Soochow Journal of Accounting
會計學報，專刊，2010 年 6 月
第 1－28 頁

經濟性與社會性因素對決定台灣中小企業創新能力的實證研究

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摘要

本論文研究經濟性與社會性因素對中小企業創新能力的影響。本論文認為，交易成本因素將直接影響到公司內部對創新能力的培養與發展，而社會資本將形成或正或負的干擾效果。本論文對紡織產業與禮品產業的台灣中小企業作問卷調查，140 個有效樣本分析結果支持本論文的假說，歸納如下：(1)資產專屬性及外部不確定性會促進公司對創新能力的培養與發展；(2)公司之間的互惠行為會加強外部不確定性對公司創新能力的促進；(3)公司之間資訊的流通會降低資產專屬性對公司創新能力的促進，但強固的社會網絡卻會加強資產專屬性對公司創新能力的促進。

關鍵詞：交易成本、社會資本、創新能力

* 成大「發展國際一流大學及頂尖研究中心計劃」(HUA99-3-6-152)

SOOCHOW JOURNAL OF ACCOUNTING
Special Issue, June 2010
PP. 1-28

The Economic and Social Determinants of Innovation Capabilities: An Empirical Study of Small and Medium Sized Enterprises in Taiwan

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ABSTRACT

This paper investigates economic and social determinants of innovation capabilities of small and medium sized enterprises (SMEs). Transaction cost factors directly influence a firm's strategy to breed and develop internal innovation capabilities where social capital plays both positively and negatively as a moderator. A survey of 140 effective samples of SMEs in Taiwan's textile and giftware industries supports our hypotheses: (1) increase in asset specificity and external uncertainty promotes strong firm innovation capabilities, (2) positive effects of external uncertainty on firm innovation capabilities become stronger as inter-firm reciprocity increases, and (3) positive effects of asset specificity on firm innovation capabilities become weaker as information increases, and stronger as network solidarity increases.

Keywords*: Transaction Cost, Social Capital, Innovation Capabilities*

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* National Cheng Kung University HUA99-3-6-152 Research Excellence Project
NSC 95-2922-I-002-085 (previous version presented in 2006 Annual Meeting of Academy of Management, Atlanta)

1. INTRODUCTION

Innovation is an important driver of a firm's long-term growth and survival. The innovation capability of a firm is even more important as a major sustainable competitive advantage than any one-shot innovation of product or process. It is a critical source of entrepreneurial economic rents based on new products and new markets, new technologies and methods of transportation, new sources of supplies, and new types of organizational arrangements (Nelson and Winter, 1982). For small and medium sized firms (SMEs) especially, the innovation capability determines their survival, growth and success in the industry.

Innovation embedded in the knowledge-based environment has recently become a mega-trend topic in either industrial or academic societies. A variety of theories have been used to explain the innovation of firms. Economic theories view the outcome of innovation as a result of the efficiency of a firm's R&D investment, its location in geographic clusters, the knowledge spillover effect, and technology transfer and cooperation. Business and management theories consider innovation from the angle of a firm's configuration of resources, its competency and capabilities, organizational learning, and organization creativities. Social theories explore the opportunity for innovation embedded in social relationships, open- or closed-form networks, and social capital. The various theoretical lines regarding firm innovation examine the phenomena from their own perspectives and rarely bridge the gaps between the disciplines.

This paper intends to bridge the theoretical gaps by reasoning firm innovation capabilities in terms of economic efficiency as well as social embeddedness. We argue that the calculation of transaction cost is the major factor motivating firms to invest in innovation activities, which in turn breed their innovation capabilities. We also argue that social capital, instead of being a direct influential element on innovation capabilities, serves as an indirect factor that may enhance or constrain the transaction cost efficiencies in developing firm innovation capabilities.

We are particularly interested in SME’s decision on developing innovation capabilities since SMEs own comparatively limited resources than large firms. This paper aims to answer the following research questions. What are the motivators

based on the rationales of transaction cost for SMEs to devote themselves to the development of innovation capabilities? Do social relationships in which SMEs are embedded provide opportunities directly to promote innovation capabilities, or does social capital play a moderating role in strengthening or weakening the influences of the transaction cost factors? This research begins by looking into the sources of innovation capabilities. Then hypotheses are derived from the transaction cost and social capital theories. After the methodological analyses with results and discussion, we present our conclusions and implications.

2. THEORIES AND HYPOTHESES

Firms in the contemporary economies compete on capabilities. The "capability-based competition" urges firms to identify and develop hard-to-imitate organizational capabilities which distinguish a firm fundamentally in business processes rather than in products and markets (Stalk *et al.*, 1992). Innovation is recognized increasingly as one of the core capabilities of firms in every industry. Innovations are the product of a firm's combinative capabilities to generate new applications from existing knowledge (Kogut and Zander, 1992).

There are two major ways for a firm to breed and enhance its innovation capability: one is the creativity of the firm itself; the other, through knowledge spillovers from outside resources. In this study, we adopt transaction cost theory to explain how firms economize their innovation capabilities internally. In addition, based the social capital perspective, we detect how firms utilize external resources to build up their own innovation capabilities.

2.1 TRANSACTION COST THEORY

The transaction cost theory resolves the optimization problem, matching transaction attributes with governance structures, where market and hierarchy are located at the two opposite ends with various hybrid forms in between (Williamson, 1991). The search of governance efficiency is under the assumptions of bounded rationality, opportunism, and the level of external uncertainty. Where transactions take place on a recurrent basis and the assets being exchanged have idiosyncratic features (Williamson, 1979), in which case the specialized quasi rent is better

appropriated under full ownership (Klein *et al*., 1978), equity joint ventures or long-term contracts will be the choice to minimize transaction costs to avoid possible opportunistic behaviors and internal uncertainties due to bounded rationality (Williamson, 1975). The "right" choice of governance structure will secure the incentive intensity, administrative controls, and legal rules of regime, under the differential capacity for autonomous and cooperative adaptations between firms involved, and thus economizes the management of cooperative value activities for the outcome (Williamson, 1999).

However, innovation activity is normally highly firm-specific and the exchange of innovation outputs in the market or between cooperative partners involves high transaction cost. The nature of innovation is highly imperfect. Imagine a firm that intends to sell its creative idea, know-how, or innovation output to other firms or other people. To what extent should that firm disclose such "asset" to potential buyers in order to get a fair price for it? If that firm demonstrates the innovation in detail, potential buyers may learn or steal the whole or part of that innovation and then decide they don't need to offer a fair price or don't even have to buy it. On the other hand, how can potential buyers know they need that innovation if they don't have a full understanding of that innovation? The market of innovation between sellers and buyers thus easily fails.

A similar situation also arises with R&D alliances when partnered firms intend to cooperate in innovation activities. When the technology development involves highly specific assets, alliance partners may suffer from goal conflicts and coordination problems because of the high transaction cost stemming from the different motivations (Powell, 1987; Terpstra and Simonin, 1993) of alliance partners. Particularly in technological innovations, a firm is vulnerable to the risk that its partner may easily imitate or learn the technology and then become a competitor. Studies found that firms with assets of greater specificity are more likely to develop technology internally rather than to establish a technology alliance (Mang, 1998; Robertson and Gatignon, 1998). On the contrary, firms engaged in technology alliances tend to make less commitment to the investment in specific assets. Delmas (1999) also provided evidence to show that firms with high technological competence tend to pursue the strategy of in-house technology

development rather than forming a technological alliance. Hence,

> **H1:** Increase in asset specificity promotes stronger firm innovation capabilities.

A company is an open-end organization facing the complexity and uncertainty posed by the environment (March and Simon, 1958). According to Williamson (1979), external uncertainty can raise transaction cost given other conditions equal. Under the assumption of bounded rationality, when environmental uncertainties become so numerous that they cannot all be considered, presumably exceeding the data processing capabilities of the parties, the complete decision tree simply cannot be generated (Williamson, 1975: p.24). If a firm chooses to outsource technology or innovation activities via market transactions or cooperative alliances, the higher the external uncertainty, the greater the transaction costs will be for that firm with external partners. Studies found that perceived environmental uncertainty promotes an aggressive technology policy on long-range strategy for the adoption and production of process, product, and service innovations (Ettlie and Bridges, 1982; Ettlie, 1983), and this motivates a firm to choose internal technology development rather than forming an alliance (Robertson and Gatignon, 1998). Thus, we argue that external uncertainty can urge a firm to choose to invest in certain technology while holding organizational buffers, and the high transaction cost associated with potential outside sources will encourage a firm to keep on breeding its internal innovation capabilities rather than to take advantage of outside alternatives. Hence,

> **H2:** Increase in external uncertainty promotes stronger firm innovation capabilities.

The transaction cost theory assumes that opportunism is human nature. Economic agents are guided by considerations of self-interest to make allowance for strategic behavior. This involves self-interest seeking with guile and has profound implications for choosing between alternative contractual relationships (Williamson, 1975: p.26). Specifically, the problem of opportunism becomes serious when only a small number of transaction parties are involved. Transactions of innovation products over the marketplace are very likely to fail because of the opportunistic attitudes between potential buyers and sellers. Problems of free-riding, imitation,

and learning can easily take place before an innovation output is actually transacted, and these problems are often managed with difficulty in an alliance focusing on R&D cooperation and innovation activities because of opportunism and the small number of partners concerned. Therefore we argue that opportunism discourages firms from outsourcing R&D innovation. Instead, it motivates firms to breed and develop their internal innovation capabilities to avoid unnecessary opportunistic behaviors of other parties.

When potential opportunism on inter-firm exchanges is high, firms tend to invest in its own innovation capabilities. Studies showed that opportunism raises the cost of R&D alliance and thus lowers alliance performance. Helm and Kloyer (2004) found that opportunism exists in inter-organizational R&D cooperation at the risk of achieving a lower profitability on the innovation return than the exchange partner, and of turning the partner into a competitor by unplanned one-sided knowledge flows. Contractual opportunism particularly in R&D alliances usually creates high misaligned governance cost for partnered firms (Sampson, 2004). Robertson and Gatignon (1998) provided the evidence that difficulty in assessing technology performance due to opportunism leads a firm to developing technology internally rather than seeking for alliance. Hence,

H3: Increase in opportunism promotes stronger firm innovation capabilities.

2.2 SOCIAL CAPITAL

People are bound for socialization. Social relationships or social networks are very important especially for SMEs to get more external economic resources or to avoid business risks (Florin *et al*., 2003). Social capital is an important resource accessed and mobilized in purposive actions (Lin, 2001). It is both appropriable and convertible and is either a substitute for, or a complement to, other resources. Moreover, social capital needs maintenance and is hard to quantify (Adler and Kwon, 2002). Coleman (1988) argued that social capital, acting as resources for organizations and individuals, exists in the structure of relations between and among actors. Major forms of social capital such as obligations, expectations and trustworthiness of structures, information channels, norms, and effective sanctions are facilitated by the closure of social networks and appropriable social

organizations. Also, within the social network boundary, social capital, regardless of its transferability and appropriability, requires members' efforts on both investment and maintenance. Sandefur and Laumann (2000) identified three benefits of social capital: its ability to facilitate or hinder the flow of information, the control of others and one's own autonomy by influence and control, and the potential it provides for social solidarity.

Social capital has its risks and costs as well as benefits. Adler and Kwon (2002) provided a working definition of social capital as goodwill available to individuals or groups, its source lying in the structure and content of the actor's social relations, and its effects flowing from the information, influence, and solidarity it makes available to the actor (p.23). Social capital offers firms a mode of interaction beyond contracts for frequent business exchanges. The relationships between or among partners, either an official, cooperative partnership or a long-term friendship, are flexible and reciprocal. They are complementary to the internal firm-specific resources, especially for SMEs, so as to facilitate access and acquisition of outside opportunities and supports for innovation, growth and success.

However, social capital is not always an asset. Sometimes it may become a liability because members in a social network also have responsibilities to help each other in keeping with solidarity and norm, which are the main forces to keep the network stable and distinct from others outside the group. In addition, the coordination cost in a high-density social network can sometimes be high in order to achieve consensus among members. Tsai (2001) found that an actor possessing high network centrality does significantly increase its innovation capability but, due to the costs associated with coordination and administration, the net effect on performance is a question mark. Indeed, Uzzi (1996) provided the evidence that social capital features a curvilinear relationship between performance and cohesiveness of the social network. He argued that embedded ties develop through stages, yielding positive returns only up to a certain degree. Viewing embeddedness as logic of exchange that promotes economy of time and integrative agreements, which will reach a threshold, *i.e.* paradox of embeddedness, while after that, embeddedness can derail performance by making firms vulnerable to exogenous shocks or insulating them from information (Burt, 1992) that exists beyond their

network.

A firm's value comes not only from the input factors but also from the network it belongs to. Kogut (2000) argued that the dynamics between internal capabilities, ensconced in specific identities and organizational structures, and the external knowledge in the market, drive a co-evolution between the emergent properties in the firm and network. Over time, knowledge, initially information, gradually becomes encoded in persisting structures that influence subsequent behaviors in two distinctive ways —either as a conduit of information or as the basis of coordination. Social networks emerge initially in response to the institutional and technological opportunities of an industry. Both Burt's networks, accrues to a broker, and Coleman's, to the members of a closed group, can generate "rents" for firms in the networks.

Social capital is believed to be capable of facilitating innovation capabilities by enhancing firm creativity as well as knowledge spillovers. Perry-smith and Shalley (2003) argued that weak ties rather than strong ties would promote creativity at work due to more accesses, exposures and autonomy. On the other hand, closeness centrality at some moderate level will contribute to higher creativity whereas peripheral positions in a network with a large number of connections with the outside will also contribute to creativity. Therefore, centrality and creativity can generate a spiral process continuous in the organizational system. Nahapiet and Ghoshal (1998) proposed that social capital in terms of structural, cognitive and relational dimensions can facilitate combination and exchange of intellectual capital, which will then create new intellectual capital. Tsai and Ghoshal (1998) further confirmed that these three dimensions of social capital have significant effects on resource exchange and combination, which are associated with product innovation and value creation.

In addition to its contribution to firm creativity, social capital is also viewed as pipes and prisms (Podolny, 2001) that allow firms to access outside knowledge and innovation resources. Firms benefit from knowledge spillovers because of social capital and network embeddedness. Tsai (2001) examined knowledge transfer in intraorganization networks on condition of the location of the interunit network which provides external access to knowledge (this is an extension from Burt's view)

and absorptive capacity which determines the internal capacity to learn.

While the transaction cost theory aims at economizing governance structures and safeguarding opportunism (Williamson, 1979), social network, as a distinctive form of governance (Powell, 1990), minimizes opportunism via reputations based on transaction history or repeated ties with partners. Reliable transactions are derived from frequent transactions between or among parties embedded in the social network (*i.e.* Granovetter's (1985) relational or structural embeddedness). Fine-grained information assists social mechanisms in penalizing any possible opportunistic behaviors by transactional parties (Coleman, 1990; Larson, 1992; Uzzi, 1997). Reciprocity existing among social network members will presumably mitigate opportunistic motivations and behaviors, minimizing potential transaction cost from cheating and thus benefiting a firm's innovation capabilities. Social capital can be viewed primarily as the accumulation of obligations among parties concerned according to the norm of reciprocity. Donors provide privileged access to resources in the expectation that they will be repaid somehow at an unspecified time in the future (Portes, 1998). Carroll and Stanfield (2003) argued that reciprocity has a different set of cultural motivations resting on a foundation of familial or political obligations and may not suffer from the two-way transfer of equivalent value of the market system.

However, reciprocity between social network members can sometimes turn social capital into a responsibility or liability. As one of the SME owners we interviewed said, “SMEs own relatively less resources and compete more difficultly than large firms. So, as a group of partners or friends in the industry, we help one another when necessary. Major actions of help vary from business consultation, financial aid, solution to technology and manufacture problems, to partner introduction.” Another SME general manager shared with us the same opinion and emphasized further by saying “Once we got other people’s help, we will give our hands in return if some day they face difficulties. Such reciprocal relationship builds up a strong friendship because people offering hands might suffer from loss of business profitability or a new business chance”. Thus, the transaction cost effect on the development of firm innovation capabilities can be strengthened by eliminating the potential “payback” on the basis of reciprocity. Hence,

H4: The positive effects of (a) asset specificity, (b) external uncertainty, and (c) opportunism on firm innovation capabilities become stronger as inter-firm reciprocity increases.

H4alt: The positive effects of (a) asset specificity, (b) external uncertainty, and (c) opportunism on firm innovation capabilities become weaker as inter-firm reciprocity increases.

Coleman (1988) argued that information channel is facilitated by closure of social networks and appropriable social organization or social structure. The closed-form social network is just like communities with their own identities so that the public-goods problem of social capital is resolved within the network boundary. High-quality information, which is transferable and appropriable, is shared between and among members within the network boundary. Thus, fine-grained information regarding innovation can be shared within the cohesive social network by mitigating the potential hazards resulting from transaction cost issues. On the other hand, a central argument of Burt (1992) on the benefit of social capital is the access or referral of information at the right timing. He emphasized that the value of an agent spanning on a structural hole in access and control information flows and business opportunities within and across various network groups. He argued that the key person in the position of a structural hole who occupies the nodes of non-redundant sources of information is capable of creating competitive advantages of information and power benefits from different circulations of information flows, no matter through strong or weak ties. However, while this kind of information can create social capital value for firm innovation, it may also pose a potential threat of information leakage due to non-redundant flows of information.

For example, the success of high-tech industries in Silicon Valley could be attributed to the atmosphere of community in which information can be shared via informal communication channels. In contrast to the fall of Route 128, the leading technologies, industrial dynamics and booming entrepreneurship in Silicon Valley have been relying on those complicated social connections based on local universities, research institutes and firms (Saxenian, 1994). It is common in a social network that people share experiences, discuss technological development, and exchange new business ideas with friends, old colleagues, suppliers and customers

—even with their competitors. Social capital offers opportunities of information exchange, and knowledge sharing can, on the one hand, reduce a firm's transaction cost with outside partners on the development of innovations, and on the other hand, motivate a firm to create barriers against outsiders, thus increasing the transaction cost, to protect its innovation outcomes from leaking to other firms or even competitors. Hence,

> **H5:** The positive effects of (a) asset specificity, (b) external uncertainty, and (c) opportunism on firm innovation capabilities become stronger as information increases.
>
> **H5alt:** The positive effects of (a) asset specificity, (b) external uncertainty, and (c) opportunism on firm innovation capabilities become weaker as information increases.

Solidarity among social network members provides complete unity and support for members within the group. Norms, trust and reciprocity are closely associated with solidarity, which is built upon the commitment and consensus of social network members. The profits of social capital that accrue from membership in a group are the basis of the solidarity which makes them possible (Bourdieu, 1985: 249). Solidarity is an emergent outcome of a common fate. The altruistic dispositions of actors in these situations are not universal but bounded by the limits of their community in which other members of the same community can appropriate such dispositions and the actions that follow as their source of social capital (Portes, 1998). Peng (2004) argued that kin solidarity plays an important role in protecting the property rights of private entrepreneurs and reducing transaction costs.

Social capital is generated by bounded solidarity and trust at the core of the group's economic advance (Portes and Landolt, 1996). Unfortunately, solidarity may become a liability within strong social-tie relationships —which can yield social capital benefits— so that access from the outside is barred. Carroll and Stanfield (2003) argued that there were many cases in which initial benefits of social capital were offset by long-term restrictions. Four negative consequences of solidarity within a dense-tie network may create cost barriers for information access and asset exchange: exclusion of outsiders, excess claims on group members,

restrictions on individual freedoms, and downward leveling norms (Portes, 1998). For example, in San Francisco's Chinatown, the close-knit community protects immigrants from outside discrimination but extracts high levels of intra-community requirements. The internal homogeneity and external barrier raised by solidarity will thus create more transaction cost on outside alternatives to breeding innovation capabilities on one's own. Hence,

H6: The positive effects of (a) asset specificity, (b) external uncertainty, and (c) opportunism on firm innovation capabilities become stronger as network solidarity increases.

H6alt: The positive effects of (a) asset specificity, (b) external uncertainty, and (c) opportunism on firm innovation capabilities become weaker as network solidarity increases.

3. METHODS

3.1 SAMPLE AND INSTRUMENT

This study investigates the determinants of innovation capabilities of Taiwan-based SMEs in the textile and giftware industries. We got 157 returned questionnaires, 140 samples are effective for our analysis.

The items in the survey questionnaire were either based on theoretical concepts derived from literatures or adapted from empirical studies. In particular, the transaction cost items were based on the theoretical concepts of Williamson (1975, 1985) and Chi (1994); the social capital items were adapted mainly from the theoretical concepts of Burt (1992), Coleman (1988) and Uzzi (1996). In answering the questionnaire, the respondents were requested to focus on company operations of the past three years. For respondents from start-up companies, experiences in the past one year would suffice. Respondents were advised to answer the questionnaire according to their actual experiences and facts. Except for questions on the general information, all items followed the seven-point Likert-type scale.

3.2 MEASURES

The independent and moderating variables in the framework were measured

by multiple items in the questionnaire. All of these measures were assessed by using a seven-point Likert-type scale, ranging from “strongly disagree” to “strongly agree”.

Four control variables were also introduced which have potential influence on the capability of new product development. They were company age, company size, multinational experience, and sub-industry in the textile and giftware industries. Company age was measured by the year, beginning with the start-up of the entrepreneurial firm while company size referred to the total amount of a firm’s financial capital. These two items were double checked with the official database provided by the Ministry of Economic Affairs, Taiwan. Multinationality and sub-industry were treated as self-reported dummies.

3.3 MODELS AND ANALYES

To assess the relationships among the variables in the conceptual framework, factor analysis was performed to extract loadings and scores to be used in the regression analysis. The most consistent factors for the theoretically- and empirically-sourced measures were obtained by using the principal component method with a one-factor restriction analysis for each construct. The principal component method was then used with varimax rotation for the performance factors. Finally, regressions analysis was run for each factor score with moderating effects to test our hypotheses.

4. RESULTS

Table 1 demonstrates factor loadings, reliabilities (*alpha*), eigenvalues and the percentages of variance for each factor of construct. The reliabilities are very high (above 0.71) for product innovation, opportunism, information and solidarity; and also good (above 0.58) for asset specificity, external uncertainty and reciprocity. It can be seen that the items in our questionnaire measure pretty well to the constructs in our model.

TABLE 1
Factor Analysis of Regression Variables

Variable	Factor loading		Communality
Product Innovation			
Uniqueness	0.894		0.800
Leadership	0.909		0.827
Competitiveness	0.700		0.490
Reliability (alpha)		0.7819	
Eigenvalue		2.116	
% Variance		70.538	
Asset Specificity			
Hard to be learned	0.810		0.656
Hard to be reverse engineered	0.850		0.722
Hard to trade by contract	0.699		0.488
Easy to transfer	-0.207		0.043
Tacit	0.223		0.050
Channel	0.481		0.231
Market knowhow	0.574		0.329
Reliability (alpha)		0.5802	
Eigenvalue		2.520	
% Variance		36.00	
External Uncertainty			
Investment in technology	0.541		0.293
Demand & preference change	0.614		0.377
Demand of search for new product	0.634		0.402
Different demand pattern	0.629		0.396
Technology change	0.676		0.457
Hard to predict technology	0.500		0.25
Reliability (alpha)		0.6442	
Eigenvalue		2.176	
% Variance		36.262	
Opportunism			
Goodwill	0.865		0.748
Trustworthy	0.872		0.761
Trust for business relationship	0.852		0.725
Anti-opportunistic behavior	0.865		0.748
Not rigid by contract	0.270		0.073
Reliability (alpha)		0.7258	
Eigenvalue		3.055	
% Variance		61.104	

Table 1 (Continued)

Reciprocity			
Friendship	0.844		0.712
Partner mutual help	0.844		0.712
Reliability (alpha)		0.5901	
Eigenvalue		1.425	
% Variance		71.246	
Information			
Exchange	0.630		0.397
Membership resource	0.882		0.777
Membership information	0.867		0.752
Reliability (alpha)		0.7189	
Eigenvalue		1.926	
% Variance		64.185	
Solidarity			
Partner selection	0.913		0.834
Partner introduction	0.913		0.834
Reliability (alpha)		0.8013	
Eigenvalue		1.669	
% Variance		83.444	

Source: this research

TABLE 2

Descriptive Statistics: Means and Standard Deviations (Factor Scores)

Variable	N=140	Mean	s.d.
Dependent variable			
Innovation Capabilities	157	-2.47E-17	1.000
TCE-variables			
Asset Specificity	156	-5.07E-17	1.000
External Uncertainty	155	-1.10E-16	1.000
Opportunism	155	5.063E-17	1.000
SC-variables			
Reciprocity	157	-2.41E-16	1.000
Information	155	-1.79E-16	1.000
Solidarity	156	-5.55E-17	1.000
Control variables			
Company Age	152	14.7336	9.408
Company Size	154	1.10E+08	3.16E+08
Multinationality	151	0.3113	0.465
Sub-industry	157	9.8599	5.700

Source: this research

Table 2 shows the descriptive statistics of means and standard deviations of each variable's factor score. Table 3 shows the Pearson correlations among all dependent, independent, moderating and control variables used in the regression analyses. No correlation is above 0.5 between independent, moderating and control variables, so multicollinearity is not a potential problem.

TABLE 3

Pearson Correlations for All Variables (Factor Scores)

Variable	1	2	3	4	5	6	7	8	9	10
Dependent variable										
1. Innovation Capabilities										
TCE-variables										
2. Asset Specificity	0.674**									
3. External Uncertainty	0.379**	0.276**								
4. Opportunism	-0.358**	-0.407**	-0.268**							
SC-variables										
5. Reciprocity	0.110	0.091	0.216**	-0.333**						
6. Information	0.255**	0.371**	0.265**	-0.403**	0.307**					
7. Solidarity	0.123	0.148	0.316**	-0.474**	0.274**	0.345**				
Control variables										
8. Company Age	0.037	-0.047	-0.053	0.042	-0.198*	-0.002	0.035			
9. Company Size	0.088	0.068	0.014	-0.019	-0.117	0.044	-0.081	0.259**		
10. Multinationality	0.000	-0.081	0.030	0.142	0.048	0.020	0.033	0.147	-0.111	
11. Sub-industry	0.115	0.164*	0.028	-0.025	0.000	0.044	-0.072	-0.108	0.147	-0.130

Note: Significant levels at 5% and 1% are marked with * and ** , respectively.

Source: this research

The regression results for innovation capabilities are demonstrated in Table 4. Four models plus a baseline model were tested. In the baseline model, where only the control variables were tested, the adjusted R-square is low, and only sub-industry is statistically significant. In Model I, asset specificity and external uncertainty (Transaction Cost, or TC, variables) show positive, statistical significance on innovation capabilities, and the adjusted R-square increases to a high level for a cross-sectional regression (0.484). When Social Capital, or SC, variables are incorporated in Model II, the TC variables remain stable while none of the SC variables show any significant, direct influence on innovation capabilities. Model II proves that SC does not play a direct or independent role in influencing the effect of innovation capabilities. And SC is further confirmed in Model III to

have an indirect or moderating effect to influence innovation capabilities via the main explanatory TC variables. In Model III, the interactions between asset specificity and information, asset specificity and solidarity, and external uncertainty and reciprocity appear statistically significant. The incremental effect of asset specificity on innovation capabilities from a unit increase of social capital information is –0.166, which means that information mitigates the influence of asset specificity on innovation capabilities. On the other hand, the incremental effect of asset specificity on innovation capabilities from a unit increase of solidarity is 0.161, which means that solidarity enhances the influence of asset specificity on innovation capabilities. And the incremental effect of external uncertainty on product innovation from a unit increase of reciprocity is 0.127, meaning that reciprocity enhances the influence of external uncertainty on innovation capabilities. The signs and significances of the exploratory TC variables and the abovementioned three TC-SC interactions remain unchanged (although economical impact increases) in Model IV, where the four control variables (company age, company size, multinationality, and sub-industry) are introduced. Meanwhile, the adjusted R-square increases to 0.514 in this full model. The exploratory power of independent TC variables carries on from Model I through Model IV, and the influences of the moderating SC variables on the TC variables are consistent in Models III and IV. Therefore, according to Model IV, hypotheses H1, H2, H4(b), H5alt(a) and H6(a) are supported. Such empirical evidence suggests that increase in asset specificity and external uncertainty promotes stronger firm innovation capabilities. And the positive effects of external uncertainty on innovation capabilities become stronger as reciprocity increases, while the positive effects of asset specificity on innovation capabilities become weaker as information increases, and stronger as solidarity increases.

TABLE 4

Multiple Regression Estimates for Innovation Capabilities

Regressor	Parameter estimates: standardized coefficient (t-statistics)				
	Baseline Model	Model I	Model II	Model III	Model IV(full)
Constant	-0.379 (-1.593)	0.0185(0.324)	0.021(0.356)	0.064(0.982)	-0.039(-0.219)
TC-variables					
Asset Specificity		0.585(8.979)***	0.584(8.570)***	0.571(8.269)***	0.586 (8.120)***
External Uncertainty		0.184(2.967)**	0.197(3.014)**	0.194(2.823)**	0.215 (3.013)**
Opportunism		-0.089(-1.367)	-0.112(-1.493)	-0.135(-1.580)	-0.135 (-1.475)
SC-variables					
Reciprocity	0.028 (0.314)		0.035(0.529)	0.027(0.412)	0.050 (0.718)
Information	0.225 (2.422)*		-0.013(-0.185)	-0.034(-0.464)	-0.060 (-0.773)
Solidarity	0.062 (0.673)		-0.072(-1.023)	-0.098(-1.292)	-0.063 (-0.786)
Interactions of TC-SC					
Asset Specificity* Reciprocity				0.030(0.427)	-0.005 (-0.070)
Asset Specificity* Information				-0.166(-2.225)*	-0.196 (-2.372)*
Asset Specificity* Solidarity				0.161(2.156)*	0.176 (2.203)*
External Uncertainty* Reciprocity				0.127(1.687)+	0.143 (1.812)+
External Uncertainty* Information				-0.064(-0.731)	-0.063 (-0.697)
External Uncertainty* Solidarity				-0.102(-1.376)	-0.097 (-1.218)
Opportunism* Reciprocity				0.003(0.032)	-0.056 (-0.517)
Opportunism* Information				-0.037(-0.424)	-0.024 (-0.260)
Opportunism* Solidarity				0.056(0.543)	0.084 (0.716)
Control variables					
Company Age	0.029 (0.324)				0.066 (0.967)
Company Size	0.070 (0.807)				0.028 (0.437)
Multinationality	0.009 (0.104)				-0.014 (-0.216)
Sub-industry	0.147 (1.751)+				-0.007 (-0.112)
Adj. R-square	0.057	0.484	0.476	0.496	0.514
F-statistics (df)	2.235(7,135)*	48.168(3,148)***	23.673(6,144)***	10.841(15,135)***	8.743(19,120)***

Note: Significant levels at 10%, 5%, 1% and 0.1% are marked with +, *, ** and ***, respectively.

Source: this research

5. DISCUSSION

5.1 MAIN EFFECTS BY TC DETERMINANT

Two of the transaction cost determinants ―asset specificity and external uncertainty― are consistently significant in influencing firm innovation capabilities. Compared with all other explanatory variables, asset specificity, especially, has a very high economic impact throughout all the models tested, where its coefficients stay above 0.54. The evidence shows that asset specificity is the most critical

determinant of firm innovation capabilities: high asset specificity promotes strong firm innovation capabilities. This is consistent with Mang (1998), Delmas (1999), and Robertson and Gatignon (1998), which found that firms with greater technology specificity are more likely to develop technology internally than to establish a technology alliance.

Meanwhile, external uncertainty is both statistically and economically important in explaining firm innovation capabilities throughout the models, expect in Model IV, where it does not significantly influence the innovation capabilities of low-performance firms. Our finding is aligned with many previous studies (Ettlie and Bridges, 1982; Ettlie, 1983; Katila and Mang, 2003; Robertson and Gatignon, 1998), which found that perceived environmental uncertainty promotes an aggressive technology policy on long-range strategy for internal innovation activities, which motivates a firm to choose internal technology development over forming an alliance. However, our findings are different from the studies by Caloghirou, Hondroyiannis and Vonortas (2003), and Cousins and Crone (2003), which found that external uncertainty leads to more outsourcing technological alliances; or Lu and Yang (2004) and Koufteros, Vonderembse and Jayaram (2005), which found no impact by environmental uncertainty. Thus, past studies show no consensus regarding the influence of external uncertainty on firm innovation strategy. Our finding can provide a strong support in both statistical and economical senses that external uncertainty encourages firms to develop their own innovation capabilities.

On the other hand, opportunism is generally shown to work in the opposite direction from our prediction though it is statistically insignificant. It is surprising to find that opportunism has a negative impact on the development of firm innovation capabilities. We cannot explain this result based on existing theories or common senses. Since it is statistically insignificant, we leave this result to be opened for further discussions.

5.2 MODERATING EFFECTS BY SC DETERMINANTS

Our findings confirm that social capital plays a moderating role in the main effects of the transaction cost factors on firm innovation capabilities. Moreover, the

elements of social capital we used in this study ―reciprocity, information and solidarity― produce their indirect effects in different manners. The following three moderating effects are statistically significant. First, the positive effects of asset specificity on innovation capabilities become stronger as solidarity increases. Since altruism based on solidarity exists only between or among actors bounded within their community, the internal homogeneity and external barrier provide strong protection for firm-specific assets. Thus, solidarity imposes more transaction cost on choosing outside alternatives to internal development of firm innovation capabilities. When asset specificity is high, solidarity creates barriers for the attempt to outsource innovations, thus motivating a firm to develop its own innovation capabilities.

Second, the positive effects of asset specificity on innovation capabilities become weaker as information increases. Social capital offers opportunities for information exchange. Information and knowledge sharing can reduce a firm's transaction costs with outside business partners on the development of innovations. In addition to internal firm creativity, as Podolny (2001) suggested, social capital is viewed as pipes and prisms that allow firms to access outside knowledge and innovation resources. Information and knowledge gradually become encoded in persisting structures that influence a firm's capabilities by providing a conduit and coordination. Therefore, information sharing based on social relationships can mitigate the risk of asset specificity upon an outsourcing strategy of innovation. Information eases transaction cost and thus motivates a firm to seek alternatives to its internal development of innovation. On the contrary, the risk of information leakage, which raises the transaction cost with outside partners, does not serve as a major factor in the decision of internal or external development of innovation.

Third, the positive effects of external uncertainty on innovation capabilities become stronger as reciprocity increases. Reciprocity can be viewed primarily as the accumulation of obligations among parties concerned. As Portes (1998) pointed out, donors provide privileged access to resources in the expectation that they will be repaid somehow at an unspecified time in the future. When external uncertainty is high, a firm is vulnerable in cooperating with outside partners by taking on the potential responsibility stemming from reciprocity that could raise the transaction

cost of innovation alliance. Thus, the transaction cost effect on the development of firm innovation capabilities can become stronger as the firm is motivated to eliminate the potential "payback" based on reciprocity.

5.3 LIMITATIONS

This study should be viewed in the light of its limitations. First, factors which were not examined in this study should not be ignored when firm innovation capability is to be studied more thoroughly. Variables which we did not investigate in this paper might also determine or influence firm innovation capabilities. For instances, the human capital of technological talents and cross-functional team organizers can result in different performances of firm innovation outputs. Meanwhile, financial resource is also important in that it supports good innovative ideas and projects to be executed successfully. Second, the measurement of dependent variables in this study might be problematic in practice as well as in nature. This paper being an empirical study based on survey outcomes, answers from individual respondents to the questionnaire are basically a reflection of their subjective judgment and mindset, and a consistent measurement across all respondents is therefore impossible to obtain, which is the major problem of social science studies based on survey results. Third, the data presented in this paper might not be fully aligned with other theories, such as the resource-based view and the prospect theory, in the explanation of firm innovation capabilities. Here we have the economic identification problem. For examples, the resource-based view argues that the importance of a firm's non-imitable, non-tradable, and non-substitutable resources is the foundation of sustained competitive advantages (Dierickx and Cool, 1989; Peteraf, 1993). Our data on asset specificity, which is hard to be traded, imitated and transferred across firms, is consistent with the resource-based view argument in the explanation of innovation capabilities. However, the prospect theory emphasizes the certainty effect and loss aversion under different contingencies (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). In the evaluation of a firm's prospects, the certainty effect draws a distinctive line between the weights attached to sure gains and to highly probable gains, whereas loss aversion focuses on loss and disadvantage, which are weighted more than gain and advantage. Thus, management teams tend to behave rather conservatively towards

irreversible investment in innovation if firm performance is satisfactory. This phenomenon cannot be explained with our data.

6. CONCLUSIONS AND IMPLICATIONS

This paper studies economic and social determinants of SMEs' innovation capabilities. Transaction cost factors are proposed to have direct influence on a firm's strategy to breed and develop internal innovation capabilities. Meanwhile, social capital is proposed to play both positively and negatively as a moderator in the effects of transaction cost factors on innovation capabilities. A survey of 140 effective samples of SMEs in Taiwan's textile and giftware industries supports our hypotheses: (1) increase in asset specificity and external uncertainty promotes strong firm innovation capabilities, (2) the positive effects of external uncertainty on firm innovation capabilities become stronger as inter-firm reciprocity increases, and (3) the positive effects of asset specificity on firm innovation capabilities become weaker as information increases, and stronger as network solidarity increases.

This paper makes the following major contributions. Firstly, the transaction cost and social capital theories are employed to simultaneously explain and examine the "economic efficiency" and "social embeddedness" reasoning on firm innovation capabilities. We argue that the calculation of transaction cost is the major factor motivating firms to invest in in-house innovation activities and thus breed their innovation capabilities. Secondly, we argue that social capital, instead of being a direct influential element on innovation capabilities, serves as an indirect driving factor that might enhance or constrain the transaction cost efficiencies in the development of firm innovation capabilities. Thirdly, we provide empirical evidence specifically from SMEs to verify the proposed determinants of firm innovation capabilities, in contrast to large firms with strong financial and human resources for building internal innovation capabilities. Our empirical results support our main arguments and offer managerial implications for SMEs regarding their economic and social concerns on firm innovation strategies. When asset specificity and external uncertainty are high, firms are advised to put more efforts and resources into breeding and developing their internal innovation capabilities, rather than

seeking for alliance with outside partners. Moreover, firms owning such social capital as solidarity and reciprocity may be subject to greater transaction cost influence from high asset specificity and external uncertainty, respectively, on their choosing an internal innovation strategy. On the other hand, social capital provides fine-grained information and communication channels, which may reduce the risk associated with asset specificity in an innovation alliance.

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