Logistics Efficiency and Firm Performance: Evidence from Indonesian Small and Medium Enterprises

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Abstract

Logistics is a decisive factor for a firm to sustain its competitive advantage. Despite the importance of logistics to firm performance, studies on logistics innovation and efficiency are extremely limited. To fill up the literature gap, this paper provides some insight into the impact of logistics innovation on firm performance and the moderating effects of logistics efficiency on logistics innovation and firm performance. Using a regression analysis on 120 samples collected from agro-based SMEs in Indonesia, it was found that innovation in information sharing and transportation coordination led to superior firm performance. The result of the study also shows that logistics efficiency mediated the relationship between innovations in information sharing and transportation coordination, and firm performance. This proves that the effect of innovation on the performance of SMEs is stronger when logictics efficiency is improved through such an innovation.

Keywords: Logistics, efficiency, innovation, performance, SMEs, Indonesia

Introduction

It has been acceptable that the small and medium enterprises (SMEs) are a significant contributor to the Gross Domestic Product (Meghana, 2005), poverty alleviation (Vandenberg, 2006), and value creation (Mukhamad Najib & Akira Kiminami, 2011). In Indonesia, SMEs are mostly located in the rural areas and involved in agro-based activities. In 2009, they totaled 52.7 million or 99.9 per cent of all establishments; provided 96.2 million jobs or 97.3 per cent of the total employment; and generated added value amounting 2,993,151 billion Rupiah or 56.5 per cent of the total added value (Mukhamad Najib & Akira Kiminami, 2011). Despite this favourable contribution, the Indonesian SMEs, as in other parts of the world, are hampered by various problems. Most of the problems are associated with internal factors, such as marketing and promotion, technology, and human capital (Antonius, 2005; Nurul Indarti, 2008; Tambunan, 2009); and external factors, namely access to capital and legality issues (Nurul Indarti, 2008).

Logistics as an integral part of the supply chain system provides the time and place utilities for a firm (Sakchuchawan *et al*., 2011) and hence it is able to enhance firm performance (Rutner and Langley, 2000). Against this backdrop, however, the Indonesian logistics performance index is still lower than the neighbouring countries, such as Malaysia and Thailand (World Bank, 2007 as cited in Zailani, 2010). This means that logistics appear to be one of the most critical issues facing Indonesian firms, especially the SMEs, to move their products right from the production units to the end consumers. Since logistics innovation and logistics efficiency in SMEs is under research, this paper provides some insight into the impact of logistics innovation on firm performance and the moderating effects of logistics efficiency on logistics innovation and SME's performance.

The results in this paper would improve the explanation on how firm performance could be improved through logistics innovation and help SMEs to enhance their performance.

Literature Review and Hypothesis

Logistics innovation and firm performance

Most activities along the distribution channel functions linking suppliers, manufactures and end consumers are concentrated in logistics. This function encompasses many activities, including order handling, information sharing, product distribution scheduling, inventory management and control, transportation, packaging, warehousing, and acquisition. Innovation in logistics is fundamental to an organization, which can be implemented in internal activities or services (Sakchuchawan *et al*., 2011). Such an innovation could enhance the coordination capabilities among channel activities, which enables firms to avoid dysfunctional operational performance and other negative consequences, such as higher inventory costs, longer delivery times, higher transportation costs, and other disadvantages (Lee, 1997).

Many studies supported the significant impact of logistics innovation on firm performance. Sakchuchawan *et al*. (2011) found that logistics as part of the supply chain system provides benefits in terms of time and place utilities; and hence it is able to enhance firm performance (Rutner and Langley, 2000). Nada (2008) found that technology as part of innovation devices enabled firm to promote organisational coordination and hence it had a positive impact on performance. Lambert and Burduroglo's (2000) findings showed that a greater improvement in logistics activities and capabilities leads to superior firm performance. This leads to the following hypothesis.

H1: Logistics innovation in all the logistics activities is associated positively with firm performance.

Mediating role of logistics efficiency

It can not be denied that logistics innovation will improve firm performance, but all the innovation in each logictics activity would increase the level of logistics efficiency first before a firm achieves a superior performance. This section shows how innovation in each logistics activity improves logistics efficiency and finally firm performance.

Order handling is recognised as one of the decisive factors for business processes in most profit-oriented company (Kritchanchai and MacCarthy, 1999). It is the main logistics activity that smooths the movement of goods or products and services (Bowersox, Closs and Helferich, 1986). The important role of order handling innovation in firm's logistics efficiency is also emphasized by many researchers. According to Gaukler (2008), the application of technological support, such as radio-frequency identification and global positioning system will enhance real-time tracking information for products and replacement orders within the value chain.

Further innovation in order handling through the application of simulation in order processing adds more value along the distribution chain, which likely improves logistics performance (Zhang, 2009). The application of the Enterprise Resource Planning Solution (ERPS) in order processing also has the ability to improve operational efficiency (Bendoly, 2004). In other words, all the innovation in order handling will lead to logistics efficiency and ultimately superior firm performance. Thus, the first hypothesis can be stated as follows:

H2a. The effect of order handling innovation on firm performance is mediated by logistics efficiency.

An effective information sharing system is vital for achieving distribution channel performance (Zhou and Benton, 2007). Having a good coordination among independent channel members, such as raw material suppliers, manufacturers, distributors and retailers enables the players to enhance logistic processes within the rapid change in market conditions (Lee *et al*., 1997). Heide (1994) found that the significant success factor for export-oriented SMEs was contingent upon the capability of the firms to manage their relationship with foreign importers. With the advent of information technology, information can be processed, transmitted and collected at a faster rate. As a result of this technological revolution, market knowledge of the firms and their relationship with the channel members within the value chain system has tremendously improved (Fern'andez, 2006), which in turn enhanced firm performance. This leads to the following hypothesis:

H2b. The effect of information sharing innovation on firm performance is mediated by logistics efficiency.

Product distribution scheduling is a logistic activity, concerning about when and where the collection of goods to be formed and delivered (Ballaou, 1978). A product scheduling method, which is coupled with material supply and product delivery, will improve logistics efficiency (Chen *et al*., 2009). Innovation in product distribution scheduling was discovered to be able to improve efficiency as well (Singh, 2009).

Furthermore, the identification of the optimal production quantities, the time to produce and the vehicle routes through a computerized method is the effective and efficient way to increase total profit (Chen *et al*., 2009). A new method of polynomial-time algorithms in solving product distribution scheduling was found to be able to minimize inventory and transportation cost (Cheng, 2009). Besides directly enhancing logistics efficiency, such an innovation will ultimately affect firm performance. As such,

H2c. The effect of product distribution scheduling innovation on firm performance is mediated by logistics efficiency.

Inventory forms a significant part of current asset of an enterprise (Kruger, 2005). A good inventory management system is a decisive factor for a firm's success (Chikan, 1990). On the contrary, inaccuracy in inventory management would create a range of problems, such as productivity loss, unwanted items of manufacturing, a reduction in the customer commitment level, and increased costs. Thus, the cost savings accumulated from improved practices in inventory management is remarkable (Meyer, 1991). The linkages between inventory management and competitive advantage, such as cost, delivery, and quality are significant (Natarajan, 1991). An innovation in inventory management and control is crucial for a firm. It allows an enterprise not only to minimize inventory costs, but also to avoid direct consequences due to the shortage of material resources (Sprague and Wacker, 1996), which directly affect distribution activities. Due the importance of inventory innovation for logistics efficiency and firm performance, the following hypothesis can be stated as,

H2d. The effect of inventory innovation on firm performance is mediated by logistics efficiency.

The role of transportation system is crucial in a distribution channel system because it could provide more efficient logistics, reduce operational costs, and promote the service quality. According to Chang (1988), transportation costs, on average, accounted for 44 percent of the total logistics costs. Therefore, an innovation in transportation coordination methods using the three major elements of smart transportation management (smart goods, smart vehicles and smart infrastructure) would bring about a positive impact on logistics performance (Stefansson, 2009). In other words, the well-operated logistics system would increase the competitiveness of enterprises (Tseng, 2005). In contrast, a poor coordination of the logistics system would lead to higher costs, longer delivery times, higher levels of loss and damage, and poor customer service (Lee, Padmanabhan and Whang, 1997). Thus,

H2e. The effect of transportation innovation on firm performance is mediated by logistics efficiency.

Packaging serves as a tool for product promotion and use. While packaging engineers see packaging as a protective device only, distribution managers perceive packaging in a broader perspective. To the latter, any changes in design, size, and media of transportation would contribute to the efficiency of a distribution system (Walter, 1977). A recent study on 800 U.S. shoppers in eight product categories demonstrated that innovation in new packaging systems directly effected price expectation and product selection among the shoppers (Lacroix, 2007). The study found that if packaging is done properly, it is very likely provides a positive return on investment (ROI) through increased market share or the ability to raise prices to cover incremental costs. Morgado, (2008) suggested that plastic material based have advantages as they can provide less material, & also permit recycling. Using plastic materials, coloring, decorating, and printing can allow the innovated packaging to receive not only all the necessary information for the customers, but also other essential aspects including customer recognition. As innovation in packaging could enhance logistics efficiency and firm performance, therefore:

H2f. The effect of packaging innovation on firm performance is mediated by logistics efficiency.

Warehousing creates time utility for prospective customer (Koyle, 1976). Finished goods or material handling in the logistic system is concentrated in and around the warehouse facility. The absence of goods in the warehouse means the interruption of the goods flows, which will add costs to transactions. To avoid this interruption, some technologies can be adopted. Such technologies could improve distribution performance in warehousing and finished good handling, which in turn leads to firm performance (Koyle, 1976).

For instance, automation and simulation in warehousing and material handling in terms of computerized hardware and software could be a solution for improving efficiency in the operation. In fact, simulation program can be an alternative for improving the existing system in the warehousing and material handling (Diaz, 1988). The use of technology, such as autonomous vehicle storage and retrieval systems (AVS/RS) and web-based design conceptualization tool for AVS/RS in the warehouse permits firms to control costs, extend capacity and improve their services to consumers (Heragu and Xiou, 2008). As such, the following hypothesis is,

H2g. The effect of warehousing innovation on firm performance is mediated by logistics efficiency.

Acquisition is a logistics activity which makes a particular or a group of product available to the logistic system. It deals with the selection of supply-source locations, quantities to be acquired, the time of purchases, and the form in which the product is to be acquired (Bowersox *et al*. 1986. Quantity and timing of purchase, location source, form of the goods, choosing single or multiple suppliers, hedging price due to changing currency value, and pricing are among the important consideration have to be carefully made by a firm in the acquisition process because this decision will give a serious impact on logistic costs (Ballou 1978). The use of new technology in acquisition would enable the firm to obtain strategic valuable resources, achieve market power, or generate strategic renewal (Graebner, Eisenhardt *et al*., 2010). Therefore:

H2h. The effect of acquisition innovation on firm performance is mediated by logistics efficiency.

Research Methods

Variables and Measures

Independent Variables

Logistics activities investigated in this study included order handling, information sharing, inventory, warehousing, packaging, product distribution scheduling, transportation coordination and acquisition. Besides research and development (R&D) activities, logistics innovation in this study referred to the application of new technologies or modification of existing methods as defined by Kongmanilaa and Takahashib (2009). Items for each logistics activity were derived from Bowersox *et al*., (1986) and Ballou (1978). The respondents were asked to indicate the level of their emphasis on each item based on a 7-point scale, ranging from "1= the least emphasised" to "7= the most emphasised".

Mediator

Logistics efficiency variable is modified from Ulaga (2003). The three items used to measure this variable were operation costs, labor costs, and other costs. Using a 7-point scale, ranging from "1= the least efficient" to "7= the most efficient", the respondents were requested to compare their logistics cost performance with their closest competitors in the same industry.

Dependent Variables

In the absence of objective measures, respondents' self-assessment over performance indicators is more relevant (Love *et al*., 2002). In line with the existing literature, firm performance variables in this study included export revenue, export intensity and firm profitability as suggested by Kongmanila and Takahashib (2009) and Murphy *et al*., (1996). Using a 7-point scale, ranging from "1 = the lowest" to "7 = the highest", the respondents were asked to compare the performance of their firm with their closest competitors in the same industry. This approach was able to indirectly control for industry influences on firm performance (Kellermanns *et al*., 2012).

Control Variables

Firm size and age of firm were used as control variables in this study and measured by number of workers and year of operation respectively. Industry was measured by a nominal scale. Competitive environment with the items on obsolescence in product technology, market change, governmental regulatory change and market conditions (Miller and Friesen, 1982) was measured in a 7-point scale, ranging from "1= the lowest" to "7= the highest".

Data Source

Data for this study were collected from agro-based small and medium enterprises (SMEs) in Yogyakarta and the nearby areas (Jogja, Sleman, Bantul).

A few stages of data collection were operationalised to assure the quality of data used in the study. In the first stage, SMEs with less than 100 full time employees were identified in the studied area. A face-to-face pilot survey was then conducted on 20 respondents to check the suitability of the questions asked as well as to validate the constructs and items used in the questionnaire. In the final stage of data collection, a self-administered questionnaire was distributed to the respondents, who were the owner-manager of SMEs. A "drop and collect" procedure was adopted in the distribution process because this would ensure a high response rate among the respondents. The questionnaire was cross-checked during the collection time to ensure that all the questions had been answered by the respondents. A total of 120 samples from export-oriented SMEs were used in the final analysis. In terms of proportion, 50.8 percent of the respondents were in the wood-based industry, 30 per cent in the craft industry and 19.2 per cent from the clothing industry. Most of the enterprises were in operation for more than seven years that is 54 per cent were 8-15 years old and 18 per cent were 16-26 years old.

Table 1 shows some tests for the data used in this study. A reliability test on various constructs on logistics innovation and efficiency as well as firm performance was run. It produced Cronbach's alphas of more than 0.7, indicating the reliability of the constructs (Pallant, 2005). A further inspection on data normality, the skewness and kurtosis values ranging between -2.0 to +2.0 indicated that the data were normally distributed (George and Mallory, 1995). Factorability and validity for all the constructs were assured since the Kaiser-Meyer-Olkin (KMO) index was exceeding 0.6 (Tabachnick and Fidel, 1996) and the Bartlett's test of sphericity was significant ($p = < 0.05$).

Results

The correlation between the independent variables is considered high when the correlation value (the Pearson correlation, *r*) is greater than 0.7. This multicolleniarity problem will result in the poor regression model (Pallant, 2005). However, the results of the correlation analysis in Table 2 shows that the relationships between the independent variables are low to modest, indicating the absence of the multicolleniarity problem and hence acceptable for performing multivariate statistical tests.

Table 1. Tests for reliability, normality and validity

Constructs	Reliability		Normality		Validity		
	Items	Cronb alpha	Skewness	Kurtosis	KMO measure	Barlett's test of sphericity	No. of factors extracted
Order handling	5	0.968	0.238	-1.337	0.797	0.000	1
Information sharing	5	0.971	0.839	-0.636	0.862	0.000	1
Product distribution	5	0.979	0.907	-0.502	0.827	0.000	1
Inventory	5	0.933	1.068	-0.125	0.848	0.000	1
Packaging	5	0.927	1.235	0.048	0.775	0.000	1
Transportation	5	0.948	0.232	-0.884	0.822	0.000	1
Warehousing	5	0.883	0.203	-0.830	0.686	0.000	1
Acquisition	6	0.921	0.215	-0.758	0.854	0.000	1
Distribution	3	0.858	0.719	1.160	0.706	0.000	1
Competitive	4	0.840	0.013	-0.230	0.720	0.000	1
Firm performance	3	0.841	-0.118	0.290	0.712	0.000	1

Source: Based on the sample survey

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Table 2. Correlation matrix between variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Order handling	-	.											
2. Information sharing &	0.506**	-											
3. Product distribution scheduling	0.345**	0.528**	-										
4. Inventory	0.116	0.439**	0.447**	-									
5. Transportation coordination	0.316**	0.370**	0.447**	0.353**	-								
6. Packaging	0.193*	0.373**	0.423**	0.493**	0.401**	-							
7. Warehousing & material handling	0.336**	0.315**	0.289**	0.407**	0.316**	0.463**	-						
8. Acquisition	0.277**	0.368**	0.355**	0.359**	0.413**	0.184*	0.343**	-					
9. Environmental hostility	-0.075	0.044	0.163	0.373**	0.220*	0.397**	0.187*	0.120	-				
10. Firm size	-0.199*	0.150	-0.075	0.122	-0.040	0.201*	0.018	-0.242**	0.232*	-			
11. Age of company	-0.033	-0.152	-0.263**	-0.139	-0.091	-0.079	-0.030	0.049	0.004	0.221*	-		
12. Industry	0.015	-0.146	-0.121	-0.181*	-0.095	-0.069	-0.011	-0.125	-0.052	-0.163	-0.149	-	
13. Logistics efficiency	0.064	0.422**	0.346**	0.335**	0.386**	0.293**	0.394**	0.281**	0.347**	0.053	-0.107	-0.160	-
14. Firm performance	0.127	0.374**	0.166	0.114	0.274**	0.268**	0.154	-0.006	0.051	0.244**	-0.050	-0.057	0.353**

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).
Source: Based on the sample survey.

As displayed in Table 3, four models were estimated in this study. This approach was undertaken because it could show how the explanatory power of the model, the *R*-square (R^2), changed when the studied variables included in the estimated models in stages and at the same time see the effects of the variables on firm performance. Model 1 included the control variables only, whilst Model 2 included all the control and independent variables. As evident in Model 2, Hypothesis 1 was partially supported because only innovations in information sharing and transportation coordination affected firm performance significantly. Controlling for firm size, firm age, industry and competitive environment, Model 3 shows that logistics efficiency was associated positively and significantly with firm performance. Based on Baron and Kenny's (1986) arguments, the two steps displayed in Model 2 and Model 3 have supported the mediator effects. The final step is to include all the control, independent and mediating variables in the model. If the inclusion of the mediator (logistics efficiency) reduces or eliminates the effects of logistics innovation on firm performance, it can be concluded that logistics efficiency mediates the relationship between logistics innovation and firm performance. As shown in Model 4, logistics efficiency had significant influence on firm performance (β = 0.301, p < 0.001) and did eliminate the significant effect of logistics innovations in information sharing and transportation coordination on predicting firm performance. This result is consistent with H2b and H2e that logistics efficiency mediated the relationships between innovations in information sharing and transportation coordination and firm performance respectively.

Table 3. Results of the hierarchical regression analysis

Independent variables	Model			
	1	2	3	4
Firm size	0.376**	0.194	0.390**	0.247
Firm age	-0.060	-0.009	-0.034	-0.007
Industry sector	-0.199	-0.002	0.207	0.167
Competitive environment hostility	-0.009	-0.027	-0.110	-0.091
Order handling		-0.029		0.002
Information sharing		0.129**		0.086
Product distribution scheduling		-0.021		-0.027
Inventory		-0.060		-0.046
Transportation coordination		0.093*		0.071
Packaging		0.050		0.063
Warehousing & material handling		0.025		-0.015
Acquisition		-0.047		-0.043
Logistics efficiency			0.419***	0.301*
R^2	0.072	0.252	0.198	0.295
Adjusted R^2	0.040	0.168	0.163	0.209
ΔR^2	0.072	0.180	0.126	0.043
F	2.227	3.005**	5.632***	3.417***

Note: Dependent variable is firm performance; * p < 0.05; ** p < 0.01; *** p < 0.001
Source: Based on the sample survey.

Discussion and Conclusion

The results in this study are consistent with the literature that innovation in all logistics processes does not bring about similar impact on firm performance. In fact, such innovation links with firm performance in different ways (Geroski and Machin, 1993). Too little and too much innovation would not give benefits to firm performance, either (Naveh *et al*., 2006). Despite that, the significant impact of logistics innovations in information sharing and transportation coordination on firm performance is sufficient to explain the variation in SME's performance.

The findings in this study also supported the hypothesis that logistics efficiency mediated the association between innovations in information sharing and transportation coordination and firm performance. The application of information technology, such as the internet enables firms to improve their market knowledge and relationship with clients and suppliers within the same value chain. This would improve logistics efficiency in terms of costs and delivey time and finally the performance of SMEs in the local and export markets. In addition, innovative transportation coordination was found to improve logistics efficiency, which directly influenced SME performance. This finding is supportive because about one to two-thirds of the enterprise expenses on logistic costs are spent on transportation (Chang, 1998). It is also consistent with Stefansson's (2009) argument that the use of technology in transportation would result in more effective and efficient transportation coordination, for instance, in selecting goods, vehicles and infrastructure, which brings about positive impact on logistics efficiency and firm performance.

Some implications can be drawn from the findings in this study. From the theoretical viewpoint, logistis innovation and logistics efficiency should be taken into account in explaining firm performance. The resource-based view (Barney, 1991) and generic strategic typology (Porter, 1985) argue that internal resource, capabilities and strategies are critical for firm performance, but many studies overlooked logistics innovation and efficiency. To SMEs, the findings in this study remind them that with globalization, the movement of product from the production point to the end consumers must be fast. Therefore, much effort has to be done by SMEs to improve their logistics efficiency in order to sustain their competitive advantages in the global market.

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