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THE EFFECT OF IT, GEOGRAPHICAL COVERAGE, SERVICES, AND MANAGERIAL COMPETENCE ON 3PL SERVICE PROVIDERS' PERFORMANCE IN CHINA

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Abstract

The resource-based view (RBV) indicates that firm performance is determined by the availability of rare and heterogeneous resources. It is important for third party logistics (3PL) firms to identify the core resources that will enable them to develop and maintain core competencies. In this study based on RBV theory, our objective is to test the effects of information technology (IT) infrastructure, IT capability, geographical coverage, range of services, and managerial competence on logistics service quality and financial performance among Chinese 3PL firms. Exploratory and confirmatory factor analysis and other tests were used to demonstrate the reliability and validity of our model constructs. Furthermore, the LISREL structural equation model estimation results illustrated that geographical coverage, range of services, and managerial competence have positive effects on financial performance; that information technology capability and managerial competence have positive effects on logistics service quality, and that geographical coverage and range of services have negative effects on logistics service quality.

Introduction

The importance of effective supply chain management (SCM) has become increasingly apparent in recent years. Businesses continue to recognize the role of SCM in creating and maintaining a strategic competitive advantage through increased customer value and satisfaction and the attendant business profitability (Mentzer, 2001; Stank et al., 1996). While a number of studies focus on supply chain performance, most of the extant literature centers on participants on the upstream side of supply chains such as manufacturers (Lieb and Miller, 2002; Lieb and Bentz, 2004). Logistics plays an increasingly important strategic role for organizations that strive to keep pace with market changes and supply chain integration (Laura and Joseph, 1998). Realizing that an essential aspect of SCM is consistent, high-quality logistics services, a great number of firms outsource their logistics activities to focus on developing competitive

advantages (Muller, 1991). However, little interest has been shown in the performance of logistics service providers. Bowersox et al. (1995) identified four paradigm shifts or changes in strategic practices resulting from the use of information technology in logistics practices. Lieb et al. (2002; 2003; 2004) considered the current status and future prospects of the third-party logistics industry in the United States. However, to the best of our knowledge, no previous study has focused on the operation and performance of 3PL firms. Little is known about what enables some logistics firms to perform better than others (Ellingera et al., 2007). It is essential for LSPs (logistics service providers) to consider ways in which they can improve the quality of logistics services and organizational performance as a means of competing in an intensely competitive market (Photis and Meko, 2005).

The resource-based view (RBV) indicates that firm performance is determined by the availability of rare and heterogeneous resources. It is important for third-party logistics (3PL) firms to identify the core resources which can be used to develop and maintain core competencies. In this study based on RBV theory, our objective is to test the effects of information technology infrastructure, information technology capability, geographical coverage, range of services, and managerial competence on the logistics service quality and financial performance of 3PL firms in China.

The remainder of the paper is structured as follows. The next section reviews the literature and develops our hypotheses. The third section explains our research methodology, including construct measurement, data collection, and hypothesis testing, and reports our results. We conclude the paper by presenting our conclusion and discussing the managerial implications.

Literature review and hypotheses

Africk and Calkins (1994) referred to a 3PL relationship as "a relationship between a shipper and a third party which, compared with basic services, has more customized offerings, encompasses a broader number of service functions and is

characterized by a longer-term, more mutually beneficial relationship.” Stank and Maltz (1996) regarded a 3PL provider as “any firm providing a good or service that is not owned by the purchaser of the good or service.” Lieb and Randall (1996) defined 3PL as “outsourcing activities that have traditionally been performed within an organization. The functions performed by the third party can encompass the entire logistics process, or more commonly, selected activities within that process.” Given that this study focuses on the relationships between internal resources and performance and because 3PL firms in mainland China are still in the developmental stage, we prefer Lieb and Randall’s (1996) definition in this context.

Several prior studies have examined 3PL performance. Germain et al. (1996) studied the relationship between the just-in-time (JIT) inventory strategy and logistics management and performance. Their findings indicated that the greater the JIT orientation of the firm, the greater the level of performance measurement information available to logistics managers, the more specialized the logistics function and decentralized logistics become, and the more integrated logistics strategic decision-making becomes with other functions. The financial and market performance of the firm also improve with JIT implementation. Ellinger et al. (2007) proposed that market orientation and certain employee development practices (service-related training, coaching, and empowerment) influence both employee and organizational performance. Panayides and So (2007) examined the influences of relationship orientation in 3PL and its impact on logistics service quality and performance. Their findings suggested that relational exchanges have a positive effect on 3PL logistics service quality and performance.

The RBV, which was proposed by Wernerfelt in 1984, has attracted considerable attention and enjoyed widespread support in the strategy literature. Barney (1991) pointed out that firms compete on the basis of “unique” corporate resources: resources that are valuable, rare, difficult to imitate, and non-substitutable. This view of the firm is based on the assumption that resources are both heterogeneous across firms and imperfectly mobile (Hunt and Morgan, 1995). In the LSP context, these resources can be tangible (e.g. equipment, plants, fleets, hardware) or intangible (e.g. organizational processes, skills, know-how, reputation), and enable LSPs to attain superior performance (Daugherty et al., 1996; Murphy and Poist, 2000) and foster strategic partnerships with customer firms (Skjoett-Larsen, 1999). Based on a study examining the competitive resources of 3PL providers in mainland China, we found that information technology infrastructure (IT inf), information technology capability (ITC),

manager competence (MC), and service network (SN) can affect logistics service effectiveness (LSE) and financial performance.

Hypotheses

Geographical coverage, the range of the service network, and performance

Shippers tend to favor 3PL service providers that cover a wide geographical area and offer an enhanced range of services networks. Bottani and Rizzi (2006) showed that shippers prefer 3PL service providers that offer a broad range of services rather than using those that provide traditional arm’s length outsourcing for a single activity. Shippers’ objective of using a one-stop shop is also fulfilled if a 3PL service provider expands its geographical coverage and range of services. Thus, 3PL service providers with wide-ranging service networks will attract more customers and increase their market share. At the same time, 3PL services providers that are willing to respond quickly to new shipping requirements through their service networks are likely to improve customer satisfaction, resulting in greater market share and better financial performance.

Hence, we propose the following hypotheses:

Hypothesis 1a: Increasing geographical coverage and service network range has a positive effect on logistics service effectiveness (LSQ);

Hypothesis 1b: Increasing geographical coverage and service network range has a positive effect on financial performance.

IT infrastructure and performance

Due to the relatively low barriers to imitation and acquisition by other firms, IT-based advantage tends to diminish fairly quickly (Clemons & Row, 1991). Therefore, IT, as part of a firm’s resource portfolio, probably does not meet the resource-based view criteria when acting alone. How IT as a resource can provide a sustained competitive advantage for a firm has become one of the key research topics in recent years.

The related literature supports the idea of IT as an enabler of logistics activities and documents its role in supply chain strategy, and several studies have directly associated higher IT usage with better performance. For example, Sum and Teo (1999) observed heavy usage of IT in the most profitable logistics service providers and identified the importance of technology as a key impact agent for the future. IT is one of the essential components of logistics systems and supports daily operations in many ways. The use of IT leads to an improvement in service level and increases the competitive posture of the company (Bowersox and Daugherty, 1995; Sum and Teo, 1999).

Hence, we hypothesize as follows:

Hypothesis 2a: Heavy usage of IT infrastructure

can positively affect financial performance;

Hypothesis 2b: Heavy usage of IT infrastructure can positively affect logistics service effectiveness (LSQ).

IT capability and performance

Given the types of IT infrastructure that have been applied to logistics activities, the successful implementation of IT, which we refer to as IT capability, is expected to bring a number of benefits to the logistics field. Closs et al. (1997) showed that IT capabilities significantly affect the overall competence of logistics providers. Furthermore, IT not only improves the effectiveness and efficiency of logistics processes, but the successful implementation of IT can have a significant impact on the practical execution of logistics strategies and on organizational structure choices. In general, enhancing a firm's IT capability can yield a wide range of potential benefits, such as improving service effectiveness, reducing data entry errors, and increasing customer service satisfaction (Piplani et al. 2004). In addition, advances in IT capabilities have significantly improved the extent of internal and external organizational information sharing. IT capability has been positively linked to firm performance (Bharadwaj, 2000; Kearns and Lederer, 2003). We thus make the following predictions:

Hypothesis 3a: Enhancing a firm's IT capability can positively affect its financial performance;

Hypothesis 3b: Enhancing a firm's IT capability can positively affect its logistics service effectiveness (LSQ).

Managerial competence and performance

RBV theory proposes that resources that are rare, valuable, and difficult to imitate enable firms to attain superior performance (Daugherty et al., 1996; Murphy and Poist, 2000). Managerial competence is one such resource. According to Gatewood and Field (1994), knowledge, skills, and abilities are predictors of success on the job. For instance, social skills, problem-solving skills, decision-making skills, and work experience have a positive effect on job performance (Matthew et al. 2004). On the one hand, decision-making skills enable managers to deal more effectively with ambiguous situations, leading to more confident and timely decisions and an ability to make difficult decisions in dynamic or volatile markets (Matthew et al. 2004). On the other hand, problem-solving skills enable managers to solve customers' problems and improve customer satisfaction. In addition, work experience and social skills have both been proven to have a positive effect on job performance (Waldman et al. 2001). Because managers' job performance is related to firm performance, we hypothesize as follows:

Hypothesis 4a: The better the managerial competence of a firm, the better will be its financial performance;

Hypothesis 4b: The better the managerial competence of a firm, the better will be its logistics service effectiveness (LSQ).

Logistics service effectiveness and firm performance

3PL organizations that deliver effective logistics services will benefit from enhanced organizational performance for several reasons. First, LSPs that keeps their clients satisfied through their ability to solve problems, keep accurate records, deliver services on time, and communicate effectively can increase customer satisfaction (Leuthesser & Kohli, 1995) and loyalty, which has been viewed as a proxy for market share (Innis & La Londe, 1994). Second, a high level of customer satisfaction has been linked to improvements in a firm's economic returns, including market share and profitability (Anderson, Fornell, & Lehmann, 1994; Crosby, Evans, & Cowles, 1990). Daugherty, Stank, and Ellinger (1998) and Stank, Goldsby, Vickery, and Savitskie (2003) have also reported empirical investigations indicating that logistics service performance (availability, reliability, and speed) ultimately has an impact on market share. Furthermore, Photis (2005) concluded that logistics service effectiveness has a positive relationship with firm performance as measured by market share, profitability, sales growth, return on investment, and overall performance. On this basis, we hypothesize that:

Hypothesis 5 : Increased logistics service effectiveness has a positive effect on the financial performance of firms.

Research methodology

Measurement Development

We measured geographical coverage and service network range by the number of service branches in capital cities and prefecture-level cities and the total number of service branches. To the best of our knowledge, no prior study has proposed measures for these items. To determine the number of service networks available in each option, we statistically analyzed the number of service networks available based on 3PL firms' Web sites in a frequency study. Our measurements of IT infrastructure and IT capability were drawn from the studies conducted by Bowersox and Daugherty (1995), Shaukat and Hua (2006), and Sum and Teo (1999). We revised the IT infrastructure items due to technological obsolescence and innovation. The respondents to our study were required to indicate the degree to which specific types of IT infrastructure were used on a Likert scale in which the responses ranged from 1-5. We also increased the number of IT capability items after holding discussions with logistics and supply chain management experts and scholars on issues such as seamless links between 3PL firms' IT systems and customers' IT systems and good

connections among 3PL firms' internal IT systems. All these measures were scored on a Likert scale in which the responses ranged from 1-5.

Our managerial competence items were taken from several studies on issues including experience in the logistics field, communication skills, decision-making ability, and problem-solving skills (Matthew et al. 2004; La Londe and Pohlen 2000; Sandberg 2000). Respondents were asked to indicate the degree to which they agreed with a statement on a Likert scale in which the responses ranged from 1-5. Logistics service quality was measured using items that capture essential aspects of the logistics domain, as defined by Mentzer et al. (2001). These items were tested and refined through interviews held with logistics managers and after being subjected to configural frequency analysis (CFA). Given the objectives of this study, logistics service quality was also conceptualized as an operational measure that encompasses the factors leading to competitive success in logistics, including reliability, timeliness, responsiveness, problem-solving ability, information accuracy, variety of services, and flexibility (Mentzer et al., 2001; Beamon, 1999; Gunasekaran et al., 2001). LSPs were asked to indicate the extent to which they were effective in the delivery of logistics services (as measured by the aforementioned items) in comparison with their competitors. All these measures were anchored on a Likert scale in which the responses ranged from 1-5.

Financial performance was measured by items such as sales growth, market share, profitability, and investment return, which were drawn from studies carried out by Morgan and Piercy (1998) and Kotabe and Murray (1990). The measurement we used for business performance was based primarily on two general approaches that involve the use of either objective or subjective measures of performance. In the context of this study, subjective measures of performance were deemed to be more appropriate than objective measures. Although it has been recognized that subjective measures of financial performance carry a degree of risk because managers are more likely to over-evaluate their own performance than others (Weber, 2001), we chose to use subjective measures because only a small proportion of Chinese 3PL companies are publicly traded and secondary data on such companies are less readily available. In addition, financial performance data are difficult to obtain through surveys of managers typically carried out in mainland China.

Sampling

The samples used for this study comprised all members of the China Federation of Logistics and Purchasing. The China Federation of Logistics and Purchasing is the biggest, most authoritative logistics association in mainland China. We used two methods to collect our samples. The first was an E-mail

survey in which we obtained the E-mail addresses of 3PL firms from their Web sites or from contact lists from logistics forums. We distributed a total of 350 questionnaires and received 31 responses. Due to the low number of respondents, we supplemented our sample by using a second method consisting of face-to-face questionnaire-based interviews with managers of 3PL firms in Shenzhen, Guangdong. This second method naturally resulted in a 100% response rate and yielded 160 questionnaires, 114 of which were usable. This left us with a total of 191 questionnaires, 145 of which were usable, resulting in a 37.45% response rate.

Results

Profile of Respondents

Among the 145 mainland Chinese 3PL firms in our final sample, 40.69% were privately owned by Chinese proprietors, 10.34% were state-owned companies, 16.55% were joint ventures, and 24.83% were foreign-owned. The number of employees of 3PL firms, indicating that about half of the respondents were at least medium-sized. Part C shows that more than 90 percent of the 3PL firms in our sample had been operating in China for more than three years. Part D indicates that more than 60 percent of the sampled 3PL firms had sales revenue of less than 5,000 million RMB in the previous year. Of the 145 3PL firms, 12.41% outsourced their entire IT function, 21.38% outsourced most of their IT function, and 31.03% outsourced a smaller part of their IT function. 10.9% of the 3PL firms in our sample provided services to the food, furniture and wood industry, while 2.96% provided such services to the construction industry. Part H shows that more than 20% of the 3PL firms in our sample provided transportation and freight forwarding services, whereas only 6.54% provided value-added services. These results imply that most 3PL firms provide traditional types of logistics services and that few have extended their operations to value-added or customized services.

Reliability and validity of measurements

We used SPSS 13.0 and Lisrel 8.70 to test both the reliability and the convergent and discriminant validity of our measurements. First, the content validity of an instrument represents the extent to which it provides adequate coverage for the construct domain or the essence of the domain being measured (Churchill, 1979). Content validity is not determined numerically, but on a subjective and judgmental basis (Emory, 1980). Prior to collecting our data, the content validity of the instrument was established by grounding it in existing literature. Pre-testing of the measurement instrument before additional data were collected further established its validity.

The scales were tested for normality and outliers using the Kaiser-Meyer-Olkin (KMO) measure of

sampling adequacy and the Bartlett test of sphericity in EFA (exploratory factor analysis). Using SPSS 13.0 to analyze the scales, we found that they all exhibited normality. The KMO values ranged from 0.76 to 0.92, comfortably in excess of the 0.50 value Kaiser (1974) suggested. All the results of the Bartlett tests of sphericity were significant at the $p < 0.00$ level. Taken together, the results indicated that the measurements had a good level of fit for factor analysis. In addition, the principal component procedure from SPSS 13.0 was used to test the latent variables. The eigen values for their factors were above the 1.0 cutoff point, while the percentage of variation was around 60 percent. All the latent constructs exhibited a good level of reliability. The constructs were accepted if the Cronbach's alpha value was greater than 0.7 (Cronbach, 1951; Flynn et al., 1994). The Cronbach's alpha values ranged from 0.83 to 0.93, exceeding the cutoff point of 0.70 suggested by Nunnally (1978).

Convergent validity indicates the degree to which different measures of the same construct are highly correlated and hence yield the same result (Hensley, 1999). Generally, a construct with a reliability value of at least 0.30 and a significant t-value for loadings (e.g., $t > 2.0$) is considered to be convergent valid (Hair et al., 1995). All the factor loadings ranged from 0.47 to 0.89 and that the T-values for the factor loadings were greater than 5.0. These results strongly suggest that all indicators measure the same construct (Anderson and Gerbing, 1988). We also calculated composite reliability to assess the reliability of the individual indicators based on confirmatory factor analysis (Bagozzi et al., 1991). Composite reliability represents the shared variance among a set of observed variables measuring an underlying construct (Fornell and Larcker, 1981) and a value of at least 0.6 is considered desirable (Bagozzi and Yi, 1988: 82). The values of composite reliability were all greater than 0.90. The average variance extracted is a direct measure of the amount of variance captured by the construct in relation to the amount of variance due to measurement error. Values of 0.50 and above are desirable (Hair, Anderson, Tatham and Black, 1998). One of methods used to test discriminant validity is to fix the correlation between various constructs to 1.0 and then re-estimate the fixed model. A significant difference in χ^2 between the fixed and unconstrained models indicates high discriminant validity (Lytle, Hom, and Mokwa, 1998). By fixing the correlation between any pair of constructs to the perfect correlation of 1, we found that the χ^2 values increased by at least 16.57. With changes in one degree of freedom, these values were significant at the $p = 0.01$ level ($\chi^2 > 6.64$). shows the correlation matrix and descriptive statistics for the research variables examined in CFA. The variable means

ranged from 2.10 to 4.08. The standard deviations for the variables ranged from 0.84 to 1.6, indicating a considerable degree of variation in the responses. The correlations ranged from 0.04 to 0.76. The hypotheses were later tested more stringently using a structural equation model (SEM).

The confirmatory factor analysis (CFA) model fit indices calculated included the χ^2 to degrees of freedom statistic of 1.87 (below the recommended value of 3.0 suggested by Bollen (1989)). The LISREL 8.70 output showed adequate model fit, as follows: (1) CFI was 0.95, NNFI was 0.95, PNFI was 0.82, and PGFI was 0.62; and (2) RMSEA was 0.10, indicating a close model fit (Steiger, 1990).

Hypothesis testing

The fit statistics indicated that the hypothesized model achieved acceptable fit ($\chi^2=881.82$; $df=480$; $p=0.00$; CFI=0.96; NNFI=0.95; PNFI=0.82; PGFI=0.63; RMSEA=0.07; SRMR=0.08). Given the satisfactory fit of the model, the hypotheses were evaluated by examining the estimated structural coefficients.

Specifically, we show the paths linking: (1) geographical coverage, service network range, and logistics service quality ($B=-0.14$; $T=-2.03$); (2) geographical coverage, service network range, and financial performance ($B=0.38$, $T=3.85$); (3) IT capability and logistics service quality ($B=0.43$, $T=3.90$); (4) managerial competence and financial performance ($B=0.38$, $T=2.98$); and (5) managerial competence and logistics service quality ($B=0.42$, $T=4.31$).

To avoid the mediated effect in the full structural equation model, we separated the latent variables, logistics service quality (LSE) and financial performance. The statistics for model fit were as follows: $\chi^2=1031.77$; $DF=488$; $p=0.00$; CFI=0.94; NNFI=0.93; PNFI=0.82; PGFI=0.61; RMSEA=0.08; and SRMR=0.08. The path value was 0.30 and the T value was 3.10. The empirical result was significant..

Discussion and implications

This study contributes to empirical research on the performance of third-party logistics firms by specifically investigating the effects of information technology infrastructure, information technology capability, geographical coverage, range of services, and managerial competence on logistics service quality and financial performance. In general, the results provide empirical evidence on the areas in which 3PL firms can take initiatives to enhance their operations and improve performance.

First, this study used the number of service branches in capital and prefecture-level cities and the total number of service branches to measure geographical coverage and service network range. The reliability and validity of our model constructs showed that the measurements we adopted are feasible. Our results indicated that increasing

geographical coverage and service network range can have positive effects on financial performance, but may have negative impacts on logistics service quality.

Second, IT infrastructure does not appear to have a significant effect on either logistics service quality or financial performance. Our results suggest that IT infrastructure does not meet the resource-based view criteria because of low barriers to imitation and acquisition by other firms (Clemons & Row, 1991). There is another possible explanation for this result. Our descriptive statistics show that less than 20% of the 3PL firms in our sample were established more than 15 years ago, making it possible that our sample firms may have begun to invest in IT infrastructure only recently. It may take some time for the benefits of such investment to be reflected in firm performance. In addition, IT capability has a significant positive effect on logistics service quality. This result is in line with that of Piplani et al. (2004). However, IT capability has an insignificant influence on financial performance. The correlations among our measurement items show that the relationship between enhanced IT capability and financial performance is positive. This insignificant result may be due to the hysteric quality of IT capability. In general, it is better for 3PL firms to focus on developing their IT capabilities rather than making excessive IT infrastructural investments.

Third, managerial competence has positive effects on both logistics service quality and financial performance. To some extent, managerial competence can be measured by relevant experience, communication skills, problem-solving ability, and decision-making ability. Our empirical results show that managerial competence could represent a unique resource (Matthew et al. 2004). 3PL firms should pay more attention to developing managerial competence in an effort to improve both operational and financial performance.

Finally, this study has shown that logistics service quality has an impact on the composite measure of firm financial performance adopted in this study. It has also shown a direct causal link between logistics service quality and financial performance. Our empirical result shows that 3PL firms may secure better financial returns, greater market share, and higher investment returns if they devote their efforts to improving logistics service quality.

Limitations and future research

Our empirical analysis was undertaken using data collected from 3PL firms in mainland China. Although our results carry with them some managerial implications, we would interpret them with caution due to several limitations. First, it is likely that more accurate results would have been

achieved if we had employed more comprehensive measurements for information technology infrastructure, information technology capability, geographical coverage, range of services, and managerial competence. Second, a larger sample would allow for more definitive managerial implications to be derived.

Future studies would be well-directed if more attention is paid to examining the relationship between business orientation and 3PL firm performance. A comparison of 3PL firms in terms of their business orientation would be a line of research worth pursuing.

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