相當程度的社會化與共識；第三，臺灣以中小企業為主軸的產業環境特色，決策過程不像歐美大企業多採組織決策，而更易由少數領導者意見為主（洪新原、張碩毅、許凱筑與張益誠，2010；Chwelos, Benbasat, and Dexter, 2001）。這樣的在地產業脈絡，也提供了相當的實務環境，讓以個人為主的科技接模式能夠在臺灣發展。

然而，大量集中以心理學為基礎的主流理論建構模式，近年來在國際間也受到許多質疑。例如：Schwarz and Chin (2007) 指出，科技接受模式過去廿年催化了大量科技使用與採納的研究，但是研究的焦點與使用的角度仍太過狹窄。對於科技接受的理解，不應只侷限在接受初期，心理接受應是多面項的，應當包含在特定的社會／環境／組織情境下發展出來，使用者行為與科技在一段時間互動，其心理了解與意願、抗拒與接受之聯結整全的關照 (Holistic View)。

此外，許多學者 (Venkatesh et al., 2007; Lucas, Swanson, and Zmud, 2007) 也指出，未來「科技採納與導入」領域的理論發展，應不侷限於既有科技接受模式的理論基礎，更應進一步拓展組織中的介入 (Interventions)、可能的權變 (Contingencies) 與其他可能更廣的社會心理的理論角度。他們也建議，應發展理論架構來引導此領域未來的研究。同時，應從更廣的資訊科技創新 (Innovating with IT) 領域，來協調過去微觀與宏觀的研究不平衡發展的趨勢，更多地去探究技術的、制度的與歷史的脈絡與情境，讓未來的研究透過資訊科技創新的故事，更豐富與完整地透呈現出來。

近年來，社交網站的快速成長，其非計畫性特質，與發展於沒有友善的界面、電

腦化時代的科技接受模式，對電腦的接受和使用之想法已有實質落差。越來越多的國際「科技採納與導入」文獻越來越注意到與科技互動的環境因素。例如：社會資本 (Stubblefield, Carter, Jones, and Siffre, 2010)，企業策略伙伴 (Kreuzer, Born, and Bernius, 2013)，晚近有學者 (Alter, 2013) 提出以工作系統理論 (Work System Theory) 取代過往的系統觀點，不只注意參與者、資訊科技與其關係，而以更整全觀點也關照到工作實務、產品／服務、客戶等環境因素都對科技接受產生影響，試圖以重新概念化、並深化簡單、線性的傳統科技接受理論。

值得注意的是，在本研究的結果中也發現，國內文獻也出現有類似這種超越傳統科技接受線性模式的新興理論使用之趨勢，逐漸浮現若干反映網路科技創新，導入更多元理論。例如：侯正裕、陳靜枝與陳鴻基 (2010) 引進心理學心流理論、池文海與許立群 (2013) 使用承諾信任理論、鄭光廷、徐士傑與林東清 (2012) 整合價值接受模式與自我效能，嘗試發展出了解分散式網路現象之使用、黏著與知識分享之意圖的新研究模式；而侯勝宗與吳思華 (2009)、侯勝宗與樊學良 (2014) 從科技意會與制度理論來研究網路社群與組織實務。這些新興理論，使用都跨越傳統科技接受模式的框架與理論、方法組合，試圖以這些高度資訊科技創新發展的臺灣本土研究，回饋國際研究社群。

展望未來，我們建議應從更廣的資訊科技創新 (Innovating with IT) 領域，協調「科技接受與採納」學域，過去微觀與宏觀理論不平衡發展的現象，更重視探究技術、制度與歷史的脈絡與情境。Orlikowski and Barley (2001) 呼籲資管研究者應對於組織內部、或在跨組織之間制度的影響力如何對於設計、使用與科技的後果與其所產生影響進行更多的了解。他們認為，有別於傳統管理理論，將管理者視為理性行動者，制度分析檢視較廣的社會與歷史力量，從明顯的法規到不明顯的文化理解如何影響到與組織的行動被影響。這些非理性的影響包括：價值、規範、規則、信念、與被視為理所當然的假設所交織的看不見的網。

Lucas et al. (2007) 也建議，未來研究應更多致力從組織的層面上，協助我們了解資訊科技創新如何會提昇組織能力，並帶來競爭優勢。同時也需要進一步地去研究系統的深層使用的問題，是建立在個人與集體的學習 (Individual and Collective Learning) 與制度性的重建 (Institutional Restructuring)，這些議題都是在系統被初次採納並獲得初步接受之後才開始發生的。

在數位網路經濟、電子商務蓬勃發展的今天，「科技採納與導入」研究不能只限於科技的議題的發展與應用，或只研究在特定地方脈絡下科技的影響，而應更多使用組織理論，發展包括制度理論、全球化、創業與後現代等主題。Orlikowski and Barley (2001) 指出，沒有制度理論的眼光，這些資管研究可能會只定睛在更狹窄的科技設計、經濟規則、或心理影響，而忽略掉電子商務更重要的社會、文化與政治面相。制度性的角度提供資管研究者一個優越的位置，將數位網路經濟加以概念化，理解成由科技、

經濟與文化與結構力量相互型塑，一個不斷浮現、衍生、鑲嵌、斷裂、即興的社會創作。

近年來，國內的研究也有更多元學術養成背景的研究者加入資訊管理學域，新的刺激也為此研究領域注入了新的研究動能，對於平衡過度集中於少數主流理論的趨勢不無貢獻。例如：蕭瑞麟、廖啟旭與陳蕙芬 (2011)、陳信宏 (2011) 從結構互融理論、制度理論探討科技採納，應大中與王存國 (2007) 從組織特性、創新特性來看組織導入成功等都納入了更多科技導入脈絡的理解，是未來值得繼續深化的方向。

此外，由於企業環境變化，更加扁平、分權化、強調團隊合作與區域協調，也有越來越多探討跨國組織（Lin and Hsu, 2010; 蕭瑞麟等，2011）、創新與組織配適、協同合作（洪新原等，2010；陳建志、陳鴻基與曹承礎，2006；孫思源、李奕信、趙珮如與吳章瑤，2007）以及知識與技術轉移的研究（江雪嬌，2009；梁定澎與陳灯能，2005）等資訊科技創新提昇組織能力的新興角度研究出現。這些先驅研究能更深層的個人與集體學習 (Individual and Collective Learning) 與制度性的重建 (Institutional Restructuring)，都是在網路經濟時代，科技在組織內、與跨組織之間採納與導入，值得後續研究繼續發展的議題。

二、研究方法與分析單元

就研究方法的角度來看，研究結果顯示，有高達八成採用實證主義取向的問卷調查法，成為主流研究方法，且有比例逐年升高、越趨集中之勢。至於使用個案研究 (12%) 與其他研究方法 (7%)，例如：混合方法、後設分析法等的論文則比例懸殊。這個結果與 Orlikowski and Baroudi (1991) 對資訊系統研究取向與其預設的研究結果類似。他們在 1983-1988 五年間四種國際重要的資訊管理期刊中，採用問卷調查 (49.1%)、實驗法 (27.1%)、個案研究法 (13.5%) 為最主要的三項研究方法，而混合方法、田野實驗法、調查工具發展、標準程序分析、行動研究等其他方法則佔少數。而 Chau, Kuan and Liang (2007) 對於國際重要資管會議論文對於資訊科技價值 (IT Value) 的分析結果，雖也是以問卷調查的比例最高 (39%)，但其研究方法的選擇也遠較國內的研究多元（個案與質性研究 24%、概念描述 20%、次級資料 5%、問題解決與模型 7%、實驗法 5%）。

相較於本研究分析國內近十五年的研究結果，即使 Orlikowski and Baroudi (1991) 研究 80 年代末文獻、Chau et al. (2007) 研究 1993-2005 的文獻，都遠比國內期刊論文採用的研究方法，具有更多樣性與豐富的研究設計。比較結果顯示國內學者在採用的研究取向上，嚴重欠缺多元性，使得此領域知識的創造受到相當的侷限性。這樣的情況顯然與有相當高比例的研究都以科技接受模式為理論架構有關。誠如前述，因為科技接受模式研究典範，提供了理論架構、研究工具、研究方法與研究技術的套裝組合，對於將「科技採納與導入」領域常態化，具有一定程度的影響力。

而在選擇分析單元方面，國內有近七成的研究，主要是以「個人」為分析單元，

「組織」的研究則不到三成，「產業」的研究則寥寥無幾。在 2000-2005 以「組織」為分析單元的研究雖曾超越「個人」的研究，在 2005 年之後卻產生了一個逆轉，「組織」研究大幅下降，而以「個人」為分析單元的研究蔚為主流。

從分析單元來看，這項結果顯國內對分析單元的選擇趨勢，與國外的研究有很大的差異性。相較於 Chau et al. (2007) 研究資訊科技價值的結果顯示，在亞太資管會議 (PACIS) 有近七成的研究、歐洲資管會議 (ECIS) 則有約九成的研究都是組織層級；而國內「科技採納與導入」研究則有近七成屬於個人層次的研究。Chau et al. (2007) 的研究顯示，亞太地區 PACIS (24%) 而在個人層次的研究，遠多於歐洲地區的研究 ECIS (8%)，這項結果似乎與我們的研究結果吻合。顯示國內相關研究分析單元的使用，與亞太地區較多傾向以個人層次為主的趨勢較一致，而與歐洲地區研究大量處理組織層次議題有明顯的差異。但即使如此，國內研究仍高度集中在實證取向的問卷調查法，使用個人層次的分析單元。

2000 年後，網際網路普及與新興企業資訊應用的開發，電子商務與行動商務的研究日益增多，新興資訊科技的引進與組織應的需求，原本應當可刺激研究議題更多元發展，注入更多創新研究之動力。何以國內研究卻反而呈現較之前更高度出集中在單一取向研究方法與個人層次分析單元的趨勢？這仍與「科技接受模式」對於國內研究的方法與研究設計的選擇的影響與引導有關。由於科技接受模式的常態科學典範幾乎可以適用於任何類型的新科技使用與接受的情境，在 2005-2015 這十年間，雖然新興網路科技、社群網站、行動商務等各種應用飛快發展，並未因為科技發展刺激更多元的理論解釋，採用科技接受模式為主要理論的研究較先前不降反升，反而集中化、同型性的情況更加明顯。

針對這樣「同型性」－理論、研究方法與分析單元配套組合發展的問題，梁定澎與陳灯能 (2005) 在比較 1980-2001 年國內外資管研究主題的文獻探討中，就已提出反省。他們指出，自 1999 年研究主題多樣性開始下降，可能代表資管學域已經成為一個獨立且成熟的學域，對於研究主題的選擇具有專注性；或是主流研究者掌握主要期刊論文刊登，造成對特定題目共同偏好；抑或是學域本身已經成熟老化，亟需外在環境變動的新刺激。

無論是成熟或是老化，多少都與此學域的學術研究者的養成方式與衡量學術貢獻的標準等制度性環境有密不可分的關係。目前國內「科技採納與導入」領域研究的衡量標準，是否提供了更多引導朝向「同型性」配套組合，而非朝向多元性發展的誘因，值得未來研究更進一步探討。例如：找尋因果關係的實證性客觀測量、與探索深層意義的詮釋性、批判性研究；個人、組織、產業、與跨國層次的研究等，採取不同的研究方法、分析單元的研究，所需耗費的時間、資源、寫作方式各有不同。推進常態科學進步、主流典範轉移的力量，往往學域中的異例 (Popper, 1972)，若將這些差異化的

研究取向，長期以平頭點方式等量齊觀，是否有可能引導資源有限的新進研究者，消極地朝向主流認同、安全性較高的專題研究與發表方向，反而扼殺了多元理論創新與鼓勵嘗試拓展知識領域的可能性？

　　一個研究學域的成熟與否，所取決的標準，應是對於不同類型的研究方法的接納與認可，而非相似、同質性主題的飽合。資深資管學者 Lee and Liebenau (1997) 指出，大多數成熟的社會科學都包括質性研究與量化研究兩者兼容並蓄，不同的規則也被廣泛接納。但是，在企業管理與資訊管理研究，經常專門仰賴企業經濟中計量方法，或是電腦或資訊軟體工程的規範方法，更難達到這樣的平衡。

　　Markus (1997) 也指出，正統的資管領域其實是由好幾塊互不聯絡的研究分枝所組成的，包括：(1) 以經濟方法宏觀檢見資訊科技的使用、管理與影響；(2) 以工程技術角度進行資訊科技的設計與開發；(3) 以社會科學方法（包括質化與量化）探討微觀層面資訊科技使用與發展的問題。這些分枝分裂的原因，主要源自於方法論上的差異。其分裂是從方研究方法、觀點到研究本質上的差異所產生的。她說，學術上的分裂會帶來明顯的負面影響，不僅威脅到整個學術領域，還會限制了研究創新與成長。因為技術與想法上的對立，不論是自己或別人，都沒辦法從研究中了解科技特質與人類行為之間的互動與轉變，因此，也限制了自我研究的潛能。邁向成熟的學域，理所當然要集合這三股研究分枝的力量，互相尊重並對話，共同攜手來突破現況。

　　而在國內研究方面早期也是由資訊科技背景研究者與企業經營研究者，為解決實務上「新資訊科技的引進」與「應用的需求」應運而生，為資訊管理領域打下了重要的知識基礎。因此，早期 (1980-1991) 研究重要主要放在系統相關議題，行為與管理議題則在晚近 (1992-2001) 有逐漸上升的趨勢（梁定澎與陳灯能，2005）。2008 年有「組織與管理」期刊發行，也鼓勵更多組織層次的研究，在「科技採納與導入」領域投入與發表，例如：陳信宏 (2010) 即探討公司採購活動改變，如何造成科技與組織間調準失靈。

　　雖然國內資管領域已有逐漸有不同分枝領域成形，朝多元且互補方向在發展，但是，就本研究結果，仍顯示在研究方法的選擇上，過度倚重少數方法，缺乏多樣性。並沒有因為近年有多樣類型的新興網絡科技應用，或是隨時間發展，使得研究方法與分析單元的多樣性增加。在過去十五年間，僅有零星的幾篇非問卷與個案方法的研究，例如：何雍慶與蔡仲宜 (2003) 使用後設分析法研究不同的彈性擴有模型、侯勝宗與樊學良 (2014)、張碩毅、洪育忠、洪為璽、張益誠與彭添誠 (2009) 採用問卷、個案混合式方法 (Mixed Method) 研究科技使用之社群效果與企業採用行動商務的生命週期。

　　科技接受模式在初始的相關研究主要聚焦於個人層次，對於資訊科技的採用與接受。Lucas et al. (2007) 指出，這一系列早期以個人採用為主的研究潮流帶來了若干的缺點，缺乏充分地考慮到更豐富的科技面、制度面與歷史面的脈絡：首先，由著眼於

資訊科技導入成功的因素，因此欠缺建立一個統整性的理論架構考量到各種不同的因素；其次，未能從過程研究汲取一些洞見來增加我們對資訊科技採用的理解；第三，這些研究在不同的組織脈絡談「個人」對資訊系統的接受與採用，卻沒有去探索「組織」本身對於科技使用或抗拒的情形；第四，這些研究也忽略所有創新的脈絡，而這些脈絡正是新科技如何被導入到特定組織所需要考量的重要情境。

Lucas et al. (2007) 我們必須承認在導入之前在組織中的制度性影響力，如何在科技採用之前或同時，賦予科技功能並協助其落實。科技接受模式雖然已有一定的研究成果累積，但是將「個人」層次的研究過度天真地套用在「團體」或「組織」層次的研究上，必須要考慮到導入所帶來的組織調適與轉型的問題。此外，科技傳散 (Diffusion) 的概念，也需要考量到在企業內個人之間或是團體之間的傳散、或是在產業層次上企業與企業之間的傳散，這些傳散內在的溝通方式、決策與行動的機制都必然有極大的差異性。因此，在「科技採納與導入」的理論建構上，應需要針對這些不同層次的研究重新加以定義並作區分。

上述的提醒也同樣適用於國內相關研究未來發展。我們應當更注意微觀個人層次與宏觀組織、產業層次研究不均衡發展的問題，在科技接受模式的基礎上向前邁進。超越個人主觀覺察 (Individual Perceptions) 的層次，納入更多重要的、且有意義的組織層次理論與科技、制度與歷史的脈絡。例如，Teo, Wei, and Benbasat (2003) 應用制度理論檢視新加坡的金融電子資訊交換的採納過程 (Financial Electronic Data Interchange; FEDI)。他們發現制度性壓力對於組織採納 FEDI 的意圖有明顯的影響。而 Hsu, Lin, and Wang (2015) 也從產業層次分析臺灣與歐洲間之跨組織金融系統的採納過程，他們的研究顯示跨境科技採納所出現的制度性距離的問題，以及組織如何調度正當化行動來回應這個問題。

未來的「科技採納與導入」領域的研究者應力圖超越科技接受模式典範所設定的研究方法，採取更多角度的研究設計，將組織脈絡與科技採納與導入間的關係更豐富、立體面的呈現，而非單純的線性關係。由於網路科技快速發展，跨組織、去邊界等全球化標準與在地實務衍生各種複雜性議題，近年來，為平衡研究方法注意嚴謹性，出現與實務界脫節，缺乏相關性的問題，與實務高度配合的實務觀照的研究方法 (Practical Research)，例如：行動研究 (Action Research)、行動設計科學 (Action design Science)、實踐取向 (Practice-based Approach) 等更受到國際研究社群的重視。在未來國內的研究中更多元的方法論與研究設計（例如：實驗法、多重混合方法、民族學誌研究、行動研究、紮根理論）與認識論途徑（例如：詮釋取向研究、批判取向研究）應更多受到鼓勵與支持。質性研究途徑可以協助探索在新興網路科技日新月益的發展，較傳統採納的決定性因素要更具動態性的採納因素。

三、研究主題

從研究主題來看，在 2000 年迄今的十五年間，網路電子商務 (59%) 是持續出現最高比例的主題，行動商務主題則是近十年內竄起的新興議題，在國內期刊論文的重要性逐漸升高，而傳統管理資訊系統的研究隨著新興科技的發展，與多數企業都有相關的系統導入，近年來有逐漸減少之勢。而這個趨勢與科技創新在企業內部應用的階段時程是相類似的：從 60-70 年著眼於基礎科技創新階段：例如：資料庫管理系統、主從架構運算；到 80-90 年系統發展創新：例如，開放性資源管理、企業資訊入口網站 (Enterprise Information Portal; EIP)、以及資訊管理、系統設計等技術流程創新等；到 2000 年以後強調服務創新：例如網路下單服務、供應鏈管理、客戶追蹤服務、組織間資訊系統整合、行動設備技術整合等。由於本研究期間是在 2000 年之後，與資訊系統發展進程相吻合，因此以網路電子商務、與發展中的行動商務等相關服務創新主題蓬勃發展。這項研究結果也與梁定澎與陳灯能 (2005) 的文獻探討的主題分析是一致的，他們將 1999 年後的資管發展階段稱以電子商務帶動的應用期。

而就國際期刊的研究主題趨勢來看，Lucas et al. (2007) 指出，從 70 年代起主要在處理企業導入資訊科技創新何以會失敗的議題、研究主題從導入企業整體的套裝解決方案，例如：ERP、SCM 與 CRM 系統導入增加成本與其更廣的影響；研究主題逐漸轉向在高度競爭市場中如何導入科技系統作為發展、調度、調適的競爭策略與方法；近年來，正如 Orlikowski and Barley (2001) 所倡議的，有越來越多與制度理論、全球化與創新、後現代複雜性的議題出現，例如：如何使用資訊科技協助企業轉型與永續發展的議題、組織間如何促成多重組織的價值網路的形成、社群科技平台等新興議題，都為既有的「科技採納與導入」研究帶來了更多不同層次的複雜性、豐富性與多樣性。

另外，今日有關「科技採納與導入」研究，最主要的關切是在協助讓企業鉅額的資訊科技投資，可以完全發揮作用。未來研究發展，應吸收一些研究者從歷史角度，來協助理論向前發展 (Lucas et al., 2007)。特別是針對資訊科技創新在企業版圖中所呈現的多元面貌（例如：雲端商務、物聯網、數位金融、智慧城市、網路資安與其後設知識系統之與風險治理架構等）進行回顧。從回顧這些創新，則可以協助理論化這些創新現象，讓我們更進一步了解此一研究學域的推進。

臺灣近年來電子商務、行動商務主題雖快速發展，但是與採用的研究方法進行交叉分析時，卻發現這些新興議題約九成以上幾乎一致採取量化問卷調查方法一元化的發展，在研究方法的選擇上，反而沒有傳統 MIS 議題研究取的多元。這個結果固然可能是因為問卷調查法處理新興議題，在資料蒐集的時效上，較其他方式有優勢，因此發表比例較高。但是，這結果卻也正呈現國內「科技採納與導入」研究方向的警訊。也就是說，當國際相關研究趨勢都已經從過去傳統科技接受角度，致力於轉向的科技採納後的行為，開始思索更具複雜性、平台整合、區域整合等不同層次議題時，國內

的研究較少採取統整性的觀照 (Holistic View) 的視野。例如：Schwarz and Chin (2007) 便指出，我們應當走出科技接受模式對於我們對科技接受概念認知的侷限，因為科技接受概念並不只是出現在採納的初期，而是在科技被使用的整個生命週期。其他形式的接受，例如：學習、調適、優化科技、採納的信任也會預先佔優勢地位，都超越了單純的科技使用。

　　因此，本研究建議未來研究主題應更考慮到新興科技的社交性 (Sociability)、互連性 (Interconnectedness)、信任 (Trust) 等角度，對針對採納後的行為更多探索，同時也應透過更多元的研究取向，例如：實驗法、次級資料分析。資訊科技導入企業組織已經有近三十年時間，而科技人造物從過去的抗拒與接受，也已經逐漸轉變成為賦能與隱身。建議未來應吸收研究者從歷史角度，反思科技與社會間在時間推進中相互型塑、與相互交織互動的（Techno-social 或 Sociomaterial Developments）過程，來協助國內「科技採納與導入」理論向前推展，與在地脈絡的意義與詮釋。突破過去從化約主題把系統、人、管理都是視為獨立研究客體的觀點，更多著眼於其互連性、鑲嵌與科技作為注意力背景的隱身性現象，與其可能帶來的非預期後果。這些不一樣的主題都可以協助理論化科技創新的現象，提昇國內較少人、組織相關之應用研究上（Lucas et al., 2007; 梁定澎與陳灯能，2005），並更進一步促使此學域的推進。

表 3 國際與國內「科技採納與導入」研究不同面相發展之比較

主題分類	相關議題			
	理論	研究方法	分析單元	主題
國際研究趨勢	以由心理學為基礎的主流「科技接受模式」，往不同的理論基礎發展如資訊科技創新、社會資本、企業策略伙伴、工作系統理論。越來越多全球化與創新、後現代複雜性的議題出現，例如：資訊科技協助企業轉型與永續發展、組織間形成多重組織的價值網路、社群科技平台等新興議題	問卷調查法、個案研究、次級資料分析、數學模式、實驗法、混合方法等較多元	從個人層級研究轉向組織層級研究，產業層級研究為新興趨勢	越來越多制度理論、全球化與創新、後現代複雜性的議題出現，例如：資訊科技協助企業轉型與永續發展、組織間形成多重組織的價值網路、社群科技平台等新興議題
國內研究趨勢	仍以「科技接受模式」主流理論，網路科技創新理論逐漸浮現，例如：心流理論、網路社群理論、制度理論、科技意會理論等	問卷調查法為主，少數個案研究	個人層級為主，少數是組織層級	網路電子商務主流、行動商務為新興主題

陸、結論

本研究回顧了自 2000-2015 年國內「資訊科技採納與導入」主題的重要文獻，並根據其理論、研究方法、分析單元與研究主題進行分析，再與國際相關研究的趨勢加以比對。研究結果發現，國內研究受到自 80 年代發展的科技接受模式主流研究典範的影響與限制，以個人層次的問卷調查研究佔極大多數，欠缺多樣性。對於當前新興的網路科技發展的社會脈絡，與過去資訊系統與基礎建設發展之差異性，缺乏有意義的連結與反思。

科技接受模式在當年所關切的問題（例如：員工不願使用生產工具）是否今日還需要解決？是否讓使用者廣泛接受創新科技仍然是一個具有挑戰性的問題？在組織與家庭都已有大量制度性地使用資訊科技的今日，這應是個不易回答的問題。我們今日所要面對的真正問題與挑戰是什麼？是在採納後才發生的問題嗎？是如何將資訊轉化成知識嗎？還是生產力、策略優勢與資訊科技使用之間的關係？我們今天的問題是，若不停頓片刻，反思主流典範與其理論、研究方法、統計配套組合對於現今研究取向的的影響，以更嚴肅的態度去擁抱科技人造物 (Technological Artifacts) 的複雜性與其所處脈絡中多元的情境因素，主流知識典範的影響是否可能變成我們面臨的一個危機？

在探討了國際「資訊科技採納與導入」主題研究近年之發展趨勢後，本研究對於國內未來相關研究方向也提供建議方向：

- 在理論方面，建議應從更廣的資訊科技創新 (Innovating with IT) 領域，協調過去微觀與宏觀理論不平衡發展的現象。創新與創新轉型為資訊管理領域提供了一個非常強有力的理論視角。這個創新視角提供我們所需要的歷史角度，同時可以提供一個理論性架構來了解新科技發展與其不斷更新科技應用。

- 此外，在數位網路經濟、電子商務蓬勃發展的今天，組織理論與制度理論在了解「資訊科技採納與導入」主題上，應受到一定程度的正視。這些理論視角有助於協助我們了解組織內部、或在跨組織之間制度的影響力如何對於設計、使用與科技的後果產生的風險等問題。對於臺灣科技產業在全球供應鏈與網路競合的整體關係，提供更具有全球化、創業與在後現代脈絡下進行永續發展的理論與策略分析。這些主題都有助於深化我們對國內產業科技創新之採納與傳散，現有的科技的、制度性的與歷史的脈絡因素的理解。

- 在研究方法方面，建議應致力於國內資訊管理領域中從經濟、技術與社會科學等不同知識論與方法論取向發展的三股研究分枝更多的對話，與有效整合既有的知識生產，產生綜效。以對話與合作來共同來突破目前研究方法與分析單元「同型性」的現況。

- 同時也建議檢視現有齊頭式的期刊發表與學術貢獻的評量標準，是否能鼓勵更多發展多樣化的相關性的研究，務實地處理當前跨組織、去邊界等全球化

標準與在地實務衍生各種複雜性議題。未來國內的研究中更多元的方法論與研究設計，例如：行動研究、行動設計科學、實驗法、多重混合方法、民族學誌研究、紮根理論、次級資料分析等研究設計，行動研究。而不同的認識論途徑（例如：詮釋取向研究、批判取向研究）應更多受到鼓勵與支持，將可協助此學域的發展邁向成熟。

- 在分析單元方面，本研究也建議未來相關研究應當更注意微觀個人 (Individual Perceptions) 層次研究與宏觀組織、產業層次研究不均衡發展的問題，納入更多組織層次理論、與產業層次之科技、制度與歷史的脈絡，回應網路社會所衍生之新興科技與人、組織與社會之多樣化議題。

- 在研究主題方面，未來應更考慮到新興科技的社交性 (Sociability)、互連性 (Interconnectedness)、信任 (Trust) 等角度，建議未來應吸收研究者從歷史角度，反思科技與社會間在時間推進中相互型塑、與相互交織互動的 (Techno-social or Sociomaterial Developments) 過程，更多著眼於其互連性、鑲嵌與科技作為注意力背景的隱身性現象，與其可能帶來的非預期後果。而在網路連結基礎建制下，二階、後設的知識與風險治理系統如何成為可能，都是可能的新興主題。

整體而言，本研究回應 Orlikowski and Barley (2001), Lucas et al. (2007) 的呼籲，建議「資訊科技採納與導入」主題應要將科技的、制度的與歷史的情境更加考量進來。在這個領域發展近卅年後，我們需要有更多從歷史脈絡的角度，以更豐富與完整的視野讓我們反思這卅年來的科技創新故事。在組織層次上，我們應要尋求能夠幫助我們了解科技創新如何能帶領我們對於組織能力並提供競爭優勢且能永續發展。

本研究主要的貢獻包括三方面，首先，透過回顧對於國內的 2000-2015 年的研究趨勢，了解「資訊科技採納與導入」主題研究的現況。並與先前國內相關文獻探討研究結果比對，協助相關領域的學術研究者理解「科技接受模式」的影響性、與目前國內研究「同型性」形成之情況與發展軌跡；其次，透過比較國外此主題研究發表之落差，我們找到發現臺灣中小企業的產業環境、研究者養成教育與背景與學術貢獻評量之制度性原因，可能強化國內外相關研究趨勢之落差，提供相關我國後續知識生產的評估與方向作為參考；最後，我們也指出國內研究與主流接軌之具體建議，期望協助此研究主題的研究在理論、方法、主題創新上都更能兼顧嚴謹性與相關性，回應企業經營實務上的需求。

A Literature Review of the Information Technology Adoption, Implementation, and Related Themes in Information Systems Research in Taiwan (2000-2015)

Shirley Ou Yang, Assistant Professor, Journalism and Mass Communication Program, International College, Ming Chuan University

Carol Hsu, Professor, Department of Management Science and Engineering, Tongji University

1. Introduction

Information Technology (IT) adoption and implementation has been a significant research theme in the past two decades in the field of information systems (IS) research. However, recent studies have called for research agendas going beyond the dominant technology acceptance model (TAM), which is centered on causal agents such as perceived ease of use and perceived usefulness. This influential theoretical model has been extensively applied, modified and discussed in terms of its antecedents, contingency variables and constructs refinements. The TAM approach and its extended model, while valuable, have arguably constrained the possibilities of different research designs and methods in examining a variety of IT adoption and implementation issues. In recent years, emerging technological applications, such as big data, social media, cloud computing and mobile technologies, have offered innovative opportunities for enabling new forms of organizational change and user experiences. Furthermore, the adoption and use of these new technologies might also be disruptive, creating new challenges for existing organizational practices. Therefore, the combination of these developments provides scholarly opportunities for discussing the theoretical implications of technology acceptance research and for identifying the venues where new theoretical underpinnings might be required if we are to strengthen our understanding of the adoption and use of information systems.

In light of the above research developments, in this paper we present our attempt to review the relevant IT adoption and implementation research papers published in Taiwan and to offer an insightful analysis on research trends over the past decade. In particular, we review the IT adoption and implementation literature published between 2000 and 2015 in Taiwan. Our two research questions follow:

1. What are the major theoretical perspectives and methodological approaches in IT adoption and implementation research developed over the past 15 years?
2. Do these developments parallel those observed in academic papers published in other international IS journal outlets?

2. Method

In this research, we employed three steps for our data collection and analysis. First, we selected journals highly relevant to IS adoption and implementation, based on the social science journal rating report published by the Ministry of Science and Technology (Chen et al., 2004). The selected journals are the Journal of Information Management, Journal of Management, Journal of e-Business, Sun Yat-Sen Management Review, NTU Management Review, Management Review and Organization and Management. Second, we used keyword searches to find relevant articles in the CEPS Chinese digital journal database. Such phrases were "technology acceptance", "innovation diffusion", "technology adoption" and "technology implementation" used. This exercise resulted in the selection of 82 articles publish between the years 2000-2015.

Third, we used Laudan (1984) reticulated model of science to analyze each paper. This model uses categories of theories, methods, and topics (goals, ends and values). Our classification of research methods was drawn from the work of Galliers (1992) on IS research methods: laboratory experiment, field experiments, surveys, case studies, theorem proofs, subjective/argumentative case studies, forecasting and future research, simulation and action research. For the classification of the research theme, we adopted a grounded approach and developed a classification system from each paper's research focus.

3. Findings

Our research findings show that similar to the research trend in international journals, TAM has been the dominant theoretical perspective for IT adoption and implementation research in Taiwan over the past 15 years. Among these 82 articles, over 60% of the research papers applied either TAM or Diffusion of Innovation (DOI) as the underlying theoretical model. We argue that the over-reliance on TAM or DOI ignores contextual diversity and limits research choices, other potential theories and research methods. Scholars from other parts of the world have shown the merits of different theoretical perspectives and alternative research methods, which have added to our theoretical knowledge of IT adoption and implementation. For instance, there is a need to focus on a deeper interpretation on the intertwined relationship between technology and organization structure in the IT-enabled change process , in particular the importance of contextual elements.

The dominance of TAM further indicates the popularity of the individual as the unit of analysis. It also shows an overreliance on surveys as the research method. We thus offer suggestions for future research on IT adoption and implementation in Taiwan. To capture a rich appreciation of the process of industry and organizational transformation, single-dimension analysis might fail to grasp the rich insight into how industry structure and organization actions impact, and are impacted by, the design and diffusion of particular IT artefacts in an organizational field. We suggest that other research methods, such as the use of use interpretive case studies or mixed research methods, add to our understanding on the process of production and reproduction of social practices in a specific industrial setting.

With respect to research topics, the majority of the research on technology adoption and implementation is related to electronic commerce. Given new technological developments, innovative topics such as mobile phones, social media, wearable devices, IoT and digital agents are used in many new businesses and personal contexts. We suggest that new theoretical underpinnings and methodological approaches are needed should we understand the adoption and use of these new forms of digital technologies.

4. Research Implications

4.1 Theoretical Implications

From a theoretical perspective, we suggest that IT adoption and implementation research in Taiwan broaden its scope and move beyond TAM and an individual-level analysis. For example, IT innovation and innovation-induced transformations provide powerful lenses with which to view the IS field. These innovative, related perspectives give a needed historical angle and robust theoretical framework with which to understand the constant change of technology innovation and development.

In terms of methodological implications, we suggest IT adoption and implementation research in Taiwan diversify its research approaches, engaging different research disciplines, such as economics, technology and social sciences. An increased dialogue focused on the findings of these research streams can create an effective synergy of bridging meaningful organizational-level theory. It could also change the past isomorphic development of research methods and units of analysis.

4.2 Managerial Implications

For managerial implications, we argue that IT adoption and implementation is not only a technological issue, but also an organizational capability that allows for competitive advantages and sustainability. Therefore, studies that more deeply consider technological, institutional and historical contexts can help managers understand the organizational change process that results from IT adoption and implementation. For instance, case studies on organizational learning with regard to innovation and restructuring can shed light on the continuance or discontinuance of IT use. This level of understanding can further enhance managerial decision-making capabilities on deploying, adapting to and implementing new forms of digital technology in today's hyper-competitive markets.

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作者簡介

* 歐陽瑜

　　銘傳大學國際學院新聞與大眾傳播學程助理教授，國立臺灣大學資訊管理研究所博士。研究興趣為風險知識管理、永續智慧城市治理、數位網路與傳播。論文曾刊登於 Journal of Electronic Commerce Research、Pacific Asia Journal of the Association for Information Systems、政治與社會哲學評論與臺灣風險公共性考察一書。

許瑋元

　　同濟大學管理科學與工程系教授，英國倫敦政治經濟學院博士。論文曾刊登於 MIS Quarterly、Information Systems Research、European Journal of Information Systems、Journal of Information Technology。現任 Journal of Information Technology Theory and Application 的共同主編。

臺大管理論叢
NTU MANAGEMENT REVIEW

Call for Papers

2018 Management Theory and Practice Conference

Managing the New Realities in Asia

April 1-2, 2018
Chengdu, China
Hosted by
College of Management, National Taiwan University (NTU)
School of Business Administration & Institute of Chinese Financial Studies,
Southwestern University of Finance and Economics (SWUFE)

Background

To promote interactions among management scholars in the Asia-Pacific region and around the world, *NTU Management Review*, published by the College of Management of National Taiwan University, invites you to attend the 2018 Management Theory and Practice Conference, which will be held at Southwestern University of Finance and Economics. The conference aims to provide an academic forum for the exchange of management-related research ideas and to provide suggestions for future researches in the Asia-Pacific region. Scholars and practitioners from throughout the world are welcomed to attend.

Scope and Topics

With the rise of the Asia- Pacific market in the global economy throughout the past decades, along with the emergence of multinationals in the Asia- Pacific, the main objective of the 2018 Management Theory and Practice Conference will focus on management-related issues from an Asia- Pacific perspective, aiming to facilitate discussions of concepts and practices in various fields of management such as accounting, finance, organizational behavior, human resources management, marketing, information management, e-commerce, productions and operations management, and corporate strategy. We welcome research papers that can bring visions and insights into management theories and practices, and we also encourage qualitative studies that depict and interpret up-to-date management practices.

We invite the authors of the original research papers aligned with our conference theme—"Managing the New Realities in Asia". Theoretical, empirical, and qualitative studies are all welcomed. Major topics of interest include, but are not limited to the following:

- Financial reporting practices and quality in the Asia Pacific region
- Management accounting and controls of companies in the Asia Pacific region
- Auditing practices and quality in the Asia Pacific region
- The evolution of the accounting information environment in the Asia Pacific region
- Investment in the Asia Pacific region
- Corporate finance in the Asia Pacific region
- Corporate governance in the Asia Pacific region
- New service and brand marketing trends in the Asia-Pacific region
- B2B marketing in the Asia Pacific region
- New concepts and theories of organizational behavior/human resources management for the Asia Pacific region
- Managing risks of value networks
- Design innovation and information systems
- Strategy and innovation from an Asia Pacific perspective
- Creating and capturing value through strategy and innovation
- Small and medium enterprise (SME) management

All submissions should follow the style of *NTU Management Review* (see below), and are subject to the double blind review process. Papers that are accepted for presentation at the conference are strongly encouraged to submit to *NTU Management Review*, which will be followed by a fast track review process.

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The one-and-a-half day conference is featured by:

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- Concurrent sessions of paper presentations
- Poster sessions
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Date: April 1 & April 2, 2018
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E-mail: ntupmcenter@ntu.edu.tw

Venue:

- Opening ceremony & closing ceremony at Hong Yuan Building (弘遠樓), Southwestern University of Finance and Economics, Chengdu, China
- Paper presentation at Jingshi Building (area B) (經世樓 B 區), Southwestern University of Finance and Economics, Chengdu, China

Important Dates

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1. All submissions should conform to the editorial guidelines and format of *NTU Management Review* (http://review.management.ntu.edu.tw/page.aspx?pid=24&lang=en). The paper review process follows the criteria of *NTU Management Review* which include significance of the topic, relevant literature, research questions, purpose, methodology and quality of analysis or coherence of argument. For further information, please visit our website at http://mtpc2018.conf.tw.

2. Manuscripts should be typed in 12-point Times New Roman and double-spaced throughout (including abstract, text, references, appendices, tables, and figures). As reviewers often prefer to write notes on the manuscript, authors should use one inch (2.54 centimeters) margins. All pages, including tables, appendices, and references should be serially numbered at the end of the article. Manuscript length should be limited to 50 pages including references, appendices, tables, and figures.

3. Each participant is responsible for the full cost of his/her attendance to the Conference, including air tickets, hotel, and registration.
4. All accepted papers are required to be presented at the Conference.

Registration Fee

Registration fee is US$250 (no other currency will be accepted), covering the following events and materials: opening ceremony, keynote speech, concurrent sessions, lunch, coffee break, welcome banquet, and conference tour.

1. Please register for the conference using the online registration website. Regular registration will be closed on **December 25, 2017**.
2. Registration confirmation will be sent to the e-mail address you provided on the registration form.
3. Each attendee must register according to the event he/she desires to attend. If the attendee plans to only participate in the banquet dinner, the cost would be US$50 per person.
4. Method of Payment: Credit card. We only accept Visa and MasterCard.

Questions and Contacts

If you have any questions, please do not hesitate to contact us.
Ms. Anita Cheng at NTU Management Review
Tel: +886-2-3366-1026
Fax: +886-2-2363-5658
E-mail: ntupmcenter@ntu.edu.tw
Website: http://mtpc2018.conf.tw

臺大管理論叢
NTU MANAGEMENT REVIEW

Special Issue
Call for Papers

新南向政策：實務挑戰與理論意涵
New Southbound Policy: Challenges & New Implications

【專題內容】

　　台灣本地市場規模有限，加上人口老化、少子化等趨勢，本土性經濟動能趨緩，然而企業必須追求永續成長，國際市場遂成為台灣企業成長動力來源。

　　東協市場與台灣毗鄰而居，經濟成長近年表現亮眼，更擁有巨大人口紅利，商業機會潛力無窮。針對東協市場，早在 90 年代台灣政府即有計畫的推動南向政策。從李登輝政府時期執行的「加強對東南亞地區經貿工作綱領」開始，乃至於陳水扁政府時期，一系列強化與東協國家政、經關係的計畫，皆以南向政策概稱。

　　2016 年台灣政府有鑑於中國大陸經濟成長趨緩，加上東協、印度、紐澳各國展現雄厚經濟發展實力，於是將新南向政策列為施政重點，希望以南向市場為腹地，尋找台灣經濟新動能。新南向政策國家可分為三個不同的區域，分別為東協十國（新加坡、越南、印尼、菲律賓、馬來西亞、泰國、柬埔寨、汶萊、緬甸、寮國），南亞六國（印度、斯里蘭卡、孟加拉、尼泊爾、不丹、巴基斯坦），以及紐西蘭及澳大利亞等兩個先進國家。

　　儘管南向政策目標市場具有高度發展潛力，然而在地各國文化、語言、法治環境、經濟情勢、以及市場特性呈現高多元且複雜，台灣企業在此經營面臨高度風險與不確定因素。舉例來說，作為外來國家企業，台商要融入當地市場需要通路，然而東協、南亞國家市場特性多元複雜，迴異於台灣市場，對台灣企業經營通路的巨大風險與負擔，此外市場通路多由當地集團企業壟斷，形成外來產品進軍東協市場的巨大障礙。

　　有鑑於此，臺大管理論叢將以「新南向政策：實務挑戰與理論意涵」為主軸，邀請相關領域的專家、學者進行質化或量化研究，提出我國業者在南進所可能遭遇之成本與挑戰，並以國企、策略、行銷、管理等相關理論為基礎進行分析，期能提出創新性、適地性經營模式以及相關因應策略，為政府及相關利益相關者 (Stakeholders) 提供建言。相關議題包括（但不限於此）：

- 南向市場進入模式與布局策略
- 南向市場通路特性與行銷策略
- 南向市場商業網絡特性
- 南向市場政策與改革趨勢
- 南向市場文化與組織內部管理議題
- 南向市場企業型態與治理模式
- 南向市場消費特性與營運模式創新
- 南向市場組織規劃與人力資源管理
- 南向市場電子商務

【專題主編】

連勇智　國立臺灣大學國際企業學系
劉佳玲　國立臺灣大學工商管理學系學系
簡睿哲　國立政治大學國際經營與貿易學系
許嘉文　國立中正大學企業管理學系

【徵稿簡約】

- 投稿文章請依本刊稿約之規定，評審程序亦依本刊審查之原則辦理。
- 投稿文長不限，但接受之出版文長則以 15,000 字為限，文稿請用 MS Word 處理，稿件格式請參考「臺大管理論叢稿約之格式說明」(http://review.management.ntu.edu.tw)。
- 來稿請至 http://review.management.ntu.edu.tw/ 線上投稿，投稿主題選擇「新南向政策：實務挑戰與理論意涵」。

【重要時程】

- 截稿時間：2018 年 3 月 2 日
- 初審決定：2018 年 6 月 1 日
- 研討會舉辦：2018 年 9 月 7 日
- 最後修改期限：2018 年 10 月
- 結果公布：2018 年 12 月

財團法人宋作楠先生紀念教育基金會
一〇七年度碩士論文獎主題範圍預告

【宗旨】

財團法人宋作楠先生紀念教育基金會為推動及鼓勵國內會計、審計、財務、稅務、資訊、及相關知識的研究發展，自民國 85 年起設立「碩士論文獎」，甄選活動迄今已超過 20 年，歷年累積獲獎之論文及佳作多達 129 篇。

在邁向新世紀之際，財團法人宋作楠先生紀念教育基金會希望透過此一獎項，鼓勵前瞻引導性之學術研究，基金會也期望藉由獲獎之優質論文及佳作，帶動相關領域之研究，引領未來國內會計、審計、財務、稅務、資訊、管理及相關知識的研究發展。

【申請資格】

國內碩士班 107 年度應屆畢業生（包括 EMBA），並經指導教授推薦者。
（投稿者可同時參加其他徵稿活動）

【論文主題範圍】

1. 會計審計及稅務相關議題
2. 會計師責任之相關議題
3. 臺灣會計師業面臨之挑戰
4. 資本市場結構與規範之相關議題
5. 企業併購相關議題
6. 金控公司或集團企業之相關議題
7. 企業風險管理
8. 臺灣企業競爭力相關之議題
9. 臺灣企業發展之最佳實務與典範研究
10. 公司治理及企業社會責任之相關議題
11. 企業倫理及道德規範
12. 民間非營利組織相關議題
13. 其他與會計及管理相關議題

臺大管理論叢　稿約

一、臺大管理論叢（以下簡稱本刊）之宗旨在出版組織與管理相關之概念性或實證性、並未曾於其他學術期刊刊登過的中、英文學術論文，或對於特定文章、書籍或學術領域重要議題之評述論文。

二、來稿經接受於本刊發表後，版權歸本刊所有，唯文責需由作者自負。除印行紙本之外，來稿需同意同步收錄於國立臺灣大學出版中心所建置的「國立臺灣大學學術期刊資料庫」。

三、擬投稿之論文原則上以 15,000 字（含圖表及中英文摘要，不含文獻及 English Summary）為原則。本刊對撰寫格式擁有修繕權，以保持一致之編輯水準。

四、來稿若符合本刊性質與形式規範，便委由各領域主編推薦評審進行雙向匿名審查；綜合評審與領域主編之意見，由總編輯決定來稿是否接受刊登、進行後續修改或予以退稿。

五、接受刊登之稿件，其論文排版後的校對由作者負責。論文一經刊登，將致贈當期期刊一冊及抽印本十本。稿件不論刊登與否，一律不退稿，作者請自留檔案。

六、2015 年起 6 月、9 月及 12 月定期出版，請國內外學術先進踴躍賜稿。

七、本刊為提升審查品質，投稿之文章（含專題徵稿，宋作楠碩士論文獎徵稿除外）需先劃撥稿件處理費 3,000 元整。若稿件進入複審或接受刊登，則不再另收費用。以上以郵戳為憑。
劃撥帳號：17653341　戶名：國立臺灣大學。

八、透過線上投稿系統投稿之論文，檔案上傳後，請一併將 3,000 元劃撥單收據，掃描後上傳，待本刊確認收到後，將開立收據給投稿者。

九、為加速論文審查與出版，請作者務必於接獲審查意見後的 4 個月內完成論文修改，並寄回審查，若未在上述期限內寄回審查，將不受理並視同退稿；如作者有特殊原因需延期，請寫信至本刊編輯室 (email: ntupmcenter@ntu.edu.tw)，由領域主編決定是否予以延期及期限，一篇稿件申請延期以一次為限。

十、中文賜稿獲本刊通知【接近接受函】後繳交 1,200-1,500 字之 English Summary（英文摘錄）一份，English Summary Guideline 請上網下載 (http://review.management.ntu.edu.tw)，再者，文獻中如有中文文獻者請務必英譯。作者必須確實對應本文，精簡呈現其所刊載之 English Summary，並負起相關文責，俾利外語讀者之參考與引用。以上請作者請專業人士加以潤飾。經本刊核定後，始予發給接受函。（英文撰稿者不需再提供 English Summary。）

十一、若以英文撰寫論文者，接受後本刊將優先刊登其論文。

臺大管理論叢 投稿格式

壹、稿件

一、文稿排列順序依序為：封面頁、摘要頁、正文（含圖表與註解）、參考文獻、附錄、
作者簡介。

二、文稿請使用 A4 大小電腦用紙打字完成，由左而右橫向排列，並註明頁碼於頁尾
置中處。中文字體請採用**新細明體**，英文則用 **Times New Roman**，內文字級數建
議為 12 級，行間的距離為 18 級。

三、封面頁內容

（一）中英文論文題目：若有副標題，正、副標題請以「：」區隔。

（二）呈現所有作者的中英文姓名、服務單位與職稱。請以適當符號標示通訊作
者 (Correspondence Author)，並呈現通訊作者的通訊地址、聯絡電話及電
子郵件帳號，若無特別標示，將以第一作者為後續校對事務溝通之對象。

（三）封面頁不需有頁碼。

（四）致謝辭或科技部計畫編號請安排於封面頁尾。

四、摘要頁內容

摘要頁為正文之首頁，請提供中英文論文題目、摘要、關鍵字，其中中文摘要以
不超過 300 字為限，英文摘要以不超過 200 字為限，關鍵字至多以五個為限。為
維持匿名審查的嚴謹性，摘要頁請勿出現任何作者姓名。

貳、論文內容格式（出版時廠商排版字型將略有調整）

一、正文章節標題之格式

中文撰寫者：內文請採用 12 點新細明。

貳、文獻探討（16 級粗黑新細明，置中）

一、忠誠度方案（14 級粗黑新細明）

（一）贈品宜多注意多樣性選擇（12 級粗黑新細明）

1. 獎酬商品中之比重（12 級新細明）

(1) 獎酬制度（12 級新細明）

英文撰寫者（含 English Summary 格式）：內文請採用 12-pt Times New Roman

2. Literature Review (16-pt bold Times New Roman, centered)

2.1 Budgetary Participation (14-pt bold Times New Roman)

2.1.1 Management Accounting Research (12-pt Times New Roman)

二、內文引註

　　內文引註應依中、英文稿之不同，遵循不同的格式要求。參考文獻部份與內文引註資料需完全相符，內文引用過的文獻需出現在參考文獻中，兩者的作者姓氏及年代也必須完全一致。請同時注意以下範例之字體粗體、斜體、底線、全形或半形之標點符號等規定。

（一）正文中的引用文獻需含作者及出版年份，出版年份置於半形括號中，例如：A (年度)。若引用文獻有兩位作者，請用「與」或「and」字連接，例如：A 與 B (年度) 或 A and B (年度)。若引用文獻有三人以上時，第一次引註中文為 A、B 與 C (年度) 而英文為 A, B, and C (年度)；第二次引註中文為 A 等 (年度) 而英文為 A et al. (年度)。

　　例：洪榮華與雷雅淇 (2002) 認為台灣股票市場存在淨值市價比效應。

　　例：Bae and Levy (1990) 利用 Black and Scholes (1973) 的選擇權定價模式評估承銷契約的價值。

　　例：員工人格特質之內外控傾向衡量，共十二題，主要係採用吳靜吉、潘養源與丁興祥 (1980) 之量表。

　　例：吳靜吉等 (1980) 以員工內外控傾向之衡量係以內外控傾向量表為基礎。

　　例：Hoy and Tarter (2004) generated ten principles related to the school context.

　　例：Masterson, Lewis, Goldman, and Taylor (2000) suggested that procedural and interactional justice affected variables via different intervening mechanisms.

　　例：This finding conflicts with that obtained by the result of Masterson et al. (2000).

（二）引註的括號內包含參考文獻之作者與出版年份時，請以「逗號」連接，例如：中文為（A 與 B，年度）而英文為 (A and B, 年度)。若文獻有三人或以上時，第一次引註中文為（A、B 與 C，年度）而英文為 (A, B, and C, 年度)。第二次引註中文為（A 等，年度）而英文為 (A et al., 年度)。

　　例：企業吸收能力不足進而會阻礙企業的成長（曾真真與簡俊成，2010）。

　　例：LTCM was very successful in its first two years (Embrechts and Kluppelberg, 1997).

　　例：建立良好的內部機制，決定企業文化的發展（陳木在、陳錦村與陳進楠，2003）。

　　例：建立良好的內部機制，決定企業文化的發展（陳木在等，2003）。

　　例：Although early justice frameworks frequently focus on distributive justice, since the early 1980s the focus has shifted to examinations of procedural justice (Bauer, Truxillo, Sanchez, Craig, Ferrara, and Campion, 2001).

　　例：Oblique rotation was used because the procedural justice rules are hypothesized

as nonorthogonal (Bauer et al., 2001).

特殊說明 (1)：如果文內同時引用兩篇或以上同一年份且第一作者、第二作者或之後順位作者依序部分相同但非完全相同的不同文獻時，為避免於文內第二次引用時只列出第一位作者與年份，而造成縮寫相同的混淆情況，故在此狀況下文內第二次引用時之縮寫可將後續順位作者列出至不會產生混淆的情況再加上年份。例如文內同時引用下列兩篇文獻時：

Marewski, J. N., Gaissmaier, W., and Gigerenzer, G. 2010. Good judgments do not require complex cognition. *Cognitive Processing*, 11: 103-121. doi:10.1007/s10339-009-0337-0

Marewski, J. N., Gaissmaier, W., Schooler, L. J., Goldstein, D. G., and Gigerenzer, G. 2010. From recognition to decisions: Extending and testing recognition-based models for multi-alternative inference. *Psychonomic Bulletin & Review*, 17: 287-309. doi:10.3758/PBR.17.3.287

第一次引用：
• Marewski, Gaissmaier, and Gigerenzer (2010) 或
  (Marewski, Gaissmaier, and Gigerenzer, 2010)
• Marewski, Gaissmaier, Schooler, Goldstein, and Gigerenzer (2010) 或
  (Marewski, Gaissmaier, Schooler, Goldstein, and Gigerenzer, 2010)
第二次引用：
• Marewski, Gaissmaier, and Gigerenzer (2010) 或
  (Marewski, Gaissmaier, and Gigerenzer, 2010)
• Marewski, Gaissmaier, Schooler, et al. (2010) 或
  (Marewski, Gaissmaier, Schooler, et al., 2010)

特殊說明 (2)：當參考文獻出現同一年份，且相同姓氏，但不同名字之作者時，為避免於文內引用時只列出作者姓氏與年份，而造成縮寫相同的混淆情況，因此，在本文文內引用時須寫明作者姓氏和名字起首字母縮寫。例如在參考文獻中：
Li, D. 2010. Does auditor tenure affect accounting conservatism? Further evidence. *Journal of Accounting and Public Policy*, 29 (3): 226-241.
Li, S. 2010. Does mandatory adoption of international financial reporting standards in the European Union reduce the cost of equity capital?. *The Accounting Review*, 85 (2): 607-636.

在本文出現時，應分別為：

Li, D. (2010) 或 (Li, D., 2010)

Li, S. (2010) 或 (Li, S., 2010)

（三）英文專有名詞字首請以大寫書寫並與縮寫之間用半形分號隔開。

例：如馬可夫鏈蒙地卡羅 (Markov Chain Monte Carlo; MCMC) 方法。

（四）括號內同時有多筆文獻時，中文引註內不同作者之間用全形分號隔開，相同作者不同年代之文獻用全形逗號隔開；英文引註內不同作者之間用半形分號加空格隔開，相同作者不同年代之文獻用半形逗號加空格隔開。

例：進入模式的選擇對於企業後續的營運有極重大之影響 (Anderson and Gatignon, 1986; Hill, Hwang, and Kim, 1990)。

例：醫療消費以人治療或保健為直接目的，不同於一般消費且存在著太多變數與不可預料之危險性（紀櫻珍、紀琍琍、吳振龍與黃松元，2006；莊茂，2000；Reeder, 1972）。

例：本研究依循 Kuemmerle (1998, 1999) 的分析觀點。

三、註釋

註腳均置於頁底並以阿拉伯數字順序標明於右上角。註腳中若有引註文獻，仍需按照內文中英文文獻引註格式，且確認該項引註有在參考文獻資料中。

例：有不少同樣卓越學院，如西北、加州（洛杉磯）、康奈爾等改稱管理學[1]。

1　如西北大學所採之學院名稱，其改變歷史為：School Commerce, 1908-1953; School of Business, 1953-1965; Graduate School of Management, 1965-1975; J. L. Kellogg Graduate School of Management, 1975 至今（最後改名乃因接受 J. L. Kellogg 基金會捐贈之故）。

例：When prices move consistently against a trader's position, marketing-to-market can cause liquidity problem.[4]

4　The problem associated with marketing-to-market has been said to be one of the main reasons that encourage commercial banks to offer new successful custom-made features contracts, see Brown and Smith (1988).

四、圖、表之處理

（一）圖、表應置於正文內；表的名稱置於表上方，圖的名稱置於圖下方，並以阿拉伯數字依序編號以區分不同之圖、表。

（二）對圖、表內容（如表中之符號）做簡要說明時，請置於圖、表下方。

（三）太過細節與繁多之圖表請放在附錄。

（四）圖表中數字需留意上下小數「點」對齊，百分比符號（％）靠右對齊。

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