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Reverse logistics capabilities and firm performance: the mediating role of business strategy

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Abstract

This study aims to examine the impact of reverse logistics capabilities on firm performance and mediating role logistics strategies. We reviewed three theories of reverse logistics capabilities: (a) Resource-based view of the firm, (b) Transaction cost economics, and (c) Institutional theory. We examined six reverse logistics capabilities: Logistics information management, close-loop capability, supply chain integration, supply chain coordination, conformity capability, and institutional incentives. We examined three reverse logistics strategies: Joint reverse logistics, manufacturer reverse logistics, third-party reverse logistics. We conducted a survey of Chinese mobile phone companies out of which we received 125 usable questionnaires with a response rate of 80%.

The results of mediated hierarchical regression support the hypothesis that reverse logistics capabilities influence firm performance. Institutional factors were more significant than supply chain factors. Close-loop capability was the most significant factor. We provide managerial implications and suggestions for future research.

Keywords: Reverse logistics, firm performance, logistics capabilities, business strategy, China, mobile phone industry.

1. Introduction

Supply chain management aims to seamlessly integrate value-creating activities of different companies across the supply chain. However, many companies fail to integrate reverse logistics with forward logistics within their own internal value chain. Reverse logistics require equal attention to forward logistics due to increased pressure from business and consumer needs, which include: (1) Financial factors: that reverse logistics impact on the bottom line is clear to industries with return rates varying from between 5 and 20 per cent (Daugherty et al. 2001) up to approximately 50 per cent (Prahinski and Kocabasoglu 2006). (2) Customer needs: the emergence of online shopping and customers' rights on return policies has created more returned products than before (Hazen et al. 2012). (3) Sustainability: Efficient reverse logistics operations have a direct, positive environmental impact by reducing post-production and post-consumption waste to landfills, water, and air, which damages the environment (Kasper et al. 2011). (4) Competition: in many industries, reverse logistics costs may exceed production costs. Lacking an integrated supply chain strategy may influence competitiveness in the long term (Ramirez 2012). (5) Legal implications: in an increasing number of countries, including EU member states, firms are held accountable for their waste disposal.

The above trends place an increasing pressure on companies to deal with reverse logistics strategically rather than operationally (Dedrick et al. 2011; Yamane et al. 2011). There is consensus that effective management of reverse logistics operations allows companies to save costs as well as serve customer satisfaction (Rubio et al. 2008; Dowlatshahi 2000; Weeks et al. 2010; Chen 2010; Franke et al. 2006). Yet, there is little theoretical support and scarce

empirical evidence to explain the extent to which reverse logistics capabilities contribute to firm performance (Ramírez et al. 2011; Jayant et al. 2012; Hazen et al. 2012).

This study aims to examine the reverse logistics capabilities that influence firm performance as well as to examine the mediating role of logistics strategy. The contribution of this study is threefold: (a) To our knowledge, this is the first study that synthesises three theories (resource-based view of the firm, transaction cost economics, institutional theory) in order to develop a research model of reverse logistics; (b) This study contributes to practitioners by offering insights from an empirical solution on how to design effective reverse logistics. Moreover, we provide insights on selecting an appropriate reverse logistics strategy to take advantage of existing logistics capabilities; (c) The context of this study was the mobile phone industry in China. We provide policy recommendations and suggestions especially for regions and countries hugely polluted to establish suitable institutional environments with incentives for companies to manage reverse logistics sustainably.

The remainder of the study is organised as follows. The following section reviews the literature on reverse supply chains. The subsequent sections present the research method and the research findings. The selection of the firm performance measures is also discussed in this research methods section in order to justify the validity of the research design. The final section discusses the findings, draws conclusions, presents managerial implications and provides recommendations for future research.

2. Literature Review

Studies on reverse logistics appeared in the 1980s and mostly dealt with technical and operational issues such as network design, optimisation, and production planning (Barnes 1982). Rubio et al. (2008) reviewed 186 research articles on reverse logistics published

between 1995 and 2005 and found that 65% of them used mathematical models and 21% case studies mainly dealing with the recovery of end-of-life products and inventory management. Efforts to synthesize the research in an integrated broad-based body of knowledge have been limited and information is mostly anecdotal (Jayant et al. 2012). For example, Bernon et al. (2011) review empirical findings and literature regarding retail reverse logistics operations in the UK and suggests that literature relating to retail reverse logistics is fragmented. This study aims to cover this gap by synthesising three theories: resource based view of the firm, transaction cost economics and institutional theory. Figure 1 presents the conceptual framework of our research model.

<<Insert Figure 1 about here >>

2.1. Resource-based Theory of the Firm

According to resource-based theory, firm resources and capabilities determine firm performance and sustainable competitive advantage (Penrose 1959; Peteraf 1993). Therefore, firms should develop reverse logistics capabilities in order to reduce costs and maximise their value offer (Olavarrieta and Ellinger 1997; Dowlatshahi 2005; Wong and Karia 2010; Ramírez et al. 2011). Reverse logistics capabilities represent the internal capabilities and processes that a firm deploys to effectively implement its reverse logistics activities. There are two categories of reverse logistics capabilities: information management capabilities and products (or services) capabilities.

Information management capabilities for reverse logistics may utilise existing assets such as information systems and product/market knowledge (Chouinard et al. 2005). However, demand for return products is often unpredictable and requires specialised knowledge (Ramírez et al. 2011). Furthermore, the integration of forward and reverse logistics at the

information level can be a challenge since demand patterns and data may be codified in different standards.

A company that has developed over time, often decades, forward logistics capabilities such as planning and controlling, flexibility, agility, and lean, may find it hard to transfer them into reverse logistics (Bernon et al. 2011). A number of factors hinder transferability from forward to reverse logistics capabilities: lack of infrastructure, poor integration capabilities, and absence of reverse logistics in the strategic agenda (Dowlatshahi 2000). Dis-integrated internal logistics operations can result in more prolonged lead times, increased transportation and warehousing costs and, often, in frustrated customers and managers (Jayant et al. 2012; Hazen et al. 2012). Weeks et al. (2010) examined the impact of reverse logistics strategies on firm profitability through operations management in the scrap steel industry and found that the combined effect of production mix efficiency and product route efficiency does have a positive impact on firm profitability, although operations management alone does not have a positive impact on profitability.

Therefore, we propose the hypotheses:

Hypothesis 1: Logistics information management is positively related to firm performance.

Hypothesis 2: Close-loop capability is positively related to firm performance.

2.2. Transaction Cost Economics

Transaction cost economics (TCE) is an established theory for analysing how an organisation economises on transactions costs by selecting governance structures that minimise costs (Williamson 1975). The key characteristics of transactions are: uncertainty, frequency, and

asset specificity (Williamson 1975). Brandenburger and Nalebuff (2011) argue that firms rarely create value in isolation; rather, they align themselves with customers, suppliers and other partners to co-develop and co-expand existing markets. Transaction cost economics helps to explain why a firm collaborates with other firms and how integration activities reduce transaction costs, resulting in superior performance (Kim 2013; Cao and Zhang 2011; Lee et al. 2009).

Supply chain integration is defined as the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organisation processes (Flynn et al. 2010). With respect to supply chain integration, transaction cost economics predicts that firms strategically choose integration governance mechanisms that minimise transaction costs and increase asset specificity (Williamson 1975). Kim (2013) argues that supply chain integration represents the exchange mechanism of resources and knowledge in a supply chain. Bagchi et al. (2005) conducted an EU survey and found that the degree of supply chain integration influences transaction costs and firm efficiency. Caridi et al. (2010) carried out a multi-case study on the relationship between context variables (such as virtuality and complexity) and conclude that the context has an influence on both supply chain integration and performance as well as on the relationship between these concepts. Gimenez et al. (2012) found that high levels of supply chain integration are only necessary in environments characterised by high supply complexity. Leuschner et al. (2013), in a meta-analysis of 86 peer-reviewed journal articles, found that there is a positive and significant correlation between supply chain integration and firm performance.

Frohlich and Westbrook (2001) note growing consensus concerning the strategic importance of integrating suppliers, manufacturers, and customers. Huo et al. (2014) examined the

moderating role of competitive strategy in the relation of supply chain integration on firm performance and found that competitive strategies significantly influence the effectiveness of internal process and product integration but have no significant moderating effect on the relationship between supply chain integration and operational performance.

Supply chain integration can be considered as a dynamic capability that firms assimilate over time. Dwyer et al. (1987) present an evolution process of chain collaboration consisting of four stages: awareness, exploration, expansion, and commitment. Zajac and Olsen (1993) propose a three-stage model of inter-organisational processes: initialisation, processing, and reconfiguration. On initialisation, partners evaluate exchange alternatives, ex-ante project the ex-post exchange costs. Initialisation is a preparation stage with partners designing their supply chain operations. In the processing stage, partners learn about and from each other, manage conflict derived from transaction uncertainty, develop supply chain knowledge, which is an intangible asset with high specificity, and create trust through frequent, successful transactions (Vlachos and Bourlakis 2006; Liu et al. 2013).

Supply chain coordination is another dynamic capability which is important for reverse logistics management. Coordination can be achieved via different governing mechanisms such as market mechanisms, contracts, and partnership arrangements. Supply chain coordination proliferates when there is a culture of collaboration rather than competition among supply chain partners (Cao and Zhang 2011). Further, collaboration allows for investment in assets specific to reverse logistics which reduces uncertainty. For example, ex-ante investments in sites like distribution or warehouse centres increase the site-asset specificity (Lamminmaki 2005). Physical asset specificity such as investment in specialised equipment and machinery also facilitates supply chain coordination. Intangible assets such as ‘greening’ the brand name stimulates brand loyalty (Chen 2010). Further, volume

uncertainty, which is created by poor forecasting of future demand patterns, is reduced by sharing of strategic information between retailers and manufactures like future new products, retail stores, and customer preferences (Eksoz et al. 2014; Mukhopadhyay and Setaputra 2011). Long-term collaboration can protect companies from opportunistic behaviour (Crosno and Dahlstrom 2008).

Cao and Zhang (2011) studied the impact of supply chain collaboration on performance of US manufacturing firms and found that collaborative advantage mediates the relationship between supply chain collaboration and firm performance for small firms while it partially mediates the relationship for medium and large firms. Dobrzykowski et al. (2012) examined four supply chain practices using a global survey of 711 firms in 23 countries and found that procurement capability was positively associated with firm performance. Vereecke and Muylle (2006) surveyed 374 firms from the engineering/assembly industry across 11 European countries and reported weak support for the hypothesised positive relationships between supplier collaboration and performance improvement.

Therefore, we propose the hypotheses:

Hypothesis 3: Integration capability is positively related to firm performance.

Hypothesis 4: Coordination capability is positively related to firm performance.

2.3. Institutional Theory

According to institutional theory, organisations must conform to the rules and belief systems prevailing in their institutional environment in order to survive and prosper (DiMaggio and Powell 1983). Recent studies reveal that organisations that possess the ability to recognise and react to signals in the external environment have a competitive advantage over organisations that are less flexible and agile (Reeves and Deimler 2011).

The capability to recognise and react to societal drivers towards ecological sustainability requires effective reverse logistics. Growing concerns about climate changes, local and regional impacts of air, ground and water pollution from industrial activities have significantly expanded the interaction between environmental management and operations (Bourlakis et al. 2014). Referring to the mobile phone industry, Franke et al. (2006) argue that reverse logistics itself is an environmental-protection and green operation activity. Countries like the US, EU, Japan and China actively support the sustainable disposition of mobile phones, giving incentives for companies willing to recognise and react to environmental concerns (Kasper et al. 2011).

Institutional theory also implies that a strong motivating force behind firm behaviour is socially based and proposes that an organisation is bound to satisfy its social stakeholders (Burns and Wholey 1993; Meyer and Rowan 1977; Scott 1987). Specifically, companies not only need to recognise and react to signals from their institutional environment but conform to its rules. This ability is more dynamic and complex than the ability to react to institutional environments since an organisation, per se, has the ability to react to its business environment. Recent studies provide empirical evidence that explain firm-level behaviours using institutional theory (Hillebrand et al. 2011; Ye et al. 2013; McFarland et al. 2008), yet the conformity capability is still largely unexplored.

Referring to reverse logistics, the conformity capability allows companies to develop effective supplier relations by conforming to common standards and business culture. Peer and industry conformity allows companies to meet the expectations of purchasers, users, government, producers and suppliers regarding matters such as quality, safety, price, performance, and sustainability. For example, upstream suppliers' raw materials defects or errors in design, production, and assembling may directly generate great influence on the

reverse logistics of downstream enterprises or even the entire supply chain (Vlachos 2014; Polák and Drápalová 2012). Scharnhorst et al. (2006) conducted a Life Cycle Assessment (LCA) of mobile phones and found that recycling the electronic scrap of mobile phone networks have clear environmental benefits. Material recycling could help lower the environmental impact of the production phase by up to 50% (Scharnhorst et al. 2006).

Therefore, we propose the hypotheses:

Hypothesis 5: Institutional incentive is positively related to firm performance.

Hypothesis 6: Conformity capability is positively related to firm performance.

2.4. Reverse Logistics Strategies

There are three reverse logistics strategies applicable in the mobile phone industry: joint reverse logistics; manufacturer reverse logistics; and, third-party reverse logistics.

(1) Joint reverse logistics

Joint reverse logistics refers to the horizontal alliance between firms in the mobile industry such as joint ventures that carry out reverse supply chain operations such as establishing a recycling centre, collaborative transportation and joint quality control (Kasper et al. 2011). A typical joint reverse supply chain contains four areas of collaboration: (i) waste disposal, (ii) product/part/material in sales, (iii) cost sharing, and (iv) profit distribution (Nnorom et al. 2009). Joint collaborations allow logistics operation models to be scaled and benefit from economies of scale as the number of returned mobiles phones increases (Jang and Kim 2010). A barrier to joint ventures is the fact that mobile phone companies are direct competitors hesitant to expose vital technologies that are protected by patents, often involved in legal

disputes among them, thus working together in reverse logistics may expose intellectual property rights (Ha et al. 2010).

(2) Manufacturer reverse logistics

Manufacturers of mobile phones can establish recycling centres and carry out mobile phone reverse logistics operations without collaborating with other companies (Yamane et al. 2011). Manufacturers need to have the necessary scale to profit from recycling their own branded phones (Dedrick et al. 2011). Apart from profit making, manufacturers can also improve product quality and enhance customer loyalty by researching and understanding product defects and customer preferences of returned products. Feeding forward logistics with insights from reverse logistics increases quick response and drives research and development in new directions. Furthermore, quality assessment and control can occur at the earliest time possible thus resulting in fewer defects and fewer product returns (Scharnhorst et al. 2006).

(3) Third-party reverse logistics

Outsourcing reverse operations to specialist third-party or fourth-party logistics companies is not uncommon in mobile phone supply chains (Assavapokee and Wongthatsanekorn 2012). Outsourcing contributes to reducing capital investment in manpower and specialised equipment and facilities thus making this business model suitable for small and medium-size enterprises with limited capacity to handle complex logistics operations (Polák and Drápalová 2012).

Therefore, we propose the hypotheses:

Hypothesis 7a: Joint reverse logistics moderate the relationship between reverse logistics capabilities and firm performance.

Hypothesis 7b: Manufacturer reverse logistics moderate the relationship between reverse logistics capabilities and firm performance.

Hypothesis 7c: Third-party reverse logistics moderate the relationship between reverse logistics capabilities and firm performance.

3. Methodology

3.1. Participants and instrumentation

We conducted a survey of mobile phone companies in China. We developed a questionnaire that included five sections: firm factors, supply chain factors, institutional factors, firm performance and logistics strategy. The questionnaire was sent to leading mobile companies in China, including Huawei, Lenovo, ZTE, Nokia, Samsung, HTC, MI, and Haier. Respondents were managers responsible for operations, supply chain, and purchasing in the above companies in different locations and areas. Managers in these companies are the most reliable respondents since they have the knowledge of internal operations, the customer, as well as supplier relations due to guanxi networks. Filtering questions excluded those respondents who could not provide adequate responses concerning reverse logistics. The survey was managed by a native Chinese speaking researcher who also transcribed the questionnaire into local languages. To obtain companies' permission, a letter that introduced the survey was sent to human resource departments obtaining their consent and permission for managers to participate in the survey. We mailed 160 questionnaires and received 125 usable questionnaires with a response rate of 80%. This level of response rate is higher than average in China which indicates that contacting the company to obtain permission prior to contacting the manager signifies a best practice in conducting surveys in China.

3.2. Specification of Variables and Measures

3.2.1. Reverse Logistics Variables

Reverse logistics variables were measured by multi-item scales. Content validity was supported by the literature review, interviews with managers and academics and a pre-test of the questionnaire. Twenty-nine items were used to measure the seven constructs. Multi-item scales enhanced the reliability of measurements. Nevertheless, we undertook factor analysis of the variable set to determine if any parsimony could be accomplished in the number of dimensions used. We prepared analyses ranging from a six to a fourteen factor solution (confirmatory and exploratory factor analysis) and carefully studied the varimax-rotated factor scores. We tried combinations of extraction methods (principal components, principal axis factoring, generalised least squares, and unweighted least squares) and rotation methods (no rotation, varimax, and direct oblimin with delta values 0, 0.4, 0.7, and 1.0 respectively). The KMI value for all solutions was relatively low (lower than 0.5) and Cronbach's alpha was a maximum of 0.6. Since none of the factor structures were easy to interpret, we decided to rely on the seven originally specified dimensions.

3.2.2. Measurement of Firm Performance

Research on logistics management has repeatedly relied upon firm performance in order to evaluate the effectiveness of logistics practices (Zhao et al. 2001; Richey et al. 2009). Studies use a mix of financial variables, such as return on assets (ROA) and return on investment (ROI) and market-based variables such as sales growth in order to derive a valid measure of firm performance. Financial and market-based measures have the advantage of being meaningful to managers seeking practices and methods to improve firm performance and profitability. Furthermore, data concerning financial or market measures are often easily and

freely available to researchers from secondary sources. However, financial and market-based measures have a significant disadvantage: they also relate to a vast number of firm and industry factors. Since each firm is unique, even for firms in the same industry, one set of performance measures cannot fit them all. In this study, we chose to measure the perceptions of reverse logistics effects on firm performance. Respondents were asked to indicate their firm's performance as compared to the industry's average in the above five items. For perceived items, a five-point scale ranging from bad (1) to very good (5) was used. We chose five different measures of firm performance: (1) firm-specific: profitability, cost, innovativeness, and (2) market-related: perceived competitive advantage, and perceived customer satisfaction.

- Firm-specific performance measures

Returned mobile phones contain valuable parts that could be reused and thus lower production costs and increase profits. Mutha and Pokharel (2009) argue that a used mobile phone can be entirely reused and propose different methods for different parts, i.e., using the plastic parts as the filling material of sound insulation products and the precious metals such as copper, gold, and silver as raw materials for new mobile phones. Furthermore, sales information about slow-selling products, combined with customer satisfaction surveys, can be utilised to readjust the reverse supply chain and re-arrange the mobile production-line (Dedrick et al. 2011). Logistics rationalisation is often referred as the 'third profit source' (Yi 2006) yet, often, small and medium enterprises lack the knowledge and resources to take advantage of it, therefore collaboration is required in reverse supply chains since mobile phones are distributed by small outlets as well as their low recycle price (Dat et al. 2012).

- Market-related: performance measures

Customers who return their mobile phones for recycling may provide feedback which provides insights concerning brand management, product design, functions, and more.

Corporate customers in the supply chain gain from less operational risk, improved buyer-seller relationship, enhanced strategic cooperation and, thus, improve their competitive position within the mobile phone supply chain (Rathore et al. 2011).

3.2.3. Control Variables

To eliminate the effects of confounding variables, we included three control variables (firm size measured by the number of employees; years implementing reverse logistics measuring experience in reverse logistics; and, number of brands reversed to origin). Firm size has long been considered an important exogenous control variable to examine a range of organisational issues (Ramaswamy 2001; Jermias 2008, Ebaid 2009). Experience in reverse logistics may influence a number of capabilities as well as the chosen strategy. Large firms may have greater capacity, capabilities and financial resources than smaller firms to acquire the necessary reverse logistics infrastructure, deal with institutional factors and control supply chain relations.

3.3. Common Method Variance

We used the Harmon's factor test to examine whether or not common methods variance in the predictor and outcome variables inflates the empirical relationship among variables (Podsakoff et al. 2003). Seventeen factors emerged, with the first factor (which, in cases of common method variance, would account for a majority of the variance) only accounting for 11.61% of the variance. Thus, common method variance is unlikely to bias this sample.

3.4. Moderation Tests

To perform mediated hierarchical regression, each dependent variable underwent a series of steps to determine if mediation existed and if that mediation was partial or full. Research by

Hair et al. (2010), MacKinnon (2008) and Baron and Kenny (1986) were applied. The steps are as follows:

1. The control variables (C) were entered into the model as block one, then the independent variables (X) were entered into the model as block two, and regressed on the dependent variables (Y).
2. The control variables (C) were entered into the model as block one, then the mediator variable (Z) was entered into the model as block two, and regressed on the dependent variable (Y).
3. The control variables (C) were entered into the model as block one, then the independent variables (X) were entered into the model as block two, and regressed on the mediator variable (Z).
4. If steps 1 - 3 produced significant models, control variables (C) were entered into the model as block one, then the mediator variable (Z) was entered into the model as block two, then the independent variables (X) were entered into the model as block three, and regressed on the dependent variable (Y).

If a significant model for step four resulted, partial mediation existed, whereas, if a non-significant model resulted, full mediation existed. If full mediation was found to exist, the effect of X on Y would be mediated or altered by Z; i.e., when Z is controlled for, the effect of X on Y will no longer be significant (Zhao et al. 2001; Baron and Kenny 1986).

4. Findings

4.1. Characteristics of Participants

Table 1 shows the characteristics of companies surveyed. Approximately half of the companies (53.28%) had between 1,001 and 3,000 employees. Above 5,000 employees equated to 21.17% of participants. Approximately half of the companies (47.45%) had implemented reverse logistics from five to eight years. Only 4.38% of the companies had implemented mobile phone reverse logistics for less than two years; thus, most of companies

had prior experience of reverse logistics. 44.53% of the companies preferred to outsource mobile phone logistics while 31.39% had developed their own reverse logistics system.

4.2. Univariate Analysis

Table 2 presents the Pearson's correlation analysis. The control variables (size, experience, and brand) showed low correlation with the performance variables. Size was associated with profitability ($r=.368$, $p<0.01$) and innovation ($r=.204$, $p<0.05$). Brand was related to customer satisfaction ($r=.310$, $p<0.01$). Control variables were not associated with reverse logistics variables except size with coordination capability ($r=.206$, $p<0.05$) and experience with conformity capability ($r=-.169$, $p<0.05$).

Regarding reverse logistics factors all, except conformity capability, showed a large to moderate association with performance variables. Integration capability and coordination capability were associated with three performance variables: Integration capability with competitive advantage ($r=-.272$, $p<0.01$), cost ($r=-. 252$, $p<0.01$) and customer satisfaction ($r=-.179$, $p<0.05$). Coordination capability was associated to a different extent with the same variables: Competitive advantage ($r=-.360$, $p<0.01$), cost ($r=-. 229$, $p<0.01$) and customer satisfaction ($r=-.246$, $p<0.01$).

----------Insert Table 2 approximately here----------

4.3. Moderated Hierarchical Model

The results of the four steps of moderated hierarchical regressions are reported in Table 3, Table 4, and Table 5. In every step, five regressions were run, one for each one firm performance variable. We entered variables in two blocks in the hierarchical analysis, the first being the control variables and the second block the independent variables. Tolerance tests showed no significant collinearity among variables.

----------Insert Table 3 approximately here----------

---------- Insert Table 4 approximately here----------

The results from Step 1 reported in Table 3 show that when reverse logistics variables (X) entered the regression model in block three, they produced significant results for customer satisfaction ($\Delta R=0.092$, $p<.1$; $F=3.840$, $p<.1$), competitive advantage ($\Delta R=0.182$, $p<.001$; $F=3.367$, $p<.001$), and cost ($\Delta R=0.111$, $p<.1$; $F=2.325$, $p<.1$). The other two performance variables, innovation and profitability, showed high correlation with control variables which may explain why the change in R square of block 2 was not significant. In step 2, the moderator variable was entered into the model instead of the reverse logistics variables. There was no significant association with any performance variable. In Step 3, where the moderator variable was the dependent variable in the regression model, again, there were no significant results (Table 3). Table 4 presents the findings of the regression model where variables were entered in three blocks: block 1 the control variables, in block 2 the moderator variables and in block 3 the independent variables. The change in adjusted R square in block 3 is significant for competitive advantage ($\Delta R=0.181$, $p<.001$; $F=3.028$, $p<.001$), cost ($\Delta R=0.114$, $p<.1$; $F=2.173$, $p<.1$), and customer satisfaction ($\Delta R=0.093$, $p<.1$; $F=3.437$, $p<.1$). As in Step 1, innovation ($\Delta R=0.074$, $p<.1$; $F=3.577$, $p<.1$), and profitability ($\Delta R=0.173$, $p<.001$; $F=9.291$, $p<.001$), showed significant correlations with control variables and non-significant correlations with the independent variables.

---------- Insert Table 5 approximately here----------

---------- Insert Table 6 approximately here----------

The beta weights, presented in Table 5 and Table 6 indicate that reverse logistics factors contribute to firm performance to a varying effect. Specifically, close-loop capability

(β=0.04, p<.001), institutional incentives (β=0.06, p<.1), and conformity capability (β=0.05, p<.1), have a significance on competitive advantage. The same variables, close-loop capability (β=0.06, p<.1), institutional incentives (β=0.06, p<.1), and conformity capability (β=0.06, p<.1) had a significant impact on cost (Table 5). The above influence should be considered as significant since all control variables (size, years, brand) as well as the moderator variable reverse logistics strategy also had significant beta weights in step 3 of the hierarchical models. Similarly, control variables and the moderator had significant beta values when profitability was the dependent variable (Table 6). In this model, close-loop capability (β=0.09, p<.1), integration capability (β=0.18, p<.1), and conformity capability (β=0.02, p<.1) had high beta values but R square change was not significant. Conversely, with customer satisfaction as the dependant variable, R square change was significant (ΔR=0.093, p<.1; F=3.437, p<.1) and logistics information management (β=0.11, p<.001), close-loop capability (β=0.11, p<.1), and conformity capability (β=0.-6, p<.1) contributed significantly to this change (Table 6).

---------- Insert Table 7 approximately here----------

5. Discussion

This study examined the reverse logistics capabilities influence on the reverse logistics performance mediated by reverse logistics strategy. By reviewing three research streams on reverse logistics and conducting a survey of Chinese mobile phone companies, this study offers three contributions: (a) it synthesises three theories (resource-based view of the firm, transaction cost economics, institutional theory) and develops a research model of reverse logistics capabilities, (b) it offers managerial implications on how to design effective reverse

logistics, (c) it provides policy recommendations and suggestions especially for regions and countries concerned with pollution aiming to establish suitable institutional environments. We discuss the contributions in the following sections.

5.1. Discussion of Empirical Results

Table 7 summarises the findings of regression analysis regarding the hypothesis testing. The first research hypothesis that logistics information management influences firm performance (H1) was rejected. There was only a low effect of logistics information management on customer satisfaction. Conversely, close-loop capability was found to influence competitive advantage, cost, and customer satisfaction and thus Hypothesis 2 is accepted.

Supply chain integration (H3) and coordination (H4) should be critical in creating value and minimising transaction costs, thus affecting firm performance. However, empirical evidence does not support the above hypotheses within the context of reverse logistics, thus H3 and H4 are rejected.

Companies that are agile enough to react to institutional incentives (H5) should perform better than others failing to recognise and react to signals from their institutional environment. Further, companies that have developed the conformity capability (H6) can manage their suppliers, which undoubtedly have great influence on their logistics activities (Assavapokee and Wongthatsanekorn 2012). Both Institutional incentives and conformity capability influenced competitive advantage and cost. Conformity capability was also related to customer satisfaction. Therefore, H5 was partially accepted and H6 was accepted. The impact of institutional incentives on cost was one of the highest among the reverse logistics factors.

In examining the moderator effects of reverse logistics strategy on firm performance, there was no support for hypotheses H7a, H7b, or H7c. There was only one significant effect of reverse logistics strategy on cost, which is in line with existing literature on reverse logistics (Assavapokee and Wongthatsanekorn 2012; Dedrick et al. 2011; Kasper et al. 2011). This finding needs further investigation and we suggest future studies to examine cost leadership strategies in other industries and within other contexts than the current study.

In summary, the findings highlight that supply chain capabilities (integration capability and coordination capability) had no influence on firm performance. Conversely, the institutional factors (institutional incentives and conformity capability) influenced three performance variables: competitive advantage, cost and customer satisfaction (expect institutional incentives on customer satisfaction). However, it was close-loop capability, derived from the resource-based view of firm theory, which had the highest effect on all three performance variables and particularly on cost and customer satisfaction. This finding indicates that integrating forward and reverse logistics should be the first priority in order to reduce cost and improve customer satisfaction. Therefore, reverse models such as outsourcing may not be suitable for reverse logistics and companies need to take strategic decisions on how to close the loop and integrate reverse logistics within their existing logistics function.

5.2. Contributions to the current supply chain literature

The conceptual framework developed herein integrates three theories: resource based view, transaction cost economics and institutional theory. As a result of an extensive literature review in the initial phase of this study, the following factors were examined: Logistics information management (Chouinard et al. 2005; Ramirez, 2012), close-loop capability (Bernon et al. 2011; Jayant et al. 2012), integration capability (Dwyer et al. 1987; Liu et al. 2013), coordination capability (Cao and Zhang 2011; Crosno and Dahlstrom 2008)

institutional incentives (Polák and Drápalová 2012; Franke et al. 2006), and conformity capability (Assavapokee and Wongthatsanekorn 2012) were identified.

According to the resource-based view of the firm (Penrose 1959; Peteraf 1993), reverse logistics assets and capabilities have a direct effect on firm performance. Close-loop integration capability had the highest influence on performance variables and particularly on cost and customer satisfaction. Therefore, findings confirm resource-based theory in the case of reverse logistics. On the other hand, transaction cost economics is an established theory that posits that companies select governance structures rather than minimise costs (Williamson 1975). Firms need to align themselves with customers, suppliers and other partners to co-develop and co-expand existing markets (Brandenburger and Nalebuff 2011). Contrary to existing literature (Dwyer et al. 1987; Liu et al. 2013; Cao and Zhang 2011; Mukhopadhyay and Setaputra 2011; Vereecke and Muylle 2006), there was no association in any hierarchical model with or without moderation effects or integration capability and coordination capability with firm performance. The results suggest that reverse logistics capabilities should be considered as an extension of existing logistics capabilities; therefore, companies focus more on firm assets and capabilities, that is, close-loop integration rather than those of the supply chain, for example, supply chain integration. According to institutional theory, companies with the ability to recognise and react to signals in the external environment have a competitive advantage over organisations that are less flexible and agile (DiMaggio and Powell 1983). Institutional abilities may be significant to reverse logistics due to their externalities especially the environmental effect of returned goods and the growing consensus among consumers concerning climate changes such as ground and water pollution from industrial activities (Kasper et al. 2011).

Along the line of evidence for the relationship between institutional factors and firm performance (Reeves and Deimler 2011; Franke et al. 2006; Polák and Drápalová 2012; Ye et al. 2013), this study provides empirical evidence that institutional factors are significant in reverse logistics and support from the government, that is, for proper disposal of returned goods, can reduce the total cost significantly. This is a significant contribution since, to our knowledge, this is the first study examining institutional factors within the context of reverse logistics. Moreover, it was found that institutional theory and not transaction cost economics theory explain better firm performance. Undoubtedly, there is a need for future research to study in more depth institutional factors' influence on reverse supply chains.

5.3. Managerial Implications

The findings of this study offer insights into how to design effective reverse logistics as well as select an appropriate reverse logistics strategy to take advantage of existing logistics capabilities. Since most small and medium size enterprises have no capacity to invest in the construction of reverse logistics facilities, collaboration with third-party reverse logistics companies is required to safeguard the effective return of mobile phones. Large-scale companies can use 3PL companies to cover remote sales areas. Firms that do not outsource need to strategically invest in reverse logistics functions such as transportation, processing, inventory and distribution. Since inefficient reverse logistics may have a huge environmental impact, firms need to be proactive with reverse logistics. They can also take a step further and engage consumers to increase their awareness on social and environmental responsibility, which can have a direct influence on their brand image.

Companies can take advantage of obsolete, old mobile phones to promote recycling. In this way, they can also gain abundant rare metals, avoid electronic garbage pollution, and stimulate the disposal industry for electronic products. The role of the government is also

significant based on the findings of this study. Since institutional influence is strong, the government could play an active role in increasing the awareness of mobile users on the recycling value and associated environmental benefits and provide incentives for mobile phone companies towards recycling and reverse logistics.

5.4. Limitations and Recommendations for Further Research

There are methodological limitations in this study. First, respondents were the only source of information, which can create a common method bias. To address this, we produced different versions of the questionnaire to deal with the self-report problem and reduce common method bias. Information from respondents working in more companies, including the public sector as well as small and medium companies would provide a stronger test of our model and can be the objective of future research. A recommendation for future research would also be to maintain the current design and compare results from different sources and industries. Further, the sample of respondents was drawn solely from the mobile phone industry in China. Culture in business relations as well as participating in surveys could moderate the reverse logistics factors and produce different results upon firm performance. Therefore, future research should examine the reverse logistics factors in other contexts and countries which could produce a basis for cross-validation of the model.

Although this study does not cover every facet of reverse logistics, it could be considered as a first comprehensive step towards the development of the theoretical domain of reverse logistics. Future research should be directed not only to refining and strengthening the constructs identified in this study, but also to expanding the domain by considering additional factors. Dynamic capabilities have been under-researched in reverse logistics literature and future studies can extend this study to this direction.

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Figure 1 Research Model and Hypotheses

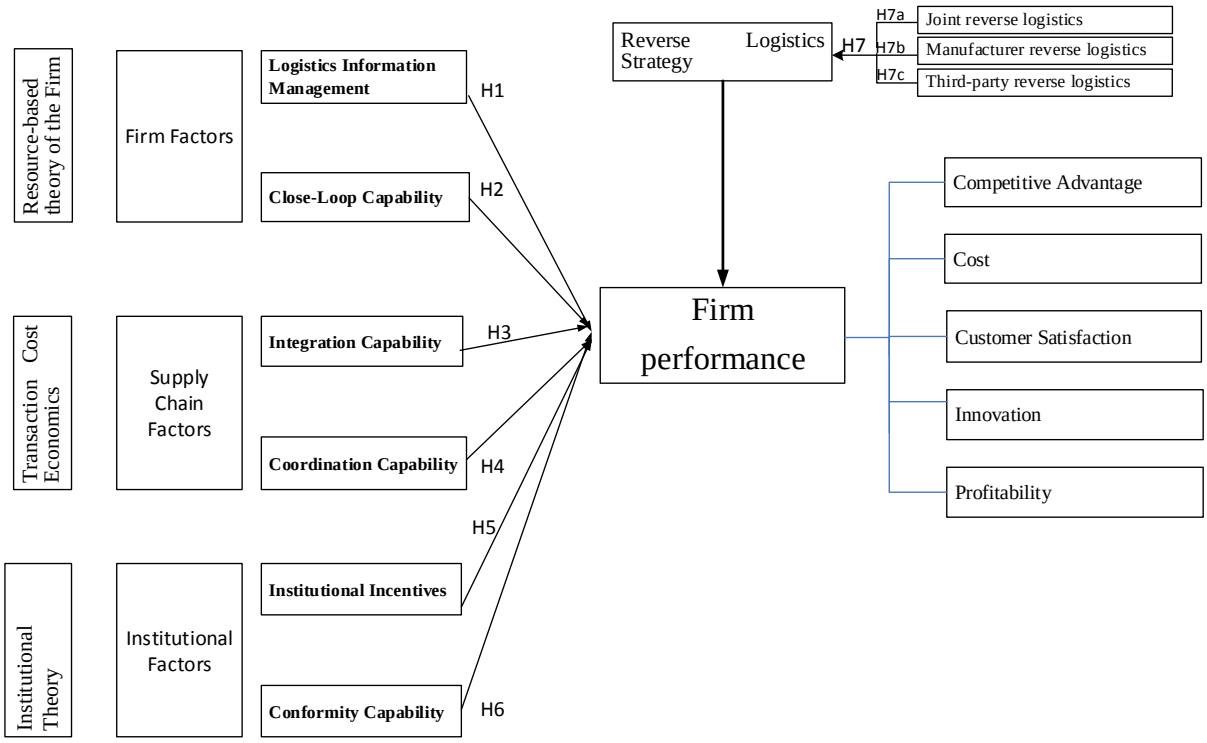

Table 1 Characteristics of Companies

Characteristics	Percentage
Brand	
Huawei	13.1
Lenovo	11.7
ZTE	12.4
Nokia	13.1
Samsung	11.7
HTC	13.1
MIONE	13.9
Haier	10.9
Number of Employees	
Less than 500	9.5
Between 500 and 1000	16.1
Between 1001 and 3000	53.3
More than 5000	21.2
Reverse Logistics	
Less than two years	4.4
Between two and five years	27.7
Between five and eight years	47.4
Between eight and ten years	13.1
More than ten years	7.3
Reverse Logistics Model	
Own Chain	19.7
Chain Collaboration	31.4
Outsourcing	44.5
Other/Not Specified	4.4

Table 2 Means, Standard Deviations and Correlation Matrix

Variables	Mea	Std.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Variable																
1. Size	2.86	0.86	1.00													
2. Experience	2.91	0.94	0.15	1.00												
3. Brand	4.48	2.29	-0.07	-.259**	1.00											
Reverse Logistics Factors																
4. Logistics Inf. Management	3.48	0.46	-0.06	-0.11	-0.09	1.00										
5. Close-Loop Capability	2.83	0.56	-0.00	-0.05	0.02	-0.16	1.00									
6. Integration Capability	3.77	0.38	-0.11	-0.03	-0.02	0.05	-.272**	1.00								
7. Coordination Capability	4.02	0.48	-.206*	-0.09	0.09	0.17	-.198*	.274**	1.00							
8. Institutional Incentives	2.21	0.40	-0.11	-0.11	-0.01	0.15	-0.01	0.03	0.13	1.00						
9. Conformity Capability	2.52	0.66	-0.16	-.169*	-0.01	-0.04	0.01	-0.16	0.06	-.195*	1.00					
Moderation Variable																
10. Reverse Logistics Strategy	2.34	0.84	0.15	-0.03	0.08	-0.07	-0.05	0.03	0.02	0.09	-0.09	1.00				
Performance Variables																
11. Competitive Advantage	3.49	0.73	-0.09	-0.02	-0.03	.215*	-.170*	.272**	.360**	0.09	0.01	0.03	1.00			
12. Cost	3.61	0.79	-0.10	-0.04	-0.12	.191*	-.183*	.252**	.229**	0.11	-0.04	-0.08	0.09	1.00		
13. Customer Satisfaction	3.26	0.68	-0.07	0.06	.310**	-0.09	0.02	.179*	.246**	0.09	-0.00	0.02	-0.00	-0.09	1.00	
14. Innovation	3.20	0.83	.204*	-0.12	0.12	-0.08	0.09	0.11	-0.03	-0.03	0.13	0.04	-.294**	-.276**	0.11	1.00
15. Profitability	3.72	0.77	-.368**	0.04	-0.16	0.16	0.02	0.12	0.10	.205*	0.01	-0.03	0.07	-0.03	-0.16	-.418**

** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed)

Table 3 Moderated Hierarchical Regression Analysis –Steps 1, 2, and 3.

		Step 1 Y=C+X			Step 2 Y=C+Z		
Performance Variables	**Block**	**F**	**Adjusted Rsquare**	**Change in adjusted Rsquare**	**F**	**Adjusted Rsquare**	**Change in adjusted Rsquare**
Competitive Advantage	Block 1 (C)	0.452	-0.01	0.010	0.452	-0.01	0.010
	Block 2 (X)	3.367***	0.135	**0.182*** **	0.411	-0.01	0.002
Cost	Block 1 (C)	1.362	0.007	0.029	1.362	0.007	0.029
	Block 2 (X)	2.325*	0.080	**0.111***	1.123	0.003	0.003
Customer Satisfaction	Block 1 (C)	6.099***	0.101	**0.120*** **	6.099***	0.101	**0.120*** **
	Block 2 (X)	3.840*	0.158	**0.092***	4.540	0.094	4.750
Innovation	Block 1 (C)	3.577*	0.053	**0.074***	3.577*	0.053	0.074*
	Block 2 (X)	2.424	0.086	0.071	2.663	0.046	1.748
Profitability	Block 1 (C)	9.291***	0.154	**0.173*** **	9.291***	0.154	**0.173*** **
	Block 2 (X)	4.027	0.166	0.048	7.026	0.150	0.002
Moderator Variable	**Step 3 Z=C+X**						
	Block	**F**	**Adjusted Rsquare**	**Change in adjusted Rsquare**			
Reverse Logistics Strategy	Block 1 (C)	1.388	0.008	0.030			
	Block 2 (X)	0.821	-0.01	0.024			

Table 4 Moderated Hierarchical Regression Analysis - Step 4 (Y=C+Z+X)

Performance Variables	Block	F	Adjusted Rsquare	Change in adjusted Rsquare
Competitive Advantage	Block 1 (C)	0.452	-0.01	0.010
	Block 2 (Z)	0.411	-0.01	0.002
	Block 3 (X)	3.028***	0.129	**0.181*** **
Cost	Block 1 (C)	1.362	0.007	0.029
	Block 2 (Z)	1.123	0.003	0.003
	Block 3 (X)	2.173*	0.079	**0.114***
Customer Satisfaction	Block 1 (C)	6.099***	0.101	0.120***
	Block 2 (Z)	4.540	0.094	4.750
	Block 3 (X)	3.437*	0.151	**0.093***
Innovation	Block 1 (C)	3.577*	0.053	0.074*
	Block 2 (Z)	2.663	0.046	1.748
	Block 3 (X)	2.164	0.078	0.071
Profitability	Block 1 (C)	9.291***	0.154	0.173***
	Block 2 (Z)	7.026	0.150	0.002
	Block 3 (X)	3.627	0.161	0.048

Table 5 Beta weights of Moderated Hierarchical Regression Analysis - Competitive Advantage & Cost

	Competitive Advantage			Cost		
Variables	**Step 1**	**Step 2**	**Step 3**	**Step 1**	**Step 2**	**Step 3**
Control variable						
Size	-0.0 0.07***	-0.08 -0.49	**-0.00 0.07*** **	-0.0 0.07***	-0.08 -1.61	**-0.03 0.08*** **
Years	-0.0 0.07***	-0.01 10.3***	**0.02 0.06***	-0.0 0.07***	-0.05 11.2***	**-0.03 0.07*** **
Brand	-0.0 0.02***	-0.01 -1.10	**-0.01 0.02*** **	-0.0 0.03***	-0.04 -1.07	**-0.04 0.03*** **
Moderator						
Reverse Logistics Strategy		0.04 -0.21	**0.02 0.07***		-0.05 -0.66	**-0.07 0.07*** **
Reverse Logistics Factors						
Logistics Inf. Management			0.24 0.13			0.19 0.15
Close-Loop Capability			**-0.04 0.11*** **			**-0.13 0.12*** **
Integration Capability			0.35 0.16			0.35 0.18
Coordination Capability			0.41 0.13			0.22 0.14
Institutional Incentives			**0.06 0.15***			**0.11 0.17***
Conformity Capability			**0.05 0.09***			**-0.02 0.10*** **
F Value	0.452	0.411	3.028***	1.362	1.123	2.173*
Adjusted R^2	-0.01	-0.01	0.129	0.007	0.003	0.079
ΔR^2	0.01	0.002	**0.181*** **	0.029	0.003	**0.114***

Table 6 Beta weights of Moderated Hierarchical Regression Analysis - Customer Satisfaction and Innovation

	Customer Satisfaction			Innovation			Profitability		
Variables	**Step 1**	**Step 2**	**Step 3**	**Step 1**	**Step 2**	**Step 3**	**Step 1**	**Step 2**	**Step 3**
Control variable									
Size	-0.0 0.06***	-0.04 4.11***	**0.01 0.06***	0.22 0.08	0.22 1.20	0.26 0.08	-0.3 0.07***	-0.35 -2.16*	**-0.32 0.07*****
Years	0.11 0.06	0.11 8.23***	0.13 0.06	-0.1 0.07***	-0.11 6.84***	**-0.07 0.07*****	0.04 0.06*	0.04 13.6***	**0.07 0.07***
Brand	0.10 0.02	0.10 -0.75	0.10 0.02	0.03 0.03	0.03 2.69**	0.04 0.03	-0.0 0.02***	-0.06 -4.89***	**-0.05 0.02*****
Moderator									
Reverse Logistics Strategy		0.00 1.85*	**-0.01 0.06*****		-0.00 -1.45	0.00 0.08**		0.04 0.61	**0.03 0.07***
Reverse Logistics Factors									
Logistics Inf. Management			**-0.11 0.12*****			**-0.08 0.15*****			0.20 0.14
Close-Loop Capability			**0.11 0.10***			0.19 0.13			**0.09 0.11***
Integration Capability			0.31 0.15			0.48 0.19			**0.18 0.17***
Coordination Capability			0.28 0.12			**-0.05 0.15*****			-0.00 0.13***
Institutional Incentives			0.18 0.14			**0.07 0.18***			0.29 0.16
Conformity Capability			**0.06 0.08***			0.25 0.11			**0.02 0.10***
F Value	6.099***	4.54	3.437*	3.577*	2.663	2.164	9.291***	7.026	3.627
Adjusted R^2	0.101	0.094	0.151	0.053	0.046	0.078	0.154	0.15	0.161
ΔR^2	0.120***	4.75	**0.093***	0.074*	1.748	0.071	0.173***	0.002	0.048

Table 7 Summary of Research Hypothesis Test Results

Hypothesis	Variables	Competitive Advantage	Cost	Customer Satisfaction	Innovation	Profitability	Decision
H1	Logistics Inf. Management	0.24 0.13	0.19 0.15	**-0.11 0.12*** **	-0.08 0.15***	0.20 0.14	Reject
H2	Close-Loop Capability	**-0.04 0.11*** **	**-0.13 0.12*** **	**0.11 0.10***	0.19 0.13	0.09 0.11*	**Accept**
H3	Integration Capability	0.35 0.16	0.35 0.18	0.31 0.15	0.48 0.19	0.18 0.17*	Reject
H4	Coordination Capability	0.41 0.13	0.22 0.14	0.28 0.12	-0.05 0.15***	-0.00 0.13***	Reject
H5	Institutional Incentives	**0.06 0.15***	**0.11 0.17***	0.18 0.14	0.07 0.18*	0.29 0.16	**Partially accept**
H6	Conformity Capability	**0.05 0.09***	**-0.02 0.10*** **	**0.06 0.08***	0.25 0.11	0.02 0.10*	**Accept**
H7	Reverse Logistics Strategy	**0.02 0.07***	**-0.07 0.07*** **	**-0.01 0.06*** **	0.00 0.08**	0.03 0.07*	**Reject as moderator**
	F Value	3.028***	2.173*	3.437*	2.164	3.627	
	Adjusted R^2	0.129	0.079	0.151	0.078	0.161	
	ΔR^2	**0.181*** **	**0.114***	**0.093***	0.071	0.048	