Top Executives' Directorate Networks and Business Value Creation: Vertical vs. Horizontal Ties

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Abstract:

Technology and globalization are making networks of relationships (or so-called social capital in the intellectual capital literature) a decisive business asset. Historically, the prevailing assumption has been that managerial value is embodied in the human capital (including experience, judgment, knowledge, skills, and expertise) that managers bring to the firm. Yet recent studies suggest this assumption is incomplete, as executives' extra-organizational networks also affect organizational strategy and performance through fostering the co-operation and risk-sharing among firms that promote innovation and flexible responses to change in a global economy. While there is growing evidence supporting the importance of social capital, objective evidence on the linkages between external networks and business value creation that uses publicly available data in analysis is still lacking. In light of this, the object of this research is to explore, using objective secondary data, whether top executives' external directorate networks can lead to the creation of business value and if so, what kinds (vertical vs. horizontal ties) are effective?

Using a sample of information electronics firms in Taiwan, this study relates top executives' directorate networks to two aspects of business value creation: *increased customer benefits* and *reduced organizational costs*. We find that firms with better-horizontally-networked executives create more business value of *increased customer benefits*, while firms with better-vertically-networked top executives create more business value of *reduced organizational costs*. For other countries intending to develop their high-tech industries, our results provide evidence on what kind of directorate network (vertical or horizontal) is most associated with particular business values, which provides insights into Taiwan's practices in network organizing and management that can serve as a referable model to build firms' networks.

This study adds credence to the notion that top executives' external ties can be seen as value drivers that provide competitive advantage to information electronics firms. For accountants, it is suggested that assessing the quality of an executive's external directorate networks and the potential contribution of this valuable resource to the creation of business value is possible. For instance, the network centrality measures used in this study to assess the quality of an executive's "social capital" could be used to broaden "balanced scorecard" type business performance measurement systems. Furthermore, qualitative measures of top executive relationship networks can be used by external analysts and investors to learn to what extent firms are capable of leveraging relationships with other firms, and thereby better predict future firm performance and value.

Key words: Vertical networks, Horizontal networks, Value creation

1. Introduction

In a corporate world where true value is no longer determined by physical assets alone, but instead by a combination of material and nonmaterial resources, a group of studies have found that intangible assets or intellectual capital, including human capital, organizational capital, and customer/social capital, are primary drivers in creating value and generating growth (e.g., Lev, 2001). Since significant amounts of resources can be acquired by firms through developing external networks (i.e., a firm's social capital) to build competitive advantage (Nahapiet and Ghoshal, 1998; Salman and Saives, 2005), and recent empirical research has shown network ties of firms fruitfully affecting their behavior and outcomes (e.g., Powell et al., 1996; Ahuja, 2000a; Salman and Sives, 2005; Zaheer and Bell, 2005), it is pivotal to consider the external organizational relationships when studying a firm's intangible assets (Powell, Koput, and Smith-Doerr, 1996). While there is growing evidence supporting the importance of social capital, objective evidence on the linkages between external networks and business value creation that uses publicly available data in analysis is still lacking. In light of this, the object of this research is to explore, using objective secondary data, whether top executives' external directorate networks can lead to the creation of business value and if so, what kinds (vertical vs. horizontal ties) are effective? Noticed that a firm's social capital is defined as top executives' external directorate networks in this study, considering that top executives' extra-organizational networks will significantly affect organizational strategy and performance (Geletkanycz and Hambrick, 1997), and one of the primary ways in which top executives invest in social relations is through participation in the network of interlocking directorships among firms (Mizruchi, 1996).

According to the "2004 Global Competitiveness Report" issued by the Geneva-based World Economic Forum, among the 102 countries covered in the report, Taiwan ranks fourth in growth competitiveness and second in technological competitiveness and innovation. Taiwan's information technology (IT) industry occupies an important position in the global high-tech manufacturing value chain after decades of development. Specifically, in 2004,

Taiwan was the fourth largest IT producer in the word, following only the U.S., Japan, and China (Jhan, 2004). Many scholars attribute this success to its complete IT industry clusters, with close cooperative relationships between upstream and downstream industrial value chains[1] to get support in information sharing, manufacturing, logistics, and innovation (Chang and Tsai, 2002). Therefore, the Taiwanese information electronics industry provides a unique setting to investigate the linkages between a firm's external networks and business value creation. Since many countries in the world, especially China in which Taiwanese businessmen have made vast amounts of investments, are trying to imitate the successful business model of Taiwanese high-tech firms, it is worthwhile to uncover the successful networking practices in Taiwanese information electronics industry.

We have studied 968 firms with executives that accepted an outside board position, between 1996 and 2003, where both the sending firm (the firm at which the executive is employed) and the receiving firm (the firm that the individual is nominated to join) are publicly traded and in the information electronics industrial value chain. Using details from top executives and board of directors' lists obtained from company proxy statements and annual reports, we create a central measure of the firm-specific network position of the receiver firm that the executive is nominated to and relate it to 7 firm-specific business value creation measures, spanning two groups: *increased customer benefits* and *reduced organizational costs*.[2] Through regression analysis, we find that sender firms create more economic valued added (EVA) from having their executives join an outside board when the receiver firm has a more central position in the industrial value chain. In addition, the more central a position the vertically-connected receiver firm has in the industrial network, the more business value of *reduced organizational costs* the sender firm creates. In contrast, the more

[1] The industrial value chain is defined as the linked set of value-creating activities from basic raw materials to the disposal of the finished product by customers.

[2] Snell et al. (1996, p.65) defined value as the ratio of benefits derived relative to the costs incurred (value = benefits/costs). Therefore, value creation occurs through *increased customer benefits*, *reduced organizational costs*, or both.

central a position the horizontally-connected receiver firm has in the industrial network, the more business value of *increased customer benefits* the sender firm creates.

This study complements prior studies on network and non-financial indicators, in several ways. Differing from recent studies that only link a firm's external ties to some single and generic organizational outcome, this study considers a complete array of external ties' impacts on business value creation. Although the basic links between external ties and organizational outcomes, such as innovation, are on the whole persuasive, the finer aspects of how top executives form external ties remain unconnected to the specific types of values created by organizations. This gap in understanding is of very important, given that firms invest significant resources to develop their social capital, often with a strategic need to enhance a specific type of value to get a competitive advantage. This study is an attempt to address this issue and therefore refine and extend comprehension of the network-value creation link. To the extent that an executive's primary employer implicitly or explicitly permits an executive to accept an outside board seat, an understanding of the conditions that may be beneficial to the executive's employing firm (the sender firm) is important. Second, this study uses objective, publicly-available data, rather than subjective data from questionnaires, to measure firm value creation and the quality of top executive network ties, which avoids response biases. In addition, this study will contribute to the stream of recent accounting literature that seeks to understand the link between non-financial leading indicators and value creation (e.g., Ittner and Lacker, 1998; Banker, Potter and Srinivasan, 2000; Nagar and Rajan, 2001). By showing which forms of external ties are most highly related to business value creation in general and to the various aspects of value in particular, our evidence is important to readers of financial statements wishing to know where to focus if they seek to identify what kind of external ties are most highly associated with business value creation.

We review the literature regarding the impact of the network relationships of firms on their behavior and outcomes and provide a hypothesis for this study in section two. In section three,

we provide the research methodology for this paper. The fourth section presents the data analyses and discussions. In the final section, we conclude the paper and provide suggestions.

2. Literature review and hypothesis development

2.1 Top executives' directorate networks

Much recent empirical research has considered the effect of network ties on a firm's behavior and outcome (e.g., Powell et al., 1996; Ahuja, 2000a; Zaheer and Bell, 2005). External networks have been demonstrated to be able to help firms acquire and combine new skills and knowledge at low costs (Gulati, Nohria, and Zaheer, 2000), to better forecast the future demands of the market and anticipate customer preference (Uzzi, 1997), and to stimulate innovation (Ahuja, 2000a; Salman and Sives, 2005) and intellectual capital creation (Nahapiet and Ghoshal, 1998). Based on these benefits, external network ties lead to higher market share, firm growth and financial performance (Powell et al., 1996; Gulati et al., 2000; Zaheer and Bell, 2005).

There are many ways to build external network ties that facilitate inter-firm collaboration. This study focuses on an external network established by senior executives using directorships. This is because executives' external directorships are the most influential of external ties, given the direct involvement of executives both in the acquisition of information and in internal decision-making (Mizruchi, 1996). The decision by an executive to accept an outside directorship can enhance shareholder value in his or her own firm through (1) reducing the level of uncertainty about resource availability (e.g., Mizruchi and Stearns, 1988), (2) learning about different management styles or strategies used in other firms (Booth and Deli, 1996, and Carpenter and Westphal, 2001) and (3) gaining important legitimacy and status benefits (Podolny, 1994). In light of these arguments and theories, a top executive's directorate network is strategically valuable, and thus, contributes to a firm's value creation and competitive advantages.

As to the quality of a top executive's directorate network, this study focuses on the network position (centrality) of the receiving firm, with the sender-firm's executive sitting on its board, and it is used to measure the quality of external networks that the sender-firm's executive holds. Positioning is critical because firms that are more centrally embedded in the network accrue more power and enjoy superior access to other firms' information and resources (e.g., Pfeffer, 1991).

2.2 Vertical ties and value creation

Different type of networks may have varying impacts on a firm's behavior and performance. In the strategic network literature, business networks are classified as vertical or horizontal ties (Blankenburg Holm, Eriksson, and Johanson, 1996; Johanson and Mattsson, 1988). Vertical networks are the relationships that firms form with customers, suppliers and distributors, while horizontal linkage networks are those formed with other firms (including competitors), research institutes and universities (Brown and Butler, 1995; Wilson and Appiah-Kubi, 2002).

Prior literature indicates that vertical ties are associated with a broad range of benefits (Wilson and Appiah-Kubi, 2002). For example, collaboration with suppliers helps firms create easier access to supplier knowledge and expertise (Conway, 1995; Lorenzoni and Lipparini, 1999), reduce product cost (Lipparini and Sobrero, 1994), improve quality of purchased material, reduce product development time (Ragatz, Handfield, and Scannell, 1997; Ritter and Gemünden, 2003), and identify improvements to remain competitive (Lincoln, Ahmadjian, and Mason 1998). All of these activities are most likely to increase production, service delivery efficiencies and reduce organizational costs.

A top executive's vertical directorate network may also be instrumental in improving customer benefits. Networks of customers, suppliers, and the like, should be able to better identify, as well as satisfy, customer needs by quickly providing an array of different services

or products suitable for use. In particular, the network relationships with customers allow firms to discover new customer needs (Bruce and Rodgus, 1991), study the market potential of product ideas (Gemünden, Heydebreck, Herden, 1992), and facilitate the development of novel solutions to customer needs (Hamel and Prahalad, 1994).

2.3 Horizontal ties and value creation

Horizontal linkages should reduce organizational costs by increasing an organization's information processing capability. The creation of lateral networks through directorate ties reduces costly information flow between partners. Furthermore, the transfer of knowledge through horizontal networks allows organizations to coordinate and integrate diverse streams of technology. This helps firms efficiently access state-of-the-art technology and knowledge to enhance their ability to exploit new technology and products (Shu et al., 2005), and avoid costly innovative duplications (Wilson and Appiah-Kubi, 2002). Stated differently, horizontal networks enable organizations to more efficiently utilize their knowledge-base and reduce redundancies in innovation.

Top executive horizontal directorate networks may also help organizations extend customer benefits. This is most likely driven by increasing quality, reliability, and flexibility through production and service innovations (Ahuja, 2000a; Shu et al., 2005). Collaboration between horizontal competitors that have different capabilities can help a firm more effectively overcome product design or development barriers (Tunisini and Zanfei, 1998), capture value from successful commercialization of technology and ideas (Teece, 1989), and enjoy strong sales growth (Feeser and Willard, 1990). Based on the theories and literature described above, we expect that the centrality of the receiver firm's position in the industrial network (the quality of top executives' directorate network) to be positively related to the business value creation of the sender firm.

3. Research method

3.1 Empirical model

Two regression equations are used to investigate the expectations of this study. They are expressed as follows:

$$VC_{i,t+1} = \alpha_0 + \alpha_1 NETWORK_{it} + \alpha_2 RDS_{it} + \alpha_3 EP_{it} + \alpha_4 MB_{it} + \alpha_5 DIVSFI_{it} + \alpha_6 SIZE_{it} + \alpha_7 AGE_{it} + \sum_{k=1996}^{2002} c_k YEAR_t + \varepsilon_{it} \quad (1)$$

$$VC_{i,t+1} = \beta_0 + \beta_1 NETWORK\_V_{it} + \beta_2 NETWORK\_H_{it} + \beta_3 RDS_{it} + \beta_4 EP_{it} + \beta_5 MB_{it} + \beta_6 DIVSFI_{it} + \beta_7 SIZE_{it} + \beta_8 AGE_{it} + \sum_{k=1996}^{2002} c_k YEAR_t + \varepsilon_{it} \quad (2)$$

Where:

VC_{it+1}	=	Value creation of firm i in year t+1, including *EVA* and various measures of *increased customer benefits* and *reduced organizational costs*, as described later;
$NETWORK_{it}$	=	The centrality of top executive networks of firm i in year t
$NETWORK\_V_{it}$	=	The centrality of top executive vertical ties of firm i in year t
$NETWORK\_H_{it}$	=	The centrality of top executive horizontal ties of firm i in year t
RDS_{it}	=	Ratio of R&D expenditures to sales for firm i in year t
EP_{it}	=	Employee productivity for firm i in year t
MB_{it}	=	Ratio of market-to-book value for firm i in year t
$DIVSFI_{it}$	=	Diversification of firm i in year t
$SIZE_{it}$	=	Size of firm i in year t
AGE_{it}	=	Age of firm i in year t
$YEAR_t$	=	Year dummy
ε_{it}	=	Error term

Value creation is a one-year time-delayed measure to take account of the possibility that top executives' networks have a lagged impact on value creation and avoid the endogeneity problem. Least-square regression is used to estimate equation (1) and (2). We use the negative binomial regression model to estimate these equations when the dependent variable is the number of patents or trademarks, since these two variables are count variables and take only non-negative integer value. We expect that network variables are positively associated with *EVA* and the variables measuring *increased customer benefits* and *reduced organizational costs*.

3.2 Variable measurement

3.2.1 Dependent variables

Economic value added. Value creation for a firm is measured by economic value added (*EVA*). Under conventional accounting, all performance measures do not completely capture intangible assets or intellectual capital performance. Asset-based performance measures such as ROA, for example, tend to overstate the performance impacts of intellectual capital because they understate an organization's capital base. Sales-based metrics may also overstate the performance benefits of intellectual capital because they do not take the cost of developing and utilizing such capital into account. Thus, *EVA*, which is most directly linked to the creation of shareholder wealth over time, is the best practical periodic performance measure (Stewart, 1991). The calculation of *EVA* is net operating profit minus an appropriate charge for the opportunity cost of all capital invested in a firm:

EVA=net operation profit－investing capital × firm's cost of capital.

Based on Stewart's (1991) estimate, the firm's cost of capital is a riskless rate, captured by the certificate of deposit rate for one year for The First Commercial Bank in Taiwan and adds the beta[3] multiplied by the estimate of market risk premium.[4] Moreover, according to Stern Stewart & Co.'s adjustments to accounting measures of operating profits and capital, we select some adjustments that require data to be objectively retrieved from the Taiwan Economic Journal (TEJ) database to adjust the net operation profit and investing capital, which reduces the effect of Generally Accepted Accounting Principles (GAAP) on the measurement of true economic profit. The items, calculations, and reasons for adjustment are presented in Table 1.

<<Insert Table 1 Here>>

Additionally, a variety of variables are used to identify the source of value creation. Creating value through *increased customer benefits* stems from either customer intimacy or product/service leadership, while creating value through *reduced organizational costs* is the

[3] The beta is estimated by a regression of the firm's stock returns over 60 quarters against the returns on the market index.

[4] The estimate of market risk premium is constituted by excess return, which is average common stock returns, based on the returns to TSE index, minus the riskless rate of 1.74 percent over the 1996-2003 periods.

result of operational excellence (Treacy and Wiersema, 1993).

Increased Customer Benefits. Three variables are employed to assess the value created for increasing benefits provided to customers, including the number of registered patents and trademarks received by firms in a given year, as well as a firm's sales growth rate. Innovations in both product design and manufacturing result in increased customer benefits through both satisfying customer needs and achieving leadership in the market. In rapidly evolving fields, such as information electronics, innovation is essential in order to stay one step ahead of customer expectations. The number of patents is a meaningful measure of innovative performance because patents are directly related to inventiveness, representing an externally validated measure of technological novelty (Griliches, 1990), conferring property rights on the assignee, and they therefore also have economic significance (Kamien and Schwartz, 1982). Except for patents, we also use the number of trademarks granted to a firm in a given year to measure increased customer benefits. By delivering customers the goods or services that can meet the values that the trademark represents, trademarks can motivate the customer to engage in repeat business and command a higher price premium. Finally, all the increased customer benefits derived from patents and trademarks, which directly help to enhance customer loyalty, will translate into more business opportunities and led to greater sales revenues. Sales growth is generally indicative of technical quality, market acceptance, and the perception of differentiated advantages (Feeser and Willard, 1990). Therefore, we also use the ratio of sales growth as a proxy for increased customer benefits.

Reduced Organizational Costs. There are also three variables utilized to measure the value created for reducing production and service delivery costs through operational excellence, namely the cost of goods sold, the selling and administration expenses (both scaled by sales) and the total asset turnover. The total asset turnover, a measure of the firm's ability to generate revenues from its assets, is defined as the ratio of sales to average book value for total assets.

3.2.2 Independent variables

Top executive external directorate networks

Four unique aspects of relational measures that tap the centrality of ties held by top executives (the receiver firms) are adopted in this study (Freeman, 1979; Salman and Saives, 2005): *degree*- which taps the extent of a firm's interaction with other members of the network and is a measure of the potential for activity; *betweenness*- which gauges the extent to which a firm is a key intermediary-i.e., in a position to control communication or resource exchange; *closeness*- which gauges a firm's independence from other members of the network; and finally *eigenvector,* which refers to the extent to which a firm is central because of the centrality of the firms to which it has ties. First, we build a matrix of pair-wise directorate ties among all members of information electronics firms listed on the Taiwan Stock Exchange (TSE) and Taiwan's computerized over-the-counter market (known as the GreTai Securities Market, GTSM) using proxy statements and annual report data. The interlock list is input into the UCINET v.5 network analysis program (Borgatti et al., 1999), and centrality measures for each member of the information electronics firms in the TSE and GTSM are generated. Finally, the data is matched with the list of ties held by each of the top executives in our sample, and the average degree, betweenness, closeness, and eigenvector centrality of firm level are then created. In Taiwan, directors are responsible for managing the firm,[5] and thus we define top executives as both directors and senior executives in a position higher than a vice general manager.

Vertical/Horizontal ties

We classify top executive directorate networks as either vertical or horizontal ties. The industrial value chain in the Taiwanese information electronics industry is formed by a

[5] Specific director responsibilities include the following: managing business operations, appointing, dismissing, and compensating management, appointing, dismissing, and compensating external auditors, legally representing the firm within the limits of its authority and approving equity and debt issues.

connection of upstream, midstream and downstream information electronics firms (see Fig. 1). Vertical ties entail top executives accepting directorships for their upstream (supplier) or downstream (customer) firms in different industrial value chain levels from that of the focal firm. In contrast, horizontal ties involve top executives accepting directorships at their allied firms in the same industrial value chain level as the focal firm.

<<Insert Figure 1 Here>>

3.2.3 Control variables

According to prior literature, we control for several exogenous variables that could influence firm value creation. Control variables include *R&D expenditures, employee productivity, market-to-book ratio, diversification, firm size,* and *firm age.* In the knowledge economy, intellectual capital is a critical resource for creating firm value (Edvinsson and Malone, 1997; Lev, 2001). We use *R&D expenditures*, scaled by sales, and *employee productivity*, defined as the contribution of sales (in thousands) per employee, to control the effects of innovation capital and human capital on value creation, respectively. Moreover, the market-to-book ratio may be a valid, simple and widely-used indicator to roughly capture intellectual capital (Edvinsson and Malon, 1997; Sveiby, 1997; and Sàenz, 2005). Thus, we use *market-to-book ratio* to control the residual effects of intellectual capital on value creation, which may not be captured by innovation capital and human capital. Diversification is another critical factor affecting firm value. However, the empirical evidence about its effects on firm value is mixed (Martin and Sayrak, 2003). We use Palepu's (1985) dt entropy to measure *diversification* without exact predication on the sign of this variable. It is conventional to control for firm-size effects in analyses of firm value/performance (Keats and Hitt, 1988). The natural log of the number of employees is used to proxy *firm size*. We also include *firm age*, measured by the number of years in which the firm has been in existence, to account for the high rate of business failures in young firms (Ittner and Larcker, 1998). Finally, year dummies are included to control for aggregate economic effects and any other effects that may be

specific to that year. Robust standard errors are reported, since multiple observations for each firm are included in the sample.

3.3 Sample selection and data source

Taiwan's information electronics firms are used to examine the relationships between top executives' networks and a firm's value creation for several reasons. First, the information electronics industry is the most important industry for Taiwan. Second, vertical and horizontal ties have been and continue to be significant features for this industry (Ma, 2000). In this industry, most research and development projects rely, to a significant extent, on new technological knowledge that is gained from external sources (Wong, Shaw, and Sher, 1998). Third, focusing on a single industry can reduce the effects of differences in field on empirical results.

Our sampling pool begins with 2437 observations over an eight-year period (1996-2003) for 629 firms listed on the TSE and GTSM. The sample is then selected according to the following three criteria: (1) all observations in the sample have their fiscal year ending on December 31 to ensure comparable data analysis; (2) following the convention of prior studies, all observations in the sample have at least one external directorate tie to prevent introducing the spurious variance that would have resulted from setting top executive networks variables equal to zero (cf., Geletkanyz, Boyd, and Finkelstein, 2001); (3) all observations have data available in the Taiwan Economic Journal (TEJ) and Intellectual Property Office (IPO) databases in Taiwan. The complete sample consists of 968 observations that met the above criteria. With regards to the data collection, financial and stock price data were obtained from the Taiwan Economic Journal (TEJ) database. In addition, we collected patent and trademark data from the Intellectual Property Office (IPO) database in Taiwan. Finally, several sources were used to identify network relationships between information electronics firms in the industrial value chain, including annual reports, company proxy statements, the Excellent Business Database System (EBDS) and the News Knowledge Database.

4. Results

4.1 Descriptive statistics and correlations

Table 2 presents the descriptive statistics and correlations for all the variables used in the study. The sample firms have average *EVA* of about NT$0.42 billion and average sales growth rates of about 21%. On average, sample firms acquired 14 patents and 2 trademarks a year. The cost of goods sold was 82% of the sales for the average firm, resulting in meager gross profit that was just barely enough to support sales and administration expenses (8% of sales) and R&D expenses (5% of sales). The sample firms had an average market-to-book ratio of about 2.13, average diversification index of about 0.33, average number of employees of 1081, and average age of 17 years.

Since the bivariant correlations of the four centrality variables (degree, closeness, betweenness, and eigenvector) are relatively high (correlation coefficients ranging from 0.30 - 0.71), questions arise as to the effects of multicollinearity. Factor analysis is used to reduce the four centrality variables into one factor, named "*NETWORK*" (alpha=0.82), and we used its factor score for regression analysis. The same method was used to measure network centrality of top executive vertical (*NETWORK_V*) and horizontal ties (*NETWORK_H*). Consequently, the resulting low inter-correlation among all explanatory variables used in the model indicates no reason to suspect multicollinearity.

<<Insert Table 2 Here>>

4.2 Regression results for the impact of top executives' networks on EVA

The results of the OLS regression runs of two models for the impact of top executives' networks on *EVA* are presented in Table 3. As shown in Table 3, these two models have significant explanatory power, with adjusted R^2s of about 0.20. The coefficient of *NETWORK* is significantly positive (p-value < .05). Moreover, when top executive vertical and horizontal

ties are differentiated, the results of model (2) show that both the coefficients of *NETWORK_V* and *NETWORK_H* are significantly positive (p-value <.05) for *EVA*. In short, these results suggest that the centrality of the receiver firm's position in the industrial network does matter to the business value creation of the sender firm and thus supports the expectation that the more centrally located the top executives' directorate networks (including both the vertically and horizontally-connected ties), the more business value the top executive's employing firm may create.

Several coefficients of the control variables are also significant. R&D input (*RDS*), a measure of a firm's innovation capital, is significantly and positively associated with *EVA*, as expected. The coefficient on employee productivity (*EP*), a measure of firm human capital, is positive and significant. Moreover, Market-to-book ratio (*MB*) is also positive and significant. Consistent with the resource-based view of the firm (Barney, 1991), these results suggest that intellectual capital is critical to creating firm value. Finally, consistent with earlier studies (cf., Robins and Wiersema, 1995), the firm size (*SIZE*) is significantly and positively associated with firm performance.

<<Insert Table 3 Here>>

4.3 Regression results for the impact of vertical and horizontal ties on value creation

Table 4 provides empirical results for the impact of the centrality of top executive vertical and horizontal ties on *increased customer benefits* and *reduced organizational costs*, respectively. As shown in Table 4, *NETWORK_H* is significantly and positively associated with the variables measuring *increased customer benefits* (with all p-values<.05), including grant of patents (*PT*), grant of trademarks (*TM*), and sales growth rate (SGW), while the association between *NETWORK_H* and the variables measuring *reduced organizational costs* are not significant. These results indicate that sender firms produce significantly higher business value for *increased customer benefits* from having one of their executives join an

outside board of an allied firm in the same level of industrial value chain as the sender firm, as well as when the receiver firm is more centrally located in the industry. Based on the above information, successful firms often require horizontal ties that facilitate firm collaboration with horizontal peer firms with different capabilities to access complementary know-how that boosts a firm's innovation, commercializes new technologies, and exploits new markets.

In contrast, *NETWORK_V* is significantly and negatively associated with cost of goods sold (*COGS*) and selling and administration expense (*SGA*), with p-values<.05. In addition, *NETWORK_V* is positively associated with total asset turnover (*ATO*), a measure of a firm's operational excellence, with a marginal significance level of 10%. Overall, these results indicate that sender firms produce significantly higher business value for *reduced organizational costs* from having one executive join an outside board when the receiver firm is in a different industrial value chain level and is more centrally located in the industry. However, although *NETWORK_V* is positively associated with variables measuring *increased customer benefits*, the relationships are not significant. These results are consistent with Lipparini and Sobrero (1994), arguing that the primary benefits from vertical networks are cost reduction and operational excellence.

This section summarizes the results of the control variables in Table 4. Overall, intangible assets, measured by R&D input (*RDS*), employee productivity (*EP*) and market-to-book ratio (*MB*) are significant determinants of business value creation. Specifically, the created business value is manifested in the increase in the number of patents and trademarks granted (*increased customer benefits*), lower costs and higher asset turnover rate (*reduced organizational costs*). The coefficients of diversification (*DT*) are positively significant for patents (*PT*) and trademarks (*TM*), with p-values<.05, suggesting that diversification can enhance innovation and commercialization by providing a stimulus of multiple knowledge bases within a single firm, leading to cross-fertilization of ideas (Ahuja, 2000a). In addition, the diversification (*DT*) is significantly and positively associated with total asset turnover (*ATO*) (p-value<.01),

indicating that firms may transfer their excess capacity to other industries to efficiently utilize their assets by adopting diversification strategies (Montgomery, 1994). For firm size (*SIZE*), the coefficients are significant and positive for patents (*PT*) and trademarks (*TM*) (with p-values<.01), implying that the large firms may enjoy advantages for technological innovation (Lin and Chen, 2005). Furthermore, firm size (*SIZE*) is significantly and negatively associated with cost of goods sold (*COGS*) and selling and administration expense (*SGA*), reaching a significance level of 1%, suggesting that Taiwanese information electronics firms enjoy the economy of scale benefits of bigger businesses. As to firm age (*AGE*), we find that older firms not only have poorer innovation and sale growth performance, but also incur higher operating cost and lower efficiency of total asset utilization. This result suggests that Taiwanese information electronics firms, operating in an environment with uncertainty and ambiguity in the innovation process, need efforts to overcome innovation inertia and operational inefficiency, as time passes. Finally, for the results of negative binomial regression, the estimated alpha coefficients are positive and significantly different from 0 (with p-values <.01), indicating that there are significant firm-level unobserved effects in the data that are captured by the heterogeneity parameter.

<<Insert Table 4 Here>>

5. Conclusions

As modern organizations become increasingly interconnected and move toward network-based models of competition, it can be expected that top executive directorate networks are likely to become an increasingly important value driver. In addition, to create and sustain a competitive advantage, a firm must understand the entire value chain in order to identify its strategically important activities and the linkages among activities both internal and external to the firm. In this study, we examine which kind of directorate network (vertical or horizontal) is most associated with seven business value creation measures. No research exists

regarding what kind of top executive external directorate networks relate most/least highly to a large set of value creation measures. This information is valuable to those who are interested in linking top executive external directorate networks to performance.

This study empirically demonstrates the positive association between *EVA* and the centrality measure of top executives' directorate networks in Taiwan's information electronics industrial value chain. In addition, we find that specific relationships will be important for creating particular business values. Our research is helpful for understanding the role of top executive external networks in the creation of business value for corporations, and thus, can offer guidelines to sender firms (i.e., the executive's employing firm) and their boards as to conditions under which the nomination of an executive to an outside board is likely to enhance shareholder value. We suggest that firms employ different types of networks, according to the strategies pursued, and hence acquire different resources and create different business values. Specifically, firms can enhance innovation performance and sales growth through building centrally-networked horizontal ties and obtaining complementary resources such as state-of-the art technology. In contrast, firms can effectively reduce product costs and increase efficiency of asset utilization through building centrally-networked vertical ties and acquiring resources such as supplier knowledge and distribution channels.

The network position of the receiver-firm could be considered an intangible strategic resource for information electronics firms. We argue that it is possible to assess the quality of an executive's external directorate networks and the potential contribution of this valuable resource to the creation of business value. The network centrality measures used in this study to assess the quality of an executive's "social capital" could be used to broaden "balanced scorecard" type business performance measurement systems. Furthermore, qualitative measures of top executive relationship networks can be used by external analysts and investors to learn to what extent firms are capable of leveraging relationships with other firms, and thereby better predict future firm performance and value. Finally, to accounting regulators, improvements in disclosures of

non-financial metrics about the identity, source, and strength of external networks would help readers of financial statements be aware of the importance of external corporate relationships and the competitive advantage they may create for a firm.

For business network literature, our analysis could offer significant evidence of what kind of benefits are brought by vertical and horizontal ties in the value creation process. However, in order to determine the generalization of these conclusions, future studies of top executive directorate networks should involve broader, cross-sector sampling, to ensure that the benefits of vertical and horizontal networks are not unique to information electronics firms.

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Table 1

Adjustments of operating profits and investing capital

Adjustment Item	Net Operating Profit after Taxes (operating income－cost of goods sold－operating expense)×(1－effective tax rate)	Capital (current assets－current liabilities without interest expense)＋fixed assets＋net book value of other assets	Adjustment Reason
R&D expenditure and advertising expenditure	＋ R&D expense and advertising expense － Amortization expense of R&D assets and advertising assets	＋ R&D assets and advertising assets	Under present accounting principles, R&D expenditures and advertising expenditures are expended in the current year. Recent research has shown that these expenditures generate a future stream of benefits. Thus, based on present accounting principles, true profits and capital are underestimated.
Bad debt expense	＋ Bad debt expense － Loss from uncollectible accounts receivable	＋ Allowance for doubtful accounts	Adjustment for bad debt expense can reflect accounting numbers on a cash basis.
Deferred income tax account	＋ (－) Deferred income tax expense (benefit)	－(＋) Increases (decreases) of deferred income tax assets ＋(－) Increases (decreases) of deferred income tax liabilities	The tax expense, presented in financial statements on an accrual basis, does not reflect real taxes owed for the period. Thus, we adjust deferred income tax items to reflect accounting numbers on a cash basis.
Income or loss from discontinued operation	－(＋) Income (loss) from discontinued operation	－(＋) Income (loss) from discontinued operation	Income or loss from discontinued operation is not regular for operation of the firm.
Construction in process	--	－ Construction in process	Construction in process is not an asset that creates economic benefit.

Table 2

Descriptive statistics and correlations

Variable	Mean	Std.	Correlation Among Variables																								
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.
1. EVA (billion)	0.42	3.76																									
2. PT	13.20	67.54	0.36[a]																								
3. TM	1.54	7.08	0.14[a]	0.14[a]																							
4. SGW	0.21	0.42	0.26[a]	0.05[c]	0.02																						
5. COGS	0.82	0.14	-0.20[a]	-0.07[b]	-0.02	-0.24[a]																					
6. SGA	0.08	0.06	-0.15[a]	-0.05[c]	-0.03	-0.23[a]	-0.06																				
7. ATO	0.88	0.51	0.15[a]	-0.08[a]	0.02	0.27[a]	0.18[a]	-0.41[a]																			
8. NETWORK	<.01	1.00	0.09[a]	0.09[a]	0.07[b]	0.01	-0.03	-0.13[a]	0.07[b]																		
9. DEGRESS	1.63	0.92	0.09[a]	0.06[c]	0.06[c]	0.03	-0.05	-0.12[a]	0.06[c]	0.92[a]																	
10. CLOSENESS	13.99	5.57	0.07[b]	0.09[a]	0.04	-0.01	-0.01	-0.16[a]	0.07[b]	0.82[a]	0.66[a]																
11. BETWEENNESS	1.13	0.97	0.08[a]	0.10[a]	0.16[a]	-0.03	-0.01	-0.04	<.01	0.74[a]	0.57[a]	0.57[a]															
12. EIGENVECTOR	5.61	9.81	0.06[c]	0.02	-0.01	0.04	-0.04	-0.08[a]	0.10[a]	0.75[a]	0.71[a]	0.43[a]	0.30[a]														
13. NETWORK_V	<.01	1.00	0.06[b]	0.04	-0.02	0.02	-0.08[a]	-0.09[a]	0.06[b]	0.62[a]	0.59[a]	0.47[a]	0.42[a]	0.53[a]													
14. DEGRESS_V	1.34	1.17	0.07[b]	0.09[a]	-0.01	0.04	-0.05[c]	-0.07[b]	0.04	0.67[a]	0.72[a]	0.49[a]	0.41[a]	0.53[a]	0.94[a]												
15. CLOSENESS_V	11.10	7.85	0.07[b]	0.13[a]	-0.01	0.01	-0.03	-0.08[a]	0.05	0.57[a]	0.50[a]	0.62[a]	0.37[a]	0.35[a]	0.87[a]	0.82[a]											
16. BETWEENNESS_V	0.96	1.19	0.04	0.11[a]	0.03	-0.01	0.01	<.01	0.01	0.54[a]	0.43[a]	0.41[a]	0.67[a]	0.25[a]	0.80[a]	0.69[a]	0.65[a]										
17. EIGENVECTOR_V	5.12	9.96	0.08[a]	0.04	-0.01	0.04	-0.06[c]	-0.05	0.06[b]	0.66[a]	0.62[a]	0.39[a]	0.29[a]	0.86[a]	0.73[a]	0.71[a]	0.50[a]	0.40[a]									
18. NETWORK_H	<.01	1.00	0.08[b]	0.10[a]	0.08[a]	0.09[a]	-0.01	-0.09[a]	0.03	0.60[a]	0.53[a]	0.51[a]	0.44[a]	0.47[a]	<.01	0.13[a]	0.11[a]	0.05	0.29[a]								
19. DEGRESS_H	1.29	1.11	0.09[a]	0.05[c]	0.07[b]	0.05	-0.03	-0.10[a]	0.04	0.65[a]	0.67[a]	0.51[a]	0.41[a]	0.49[a]	0.16[a]	0.31[a]	0.24[a]	0.16[a]	0.34[a]	0.94[a]							
20. CLOSENESS_H	11.36	7.60	0.07[b]	0.07[b]	0.05	0.03	<.01	-0.11[a]	0.02	0.55[a]	0.43[a]	0.66[a]	0.40[a]	0.29[a]	0.11[a]	0.21[a]	0.26[a]	0.20[a]	0.23[a]	0.86[a]	0.80[a]						
21. BETWEENNESS_H	0.88	1.07	0.07[b]	0.05[c]	0.14[a]	0.02	-0.01	-0.04	-0.03	0.53[a]	0.41[a]	0.44[a]	0.68[a]	0.23[a]	0.02	0.13[a]	0.15[a]	0.19[a]	0.16[a]	0.81[a]	0.69[a]	0.64[a]					
22. EIGENVECTOR_H	4.49	9.57	0.04	0.02	<.01	0.03	-0.03	-0.09[a]	0.09[a]	0.62[a]	0.58[a]	0.37[a]	0.24[a]	0.84[a]	0.31[a]	0.35[a]	0.24[a]	0.13[a]	0.61[a]	0.69[a]	0.68[a]	0.45[a]	0.37[a]				
23. RDS	0.05	0.05	-0.06[b]	0.12[a]	<.01	0.09[a]	-0.33[a]	0.33[a]	-0.21[a]	-0.05[c]	-0.07[b]	-0.04	-0.02	-0.04	0.04	0.01	0.08[a]	0.05	-0.02	-0.02	-0.02	<.01	-0.01	-0.01			
24. EP	10.44	16.89	0.20[a]	0.06[c]	0.07[b]	0.01	0.15[a]	-0.24[a]	0.48[a]	0.07[b]	0.03	0.11[a]	0.05	0.06[c]	0.04	0.02	0.04	0.03	0.08[b]	0.06[b]	0.04	0.10[a]	0.03	0.04	-0.14[a]		
25. MB	2.13	1.48	0.36[a]	0.15[a]	0.07[b]	0.27[a]	-0.32[a]	-0.18[a]	0.27[a]	0.05	0.11[a]	-0.05	0.02	0.06[b]	0.10[a]	0.14[a]	0.05	0.06[c]	0.10[a]	0.02	0.07[b]	-0.02	0.01	0.05	0.11[a]	0.17[a]	
26. DT	0.33	0.38	0.01	0.01	0.02	-0.02	0.03	-0.04	0.14[a]	-0.01	<.01	-0.06[b]	0.05	<.01	0.08[a]	0.06[c]	0.03	0.11[a]	-0.02	-0.14[a]	-0.13[a]	-0.16[a]	-0.08[a]	-0.03	-0.03	0.06[c]	0.06[b]
27. EMPLNO	1081	2014	0.16[a]	0.45[a]	0.16[a]	0.02	0.07[b]	-0.13[a]	-0.07[b]	-0.02	0.01	-0.07[b]	0.03	-0.02	0.05	0.06[c]	0.04	0.07[b]	<.01	-0.01	<.01	-0.02	0.03	<.01	-0.02	-0.03	0.09[a]	0.10[a]
28. AGE	16.71	7.65	-0.08[b]	0.01	0.04	-0.11[a]	0.21[a]	0.01	-0.06[c]	-0.09[a]	-0.07[b]	-0.16[a]	-0.05[c]	-0.03	-0.06[c]	-0.06[b]	-0.12[a]	-0.06[c]	-0.05[c]	-0.15[a]	-0.17[a]	-0.23[a]	-0.09[a]	-0.04	-0.22[a]	0.03	-0.18[a]	0.25[a]	0.27[a]

Note: The number of observations is 968. 2. [a] significant at p<0.01, [b] significant at p<0.05, [c] significant at p<0.1. 3. EVA is the economic value added in year t+1. PT is the number of inventive patents granted in year t+1. TM is the number of trademarks granted in year t+1. SGW is the sales growth rate in year t+1. COGS is the cost of goods sold in year t+1, scaled by sales. SGA is the sales and administration expense in year t+1, scaled by sales. ATO is the total asset turnover in year t+1. NETWORK is a measure of top executives' network relationships, which is a factor score of degree centrality (*DEGREE*), closeness centrality (*CLOSENESS*), betweenness centrality (*BETWEENNESS*), and eigenvector centrality (*EIGENVECTOR*). NETWORK is further classified as vertical network relationships (*NETWORK_V*) and horizontal network relationships (*NETWORK_H*), where *NETWORK_V* is a factor score of degree centrality of vertical linkages (*DEGREE_V*), closeness centrality of vertical linkages (*CLOSENESS_V*), betweenness centrality of vertical linkages (*BETWEENNESS_V*), and eigenvector centrality of vertical linkages (*EIGENVECTOR_V*) and *NETWORK_H* is a factor score of degree centrality of horizontal linkages (*DEGREE_H*), closeness centrality of horizontal linkages (*CLOSENESS_H*), betweenness centrality of horizontal linkages (*BETWEENNESS_H*), and eigenvector centrality of horizontal linkages (*EIGENVECTOR_H*). RDS is the R&D expenditure, scaled by sales. EP is the employee productivity. MB is the market-to-book ratio. DT is the Entropy measure of firm diversification. EMPLNO is the number of employees. AGE is firm age, which is defined as the number of years for which a firm has been in existence.

Table 3

Regression of EVA on Top Executives' Networks

Variable	Pred. Sign	Dependent variable: EVA in year t+1	
		(1)	(2)
Intercept	?	-3.5851**	-3.5736**
		(1.7232)	(1.7477)
NETWORK	+	0.1798**	
		(0.0888)	
NETWORK_V	+		0.4074***
			(0.1463)
NETWORK_H	+		0.1418**
			(0.0802)
RDS	+	5.8777**	6.0157***
		(2.5274)	(2.4922)
EP	+	0.0269**	0.0269**
		(0.0156)	(0.0155)
MB	+	0.9508***	0.9499***
		(0.2705)	(0.2730)
DT	?	-0.0528	-0.0235
		(0.2428)	(0.2479)
SIZE	+	0.4946***	0.4898***
		(0.1936)	(0.1959)
ln (AGE)	+	-0.2610	-0.2501
		(0.2539)	(0.2541)
Adjusted R-squared		0.1910	0.2197
model F(p)		17.3121	16.0927
		(<.0001)	(<.0001)
white test F(p)		7.1022	6.4189
		(<.0001)	(<.0001)

Notes: 1. Standard errors are in parentheses. 2. *** significant at p<0.01, ** significant at p<0.05, * significant at p<0.10. 3. All VIFs <2.5. 4. Please refer to Table 2 for variable definitions. 5. In all cases, the estimated standard errors have been adjusted using White's (1980) heteroskedasticity adjustment. 6. n=968.

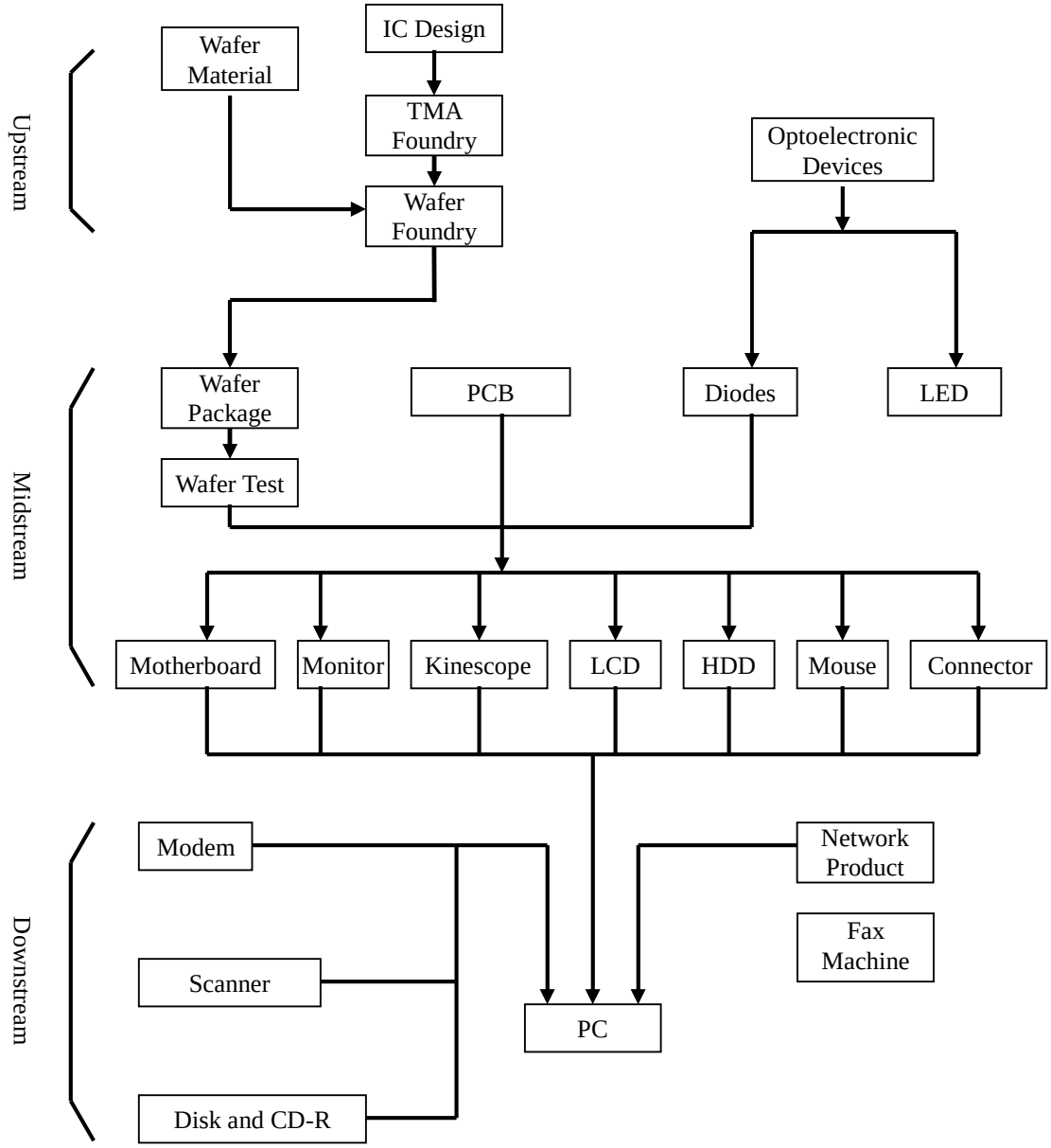
Table 4
Regression of Business Value Creation on Vertical and Horizontal Linkage Networks

Dependent variable: Value creation (VC_{t+1})

Variable	Pred. Sign	Value creation					
		Increased customer benefits			Reduced organizational costs		
		PT	TM	SGW	COGS	SGA	ATO
Intercept	?	-8.5420***	-4.9721***	0.2639**	0.7255***	0.1207***	1.0347***
		(0.7126)	(0.6332)	(0.1141)	(0.0466)	(0.0146)	(0.1295)
NETWORK_V	+/-	0.0427	0.0881	0.0090	-0.0076**	-0.0029**	0.0283*
		(0.0754)	(0.0721)	(0.0112)	(0.0042)	(0.0015)	(0.0194)
NETWORK_H	+/-	0.3134***	0.1182**	0.0268**	-0.0056	-0.0028	-0.0083
		(0.0924)	(0.0682)	(0.0146)	(0.0043)	(0.0022)	(0.0180)
RDS	+/-	21.0325***	5.3726***	0.2867	-0.7452***	-0.3343***	1.9525***
		(2.4863)	(1.5280)	(0.2792)	(0.1534)	(0.0843)	(0.3317)
EP	+/-	0.0427***	0.0198***	-0.0002	-0.0015***	-0.0006***	0.0106***
		(0.0094)	(0.0067)	(0.0009)	(0.0004)	(0.0001)	(0.0027)
MB	+/-	0.0944**	0.1228***	0.0084	-0.0205***	-0.0047***	0.0600***
		(0.0499)	(0.0469)	(0.0099)	(0.0031)	(0.0010)	(0.0136)
DT	?	0.4853**	0.3744**	0.0470	-0.0043	-0.0105*	0.1765***
		(0.1941)	(0.1802)	(0.0368)	(0.0109)	(0.0056)	(0.0412)
SIZE	+	1.6971***	0.5525***	0.0142	-0.0153***	-0.0140***	-0.0028
		(0.0833)	(0.0672)	(0.0127)	(0.0049)	(0.0026)	(0.0162)
ln (AGE)	+/-	-0.8806***	0.1104	-0.0563**	0.0173*	0.0158***	-0.0831**
		(0.1969)	(0.1734)	(0.0325)	(0.0120)	(0.0055)	(0.0360)
Alpha	?	3.1978***	2.1428***	--	--	--	--
		(0.2352)	(0.2184)	--	--	--	--
Log likelihood		-1634.01	-1015.43	--	--	--	--
Adj. R^2		--	--	0.0824	0.2178	0.1881	0.2564
Model F(p)		--	--	5.5617	15.1394	12.7682	18.5144
		--	--	(<.0001)	(<.0001)	(<.0001)	(<.0001)
White test F(p)		--	--	1.4089	0.9327	2.1544	1.8048
		--	--	(0.0092)	(0.6597)	(<.0001)	(<.0001)

Notes: 1. The number of observations in all cases is 968. 2. Standard errors are in parentheses. 3. *** significant at p<0.01, ** significant at p<0.05, * significant at p<0.10. 4. All VIFs <2.5. 5. Please refer to Table 2 for variable definitions. 6. In all cases the estimated standard errors, except for regression of innovation performance on networks, have been adjusted using White's (1980) heteroskedasticity adjustment.

Figure 1: The industrial value chain of information electrics industry



Data source: Ma, W.Y. 2000. The Issue of Management and Economy in Taiwan High-Technological Industry: Samples of Hsin-Chu Science-Based Industrial Park. Taipei: Tsang-Hai.