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Reverse logistics in Malaysia: The Contingent role of institutional pressure

Kuan Siew Khor [a,*], Zulkifli Mohamed Udin [b], Thurasamy Ramayah [c,d], Benjamin T. Hazen [e]

[a] Sunway University Business School, Bandar Sunway, 47500 Subang Jaya, Selangor, Malaysia
[b] School of Technology Management and Logistics, UUM College of Business, Universiti Utara Malaysia, UUM, 06010 Sintok, Kedah, Malaysia
[c] School of Management, Universiti Sains Malaysia Minden, 11800 Penang, Malaysia
[d] UTM International Business School (UTM-IBS) Level 10, Menara Razak, Universiti Teknologi Malaysia Kuala Lumpur, Jalan Sultan Yahya Petra (Jalan Semarak), 54100 Kuala Lumpur
[e] Department of Marketing and Supply Chain Management, University of Tennessee, Knoxville, TN 37996, United States

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ABSTRACT

Reverse logistics is a primary component of green supply chain management initiatives and is often analysed from a broad perspective. Rooted in the resource-based view of the firm, this empirical study decomposes reverse logistics into five commonly adopted disposition options (repair, recondition, remanufacture, recycle, and disposal) to examine the effects of using each option on measures of environmental performance, profitability, and sales growth. Considering institutional theory, this study also investigates the moderating role of both regulatory and ownership pressure on the relationship between each reverse logistics disposition option and levels of performance. Using survey data collected from managers at 89 ISO14001 certified electrical and electronic equipment manufacturing firms, regression models test a series of hypothesized relationships. Results suggest that under the presence of institutional pressure, use of disposition options results in increased levels of performance in some cases. The recovery of valuable components during product recondition and remanufacture activities contributes to enhanced environmental and economic benefits. Conversely, product recycling and disposal activities are not necessarily performance-inducing initiatives in the face of regulatory pressures The findings of this study can be used to inform business decisions regarding the adoption and use of reverse logistics strategies. Legislative frameworks regarding extended producer responsibility are recommended in order to motivate the implementation of reverse logistics product disposition activities.

1. Introduction and background

Globalisation and the advancement of information infrastructures have elevated the general concern towards environmental and human health issues created by mismanagement of electrical and electronic equipment (EEE) waste. Consumption rates of EEE have surged to the point where manufacturers are often bound to take physical and/or financial responsibility for collecting products from downstream consumers and reutilizing or disposing of them properly (Das and Posinasetti, 2015; Kumar and Putnam, 2008; Lee and Na, 2010). For instance, European Union Directive 2002/96/EC on Waste of Electrical and Electronic Equipment (WEEE) encourages participation by businesses and consumers to reduce landfill waste. Indeed, industrialised countries are leading the way in terms of adoption of environmentally conscious practices. Malaysia is not exempted from such evolving trends, as evidenced by the fact that EEE accounted for RM249.8 billion in value in fiscal year 2010, equivalent to 51.2% of total manufacturing exports.

The rising concern about transboundary movement of waste has encouraged the introduction of a new governmental policy entitled "Guidelines for the Classification of Used Electrical and Electronic Equipment in Malaysia" to control and restrict the exportation of e-waste for the purpose of convenient liquidation or disposal (2010). This guideline was developed in support of the Basel Convention on the Transboundary Movements of Hazardous Waste and Their Disposal. Manufacturers are encouraged to shift from only using reactive approaches to pollution prevention such as ensuring proper disposal to adopting more proactive approaches that promote lifecycle stewardship and facilitate higher yields of recoverable products. Although some products with lower residual value are more likely to undergo material recycling, energy recycling, or proper disposal, products with higher residual

* Corresponding author. Tel.: +603 7491 8622x7279; fax: +603 5635 8633
E-mail addresses: kuansiewk@sunway.edu.my (K.S. Khor), zulkifli@uum.edu.my (Z.M. Udin), ramayah@usm.my (T. Ramayah), hazen@utk.edu (B.T. Hazen).

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value can be reused in part or in whole (Gobbi, 2011). Reverse logistics facilitates recoverability of all such product returns (Huscroft et al., 2013).

According to Rogers and Tibben-Lembke (1999), reverse logistics is defined as the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal. Used and unused finished goods moved in the reverse direction undergo a process of product downcycling, which is defined as the use of multiple cycles of recovery to allow reuse of valuable assets based on functionality of products, modules, and/or components. Product downcycling facilitates multiple recovery loops to extend products' useful life and reduces demand for landfill disposal. Product disposition is a key component of this process and is one of the core reverse logistics activities (Prahinski and Kocabasoglu, 2006). Prahinski and Kocabasoglu (2006) define product disposition as the integration of activities related to deciding what to do with a returned product and facilitating that course of action, to include issues relating to transportation, facilities, and information systems. Previous work analysing literature in the areas of closed-loop supply chains, green supply chains, reverse logistics, and environmental management identifies five of the most frequently adopted product disposition options as repair, recondition, remanufacture, recycle, and disposal (Khor and Udin, 2012; Hazen et al., 2012a, 2012b).

Consistent with definitions proffered by Khor and Udin (2012) and Hazen et al (2012a, 2012b), *repair* denotes fixing or replacing malfunctioning components or modules in order to restore the existing product to working order. *Recondition* denotes a higher order option than repair in that some level of product disassembly in order to restore the existing used product to specified working conditions is required. Reconditioning involves testing and repairing or replacing components or modules that have either failed or are suspect to fail soon. *Remanufacture* denotes a higher order option than recondition and is the process of restoring used products to at least original equipment manufacturer (OEM) performance specifications (Neto et al., 2016). This involves complete product disassembly before proceeding with extensive testing, restoration and replacement of worn-out or outdated components or modules. *Recycling* denotes a series of processes aimed toward extracting reusable materials from used products or components and includes collecting, shredding, sorting and processing material for reuse in new products after the original product or component has lost its identity and functionality. *Disposal* denotes the process of properly landfilling or incinerating parts or products. This option is typically chosen on the condition that other disposition options are seen as too complex or cannot be made beneficial due to, perhaps, a lack of market options.

Product returns include manufacturing-related, distribution-related, and customer-related returns (Flapper, 2003; Rogers and Tibben-Lembke, 1999). Although some firms are familiar with redistribution of returns, very few firms take responsibility for products that have reached end-of-life and those that do typically do so only because of the need to comply with country- or region-specific environmental regulations. Most of the legislative requirements that promotes circular economy and efficiency of resource utilization have been introduced or improvised during the recent decade (Zhu et al., 2015; Gottberg et al., 2006; Yu et al., 2008). In addition to assigning responsibility for disposing of EEE to original equipment manufacturers (OEMs), extended producer responsibility regulations have been developed to mobilise specific mechanisms related to reverse logistics management so as to encourage collection and recovery of end-of-use products. In addition, independent non-government organizations such as Greenpeace International periodically measure and rank sustainability initiatives, utilising media influence to encourage companies to maintain brand image. Thus, firms face negative environmental publicity and non-compliance costs alike if proper reverse logistics processes are not established and followed.

Although motivated by environmental and regulatory compliance, manufacturers' resource allocation decisions necessitate returns on investment for new initiatives (such as reverse logistics practices) in terms of not only environmental benefits, but also economic ones (Hayami et al., 2015; Özdemir-Akyıldırım, 2015). According to Rogers et al (2010), and Tengku-Hamzah (2011), secondary markets enabled by factory outlets, flea markets, auctions, third-party repair facilities, and remanufactured product providers readily consume large quantities of dispositioned products. Therefore, firms might realize monetary benefits associated with instituting reverse logistics product disposition activities. Given that the cost of remanufactured or otherwise reclaimed products is lower than new products due to reduced material and overhead costs (Seitz and Wells, 2006), the profitability of product disposition activities is promising when they are accompanied by well-planned strategies.

Past empirical studies consider recovery of investment including sales of excess or used materials and capital equipment (Zhu et al., 2007; Zhu et al., 2008). To date, there is little evidence to suggest that the use of reverse logistics disposition activities will lead to performance outcomes beyond those related to mere resource recovery. In addition, internal and external pressures like those described above continue to create greater impetus for firms to outline standards of sustainable production and consumption (Agamuthu and Victor, 2011). It is important for firms to understand not only how to design reverse logistics services but also the implications thereof (Andel, 1997; Ayres et al., 1997). This research contributes to the reverse logistics performance literature (e.g. Eltayeb et al., 2010) to examine performance outcomes realized via use of reverse logistics product disposition options, and investigate intervening effects of institutional pressures on these relationships.

2. Theoretical framework and hypotheses development

2.1. Reverse logistics disposition and performance

Consistent with the resource-based view (RBV) of the firm, investment in resources that enable reverse logistics disposition activities should develop capabilities that lead to improved measures of performance. Several studies quote timing, quantity, and quality as issues that determine the value of recoverable assets (Fernández et al., 2008; Guide Jr et al., 2000) whereas other studies identify complexity, level of disassembly, and residual value of products as factors that differentiate the choice of disposition options (Gobbi, 2011; King et al., 2006; Krikke et al., 1998; Talbot et al., 2007; Thierry et al., 1995).

Repair, recondition, and remanufacture are disposition options that improve the quality of the returned product to functional condition in order to enable resale. The success of product remarketing allows firms to generate new revenues that in turn finance expenditures incurred during asset recovery and promote growth. Indeed, previous research has evaluated the performance of reverse logistics from the perspective of profitability and sales growth (Khor and Udin, 2013; Skinner et al., 2008; Talbot et al., 2007; Yang et al., 2011). In addition, cost-efficiency of recycling and responsible disposal activities is also a primary concern when managing reverse logistics. Regardless of the disposition option chosen, firms must be able to derive benefits from product disposition activities. For example, Sroufe (2003) indicated that environmental recycling and waste practices are significantly related to firm performance but the latter process leads to higher levels of performance. In other instances, research shows that there are significant market opportunities for products such as remanufactured engines (Seitz and Wells, 2006), and there is a considerable demand for used parts from independent second hand repair shops (Tengku-Hamzah, 2011).

There is a crucial need to re-examine the performance outcomes derived from the use of reverse logistics disposition options because previous research reports mixed results. For instance, Skinner et al. (2008) acknowledged several distinct disposition strategies in reverse logistics management, and their empirical study revealed that only recycling and disposal improve economic performance. In a separate study on Malaysian manufacturing firms, Eltayeb et al. (2010) indicated that reverse logistics is associated with significant cost reduction but not related to improved economic outcomes. This finding could be attributed to the fact that reverse logistics reduces the costs of goods that re-enter the secondary market, but the cost savings is not sufficient enough to offset costs and render the reverse logistics business profitable. In addition, different measures of performance are often not considered in the literature. To this end, Sroufe (2003) contributed to the literature by considering operational performance, market performance, and environmental performance as outcomes when analysing environmental waste and recycling practices, and Zhu et al. (2007) analysed environment performance and economic performance derived from investment in recovery. This study makes a similar contribution.

This research focuses on all five primary disposition options to examine the relationship between each option and measures of performance in terms of environmental performance, profitability, and sales growth. Each performance outcome can help firms to set objectives, evaluate success, and determine future courses of action for each product disposition option. These performance measures have been analysed as components of performance in past environmental management studies (Chan and Fang, 2007; Fraj-Andrés et al., 2009) and therefore seem suitable for examination as outcome variables in this research.

Hypothesis 1. Employment of reverse logistics product disposition options [(i) repair, (ii) recondition, (iii) remanufacture, (iv) recycle, and (v) disposal] is positively related to measures of performance [(i) environmental performance, (ii) profitability, and (iii) sales growth].

2.2. Institutional pressure

Institutional theory is applied herein to provide additional insight into the relationship between reverse logistics disposition activities and measures of performance. Organisations are bound by legitimacy extended by institutional actors and thus might undertake pollution prevention initiatives out of conformance to norms, rules, and regulations instituted by internal and external forces. Jennings and Zandbergen (1995) are among the earliest scholars to examine sustainable practices from the lens of institutional theory. Generally, organisations respond to three classes of pressure: coercive, mimetic, and normative (DiMaggio and Powell, 1983; Zhu and Sarkis, 2007). The pressures exerted by institutional actors have been useful in elevating environmental performance of firms that exercise compliance to legal requirements so as to remain competitive. Additionally, this study examines ownership pressure, also known as shareholder pressure, because the interests of capital investors have been found to significantly influence top management's decisions (Delmas and Toffel, 2004). Delmas and Toffel (2004) and Hoffman (2001) were among the first to introduce the shareholder as a field-level institutional actor that influences firm's organisational practices.

Considering procedural isomorphism, Jennings and Zandbergen (1995) use institutional theory to suggest that the introduction of coercive pressure significantly promotes diffusion of environmental protection practices, particularly among firms that have adopted such practices in direct reaction to legislative mandates. Miemczyk (2008) analysed end-of-life product recovery capabilities based on institutional influences, and found that legitimacy is the central focus that drives organisations to implement appropriate approaches in dealing with multifaceted complexities associated with product recovery. The legitimacy of firms' practices is also susceptive to shareholder influence. Owning a stake in the business allows owners to exert pressure on firms to establish win-win strategic initiatives that harmonize business needs and environmental needs (Hoffman, 2001). Although the influence of owners can be traced back to stakeholder theory, this influence can also be explained from the perspective of institutional theory because the pressure asserted by owners or shareholders has the capability to institutionalise environmental practices that can bolster a firm's reputation and/or allay risks associated with noncompliance (Darnall et al., 2008; Delmas and Toffel, 2004).

Despite the fact that the Malaysian EEE manufacturing industry continues to experience growth every year, it is unlikely that reverse logistics development will naturally grow at the same rate. Zhu et al. (2008) showed that environmental management standards adopted by firms across several industries are affected by isomorphism. Generally, the level of influence exerted by institutional pressures also affects commitment to extracting 'cost of goods sold' from returns. In the case of Malaysia, the lack of reverse logistics programmes promoting product reuse initiatives (Eltayeb et al., 2010) showed that the competition for recoverable assets is low and green consumerism has yet to permeate sociocultural systems. Hence, the model developed herein excludes mimetic and normative pressure as institutional forces because (a) only a very small number of firms in Malaysia have committed to product reprocessing and (b) the environmental sentiment of Malaysian consumers has yet to develop to a point where reclamation of EEE products might be seen as a requirement or anticipated norm.

In addition to committing resources to establishing disposition operations, regulatory and ownership pressures also affect organisation-wide commitment to product recovery activities. Indeed, previous studies acknowledge the influence of institutional pressure on product and/or investment recovery (Ye et al., 2013; Miemczyk, 2008; Zhu and Sarkis, 2007). Zhu and Sarkis (2007) showed that regulatory pressures exert significant moderating effects on the relationship between positive economic performance and investment recovery. In some instances, regulatory requirements are damaging to firms who are at the early stages of reverse logistics implementation due to deficient experience and lack of technological and infrastructural development. For Malaysia, Environmental Quality (Scheduled Waste) Regulations of 2005 and Solid Waste and Public Cleansing Management Act of 2007 are among the notable regulations that serve to motivate use of environmentally friendly or recyclable material, as well as product recovery activities. Apart from stimulating development of voluntary take back initiatives, the introduction of legislative policies to organisations in the EEE industry also stimulates non-voluntary returns processing (Agamuthu and Victor; 2011; Rahman and Subramanian, 2012). As a complement to regulatory pressure, ownership pressure is another institutional actor that drives isomorphic behaviours in product recovery given that reverse logistics activities are consistent with environmentally sustainable practices (Henriques and Sadorsky, 1996; Hoffman, 2001). For example, research by Delmas and Toffel (2004) showed how parent companies that hold multinational subsidiaries maintained substantial authority over host country operations because environmental impacts and perceptions contribute significantly to brand reputation.

Regulatory pressure is an external factor that is significantly associated with adoption and use of environmental management and product recovery initiatives (Chan and Fang, 2007; Huang et al., 2015). For instance, Henriques and Sadorsky's (1996) study suggests that risk of noncompliance is a significant expenditure that results from violation of legal sanctions. Other research on environmental management shows that regulatory and ownership pressure are significant drivers to environmental commitment (Darnall et al., 2008; Henriques and Sadorsky, 1999). Yang and Rivers (2009) point out that the influence of shareholders in managerial decision-making is particularly important among companies that raise capital through equity issuances. Darnall et al. (2008) also point out that firms that incur financial liabilities due to poor environmental reputation may inhibit existing and/or potential owners' interest to invest. Considering the aforementioned theoretical and literature support, it follows that regulatory and ownership pressure should be included as intervening variables in a model that includes direct effects of reverse logistics disposition options on performance.

Hypothesis 2. Institutional pressures [(i) regulatory pressure, and (ii) ownership pressure] moderate the relationship between employment of each reverse logistics disposition option and measures of performance [(i) environmental performance, (ii) profitability, and (iii) sales growth].

In summary, the aforementioned theory and literature suggest that reverse logistics product disposition options (repair, recondition, remanufacture, recycle, and disposal) are associated with measures of performance (environmental performance, profitability, and sales growth). It is also suggested that this relationship is moderated by institutional pressure (regulatory pressure and ownership pressure). The hypothesized model is presented as Fig. 1.

3. Research method

3.1. Questionnaire development

This research used a survey method as a means to gather data. The measurement items were adapted from the reverse logistics, green supply chain, and environmental management literature. A pilot study was used to solicit feedback regarding the measures from academic and industry experts to ascertain the content validity and functionality of the questionnaire (Babbie, 1990; Zikmund, 1991). The questionnaire asked respondents to evaluate 34 items regarding the extent to which reverse logistics product disposition options were used in their organization (Guide Jr et al., 2000; King et al., 2006; Skinner et al., 2008; Talbot et al., 2007; Thierry et al., 1995). Respondents were then to assess 23 items regarding performance (Daugherty et al., 2001; Eltayeb et al., 2010; Heese et al., 2005; King and Lenox, 2001; Zhu et al., 2007). Finally, 13 items were used to assess perceived regulatory and ownership pressures (Darnall et al., 2008; Eltayeb et al., 2010; Henriques and Sadorsky, 1996). All items were assessed using a five-point Likert-type scale and can be found in Appendix.

3.2. Control variable

Number of employees reflects a firm's size and can also indicate the availability of resources that can lead to development of non-imitable capabilities. For instance, González-Benito and González-Benito (2005) show that firm size is relevant in explaining business performance. Zhu and Sarkis (2007) argue that larger firms experience greater environmental pressures and their study found evidence to suggest a significant effect of firm size on performance derived from green supply chain initiatives. Therefore, firm size in terms of number of employees is used as a control variable in this research.

3.3. Data collection and sample characteristics

The survey was administered to Malaysian EEE manufacturing firms that have obtained ISO14001 certification for environmental management. González et al. (2008) pointed out that firms that have obtained similar or equivalent certification have greater inclination to integrate environmental initiatives within both the firm's operating practices and with upstream supply chain partners. The sampling frame for this study was obtained from FMM-MATRADE Industry Directory for Electrical and Electronics 2007/2008, from which 177 organisations were chosen. The manager responsible for Environmental, Health, and Safety and/or ISO14001 compliance was contacted. Those targeted were encouraged to participate in several ways, which include receiving a pre-notification that explained the study objectives, a personalized survey package, and having the choice to return the survey through either conventional mail or electronic mail. A series of friendly reminders were sent to potential participants. Out of 98 usable responses received, nine respondents were excluded from analysis because they indicated that their organisations do not implement reverse logistics practices for both products and packaging. Therefore, the number of unique and usable responses for this study is 89. Considering the smallest observed full-model R-square value of.357, alpha value of 0.05 and 14 predictors, post-hoc power analysis indicates that the sample size of 89 yields a power of 0.997 for the analyses described in the following section (Soper, 2015).

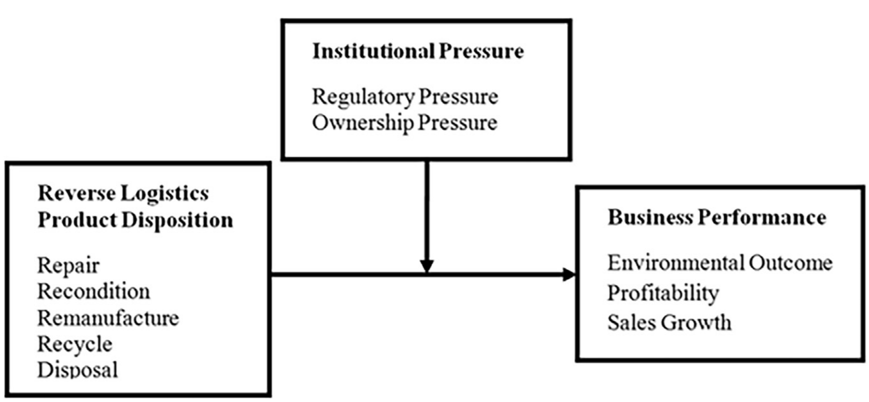

Fig. 1. Research framework.

4. Results

4.1. Measure assessment and descriptive statistics

Prior to conducting the analyses, the potential for non-response bias was assessed via chi-square comparison of early (within the first month) and late (amongst the last) responders. Upon analysing and comparing firms' demographic profiles including industry subsector, type of business, ownership status, age of business, number of employees, total current assets, and average annual revenue, no significant differences between early and late responses were found ($p > 0.05$).

In regards to common method bias, the Harman's one factor test was applied to detect the emergence of one single factor, or a general factor accounting for more than 50% of the covariance among the measures (Podsakoff et al., 2003). This test showed that common method variance is of minor concern as the unrotated factor solution revealed that the first factor account for 29.4% of the variance whereas all factors account for 79.8% of unique variance collectively.

Next, exploratory factor analysis assessed the loadings of measurement items that reflect reverse logistics product disposition option, performance, and institutional pressure variables. Due to the small sample size, Hair et al. (2010) suggest that only items with factor loading above 0.5 should be used. Principal component analysis using varimax rotation was applied and the values for Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity for the extracted factors were assessed. According to Kaiser (1970), KMO values above 0.5 are acceptable, and greater values suggest consistent and distinct factors. Field (2009) points out that high KMO values also indicate sample size adequacy for factor analysis. For this study, the KMO values for all variables are considered sufficient because they were calculated to be between 0.783 and 0.827. In addition, Bartlett's test of sphericity was significant, indicating that the correlation matrix is not an identity matrix.

Finally, eigenvalues were assessed. The eigenvalue of extracted factors should exceed 1.0, and items with low loadings or that load strongly across multiple factors should be removed (Hair et al., 2010). Analysis revealed five factors (repair, recondition, remanufacture, recycle, and disposal) accounting for 76.37% of the variance in the reverse logistics product disposition measures, three factors (environmental performance, profitability, and sales growth) contributing 64.98% of the variance in the performance measures, and two factors (regulatory pressure and ownership pressure) contributing 62.01% of the variance in the institutional pressure measures.

Reliability analysis evaluates the consistency of a survey instrument in measuring what is intended (Field, 2009; Ho, 2006). Table 1 presents reliability analysis results; Cronbach's alpha coefficients for all variables are within a range of 0.873 to 0.969, which is well above the lower limit of 0.70 recommended by Nunnally (1978). No item deletion was required to improve the reliability of measurement scales because the items demonstrated internal consistency. Among the product disposition options that recover the greatest residual value, Table 1 shows that repair is the most widely adopted practice ($\bar{x}=3.46$) whereas recondition, remanufacture, and recycling are recovery practices that are less utilized. Average values for performance are as follows: environment outcome ($\bar{x}=3.88$), profitability ($\bar{x}=3.10$), and sales growth ($\bar{x}=3.01$). In terms of institutional pressure, the influence exerted by regulatory pressure is higher ($\bar{x}=3.80$), whereas ownership pressure exerts moderate influence ($\bar{x}=3.00$).

Table 1
Summary of reliability analysis and descriptive statistics.

Variables	No. of items	Cronbach's alpha	Mean (μ)	Standard deviation (σ)
Reverse logistics product disposition:				
Repair	5	0.899	3.46	1.05
Recondition	8	0.959	2.77	1.19
Remanufacture	8	0.969	2.42	1.17
Recycle	9	0.897	2.71	1.04
Disposal	4	0.896	3.87	1.01
Business performance				
Environment outcome	8	0.903	3.88	0.80
Profitability	8	0.920	3.10	0.94
Sales growth	7	0.922	3.01	1.07
Institutional pressure				
Regulatory pressure	8	0.904	3.80	0.77
Ownership pressure	6	0.873	3.00	0.95

4.2. Correlation analysis

A two-tailed Pearson's product-moment correlation analysis was used to verify the direction and strength of association between constructs. Some reverse logistics product disposition options are associated with measures of performance at medium strength, $0.30 < r < 0.49$ and low strength, $0.10 < r < 0.29$ (Cohen, 1988). Based on the framework for identifying moderating variables depicted by Sharma, et al. (1981), a quasimoderator is indicated by the presence of a significant interaction term, as well as a relationship between the moderator variable and criterion variable. With reference to Table 2, institutional pressure is positively correlated to all measures of performance at medium strength.

4.3. Regression analysis

Four-step hierarchical regression analyses were applied for testing the direct and moderating relationships. The first step accounted for the effect of the control variable, firm size. The second step tested Hypothesis 1 by assessing the direct relationships between each reverse logistics product disposition option and measure of performance. Step 3 incorporated institutional pressures as direct predictors of performance, whereas Step 4 examined the inclusion of interaction terms (Sharma et al., 1981). Six regression models were developed to consider all three measures of performance (outcome variables) in addition to the two moderating variables. As shown in Tables 3 and 4, the variance accounted for in the model continued to increase during Step 3 and Step 4; significant F statistics verify that this increase is significant (Ho, 2006). Subsequently, the interaction terms were explored further by plotting the predictors (reverse logistics product disposition options) against high and low predicted values for the moderating variables (Frazier et al., 2004).

Firm size did not contribute significant variance in predicting performance in the full model. Based on Step 2, only product repair ($\beta=0.217$, $p < 0.10$) and recycling ($\beta=0.280$, $p < 0.05$) are rent-seeking disposition options that accounted for 35.7% of variance in profitability. Additionally, remanufacture ($\beta=0.647$, $p < 0.001$) contributed 34.2% of variance in sales growth. Therefore, only three out of fifteen capability-performance relationships are significant. Hypotheses 1(i), 1(iii) and 1(v) are partially supported whereas Hypothesis 1(ii) and (iv) are not supported because both recondition and disposal do not have significant relations with measures of performance.

Table 2
Pearson's Product-Moment Correlation Analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Repair	1									
(2) Recondition	0.545***	1								
(3) Remanufacture	0.479***	0.704***	1							
(4) Recycle	0.373**	0.346**	0.494***	1						
(5) Disposal	0.306†	0.287*	0.188	0.296**	1					
(6) Environmental Outcome	0.041	0.174	0.183	0.260*	0.271*	1				
(7) Profitability	0.417***	0.398***	0.401***	0.437***	0.113	0.430***	1			
(8) Sales Growth	0.079	0.249*	0.458***	0.160	0.024	0.313**	0.487***	1		
(9) Regulatory Pressure	0.241*	0.169	0.133	0.175	0.440***	0.348**	0.458***	0.318**	1	
(10) Ownership Pressure	0.183†	0.315**	0.338**	0.360**	0.103	0.330**	0.462***	0.476***	0.440***	1

Significant levels (2-tailed)

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
† $p < 0.10$

Table 3
Hierarchical regression analysis: Contingent role of regulatory pressure.

Reverse logistics product disposition	Business performance of reverse logistics											
	Environmental outcome				Profitability				Sales growth			
	Step 1	*Step 2*	*Step 3*	*Step 4*	*Step 1*	*Step 2*	*Step 3*	*Step 4*	*Step 1*	*Step 2*	*Step 3*	*Step 4*
Control variable												
Small firms	−0.087	−0.044	0.063	0.197	0.147	0.137	0.306*	0.580***	−0.041	0.025	0.147	−0.157
Medium firms	−0.080	−0.073	−0.009	0.232	0.130	0.053	0.154	0.384**	0.125	0.033	0.106	−0.121
Large firms	0.000	0.012	0.038	0.236	0.273	0.311†	0.352*	0.620***	0.289	0.351*	0.380*	0.096
Independent variable												
Repair		−0.182	−0.230	3.266**		0.217†	0.141	2.080**		−0.135	−0.190	−0.349
Recondition		0.093	0.116	−3.313*		0.211	0.247†	−4.786***		−0.058	−0.032	4.889***
Remanufacture		0.080	0.078	0.282		0.081	0.078	2.206**		0.647***	0.645***	-2.965***
Recycle		0.200	0.178	−0.850		0.280*	0.244*	−0.983		−0.062	−0.088	1.643*
Disposal		0.212	0.110	0.461		−0.129	−0.291**	1.368*		−0.057	−0.174	−1.682**
Regulatory pressure			0.302*	0.652			0.479***	0.777*			0.345**	0.754*
Interaction term												
Repair*regulatory				−4.754**				−2.702*				0.372
Recondition*regulatory				4.423*				6.276***				−6.055***
Remanufacture*regulatory				−0.378				−2.610**				4.366***
Recycle*regulatory				1.131				1.373†				−2.046*
Disposal*Regulatory				−0.375				−2.234**				2.006*
R^2	0.009	0.140	0.206	0.396	0.031	0.355	0.520	0.630	0.081	0.342	0.428	0.611
F Change	0.218	2.013†	5.347*	3.784**	0.767	6.627***	22.28***	3.569**	2.084	5.244***	9.734**	5.668***
F	0.218	1.345	1.869†	2.810**	0.767	4.543***	7.816***	7.292***	2.084	4.292***	5.402***	6.744***
Durbin-Watson	1.909				1.724				1.983			

Significant levels:

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
† $p < 0.10$

4.4. Analysis of interactions

The inclusion of institutional pressures significantly improved total variance explained for each regression model. The significant F statistics suggest that regulatory and ownership pressures are significant predictors of performance. This result is also an indication that institutional pressures can be quasimoderating variables as well as intervening, exogenous, antecedent, suppressor, or predictor variables (Sharma et al., 1981). Interaction terms for disposition options (repair, recondition, remanufacture, recycle, and disposal) and regulatory pressure are presented in Table 3. All of the interaction terms are significant predictors of profitability and sales growth, with the exception of the repair and regulatory pressure interaction that does not predict sales growth. For environmental performance, only the interaction terms involving repair and recondition with regulatory pressure are significant. As regulatory pressure is significant in predicting performance (Step 3), regulatory pressure is shown to be a quasimoderating variable and Hypothesis 2 is partially supported. As shown in Fig. 2, high regulatory pressure induces higher environmental performance from the implementation of product repair and recondition activities.

Plots of significant interactions between product disposition options and regulatory pressure present additional evidence that profitability improves when regulatory influences are higher. Despite relatively low reverse logistics implementation, Fig. 3 presents evidence that the effect of regulatory pressure is particularly significant for repair, recondition, and remanufacturing activities as products with higher residual value are recovered and reutilized. In terms of disposal, stricter guidelines for waste handling, storage, treatment, and disposal created adverse effects

Table 4
Hierarchical regression analysis: Contingent role of ownership pressure.

Reverse logistics product disposition	Business performance of reverse logistics											
	Environmental outcome				Profitability				Sales growth			
	Step 1	*Step 2*	*Step 3*	*Step 4*	*Step 1*	*Step 2*	*Step 3*	*Step 4*	*Step 1*	*Step 2*	*Step 3*	*Step 4*
Control variable												
Small firms	−0.087	−0.044	−0.033	−0.062	0.147	0.137	0.148	0.156	−0.041	0.025	0.040	0.048
Medium firms	−0.080	−0.073	−0.105	−0.265	0.130	0.053	0.019	−0.124	0.125	0.033	−0.012	−0.095
Large firms	0.000	0.012	−0.033	−0.089	0.273	0.311†	0.262	0.183	0.289	0.351*	0.287†	0.250
Independent variable												
Repair		−0.182	−0.170	−0.561		0.217†	0.230†	0.308		−0.135	−0.118	0.222
Recondition		0.093	0.043	2.135**		0.211	0.156	1.685**		−0.058	−0.128	0.932
Remanufacture		0.080	0.057	−2.085**		0.081	0.056	−2.210***		0.647***	0.616***	−0.879
Recycle		0.200	0.121	0.736†		0.280*	0.193	0.391		−0.062	−0.173	0.051
Disposal		0.212	0.227†	0.601		−0.129	−0.113	0.177		−0.057	−0.037	0.376
Ownership pressure			0.272*	0.908			0.294**	0.561			0.380***	1.203*
Interaction Term												
Repair*ownership				0.656				−0.151				-0.617
Recondition*ownership				−2.809**				−1.977*				-1.402†
Remanufacture*ownership				2.821**				3.040***				2.041*
Recycle*ownership				−0.868				−0.275				−0.296
Disposal*Ownership				−0.726				−0.563				−0.691
R^2	0.009	0.140	0.198	0.357	0.031	0.355	0.423	0.574	0.081	0.342	0.456	0.548
F Change	0.218	2.013†	4.708*	2.962*	0.767	6.627***	7.657**	4.242**	2.084	5.244***	13.62***	2.434*
F	0.218	1.345	1.786†	2.379*	0.767	4.543***	5.297***	5.769***	2.084	4.292***	6.057***	5.193***
Durbin-Watson	2.088				1.796				1.714			

Significant levels:

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
† $p < 0.10$

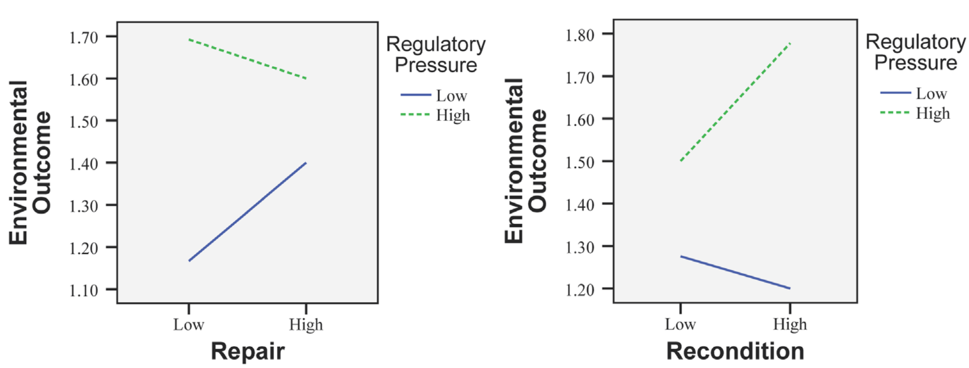

Fig. 2. Plot of significant interactions: moderating influence of regulatory pressure on relationship between (i) repair and (ii) recondition and environmental performance.

on firms' profitability. Nevertheless, coercive pressures may not be felt without the presence of adequate enforcement bodies.

With reference to Fig. 4, the influence of low regulatory pressure is shown to encourage sales growth. The presence of high regulatory pressure is a positive reinforcement to the sales of reconditioned and remanufactured products. However, an inverse relationship is uncovered for sales of recyclable and disposable goods, perhaps because the presence of hazardous substances restricts transboundary movement of electronic waste. In other words, recyclables and disposables cannot be marketed as simple second-hand goods for the purpose of end-of-life disposal in countries with underdeveloped regulations. For product repair activities, the interaction terms were insignificant. This might be due to the advent of alternative reasons for repair activities, such as the need to repair warranted goods as part of an established after-sales service programme aimed toward maintaining customer relations (De Brito and Dekker, 2003; Rogers et al., 2010).

Table 4 presents the results of four-step hierarchical regression analyses to determine the moderating role of ownership pressure. The results are consistent because the interaction terms between recondition and remanufacture with ownership pressure contributed to significant F statistic changes across every measure of performance. Because ownership pressure is directly related to each dependent variable (Step 3), ownership pressure is shown to additionally act as a quasimoderator that strengthens capability-performance relationships. Fig. 5 illustrates the effect of ownership pressure where a steeper slope is observed, perhaps indicating that shareholders' voices are influential to firms' business decisions. The implementation of recondition and remanufacture activities is beneficial as a large portion of costs of goods sold, also known as recoverable value, can be extracted and made available for additional use. With the presence of regulatory and ownership pressure, the plotted graphs show that reusability of EEE products, in whole or in part, is environmentally and economically beneficial to firms.

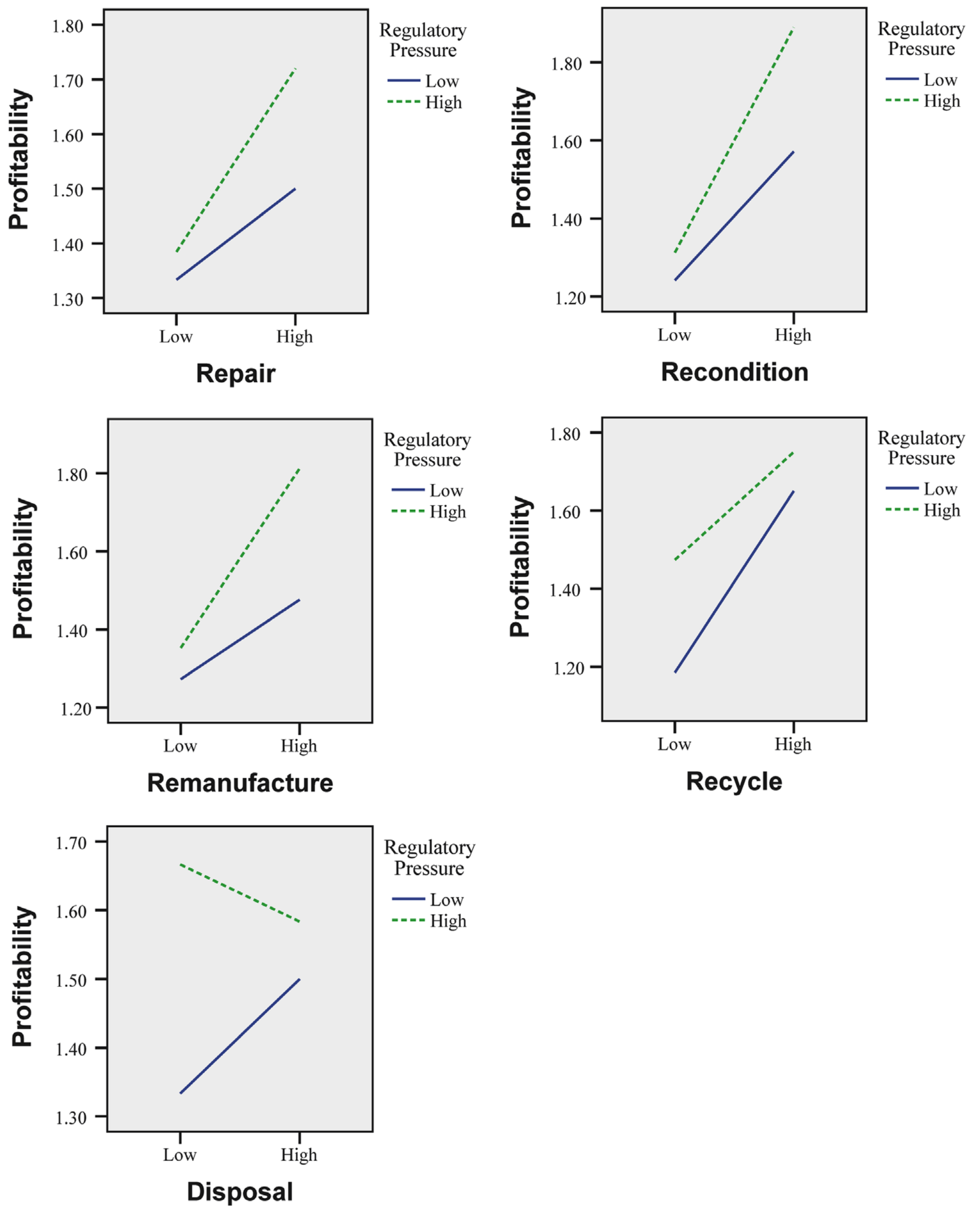

Fig. 3. Plot of significant interactions: moderating influence of regulatory pressure on relationship between (i) repair, (ii) recondition, (iii) remanufacture, (iv) recycle, and (v) disposal on profitability.

In contrast, interaction terms involving recycling and disposal are not significantly related to performance as recovery of tainted materials is considered a complex and cost-bearing green initiative. Additionally, ownership pressure predicts business performance of reverse logistics but does not combine with repair to create a significant interaction. It is suspected that this disposition option is instead considered to be a fundamental service offering that addresses minor quality glitches in sold equipment.

5. Discussion

The results of this study affirm the central role of institutional pressure, namely regulatory and ownership pressure, as moderators that alter the strength of relationships found between measures of performance and reverse logistics disposition options. Based on Table 5, Hypothesis 2 is partially supported where all disposition options, and particularly repair, recycle, and disposal, evoke higher measures of performance when the influence of regulatory pressure is included.

Gobbi's (2011) findings suggest that environmental legislation shifts producers' attention to alternative recovery strategies. Similarly, this study's results suggest that a firm's environmental performance can be enhanced via adopting repair and recondition activities, yet both of these options elicit no environmental performance in the absence regulatory directives. According to Eltayeb et al. (2010), manufacturers are more receptive to commercial-related returns than environmental-related returns. This explains the significant environmental contribution from extending product's useful life through repair and recondition activities. Recycling and disposal are considered second-class recovery options because only reusable components and materials are recovered whereas residual materials are landfilled or incinerated. In Malaysia, some companies subcontract these activities to third party service providers because the capital expenditure of recycling technologies is too high for cost-efficient recovery. Therefore, profitability of recycling and disposing of

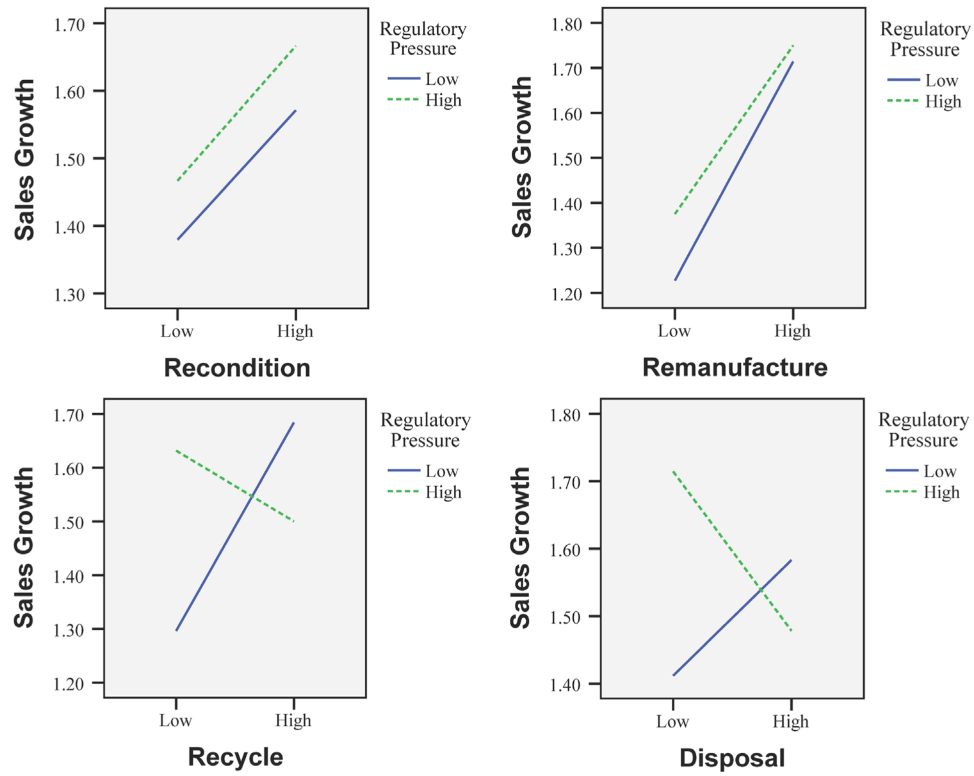

Fig. 4. Plot of significant interactions: Moderating influence of regulatory pressure on relationship between (i) recondition, (ii) remanufacture, (iii) recycle, and (iv) disposal on sales growth.

returns is evident as e-waste recycling companies are expected to reimburse clients based on waste quantity and composition reports. Additionally, informal recycling activities are commonly found among scavengers, backyard dismantlers, and scrap dealers as they take on producers' responsibilities in staving off early product retirement (Tengku-Hamzah, 2011). Consistent with the views of Abdulrahman et al. (2014), we recognized that the Malaysian government seemed to soft-pedal the introduction of strict environmental regulations to maintain its appeal to foreign direct investors.

The findings revealed that development of legislative requirements elicits positive measures of performance for multiple recovery approaches. Literature suggested that reverse logistics management achieves better environmental performance at the expense of economic performance. However, under the presence of regulatory pressure, this study showed that repair, recondition, remanufacture, recycle, and disposal activities are profitable for business and both product recondition and remanufacture significantly contribute to sales growth. Even in the absence of regulatory influence, sales of remanufactured product is significant; this condition is largely attributed to lower cost of goods sold as high quality used parts are retrieved to assemble like-new quality products (Mollenkopf and Weathersby, 2003). The development of a national framework to govern extended producer responsibility should be widely received because sustainable consumption has gained momentum across many global markets. Because the residual value of returns is time-sensitive, key players in the reverse supply chain ought to coalesce resources to focus on quick redistribution to ensure that recovered products undergo extension of product lifecycle. In time, the development of regulatory constraints will negatively affect the sales growth of recyclables and disposables. This is attributed to stricter regulations that create barriers for exporting second hand EEE to countries with weaker legal frameworks (Shinkuma and Huong, 2009; Tengku-Hamzah, 2011). Similarly, Huang and Yang (2014) revealed that regulatory pressure have adverse effects on the profitability of reverse logistics innovation and this could be attributed to the maturity of environmental management standards, which constantly evolves to suit the demands of sustainable development. On the other hand, the existence of regulatory pressure consistently improves the performance realized by recondition activities.

In the presence of ownership pressure, product recondition and remanufacturing activities generate positive and significant contributions to environmental performance, profitability, and sales growth indicators. Both types of product disposition contain fairly high residual value (Gobbi, 2011) and a major portion of invested material and energy are reused through a series of processes within the closed-loop supply chain (Seitz and Wells, 2006; Talbot et al., 2007). Accepting returns to extend the lifecycle of components, subassemblies, and products is a green initiative supported by owners as redistribution of used products or new products with used subassemblies reduces landfill disposal and generates revenue from a smaller amount of cost of goods sold. In the case of Malaysia, a number of independent second-hand repair shops and scrap dealers exist to prolong products' lifecycle including cannibalising e-waste to maintain spare parts inventories (Tengku-Hamzah, 2011). From this study, the presence of ownership pressure seems to facilitate the performance of reverse logistics management for products with substantial residual value.

On the other hand, none of the interaction terms involving ownership pressure and repair, recycle, and disposal are significant.

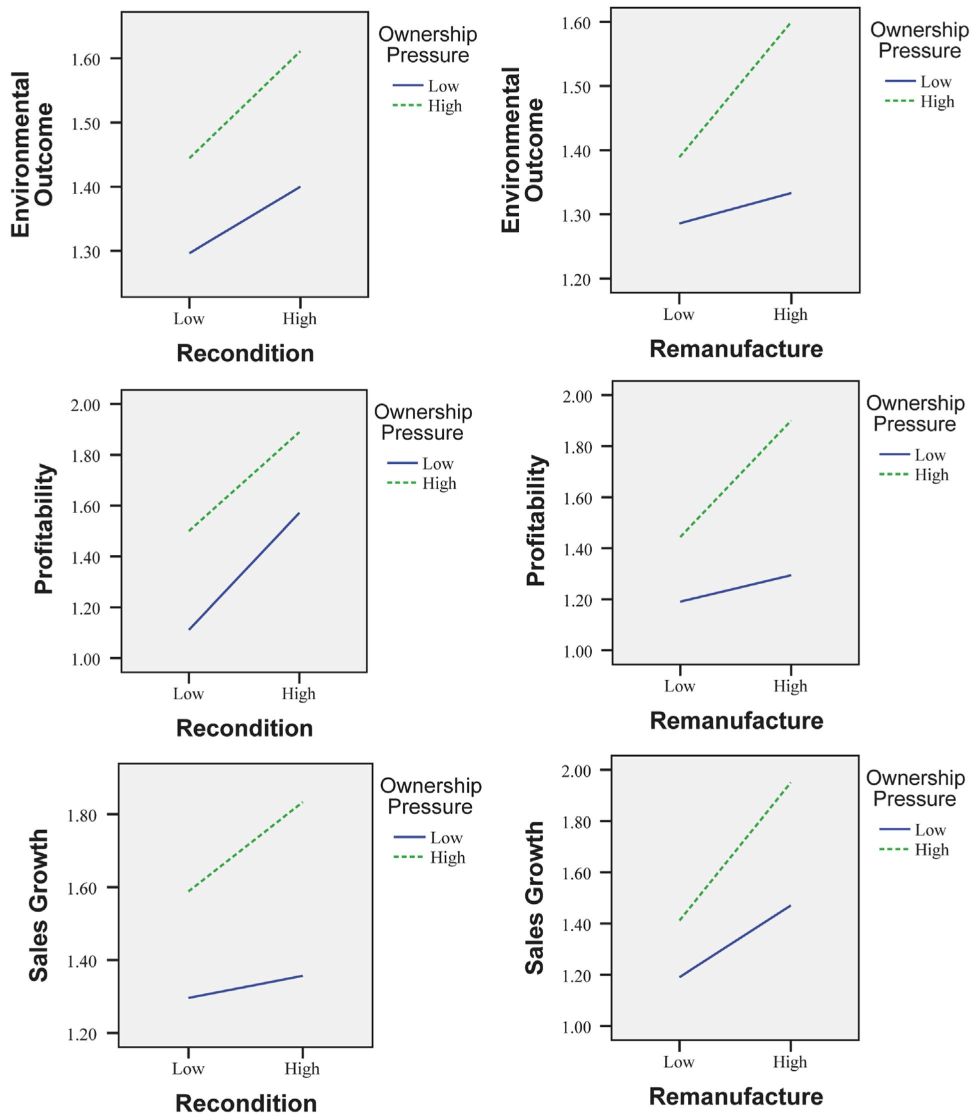

Fig. 5. Plot of significant interactions: Moderating influence of ownership pressure on relationship between recondition and remanufacture with environmental performance, profitability, and sales growth.

Table 5
Summary of results.

Reverse logistics product disposition	Environmental outcome		Profitability		Sales growth	
	Regulatory pressure	*Ownership pressure*	*Regulatory pressure*	*Ownership pressure*	*Regulatory pressure*	*Ownership pressure*
Repair	Yes	-	Yes	-	-	-
Recondition	Yes	Yes	Yes	Yes	Yes	Yes
Remanufacture	-	Yes	Yes	Yes	Yes	Yes
Recycle	-	-	Yes	-	(Yes)	-
Disposal	-	-	Yes	-	(Yes)	-

Note: 'Yes' means interaction term is significant and hypothesis is supported; '-' means interaction term is not significant and hypothesis is not supported; '(Yes)' means interaction term is significant and the hypothesized relationship is supported at negative direction.

These contrasting findings show that even though owners are institutional actors who motivate firms to adopt environmental management practices (Darnall et al., 2008; Henriques and Sadorsky, 1999), this aspect does not strengthen the outcome of product recycling and disposal beyond mere compliance. In maintaining shareholders' interest, Yang and Rivers (2009) indicate that owners of listed shares influence a firm's attitude towards social and environmental responsibility, to include the development of environmental policies and efforts to negate undesirable media headlines. Therefore, waste management standards are dependent on legislative development as top management is more responsive to risks and penalties from noncompliant operating behaviours that might negatively affect owners' interests. Furthermore, firms that have obtained ISO14001 environmental management certification are less of a liability to investors. For repair, returns are accompanied by warranty documents and these instances occur only for damaged products and recalls (Autry, 2005). Acceptance of return for repair is the earliest recovery practice that can induce customer loyalty and some firms offer liberal return policies to minimise negative repercussions of malfunctioned products. Hence, it seems that ownership pressure does not influence performance with regard to product repair even though the opportunity to upsell for the benefit of both parties is present.

5.1. Limitations and suggestion for future research

Due to the fact that only ISO14001 certified EEE manufacturing firms enlisted with FMM and MATRADE were addressed by this study, generalisability of findings may improve by taking into account firms that have obtained environmental management qualifications from other certification bodies such as SIRIM (Standards and Industrial Research Institute of Malaysia). Additionally, the results of this study are not directly applicable to other industries such as food and beverage, chemical, construction, or furniture industries due to differences in products' recoverability characteristics. Future studies should investigate the influence of other components of reverse logistics management on measures of performance such as reverse logistics information technology capabilities and innovation capabilities (Genchev, 2007; Hazen et al., 2014) as well as product acquisition, transportation and inventory management, and distribution and sales (Prahinski and Kocabasoglu, 2006). Other components of institutional pressure such as normative and mimetic pressure may further explain the framework understudy. The application of case study research design such as semistructured interviews or focus groups could help to obtain in-depth information on the issues that challenge successful implementation of reverse logistics management. In fact, literatures have suggested that knowledge diffusion of leading manufacturers from developed countries, particularly those that have progressed beyond legislative requirements, is a valuable resource (Gunasekaran et al., 2015; Zhu et al., 2015). Hence, investigating the influence of leading firms in requiring their pool of suppliers to comply with stricter regulations would assist sustainable supply chain management.

6. Concluding remarks

The development of regulatory policy is important to promoting producers' involvement in pollution prevention initiatives. Among the East Asian countries, Terazono et al. (2006) point out that examples of electronic waste and/or recycling regulations including Japan's Home Appliances Recycling Law of 1998 and Promotion of Effective Utilization of Resources Law of 2001, Korea's Extended Producer Responsibility in Recycling Law of 2003, and Taiwan's Waste Disposal Act of 1998. For Malaysia, the Department of Environment (DOE) established guidelines to restrict importation and exportation of e-waste whereas producer responsibilities are outlined by the Environmental Quality (Scheduled Wastes) Regulation of 2005 and the Solid Waste and Public Cleansing Management Bill of 2007. In due course, higher enforcement levels and further amendments to these provisions will take place to cement the commitment of key industry players to prevent pollution via product recovery.

Reverse logistics management is an emerging business practice that supports the objectives of sustainable production and consumption. Often, firms are more inclined to invest resources in forward supply chain processes and are hesitant to adopt reverse logistics practices because the economic benefits of doing so are not very clear (Hall et al., 2013). This study helped to fill this gap and found that without regulatory pressure, only returns accepted for repair and recycling are profitable for business whereas remanufacturing activities affect sales growth. Further, ownership pressure and the development of legal frameworks encouraged improvement on all performance measures, and particularly for those derived from product recondition and remanufacturing activities. At the same time, regulatory pressure causes a decline in sales growth of recyclables and disposables due to export restrictions instituted on used goods. Based on the findings of this study, it is suggested that the introduction of policies promoting extended producer responsibility is necessary to garner commitment from members of the supply chain. Subsequently, ownership pressure explains risks of noncompliance. In conclusion, the implementation of reverse logistics is a significant green initiative that can lead to increased measures of performance, especially in the presence of institutional pressures. Indeed, greater commitment to reverse logistics management might allow firms to align with and capitalize on sustainable resource consumption.

Appendix

1. Reverse logistics product disposition

(a) Repair

- Correction of faults in a product.
- Restore product to working order.
- Prolongs the product's lifecycle.
- Replaces broken parts that have failed.
- Involves disassembly at product level.

(*Cronbach's alpha* = 0.899)

(b) Recondition

- Collecting used products from customers for reconditioning.
- Work for returning used products to a satisfactory working condition.
- Inspects critical modules in the products.
- Extends functional use of the products.
- Replaces all major components that have failed or that are on the point of failure.
- Involves disassembly up to module level.
- Involves product upgrade within specified quality level.
- Warranty for reconditioned products is less when compared to remanufactured product.

(*Cronbach's alpha* = 0.959)

(c) Remanufacture

- Involves collecting used products from customers for remanufacturing.
- Work for returning products to at least OEM original performance specifications.
- Inspects all modules and parts in the product.
- Involves disassembly up to part level.
- Involves product upgrade up to as-new quality level.
- Warranty for remanufactured product is highest compared to other disposition options.
- Work of building a new product on the base of a used product.
- Suppliers are required to collect back remanufacturable products.

(*Cronbach's alpha* = 0.969)

(d) Recycle

- Involves collecting used products from customers for recycling.
- Involves collecting used packaging from customers for recycling.
- Procedures for recycling have been established.

- Procedures for handling hazardous materials for end-of-life products have been established.
- Recycling procedures reduce the amount of energy required for extracting virgin material.
- Material recycling is the re-melt of materials to make new products.
- Energy recycling is the extraction of heat from burning materials.
- Involves disassembly up to material level.
- Involves reusing materials from used products and components.

(*Cronbach's alpha*=0.897)

(e) Disposal

- The amount of waste for disposal is minimised.
- Involves appropriate storage of waste.
- Involves appropriate dumping of waste.
- Involves appropriate treatment of waste.

(*Cronbach's alpha*=0.896)

2. Business performance of reverse logistics

(a) Environmental performance

- Significant reduction of air emission.
- Significant reduction of wastewater pollution.
- Significant reduction of solid waste generation.
- Significant reduction of hazardous waste consumption.
- Minimal occurrence in environmental accidents, namely spills.
- Minimal occurrence in fines or penalties pertaining to improper waste disposal.
- Recognition or reward for superior environmental performance.
- Significant improvement in commitment towards environmental management standards or practices.

(*Cronbach's alpha*=0.903)

(b) Profitability

- Significant improvement in revenue from after sale services.
- Significant improvement in reclaiming reusable products.
- Significant reduction in inventory investment.
- Significant reduction in cost of goods sold for recovered products.
- Significant reduction in the cost for purchasing raw materials, components, or subassemblies.
- Significant reduction in the cost of packaging.
- Significant reduction in cost for waste treatment.
- Significant reduction in cost for waste disposal.

(*Cronbach's alpha*=0.920)

(c) Sales growth

- Significant improvement in sales of used products at secondary market.
- Significant improvement in sales of new products through price discounts.
- Significant improvement in sales of new technologies by means of trade-in programmes.
- Significant improvement in market share.
- Significant improvement in relationship with customer to encourage repeat buyers.
- Significant improvement in corporate environmental reputation among environmentally conscious customers.
- Significant improvement in sales growth.

(*Cronbach's alpha*=0.922)

3. Institutional pressure

(a) Regulatory pressure

- By taking back products, my firm tries to reduce or avoid the threat from current environmental regulations.
- By taking back products, my firm tries to reduce or avoid the threat of future environmental regulations.
- My firm's parent company sets strict environmental standards for my firm to comply with.
- There are frequent government inspections or audits on my firm to ensure that the firm is in compliance with environmental laws and regulations.
- Environmental regulations are important influence to the environmental practices of my firm.
- Environmental regulations present risk related to unacceptable product impacts.
- Environmental regulations present risk related to penalties due to noncompliance.

(*Cronbach's alpha*=0.904)

(b) Ownership pressure

- Risk of shareholder discontent with environmental fines that lower profits.
- Risk of shareholder concerns when the company does not achieve environmental goals.
- Risk of difficulties in raising new capital or attracting new investors.
- Risk of lower share price due to shareholders' investment withdrawal.
- Financial incentives offered by the Malaysian government, such as grants and tax reductions, are significant motivators for my firm to adopt reverse logistic product disposition.
- Financial incentives offered by international organisations, such as United Nations, are significant motivators for my firm to implement reverse logistics.

(*Cronbach's alpha*=0.873)

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