Supply Chain Management: an International J

Re-evaluating supply chain integration and firm performance: Linking operations strategy to supply chain strategy

Journal:	*Supply Chain Management: an International Journal*
Manuscript ID	SCM-05-2018-0189.R4
Manuscript Type:	Original Manuscript
Keywords:	Supply-chain management, Performance, Surveys

Title:
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Abstract:

Purpose – This paper aims to explore the performance implications of supply chain integration (SCI) taking a strategic perspective. Thus, this research is set to provide answers to the following research questions: (1) Does a higher degree of SCI always leads to greater firm performance improvements? Since the answer to this question is likely to be no, we explore the performance implications from a strategic perspective: (2) Is the SCI – performance relationship contingent on a company's competitive priorities (i.e., operations strategy)?

Design/methodology/approach – We explore our questions through multiple quasi-independent datasets to test the impact of SCI on firm performance. Furthermore, we provide a more nuanced conceptual and empirical view to explore the previously uncovered contradictory results and contingent relationship challenging the "more integration equals higher firm performance" proposition.

Findings – The results only provide partial support for the proposition that more integration is always beneficial in the supply chain context. We also identified that the impact of SCI on financial performance is contingent on a company's competitive priorities.

Originality/value – This study provides a much-needed comprehensive assessment of the SCI – performance relationship through critically re-evaluating one of the most popular propositions in the field of supply chain management. The results can be extrapolated beyond the dyad, as we conceptualize integration simultaneously from an upstream and downstream perspective.

Keywords:
Supply chain integration, contingency factors, performance, operations strategy

1. Introduction

The paper *"arcs of integration: an international study of supply chain strategy"* by Frohlich and Westbrook (2001) (FW2001 hereafter) arguably has a significant influence on supply chain research in general and supply chain integration (SCI) in particular. FW2001 put the SCI topic into the spotlight of operations management (OM) research (Leuschner *et al.*, 2013, Kamal and Irani, 2014, Mackelprang *et al.*, 2014, Ataseven and Nair, 2017). The general view from the SCI literature is that increased integration leads to improved firm performance (Frohlich and Westbrook, 2001). Researchers have extensively applied theories, such as the resource based view (RBV) (Barney, 1991), relational view (RV) (Dyer and Singh, 1998), transaction cost economics (TCE) (Coase, 1937, Williamson, 1979), and information processing theory (IPT) (Galbraith, 1974), and suggested that SCI can be a source of lasting competitive advantage (Mesquita *et al.*, 2008, Chen *et al.*, 2009), a strategic partnership that creates value (Mesquita *et al.*, 2008), and a way to reduce transaction costs (Rosenzweig *et al.*, 2003, Zhao *et al.*, 2011) and decision uncertainty (Schoenherr and Swink, 2012). Consequently, it has been concluded that the more companies integrate, the higher their potential performance benefits at the strategic and operational level.

However, empirical findings are inconsistent. Although some research has found a positive relationship between SCI and performance (Frohlich and Westbrook, 2001), others find insignificant (Danese and Romano, 2011, Wiengarten *et al.*, 2014), curvilinear relationships (Terjesen *et al.*, 2012) and contingent relationships (Wong *et al.*, 2011) . Some researchers have started to propose that there might be an optimum level of integration or diminishing returns from "too much" integration (e.g., Das *et al.*, 2006). Additionally, researchers have proposed that previous research might have developed model that were too simplistic, ignoring the role of contingency factors (e.g. Gimenez et al., 2012).

To address these inconsistencies in the literature, and defragment and consolidate this line of research, this paper aims to further explore the SCI-firm performance relationship. Specifically, the objective of this research is to explore the reasons why, at least in some instances, SCI does not lead to firm performance improvements. Thus, this research is set to provide answers to the following research questions: (1) *Does a higher degree of SCI always leads to greater firm performance improvements?* And since the answer to this question is likely to be no, we further explore: (2) Is the SCI – performance relationship contingent on a company's competitive priorities (i.e., operations strategy)? (Ward and Duray, 2000, Joshi *et al.*, 2003).

We provide answers to these research questions with data collected through the *International Manufacturing Strategy Survey* (IMSS). Specifically, we use data collected in multiple years to more meaningfully attend the "always" adjective in our first research question. Furthermore, the use of multiple rounds of IMSS data enable us to examine the evolution of the relationship between SCI and performance over a twenty-year period and contribute to the stability discussion of the relationship.

This article is structured as follows. In the following section, we review the theoretical and empirical underpinnings of previous SCI research, after which the hypotheses are developed and proposed. We then present the research design and measurement of constructs. Finally, after analysing and presenting the results, we conclude by discussing both the theoretical and practical implications of our results.

2. Literature review

SCI has been defined from different perspectives in terms of the direction of integration, whether it being external integration with customers and suppliers and internal integration between departments (Flynn *et al.*, 2010, Wong *et al.*, 2011) and in terms of the depth of the relationship, being it at the operational information exchange level or at the strategic level (Wiengarten and Longoni, 2015). Defining SCI as a multi-dimensional construct, Liu *et al.* (2016) concluded that SCI has four key components: information integration, synchronised planning, operational coordination, and strategic partnership. In addition, Wiengarten *et al.* (2014) proposed that the strength of the relationship, approximated through practices and activities that supply chain partners are engaged in, can be divided into coordinative and collaborative integration.

An extensive body of literature has been accumulated that links SCI to firm performance (Leuschner *et al.*, 2013, Kamal and Irani, 2014, Mackelprang *et al.*, 2014). The consensus results of these empirical studies suggest that an increase in integration practices lead to an increase in performance, and a lack of integration may have an adverse effect on performance. It seems as previous research predicts an almost linear positive relationship between SCI and performance. However, more recent work has started to question and challenge this unconditional assumption in terms of non-linearity and contextual influences (Das *et al.*, 2006, Terjesen *et al.*, 2012, Zhao *et al.*, 2015). The subsections of the literature review are organized around the non-linearity and contextuality arguments and will provide a comprehensive review of the articles listed in Table 1.

2.1. Supply chain integration and firm performance

The relationship between SCI and performance has been extensively examined, but the results are still relatively inconclusive when considering the selected dimensions of integration and performance. Research has found positive (Frohlich and Westbrook, 2001, Schoenherr and Swink, 2012), mixed (Flynn *et al.*, 2010, Wiengarten *et al.*, 2014), non-linear (Das *et al.*, 2006, Terjesen *et al.*, 2012) and contingent relationships (Danese and Romano, 2013, Wiengarten et al., 2014) between SCI and performance. A summary of selected representative SCI empirical research is presented in Table 1. The table breaks the SCI-performance studies down into positive findings, mixed findings, non-linear findings, and contingent findings.

The table indicates that research has conceptualized SCI in distinct but consistently reoccurring categories. In its most simple form SCI has been treated as a single construct (Terjesen *et al.*, 2012, Huang *et al.*, 2014). However, the majority of studies have adopted a conceptualization that is based on the arcs of integration by Frohlich and Westbrook (2001). Based on this concept SCI is decomposed on the upstream and downstreamn component of SCI (i.e., supplier and customer integration). Furthermore, integration is divided between internation and external integration (Flynn *et al.*, 2010, Wong *et al.*, 2011).

In terms of performance, prior research has examined performance considerations from both an operational performance and financial perspective. Operational performance has been conceptualised as a single construct or through its widely known sub-dimensions (i.e., such as quality, delivery, flexibility, and cost). Financial performance has been frequently conceptualised through firm level indicators such as return on investments, return on assets, sales, and return on sales. In addition, financial performance has been frequently viewed as a secondary performance outcome, which is affected by the primary performance outcome operational performance.

[INSERT TABLE 1 ABOUT HERE]

SCI researchers have explored the SCI – firm performance relationship through multiple lenses. Key theories applied in this field have been the RBV and TCE. RBV proposes that companies engage in interorganizational relationships (IORs) to obtain access to essential complementary resources that are outside their company boundaries. Thus, through practicing SCI firms get access to additional resources that are rare, valuable, inimitable and non-substitutional (Barney, 1991), which may lead to sustainable competitive advantages and thus improve firm performance. TCE, on the other hand, views IORs as hybrid structures, which can be categorised somewhere between market-based and hierarchical structures. TCE proposes that companies choose the government mode depending on certain transaction costs, which include information costs, negotiation costs, and monitoring (or enforcement) costs (Williamson, 1991). TCE concludes that performance is improved through choosing the right government mode, which could be an IOR characterised by integration from a supply chain perspective.

Organisational theorists, on the other hand, argue that organisations build external relationships to more effectively accomplish tasks and to reinforce interorganisational and personal relationships (Parmigiani and Rivera-Santos, 2011). Some of the most widely applied organisational theories in our field are resource dependency theory, stakeholder theory, institutional theory and social network theory. The underlining argument of these theories is that individuals (e.g., managers) and organizations are all part of a broader social context (Uzzi, 1996). Resource dependency theory proposes that firms are interlinked and the output of one firm is the input of another (Hillman *et al.*, 2009). Stakeholder theory proposes that firms will cooperate with influential stakeholders to reduce uncertainty (Freeman, 1984). Institutional theory is about legitimacy and its basic assumption is that organizational actions are socially constructed and constrained by isomorphic pressures (DiMaggio and Powell, 1983). Relatedly, social network theory proposes that interactions (e.g., communications) between actors should be viewed an embedded system and companies can observe behavioural patterns to predict actions and capabilities (Choi and Kim, 2008).

In this paper we focus on the potential tension between the RBV and TCE to theoretical underpin and explore the SCI – performance relationship. These two theories are of particular interest as they can highlight some of inconsistencies of previous research.

From an RBV perspective the argument that more integration leads to higher performance gains, as formulated in RQ1, seems compelling. Through higher levels of integration, the SCI practice becomes more valuable, rarer, more difficult to be substituted and more difficult to be copied by competitors. Similarly, Schoenherr and Swink (2012) extended the RBV with the relational view (Dyer and Singh, 1998), and argued that the tighter the relationship (i.e., the degree of integration), the higher the potential for relational rents and thus sustainable competitive advantages. (Zhang and Huo, 2013) also applied the RBV and identified that more CI and SI integration leads to higher financial performance. They also identified that trust and dependency are required for integration. However, some studies that have based their propositions on RBV have also identified mixed findings (e.g., Devaraj *et al.* (2007); Flynn et al., 2010).

When applying the TCE perspective it can be argued that the performance implication of SCI depends on the transaction costs and it could be the case that in some relationships an integrative approach might be too costly, e.g. due to monitoring costs in un-trustful relationships. Swink *et al.* (2007) argued that firms that integrate too closely with their suppliers are exposed to higher levels of risk through adverse selection, moral hazard and opportunity costs. Zhao *et al.* (2015), have applied the RBV and TCE and identified an inverted U-shaped impact of SCI on FP. They argued that when taking a TCE perspective increasing levels of SCI will lead to risks and coordination costs that may outweigh the potential returns of SCI. Zhao *et al.* (2015) concluded that the positive effects of SCI comes from enabling firms to gain excess, acquire and utilize resources and capabilities and the negative effects from the diminishing returns of SCI.

In conclusion, we believe that these opposing views and findings present a need for re-evaluation that would help researchers and foremost practitioners to understand the direct performance implications of their company's SCI initiatives. Furthermore, through using multiple datasets that have been collected over multiple years, we can at least, be more confident in our assessment and conclusion regarding the performance implications of SCI. Subsequently, we propose:

H1. Higher degrees of supply chain integration (i.e., supplier and customer integration) lead to greater performance improvements (i.e., operational and financial performance).

2.2 Contextual considerations for the SCI – performance relationships

Some researchers have started to explore and explain the contradictory findings, highlighted above, through contextual variables, mainly at the firm and country level.

While the operational performance efficacy of internal and external SCI is well studied in the literature (Leuschner *et al.,* 2013), our understanding of contextual supporting and dampening factors is still limited. Specifically, researchers have started to argue that contextual factors can have a positive or negative influence on the SCI – performance relationship.

Contingency research has progressively increased in operations and supply chain management in the past years (Sousa and Voss, 2008). This stream of research has resulted in a paradigm shift of OM best practices (e.g., quality management), refuting the universal performance improvement proposition of such practices. The contingency perspective (Donaldson, 2001) proposes the impact of operational and supply chain practices on firm performance are contingent on various organizational and external factors (Sousa and Voss, 2008).

At the country level, Wiengarten et al. (2014) for example, explored the impact of a country's logistical capabilities on the SCI – performance relationship. Besides others they identified that plants operating in countries with superior logistical capabilities do not gain the same performance benefits from external integration as plants operating in countries with relatively low levels of logistical capabilities. Furthermore, Wong et al. (2011), explored the contingency effects of environmental uncertainty on the SCI – operational performance relationship. They proposed and confirmed that under high environmental uncertainty, the associations between supplier/customer integration, and delivery and flexibility performance will be strengthened.

Similarly, researchers have also confirmed multiple contingency factors that impact on the SCI – performance relationship at the firm level. For example, Vanpoucke *et al.* (2017) explored the importance of information technology (IT) for the success of customer integration. Besides others they identified that IT use in customer integration strengthens the relationship between operation integration and delivery performance. Moreover, Danese and Romano (2011) identified that SI positively moderates the relationship between CI and efficiency.

2.3 Supply chain integration and competitive priorities

The degree of integration with suppliers and customers is an integral strategic decision that has clear implications as to how a company is positioning itself strategically. And as identified in the previous section that previous research proposes a link between SCI and firm performance. Operations management and supply chain management are practically, conceptually and from a performance perspective deeply interwoven. Literature proposes that a company's strategy need to be in alignment with its operations strategy (Ward and Duray, 2000) and with its supply chain strategy (i.e., from a product perspective (Fisher, 1997). However, rarely has the literature focused on the strategic interrelationship between operations and supply chain strategy.

Operational objectives also translate to competitive priorities, in the form of cost, quality, delivery and flexibility. These priorities in turn establish, guide and measure a firm's operational strategy. Traditionally, operations strategy research has investigated the interlinkages between operations and organizational strategy. Similarly, supply chain research has focused on the interlinkages between supply chain strategy and organizational strategy in terms of product characteristics. The relationship between both executing entities at the organizational and supply chain level has been overlooked.

However, the potential influences at both levels between each other can be illustrated. For example, it could be argued that it is more appropriate to follow a differentiation strategy at the operational level (i.e., non-efficiency priorities) in cases of high levels of SCI, since SCI is costly to implement. Thus, whenever the product that comes out of the operations processes is designed to follow a differentiation strategy that does not priorities cost efficiency the supply chain processes do not need to be integrated. However, at the same time a counterargument could be formed towards efficiency gains through supply chain process integration.

Subsequently, with the strategy dependency proposition we explore the "fit" perspective of contingency research (Sousa and Voss, 2008). We are particularly exploring the fit perspective from a strategic priority position. Danese and Romano (2013) explored the moderating role of supply network structure on the customer integration-efficiency relationship. They identified that the relationship between CI and cost reduction is contingent on the supply network structure. CI only increases efficiency when the supply network is designed to shorten lead time. These results suggest that the strategic orientation matters in terms of generating value. In this paper we chose to test the strategic orientation on the SCI – performance relationship through a generic performance variable (i.e., financial performance). Choosing financial performance as our DV allows us to explore the generic influence of strategic priorities on the SCI – performance relationship. Operational performance in terms of cost, quality, delivery and flexibility already implicitly carries the priority perspective. Subsequently, we propose the following hypothesis:

H2. The impact of supply chain integration (i.e., supplier and customer integration) on financial performance is moderated by a firm's competitive priorities (i.e., cost, quality, delivery, flexibility).

3. Research method

3.1. Data: A quasi-longitudinal design

We used multiple round of IMSS data to test the linear and non-linear relationship between SCI and firm performance. Whilst we use data from five rounds of the IMSS, we are unable to match the samples from different rounds of the survey because of the anonymity of the respondents. Therefore, the repeated cross-sectional design is not longitudinal *per se* (Schutt, 2008, Narasimhan and Schoenherr, 2013), but it represents significant improvements in contrast to single cross-sectional design since the results of repeated cross-sectional research are more reliable.

The IMSS surveys have been conducted for six rounds, which enables us to achieve our objective through adopting a repeated cross-sectional design to enhance the validity of the results. The first round of IMSS survey was conducted at 1992, and data was subsequently collected approximately every four years. The most recent dataset, the sixth round, was collected in 2014. The IMSS surveys were conducted in different countries through a collaborative research network of partners, aiming at examining strategies and practices adopted by manufacturing companies and their performance implications. In each country, the local partners and their research teams were responsible for the data collection process. To ensure the equivalence of data collection in different countries, the questionnaires were originally designed in English by a group of operations management researchers based on existing literature and discussions with practicing managers. If required, the questionnaires were translated into local language by the local research teams. To minimise language inconsistencies, the questionnaires were translated backward and forward from the local language to English by the support of professional translators. The IMSS questionnaires include several sections, including competitive strategy, business environment, servitization activities, production and supply chain management practices, and global manufacturing networks. The questions were designed mainly using a five-point Likert scale, along with some objective measures that are absolute or percentages. The surveys were conducted at the plant level in manufacturing industries. Participants were manufacturing managers (or equivalent) of each plant deemed to be the most knowledgeable informants to answer the survey questions.

The IMSS datasets have been widely used to conduct SCI research. For example, the FW2001 is based on IMSS data (IMSS-II, year 1996). Also, later rounds of the IMSS dataset were used in studies by Wiengarten *et al.* (2014). Thus, we will test our hypotheses using IMSS II and subsequent rounds of the survey including IMSS-III (year 2000), IMSS-IV (year 2005), IMSS-V (year 2009) and IMSS-VI (year 2014). Table 2 provides an overview of the country distribution of the plants in each round of survey. Consistent with FW2001, we delete cases that have missing values. In general, the IMSS-II (1996) has a higher portion of missing values compared the subsequent years. We eliminate responses that have more than 50% missing values at either integration or performance items. This reduces the sample size of IMSS-II to 293. Our sample of IMSS-II is slightly different from that of FW2001, which contains 322 responses (they did not illustrate how they selected cases, therefore it is not possible to replicate their sample of 322 cases). For the other rounds of IMSS, we deleted cases that have missing values in the integration or performance section.

[INSERT TABLE 2 ABOUT HERE]

3.2 Measures

We focus on external integration and measure it along two dimensions: supplier integration *(SupInt)* and customer integration *(CusInt)*. The IMSS questionnaire uses previously validated questions from the literature to measure integration (Frohlich and Westbrook, 2001, Wiengarten *et al.*, 2014). In the IMSS-II, we replicate FW2001's approach and used 16 items to measure integration. In the IMSS-III, IMSS-IV, and IMSS-V, the original scales for SCI are all similar but are slightly different from the IMSS-II. In the IMSS-VI, the questions of SCI, which were adjusted according to the latest integration literature, are substantially different from the early rounds of the survey. After conducting the factor analysis, we delete several items that have either low loadings or high cross-loadings to ensure validity. Although the final scales used to measure SCI are slightly different for the five datasets, the essence of them are very similar and include core components of integration, such as information sharing, collaboration, inventive alignment and joint decision-making (Leuschner *et al.*, 2013). All items are listed in Table 3.

[INSERT TABLE 3 ABOUT HERE]

Competitive priorities are measured based on the importance of cost, quality, delivery, and flexibility in wining customer orders (Boyer and Lewis, 2002, Peng et al., 2011). The measurements of competitive priorities in different rounds are consistent. Cost is measured as the importance of "having lower selling price" to win orders; quality is measured as the importance of offering superior "conformance quality (conformance to customer specifications)"; delivery is measured as the importance of offering "more reliable deliveries"; flexibility is measured as the importance of providing "wider product range". The measurements are based on five-point Likert scale, where 1 refers to “not important” and 5 refers to “very important”. All items are listed in Table 3.

Operational performance is a multi-dimension construct, and the most widely accepted dimensions are quality, delivery, flexibility, and cost (Flynn *et al.*, 2010, Wiengarten *et al.*, 2011, Wong *et al.*, 2011, Schoenherr and Swink, 2012). IMSS questionnaires use widely accepted items for these four dimensions, which have been re-validated in multiple studies (Wiengarten *et al.*, 2014). In the IMSS-II, operational performance was measured as a percentage of improvements compared to the last year. In later rounds, the IMSS questionnaires measure improvements of operational performance on a five-point Likert scale based on the manager’s perception of the improvements in operational performance with relation to the previous three years, whereas 1 indicates “much lower” and 5 indicates “much higher”.

Among all the indicators of financial performance, sales and profitability seem to be the most frequently used measures in operations management research (Rosenzweig *et al.*, 2003, Terjesen *et al.*, 2012, Swink and Schoenherr, 2015). In IMSS-II, there is no indicator for sales, so we used profitability to measure financial performance (as a percentage of improvements compared to the last year ago). The IMSS-III uses objective measures for sales and profitability, and the respondents were asked to report the exact figures of sales and return on sales (ROS). By contrast, the later rounds use five-point Likert scales to measure sales and profitability. Sales was measured based on the managers’ perception of the improvements of sales compared to three years ago. Profitability is measured based on managers’ perception of the ROS improvements compared to three years ago. Both the sales and profitability scales are based on a five-point Likert scale in terms of the degree of change in these two indicators, with 1 indicates much lower and 5 indicates much higher.

We controlled for several factors, both at the country and plant level, that may interfere with the relationship between integration and performance. At the country level, we controlled for the economic development level and economic growth of the host country of each plant because plants in developed countries might benefit from a supportive institutional environment (Meyer and Peng, 2016), and because plants in a munificent environment might face less competition (Terjesen *et al.*, 2012). We measured economic development using the natural logarithm of the gross domestic production (GDP) per capita *(GDPPC)* and measure economic growth by GDP growth *(GDPG)*. We collected country-level data for the years 1996, 2000, 2004, 2008, and 2012 (in accordance with the anchor year on which the survey data was based) from the *World Bank* database. At the plant level, we controlled for plant size (*Size*) because firms with different sizes might use different integration strategies and because large-sized companies tend to have stronger bargain power and are more likely to benefit from economies of scale (Cao and Zhang, 2011). We measured plant size through the natural logarithm of the number of employees in each plant.

3.3 Construct validation

Content validity was ensured in two ways. Firstly, the questionnaires were designed by experienced operations management researchers and are grounded in existing literature; their expertise and knowledge contributed to the validity of the survey questions. In addition, manufacturing managers were also involved in the questionnaire design stage; this ensures the relevance of the questions. Secondly, a pilot test was conducted before the questionnaires were sent to respondents; this ensures the questions to be clear and precise.

In the IMSS-II, we use the same indicators as FW2001, and confirm the reliability and validity of the IMSS-II data. Due to the objective measures and large-scale missing value of firm performance, we replicate their study by assessing the validity and reliability of SCI measurements based on principal components analysis. Our results are identical with FW2001, indicating that validity and reliability are acceptable.

In later rounds of the IMSS, we conduct confirmatory factor analysis (CFA) for each survey round to assess the convergent validity of the scales. We develop measurement models with multi-item constructs for SCI (i.e., customer and supplier integration) and operational performance (i.e., cost, quality, delivery, and flexibility). The CFA results indicate that, in the IMSS-III, IMSS-IV, IMSS-V, and IMSS-VI, the measurement models are well fitted to the datasets, and all factor loadings are higher than 0.5 and significant at 0.05, confirming the convergent validity of the scales. A summary of reliability and validity test results is presented in Table 4.

We assess the discriminant validity by comparing the squared root of average variance extracted (AVE) of each construct and its correlation with other constructs (the Fornell-Larcker criterion). The results indicate that the squared roots of AVE for all variables are higher than their correlation with other variables, providing an indication of the discriminant validity of the scales. We also calculated the Heterotrait-Monotrait Ratio (HTMT) for all latent variables using SmartPLS. Results indicate that all HTMT coefficients are lower than 0.85. This provides further indication of discriminant validity (Henseler *et al.*, 2015). In addition, the composite reliability and Cronbach's alpha coefficients of multi-item variables are greater than 0.6. The results indicate the scales are reliable (a detailed validity and reliability test report is available from the authors upon request).

[INSERT TABLE 4 ABOUT HERE]

3.4 Common method bias

This research uses single-respondent and perceptual data, which is susceptible to common method variance (CMV). In order to minimize CMV, the IMSS team followed the guidance of current literature (Podsakoff *et al.*, 2003). The questions in the questionnaires are clear and precise, and the scales for SCI and performance are in different sections of the questionnaire. During the data collection stage, the IMSS team guaranteed the anonymity of respondents to encourage them to provide accurate information. In addition, we conduct Harmon's single factor approach to evaluate the seriousness of CMV. We conduct component factor analysis in the IMSS-III, IMSS-IV, IMSS-V, and IMSS-VI datasets. The first factor only accounts for a small portion of the total variance (with 26.656%, 24.960%, 24.351%, and 28.694%, respectively). Moreover, in each dataset, we construct one-factor models, measured by all the items, and conduct CFA. The one-factor models generally show poor fit indices, indicating the CMV might not seriously bias the results.

4. Results

4.1 Testing the linear relationship

We conduct OLS regression to test how supplier integration and customer integration impact on operational and financial performance (H1). The regression results for the IMSS-II are presented in Table 5. In terms of the controls, IMSS-II results indicate that firm size is positively related to performance indicators, supporting the prediction that large-sized firms are more likely to benefit from economies of scales. In contrast, GDP per capita is negatively related to both operational and financial performance, indicating that companies in developed countries do not necessarily benefit from the well-established institutional context. The SCI results indicate a lack of support for H1 since the relationships between integration (both customer integration and supplier integration) and performance (all performance indicators, including quality, delivery, flexibility, cost, and profitability) are not significant.

[INSERT TABLE 5 ABOUT HERE]

Table 6 present the results of linear relationship test based on IMSS-III. In terms of the control variables, firm size is positively related to sales (β=0.974, $p<0.001$). In contrast, GDP per capita is negatively related to quality performance (β=-0.103, $p<0.01$) and delivery performance (β=-0.117, $p<0.05$), and positively related to sales (β=0.855, $p<0.001$). Regarding the main effects, the results show that supplier integration is positively related to quality performance (β=0.092, $p<0.05$), delivery performance (β=0.107, $p<0.05$), flexibility performance (β=0.155, $p<0.001$), cost performance (β=0.166, $p<0.001$), and sales (β=0.144, $p<0.1$). However, supplier integration is not related to profitability. In addition, except for a negative impact on sales (β=-0.142, $p<0.1$), customer integration does not significantly affect the other performance indicators. Thus, we conclude that H1 is only partially supported for supplier integration and is not supported for customer integration.

[INSERT TABLE 6 ABOUT HERE]

Table 7 presents the results for IMSS-IV. Among all the control variables, GDP per capita is negatively related to quality performance (β=-0.128, $p<0.01$), delivery performance (β=-0.127, $p<0.05$), and sales (β=-0.226, $p<0.01$). In terms of the main effects, the results indicate that supplier integration is positively related to quality performance (β=0.061, $p<0.1$), delivery performance (β=0.078, $p<0.1$), flexibility performance (β=0.114, p<0.01) and cost performance (β=0.107, p<0.01). However, the relationship between supplier integration and financial performance measured by sales and profitability is insignificant. In addition, customer integration is positively related to operational performance, including quality performance (β=0.138, p<0.001), delivery performance (β=0.139, p<0.01), flexibility performance (β=0.077, p<0.05) and cost performance (β=0.088, p<0.01). Consistent with supplier integration, the relationship between customer integration and financial performance is insignificant. Thus, the results suggest that H1 is only partially supported for firm performance measured by operational performance.

[INSERT TABLE 7 ABOUT HERE]

Table 8 illustrates the regression result of the IMSS-V. The results indicate that GDP growth is positively related to quality performance (β=0.045, p<0.01), cost performance (β=0.060, p<0.001), sales (β=0.058, p<0.05) and profitability (β=0.051 p<0.05). In terms of the main effects, supplier integration is positively related to delivery performance (β=0.099, p<0.05), flexibility performance (β=0.117, p<0.01), and cost performances (β=0.143, p<0.001). However, its impact on sales and profitability is insignificant. By contrast, the relationships between customer integration all performance indicators are insignificant. The results indicated that H1 is supported for supplier integration and operational performance.

[INSERT TABLE 8 ABOUT HERE]

Table 9 shows the relationship between integration and performance indicators in the IMSS-VI dataset. Regarding the control variables, firm size is positively related to sales (β=0.052, p<0.05), indicating that larger plants tend to have higher sales improvements; GDP growth is negatively related to flexibility performance (β=-0.026, p<0.05); GDP per capita is negatively related to quality (β=-0.166, p<0.001), delivery (β=0.201, p<0.001), and flexibility performances (β=-0.112, p<0.001), sales (β=0.064, p<0.1), and positively related to cost performance (β=0.100, p<0.01). In terms of the main effects, supplier integration has a positive impact on operational performance in terms of quality (β=0.110, p<0.05), delivery (β=0.101, p<0.05), flexibility (β=0.093, p<0.05), and cost performances (β=0.118, p<0.01). However, supplier integration does not have a significant impact on financial performance measured by sales and profitability. In contrast, customer integration is positively related to quality performance (β=0.078, p<0.1), delivery performance (β=0.079, p<0.1), flexibility performance (β=0.118, p<0.01), sales (β=0.096, p<0.05), and profitability (β=0.123, p<0.05). The results indicate that H1 is supported in IMSS-VI.

[INSERT TABLE 9 ABOUT HERE]

In summary, the test of the linear relationship shows that supplier and customer integration mostly have positive impacts on operational performance. But their positive impacts on financial performance are only partially supported. Thus, we can conclude that SCI does not "always" lead to performance gains.

4.2 Testing the contingent relationship

Table 10 presents the moderation hypothesis test results when sales is the dependent FP variable. Model 1-4 presents the full model after adding interaction terms of the competitive priorities (i.e., cost, quality, delivery, flexibility) and supply chain integration (i.e., supplier integration and customer integration) based on IMSS-III, IMSS-IV, IMSS-V, and IMSS-VI (IMSS-II was not included as it does not have sales indicators). In the IMSS-III, regression results show the quality priority positively moderates the relationship between supplier integration and sales (β=0.232, p<0.05), and negatively moderate the relationship between customer integration and sales (β=-0.192, $p<0.1$). The moderation plots (graph A and B in Figure 1) indicate that under high levels of quality emphasis in competitive priorities, supplier integration improves sales, while customer integration reduces sales. In addition, the delivery priority negatively moderates the relationship between supplier integration and sales (β=-0.194, $p<0.1$). The moderation plot (graph C in Figure 1) shows that supplier integration is more likely to improve sales under low delivery emphasis. The IMSS-IV results show that the relationship between supply chain integration is not moderated by competitive priorities. In the IMSS-V, results indicate that the delivery priority weakens the relationship between customer integration and sales (β=-0.156, $p<0.1$), while the flexibility priority strengthens the relationship between supplier integration and sales (β=0.108 $p<0.1$). The moderation plots (graph D and E) show that under high levels of delivery emphasis, customer integration reduces sales, while supplier integration improves sales. In the IMSS-VI, the cost priority negatively moderates the relationship between supplier integration and sales (β=-0.134, $p<0.01$), and positively moderate the relationship between customer integration and sales (β=0.120, $p<0.01$). The moderation plots (graph F and G) indicate that under high cost emphasis, supplier integration reduces sales while customer integration enhances sales.

[INSERT TABLE 10 ABOUT HERE]

[INSERT FIGURE 1 ABOUT HERE]

The moderation hypotheses tests when profitability is the dependent FP variable is presented in Table 11. In the IMSS-II, the delivery priority negatively moderates the relationship between customer integration and profitability (β=-12.627, $p<0.1$). The moderation plot (graph A in Figure 2) also supports that under low levels of delivery emphasis in competitive priorities, customer integration is more likely to improve profitability. In the IMSS-III, IMSS-IV, and IMSS-V data. The low F-statistics indicate that the regression coefficients in the model 2-4 are not reliable. Thus, the relationship between supply chain integration and profitability is not moderated by competitive priorities in these datasets. In the IMSS-VI, the quality priority weakens the positive relationship between supplier integration and profitability (β=-0.107, p<0.1). As illustrated in Figure 2 (graph B), the slope is steeper under low emphasis of delivery in competitive priorities. In addition, the delivery priority enhances the relationship between supplier integration and profitability (β=0.126, p<0.05) and weakens the impact of customer integration on profitability (β=-0.110, p<0.1). The moderation figures (graph C and D in Figure 2) show that the implementation of supplier integration is more likely to improve profitability under high delivery priority, while customer integration is more likely to improve profitability under low delivery priority.

[INSERT TABLE 11 ABOUT HERE]

[INSERT FIGURE 2 ABOUT HERE]

In conclusion, after controlling for economic conditions and plant size, the results of the regression approach in different rounds of IMSS suggest that the support for the "always" improves performance is quite divergent (Table 12). While some relationships gain general support, such as supplier integration's impact on quality, delivery, flexibility, and cost, other relationships gain less support, such as supplier integration on financial performance, and customer integration on operational and financial performance.

[INSERT TABLE 12 ABOUT HERE]

5. Discussion

This paper was set out to provide answers to our previously stated research questions: (1) *Does a higher degree of SCI always leads to greater firm performance improvements?* Since the answer to this question is likely to be no we further explore: (2) Is the SCI – performance relationship contingent on a company's competitive priorities?

We seek to prompt and answer these questions since they concern issues that are at the core of supply chain management. And a coherent assessment of such would make significant theoretical and managerial contributions to our community. The first part of this research (i.e., research question 1) has mostly been addressed in a piecemeal approach in previous research. We provided a much more coherent assessment from a measurement and methodological perspective. The second part of this research (i.e., research question 2) has also not been fully addressed by previous research and we sought to address contingency concerns from a strategic organizational perspective.

The answer to our first question is a clear no. SCI does not always improve firm performance. This is likely to be an expected outcome of our analysis. Whilst SCI has been marketed as a cure for many supply chain issues, previous research has already started to establish that this might not be the case (Das *et al.*, 2006, Terjesen *et al.*, 2012, Wiengarten *et al.*, 2014).

At the beginning of this research it was already clear that providing such a clear statement in response to our second research question was not achievable. Our results prompt towards the importance of contingency factors impacting on the performance implications of SCI. We have identified that a company's strategic pre-disposition in terms of its competitive priorities impact on the performance implications of SCI.

Our results make multiple theoretical and managerial contributions and advancements which will be discussed in the following sections.

5.1 Implications for theory

Previous SCI research has applied multiple theories to support the proposition that higher levels of integration lead to an increase in firm performance with the RBV and TCE being amongst the most prominent once. Both theories, when applied to the SCI context, can be interpreted to question the unconditional SCI – performance relationship. From a resource-based perspective it is questionable whether or not the relationship between supply chain partners is a source of performance improvements on its own or a means to gain excess to resources that lead to performance improvements. Furthermore, the lasting (i.e., sustainable) performance improvements have largely been overlooked in SCI research applying the RBV (Wiengarten and Longoni, 2015). Additionally, the transaction cost view might suggest a tipping point from which too much integration increases transaction costs through e.g., increased monitoring costs. Sharing too much information might as well have as much detrimental implications on firm performance as sharing too little.

Firstly, our results cannot confirm the unconditional interpretation of these theories and some previous empirical findings that suggest a positive relationship between integration and performance (Frohlich and Westbrook, 2001, Schoenherr and Swink, 2012). The results reveal that SCI in terms of customer and supplier integration does not always improve firm performance (see Table 15), especially the customer side of SCI does not seem to significantly affect firm performance. Furthermore, in terms of the type of the dependent variable, it seems that SCI does not improve financial performance, conceptualised through sales and profitability. Thus, these results reject our first hypotheses. It seems that the RBV and TCE need to be applied more carefully to test the SCI – firm performance relationship. Very few studies have suggested this through empirically exploring and confirming that SCI does not consistently improve firm performance (Das *et al.*, 2006, Terjesen *et al.*, 2012). We contributed to this developing stream of literature through providing a coherent assessment using multiple samples, customer and supplier integration measures and multiple firm performance indicators in terms of financial and operational firm performances.

Although the use of multiple rounds of cross-sectional data is not, per se, a longitudinal test of the relationship between integration and performance, it should enhance our understanding of the performance implication of integration. On the one hand, the use of multi-year data allows us to observe the dynamic of this relationship over time. We expected the strength of the relationship between integration and financial performance to increase over time because of the learning effect. As firms learn how to implement the integration practice, they could increase the efficiency of coordination with suppliers and customers. However, our results do not show this pattern. Instead, the results show that only in the IMSS-III, integration (both supplier integration and customer integration) could increase sales, and in the IMSS-VI, customer integration increases both sales and profitability. But in other rounds of IMSS data, the relationships between integration and financial performance are not significant. Inconsistent with our expectation, the financial benefits of integration do not show an increasing pattern. A possible explanation is the competition effect. When SCI becomes mature, more and more firms started to implement this practice (Huo et al., 2013). Consequently, the marginal competitive advantage and subsequent financial benefits gained from integration might decrease due to competition. On the other hand, using multiple round data could enhance the validity of our results (Narasimhan and Schoenherr, 2013). The results, based on different rounds of IMSS data, show some consistent pattern. For example, the relationship between supplier integration and operational performance (e.g. quality, delivery, flexibility, and cost efficiency) tend to be significant (except for the IMSS-II). In addition, in contrast to financial performance, integration is more likely to increase operational performance. Supplier integration is more effective in increasing operational performance than customer integration. In contrast to results that are based on single cross-sectional data that is subject to the environmental context when the data was collected, results based on multiple year data is more robust.

Secondly, we followed the theoretical explanations and sparse empirical evidences and suggested that there might be an optimum level of SCI to achieve performance gains. Previous literature has debated multiple reasons that may have caused these inconsistencies. Literature has proposed that the inconsistencies might be due to differences in the conceptualisation of the SCI and firm performance constructs (Leuschner *et al.*, 2013, Mackelprang *et al.*, 2014), contextual factors (Huang *et al.*, 2014, Wiengarten *et al.*, 2014, Liu *et al.*, 2016), or a general false assumption of the more integration equals to higher performance equation. We propose that these causes are somewhat interrelated through the common nominator in the form of theory.

Thirdly, certain contextual factors, others than our control variables, might influence the direct relationship that we have not accounted for in this research. Previous research has already suggested and started to further explore the impact and importance of contextual factors on the efficacy of SCI. Contingency factors might occur at various levels of analysis. Some studies have started investigating these factors at the organizational and country level (Wong *et al.*, 2011, Huang *et al.*, 2014, Wiengarten *et al.*, 2014). Our complex findings further emphasize the importance of taking a contingent view and considering more contextual factors that might moderate the relationship between integration and performance. We identified that it does matter whether a company is driving a differentiation or cost leadership strategy in terms of its pre-disposition towards competitive priorities. Whilst our results are not conclusive, they need to be taken into consideration when theorizing the SCI – performance relationship (Donaldson, 2001).

In summary, we can make two overall theoretical conclusions from our results. Firstly, SCI does not univocally improve firm performance; and secondly, the impact of SCI on performance seems to be much more complex as previously assumed. This leads us to question the linearity and direct SCI – performance proposition (Frohlich and Westbrook, 2001, Schoenherr and Swink, 2012). These findings and conclusions are likely to be of great importance for practitioners.

5.2 Implications for practice

Our results indicate that managers need to be aware that SCI does not univocally improve performance. Some dimensions such as supplier integration might improve operational performance but do not necessarily improve a firm's financial performance suggesting that instead it may come at a significant financial cost. Thus, managers need to be aware that more integration does not necessarily always lead to higher performance gains. SCI is a resource that comes at a cost which might diminish some of its initial returns. Thus, depending on the sourcing needs and situation, managers need to take a more differentiated approach to supplier and customer integration. Additionally, the performance implication of SCI is context dependent and that context is the organisational strategy. It is important to know for manager that depending on their company's strategic pre-disposition, SCI can have a stronger or relatively weaker impact on financial performance. This is an important finding when managers benchmark performance and as to when, and to what extent, to implement SCI.

Our findings and conclusions do not dispute that SCI is an important practice to manage a company's supply chain. Our findings and conclusions do also not dispute the potential performance benefits that are achievable through SCI. However, we provide evidence that performance benefits are not consistent and that managers need to be careful as to when to practice integration and how much to integration with customers and suppliers. From a managerial viewpoint these findings might not come as a surprise. However, previous research and theoretical underpinnings positioned SCI in a much more enthusiastically. We provide a coherent and integrative assessment and provide evidence to question these previous conclusions.

6. Conclusion

SCI has become an integral part of supply chain management from a theoretical and managerial point of view. The objective of this paper was to explore the reasons why, at least in some instances; SCI does not lead to firm performance improvements. We tried to do so through using multiple rounds of IMSS datasets, thus testing the hypotheses using multiple samples. Especially, from a quantitative viewpoint, our paper has some limitations that need to be highlighted when interpreting our results. Firstly, this replication study relies on quasi-independent sets of data. Although we use multiple datasets at different points of time to test the performance implications of SCI, it is not a longitudinal study *per se*. However, we believe that the repeated cross-sectional design provides a significant improvement over previous studies and is very appropriate for this study. Secondly, the IMSS data has its methodological limitations. The sampling is not completely random. Future research should be more careful with the sampling procedure to increase the confidence of the results. Additionally, the IMSS only employs a single-respondent survey design that is vulnerable to common method bias. Lastly, the SCI and firm performance measures used in IMSS survey rounds changed slightly over the years. Whilst this, to some extent, reflect changes in the management and business environment in terms of preferences, technologies, and preferences, it also presents a limitation in terms of results-comparability.

Nevertheless, despite these limitations our study makes multiple theoretical advancements and theoretical contributions that we hope will encourage other researchers to go beyond the linear SCI – performance proposition. It is compelling to suggest that SCI, although complex, is a high potential remedy for supply chain management. It might well be, but researchers and practitioners alike need to investigate and apply its tools in a much more nuanced approach.

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Table 1. Summary of SCI-performance studies

Article	IVs	DVs	Theory	Moderators/mediators	Findings / Arguments
			Positive relationship between SCI and Performance		
Frohlich and Westbrook (2001)	SI, CI	OP and FP	Not specified.	None.	• Integration increases both OP and FP.
Droge *et al.* (2004)	Internal integration, External integration	Time-based performance, financial performance, market share	Not specified.	Mediator: time-based performance.	• Both internal integration and external integration are positively related to time-based performance, such as time to market, time to product, and responsiveness. • After controlling for time-based performance, internal integration and external integration also have a direct impact on market share performance and financial performance. • Internal integration and external integration have a synergy effect on performance.
Swink *et al.* (2005)	Strategy integration	Market-based performance	Not specified.	Mediator: Manufacturing capability	• The relationship between strategy integration and market-based performance is fully mediate by manufacturing capabilities, such as cost efficiency, process flexibility, and new product flexibility.
Villena *et al.* (2009)	SCI	OP	Not specified.	None.	• SCI is positively related to both subjective and objective OP measures.
Jayaram *et al.* (2011)	Supplier coordination, customer coordination.	Flexibility, Quality	CT	Moderators: firm size, clock speed	• Supplier coordination is positively related to both flexibility and quality performance. • Customer coordination is positively related to both flexibility and quality performance. • The relationship between supplier coordination and quality performance is stronger for large firms. • The relationship between customer coordination and flexibility performance is stronger for small firms.
Schoenherr and Swink (2012)	SI, CI	Quality, Delivery, Flexibility, Cost.	RBV and IPT.	Moderator: II	• Greater arc of external integration lead to higher levels of quality, delivery, flexibility, and cost performance. • External integration has a stronger impact on delivery and flexibility performance when internal integration is high.
Jitpaiboon *et al.* (2013)	SI	OP	Not specified.	None.	• Supplier integration is positively related to OP. • IT use is the enabler of customer and supplier integration.
Zhang and Huo	CI, SI	FP	RBV	None.	• Both CI and SI are positively related to FP.

(2013)					• Trust and dependence are the antecedents of CI and SI.
Horn *et al.* (2014)	II, SI	Global sourcing project success	Social capital theory	Mediators: cognitive capital, structural capital, and relational capital.	• External integration with suppliers increase the likelihood of global project success. • Internal integration affects external integration through the accumulation of social capital.
Ralston *et al.* (2015)	II, SI, CI	OP and FP	The structure–conduct–performance perspective	Mediator: demand responsiveness	• Strategic internal integration is positively related to strategic supplier integration and customer integration. • Strategic supplier integration and customer integration increases OP and FP through increasing demand responsiveness.
Liu *et al.* (2015)	Internet-enabled supply integration; Internet-enabled demand integration	OP	Not specified.	None.	• Both Internet-enabled supply integration and Internet-enabled demand integration are positively correlated with firm performance measured by executives' perception of OP relative to main competitors.
Mixed findings					
Stank *et al.* (2001)	Internal collaboration, External collaboration.	Logistical service performance.	Not specified.	None.	• Internal collaboration and external collaboration are positively correlated. • Internal collaboration increases logistical service performance, but external collaboration with suppliers and customers does not increases performance.
Gimenez and Ventura (2005)	Logistics-production integration, logistics-marketing integration, external integration.	Logistical performance	Not Specified.	None.	• Both logistics-production integration and logistics-marketing integration are positively related to external integration. • External integration increases logistical performance, but both logistics-production integration and logistics-marketing integration are not significantly related to logistical performance.
Devaraj *et al.* (2007)	eBusiness technology, SI, CI	OP	RBV, RV, and theory of swift and even flow.	SI, CI	• SI significantly improve OP, while the relationship between CI and OP is insignificant. • eBusiness technology improve performance through SI.
Flynn *et al.* (2010)	SI, CI, II	OP and FP	RBV	Mediators: SI, CI	• Internal integration increases both OP and FP. • Customer integration increases OP. • Supplier integration is not correlated with both OP and FP.
Yu *et al.* (2013)	SI, CI, II	FP and Customer satisfaction	OL	Mediators: SI, CI	• Internal integration is the basis for supplier and customer integration. • CI has a positive impact on customer integration, but its impact on FP is insignificant. • SI has a positive impact on FP, but its impact on customer satisfaction is insignificant.
Non-linear relationship between SCI and Performance					
Terjesen *et al.*	SCI	OP	Differentiation-	Moderators:	• SCI has an inverted U-shaped impact on OP.

(2012)			integration duality and CT.	Modularity-based manufacturing practices (MBMP), Environmental uncertainty.	• MBMP enhance the relationship between SCI and OP. • Environmental uncertainty enhances the moderating effect of MBMP.
Das *et al.* (2006)	SI	OP	RBV, KBV, TCE, and institutional theory.	None	• Low levels of supplier integration improve manufacturing performance. However, the benefit of integration is subjected to diminishing return.
Zhao *et al.* (2015)	SI, CI, II	FP	RBV and TCE	Moderator: Top management support.	• SCI has an inverted U-shaped impact on FP. • Top management support act as complementary asset to SCI and enhance the benefit of SCI.
Contingent relationship between SCI and Performance					
Wiengarten *et al.* (2014)	SI, CI	Cost; Flexibility; Delivery	Not specified.	Moderator: Logistical capability	• Supplier and customer integration increases operational performance; • In low logistical capability countries, customer integration has a stronger impact on operational performance.
Wong *et al.* (2011)	SI, CI, II	Quality, delivery, cost, flexibility	CT and IPT.	Moderator: Environmental uncertainty	• SCI improves operational performance. • Under high environmental uncertainty, supplier integration has a stronger impact on delivery and flexibility. • Under high environmental uncertainty, customer integration has a stronger impact on flexibility.
Huang *et al.* (2014)	SCI	Supplier performance (FP)	Efficiency vs. flexibility	Moderators: Demand uncertainty, technology uncertainty	• SCI improves supplier's performance; • Demand uncertainty weakens the relationship between SCI and supplier's performance; • Technology uncertainty strengthens the relationship between SCI and supplier's performance.
Gimenez *et al.* (2012)	SC practice, SC pattern, SC attitude.	Service performance, cost reduction	Not specified.	Moderator: Supply complexity	• The effectiveness of SCI is contingent on supply complexity. SCI only improve performance when supply complexity is high.
Danese and Romano (2013)	CI	Cost reduction	CT	Moderator: Supply network structure	• The relationship between CI and cost reduction is contingent on the supply network structure. CI only increases efficiency when the supply network is designed to shorten lead time.
Vanpoucke *et al.* (2017)	Information exchange, operational integration	Cost, delivery, flexibility	Not specified.	Moderator: IT use	• Operational integration fully moderates the relationship between information exchange and operational performance. • IT use in supplier integration strengthen the impact of operational integration on cost-efficiency and delivery performance.

					• IT use in customer integration strengthens the relationship between operation integration and delivery performance.

Note: SC – supply chain; SCI – supply chain integration; SI – supplier integration; CI – customer integration; II – internal integration; OP – operational performance; FP – financial performance; RBV – resource-based view; RV – relational view; TCE – transaction cost economics; CT – contingency theory; OL – Organizational learning; IT – information technology.

Table 2. Sample distribution

Locations	IMSS-II	IMSS-III	IMSS-IV	IMSS-V	IMSS-VI
Argentina	17	10	40		
Australia	22	34	9		
Belgium		14	26	24	20
Brazil	9	27	12	27	28
Canada	18		21	11	19
Chile	7				
China	a	15	29	32	106
Croatia		24			
Denmark	9	27	30	15	32
Estonia			15	19	
Finland	7				30
Germany	22	21	16	30	11
Greece			7		
Hong Kong	2				
Hungary	24	47	50	55	51
India					84
Ireland		27	10	5	
Israel			16		
Italy	36	48	31	40	37
Japan	12			17	77
Korea	20			41	
Malaysia					12
Mexico	3			15	
Netherlands	10	11	50	36	46
New Zealand	6		25		
Norway	3	31	13		24
Peru	4				
Portugal			9	8	29
Romania					38
Slovenia					17
Spain	17	15		28	21
Sweden	8	14	61		25
Switzerland				26	18
Taiwan				30	26
Turkey			33		
UK	17	40	12	17	
USA	20	10	31	59	35
Venezuela			25		
Total	293	415	571	535	786

Table 3. Survey items

IMSS-II
Supplier/Customer Integration activity (To what extent do you organizationally integrate activities with your suppliers and customers? (Based on a five-point Likert scale, where 1 refers to "none" and 5 refers to "extensive"))
• Access to planning systems
• Sharing production plans
• Joint EDI access/networks
• Knowledge of inventory mix/levels
• Packaging customization
• Delivery frequencies
• Common use of logistical equipment/containers
• Common use of third-party logistical services
Competitive priorities (Consider the degree of importance of the following goals to your major customers (Based on a five-point Likert scale, where 1 refers to "not important", and 5 refers to "very important").)
• Cost efficiency: having "lower selling prices".
• Quality: offer superior "manufacturing quality".
• Delivery: offer "more dependable deliveries".
• Flexibility: provide "a wider product range".
Performance (In the following list, we ask you to mentally construct an index for each manufacturing performance indicator. We ask you to assume that the beginning of 1994 is the base with index 100. How large would you estimate that the percentage change in the index today (1996) would be? (% change against self)
• **Quality:** customer satisfaction, conformance quality, supplier quality.
• **Delivery:** delivery lead time, customer service, on-time delivery.
• **Flexibility:** manufacturing lead time, equipment changeover time, procurement lead time, inventory turnover, product variety, speed of product development.
• **Cost:** average unit manufacturing cost, materials and overhead total costs, work/direct labor productivity.
• **Financial:** profitability
IMSS-III
Supplier/Customer Integration activity (How do you coordinate planning decisions and flow of goods with your suppliers and customers? (The level of adoption based on five-point Likert scale, where 1 refers to "none" and 5 refers to "extensive"))
• Share information about the inventory levels
• Share information about production planning decisions and demand forecast
• Agreements on delivery frequency
Competitive priorities (Consider the degree of importance of the following goals to your major customers (Based on a five-point Likert scale, where 1 refers to "not important", and 5 refers to "very important").)
• Cost efficiency: have "lower selling prices".
• Quality: offer superior "conformance quality".
• Delivery: offer "more dependable deliveries".
• Flexibility: provide a "wider product range".
Performance (Please indicate the amount of change of the following performance dimensions over the last three years? (Based on five-point Likert scale, where 1 refers to "strongly deteriorated", and 5 refers to "strongly improved"))
• **Quality:** manufacturing conformance, product quality and reliability
• **Delivery:** delivery speed, delivery reliability
• **Flexibility:** volume flexibility, mix flexibility

• **Cost:** procurement costs, labor productivity, overhead costs
• **Financial** (Please indicate the current performance for your business on the following dimensions.): sales, return on sales
IMSS-IV
Supplier/Customer Integration activity (How do you coordinate planning decisions and flow of goods with your key/strategic suppliers and customers? (The level of adoption based on five-point Likert scale, where 1 refers to "none" and 5 refers to "high"))
• Share inventory level knowledge
• Share production planning decisions and demand forecast knowledge
• Order tracking/tracing
• Agreements on delivery frequency
• Dedicated capacity
• Collaborative Planning, Forecasting and Replenishment
Competitive priorities (Consider the importance of the following attributes to win orders from your major customers (Based on a five-point Likert scale, where 1 refers to "not important", and 5 refers to "very important").)
• Cost efficiency: having "lower selling prices".
• Quality: offer superior "conformance quality".
• Delivery: offer "more dependable deliveries".
• Flexibility: provide "wider product range".
Performance (How has your operational performance changed over the last three years? (Based on five-point Likert scale, where 1 refers to "deteriorated more than 10 %", and 5 refers to "improved more than 50 %"))
• **Quality:** conformance quality, product quality and reliability
• **Delivery:** delivery speed, delivery reliability
• **Flexibility:** volume flexibility, mix flexibility, product customization ability
• **Cost:** unit manufacturing cost, procurement costs, manufacturing overhead costs
• **Financial:** sales, return on sales
IMSS-V
Supplier/Customer Integration activity (How do you coordinate planning decisions and flow of goods with your key/strategic suppliers and customers? (The level of adoption based on five-point Likert scale, where 1 refers to "none" and 5 refers to "high"))
• Share inventory level information with suppliers
• Share production planning and demand forecast information with suppliers
• Dedicated capacity with suppliers
• Vendor managed inventory or consignment stock with suppliers
• Plan, forecast and replenish collaboratively with suppliers
Competitive priorities (Consider the importance of the following attributes to win orders from your major customers (Based on a five-point Likert scale, where 1 refers to "not important", and 5 refers to "very important").)
• Cost efficiency: lower selling prices.
• Quality: superior "conformance to customer specifications".
• Delivery: more dependable deliveries.
• Flexibility: wider product range.
Performance (How has your operational performance changed over the last three years? (Based on five-point Likert scale, where 1 refers to "deteriorated more than 5 %", and 5 refers to "improved more than 25 %"))
• **Quality:** conformance quality, product quality and reliability
• **Delivery:** delivery speed, delivery reliability
• **Flexibility:** volume flexibility, mix flexibility, product customization ability
• **Cost:** unit manufacturing cost, procurement costs, manufacturing overhead costs

• **Financial:** sales, return on sales
IMSS-VI
Supplier/Customer Integration activity (Indicate the effort put in the current level of implementation of, action programs related to external integration. (Current levels of adoption based on five-point Likert scale, where 1 refers to "none" and 5 refers to "high"))
• Sharing information with key suppliers/customers (about sales forecast, production plans, order tracking and tracing, delivery status, stock level)
• Developing collaborative approaches with key suppliers/customers (e.g. supplier development, risk/revenue sharing, long-term agreements)
• Joint decision making with key suppliers/customers (about product design/modifications, process design/modifications, quality improvement and cost control)
• System coupling with key suppliers/customers (e.g. vendor managed inventory, just-in-time, Kanban, continuous replenishment)
Competitive priorities (Consider the importance of the following attributes to win orders from your major customers (Based on a five-point Likert scale, where 1 refers to "not important", and 5 refers to "very important").)
• Cost efficiency: lower selling prices.
• Quality: superior "conformance to customer specifications".
• Delivery: more dependable deliveries.
• Flexibility: wider product range.
Performance (How has your manufacturing performance changed over the last three years? (Based on five-point Likert scale, where 1 refers to "decrease (-5 % or worse)", and 5 refers to "strongly increased (+25 % or better)"))
• **Quality:** conformance quality, product quality and reliability
• **Delivery:** delivery speed, delivery reliability
• **Flexibility:** volume flexibility, mix flexibility, product customization ability
• **Cost:** unit manufacturing cost, procurement costs
• **Financial** (Please indicate your Sales and Return on Sales of the business unit in 2012 in contrast to three years ago. (Based on five-point Likert scale, where 1 refers to "much lower", and 5 refers to "much higher")): sales, return on sales

Table 4. Summary of reliability and validity tests

	CFA model fit	CFA factor loadings	Squared roots of AVE	Cronbach's alpha	Composite reliability
IMSS-III	CMIN/DF=3.141, RMR=0.050, GFI=0.933, AGFI= 0.893, CFI=0.909, NFI=0.873, IFI=0.910, RMSEA=0.072	All significant and lager than 0.50.	All larger than the correlation with other variables.	All larger than 0.70.	All larger than 0.70.
IMSS-IV	CMIN/DF=2.956, RMR=0.053, GFI=0.917, AGFI= 0.892, CFI=0.908, NFI=0.868, IFI=0.909, RMSEA=0.059	All significant and lager than 0.50.	All larger than the correlation with other variables.	All larger than 0.70.	All larger than 0.70.
IMSS-V	CMIN/DF=3.999, RMR=0.061, GFI=0.893, AGFI=0.855, NFI=0.872, IFI=0.901, CFI=0.900, RMSEA=0.075	All significant and lager than 0.50.	All larger than the correlation with other variables.	All larger than 0.70.	All larger than 0.70.
IMSS-VI	CMIN/DF=3.270, RMR=0.038, GFI=0.952, AGFI=0.929, NFI=0.949, IFI=0.964, CFI=0.964, RMSEA=0.054	All significant and lager than 0.50.	All larger than the correlation with other variables.	All larger than 0.70.	All larger than 0.70.

Table 5. Regression coefficients of IMSS-II

	Model 1 Quality	Model 2 Delivery	Model 3 Flexibility	Model 4 Cost	Model 5 Profitability
Intercept	323.211***	334.160***	338.203***	350.391***	302.943***
	(8.169)	(7.840)	(7.578)	(8.514)	(4.294)
Firm size	7.105***	6.188***	6.707***	6.910***	7.299*
	(4.161)	(3.366)	(3.421)	(3.861)	(2.483)
GDPG	1.486	1.386	1.891	2.495†	1.276
	(1.142)	(0.982)	(1.293)	(1.838)	(0.568)
GDPPC	-33.402***	-33.937***	-34.645***	-36.963***	-30.922***
	(-8.294)	(-7.797)	(-7.674)	(-8.843)	(-4.305)
SupInt	1.991	2.628	4.430	1.973	4.539
	(0.624)	(0.759)	(1.245)	(0.597)	(0.805)
CusInt	3.855	2.617	0.494	2.767	5.640
	(1.242)	(0.771)	(0.143)	(0.864)	(1.018)
R^2	0.302	0.267	0.263	0.326	0.130
Adj-R^2	0.285	0.249	0.245	0.308	0.106
F-value	17.545	14.568	14.466	18.926	5.487

Notes: †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 6. Regression coefficients of IMSS-III

	Model 1 Quality	Model 2 Delivery	Model 3 Flexibility	Model 4 Cost	Model 5 Sales	Model 6 Profitability
Intercept	4.574***	4.851***	4.059***	3.223***	3.426***	-7.215
	(11.673)	(9.692)	(8.589)	(7.546)	(3.893)	(-0.765)
Firm size	0.011	-0.000	0.019	-0.004	0.974***	0.084
	(0.411)	(-0.014)	(0.602)	(-0.142)	(17.130)	(0.131)
GDPG	0.019	-0.005	0.001	0.017	0.038	0.838†
	(1.167)	(-0.255)	(0.054)	(0.985)	(1.108)	(1.926)
GDPPC	-0.103**	-0.117*	-0.049	0.021	0.855***	1.309
	(-2.773)	(-2.478)	(-1.101)	(0.509)	(10.142)	(1.487)
SupInt	0.092*	0.107*	0.155***	0.166***	0.144†	-0.385
	(2.417)	(2.209)	(3.373)	(4.006)	(1.764)	(-0.405)
CusInt	0.062	-0.008	-0.010	0.026	-0.142†	0.103
	(1.622)	(-0.174)	(-0.226)	(0.622)	(-1.790)	(0.113)
R^2	0.090	0.039	0.055	0.084	0.618	0.030
Adj-R^2	0.077	0.025	0.041	0.070	0.611	0.006
F-value	6.735	2.766	3.918	6.181	85.913	1.245

Notes: †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 7. Regression coefficients of IMSS-IV

	Model 1 Quality	Model 2 Delivery	Model 3 Flexibility	Model 4 Cost	Model 5 Sales	Model 6 Profitability
Intercept	4.444***	4.199***	3.709***	2.983***	5.173***	1.541†
	(8.251)	(6.660)	(7.070)	(5.974)	(6.080)	(1.828)
Firm size	-0.036	0.003	-0.015	0.021	-0.009	-0.062
	(-1.482)	(0.096)	(-0.653)	(0.949)	(-0.233)	(-1.587)
GDPG	0.005	0.009	-0.003	-0.011	0.002	0.020
	(0.428)	(0.604)	(-0.247)	(-0.961)	(0.107)	(0.980)
GDPPC	-0.128**	-0.127*	-0.062	-0.042	-0.226**	0.118
	(-2.805)	(-2.367)	(-1.402)	(-0.995)	(-3.127)	(1.645)
SupInt	0.061†	0.078†	0.114**	0.107**	-0.003	-0.003
	(1.701)	(1.857)	(3.259)	(3.219)	(-0.054)	(-0.052)
CusInt	0.138***	0.139**	0.077*	0.088**	0.056	0.068
	(3.807)	(3.282)	(2.199)	(2.637)	(0.963)	(1.166)
R^2	0.115	0.103	0.069	0.073	0.055	0.016
Adj-R^2	0.107	0.095	0.060	0.065	0.046	0.005
F-value	14.575	12.874	8.289	8.811	5.979	1.523

Notes: †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 8. Regression coefficients of IMSS-V

	Model 1 Quality	Model 2 Delivery	Model 3 Flexibility	Model 4 Cost	Model 5 Sales	Model 6 Profitability
Intercept	3.964***	4.434***	3.935***	2.783***	4.624***	2.459**
	(6.186)	(6.691)	(6.217)	(4.833)	(4.335)	(2.831)
Firm size	-0.003	-0.035	-0.022	-0.003	0.008	-0.024
	(-0.128)	(-1.538)	(-0.993)	(-0.173)	(0.208)	(-0.815)
GDPG	0.045**	0.029†	0.031†	0.058***	0.060*	0.051*
	(2.710)	(1.688)	(1.904)	(3.929)	(2.186)	(2.247)
GDPPC	-0.076	-0.099	-0.057	-0.007	-0.210*	0.003
	(-1.261)	(-1.578)	(-0.955)	(-0.130)	(-2.079)	(0.035)
SupInt	0.061	0.099*	0.117**	0.143***	-0.024	0.011
	(1.445)	(2.267)	(2.802)	(3.773)	(-0.345)	(0.192)
CusInt	0.013	0.035	-0.024	0.009	0.011	-0.035
	(0.306)	(0.806)	(-0.576)	(0.229)	(0.155)	(-0.617)
R^2	0.053	0.055	0.042	0.095	0.047	0.019
Adj-R^2	0.044	0.046	0.033	0.086	0.038	0.008
F-value	5.842	6.058	4.597	10.918	5.066	1.832

Notes: †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 9. Regression coefficients of IMSS-VI

	Model 1 Quality	Model 2 Delivery	Model 3 Flexibility	Model 4 Cost	Model 5 Sales	Model 6 Profitability
Intercept	4.831***	5.207***	4.361***	1.457***	3.527***	2.752***
	(14.400)	(15.078)	(14.151)	(4.466)	(8.783)	(6.953)
Firm size	-0.001	0.001	-0.010	0.000	0.052*	0.029
	(-0.035)	(0.078)	(-0.604)	(0.013)	(2.452)	(1.397)
GDPG	-0.001	-0.008	-0.026*	0.014	0.006	0.011
	(-0.111)	(-0.750)	(-2.553)	(1.289)	(0.471)	(0.889)
GDPPC	-0.166***	-0.201***	-0.112***	0.100**	-0.064†	0.002
	(-5.179)	(-6.083)	(-3.793)	(3.196)	(-1.655)	(0.058)
SupInt	0.110**	0.101*	0.093*	0.118**	-0.006	0.046
	(2.708)	(2.405)	(2.489)	(2.991)	(-0.132)	(0.966)
CusInt	0.078†	0.079†	0.118**	0.056	0.096*	0.123*
	(1.933)	(1.905)	(3.171)	(1.411)	(1.984)	(2.571)
R^2	0.112	0.119	0.089	0.041	0.033	0.037
Adj-R^2	0.107	0.113	0.083	0.035	0.026	0.030
F-value	19.722	20.937	15.122	6.648	5.008	5.568

Notes: †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 10. Moderation test results (sales as DV)

Models	Model 1	Model 2	Model 3	Model 4
Data	IMSS-III	IMSS-IV	IMSS-V	IMSSVI
DVs	Sales	Sales	Sales	Sales
Intercept	3.676***	5.514***	5.061***	3.327***
	(3.953)	(6.372)	(4.568)	(8.120)
Size	0.972***	-0.020	-0.007	0.047*
	(15.995)	(-0.505)	(-0.192)	(2.267)
GDPG	0.036	-0.011	0.048†	0.011
	(0.949)	(-0.520)	(1.714)	(0.861)
LNGDPPC	0.832***	-0.246***	-0.244*	-0.039
	(9.278)	(-3.358)	(-2.328)	(-1.001)
SupInt	0.156†	-0.010	-0.030	-0.041
	(1.777)	(-0.172)	(-0.411)	(-0.826)
CusInt	-0.096	0.082	0.009	0.092†
	(-1.099)	(1.350)	(0.128)	(1.869)
CostImp	-0.007	-0.113*	-0.160**	-0.038
	(-0.109)	(-2.320)	(-2.670)	(-1.109)
QualImp	0.019	0.030	0.019	0.157**
	(0.207)	(0.465)	(0.241)	(3.135)
DeliImp	-0.183*	-0.045	0.002	0.067
	(-2.027)	(-0.718)	(0.025)	(1.356)
FlexImp	0.024	0.099*	-0.026	0.007
	(0.349)	(1.988)	(-0.440)	(0.171)
SupInt × CostImp	0.030	-0.085	-0.045	-0.134**
	(0.400)	(-1.497)	(-0.647)	(-3.256)
CusInt × CostImp	0.038	0.003	0.029	0.120**
	(0.480)	(0.044)	(0.451)	(2.766)
SupInt × QualImp	0.232*	-0.102	0.070	-0.059
	(2.114)	(-1.443)	(0.743)	(-0.981)
CusInt × QualImp	-0.192†	-0.048	0.153	-0.059
	(-1.740)	(-0.613)	(1.584)	(-0.925)
SupInt × DeliImp	-0.194†	0.034	0.054	0.104
	(-1.733)	(0.471)	(0.695)	(1.612)
CusInt × DeliImp	0.037	-0.049	-0.156†	-0.072
	(0.308)	(-0.648)	(-1.926)	(-1.156)
SupInt × FlexImp	0.016	0.034	0.108†	-0.020
	(0.202)	(0.584)	(1.846)	(-0.422)
CusInt × FlexImp	-0.061	0.069	-0.083	-0.029
	(-0.705)	(1.089)	(-1.337)	(-0.620)
R^2	0.621	0.098	0.079	0.097
Adjusted R^2	0.594	0.067	0.047	0.076
F-value	23.153	3.173	2.480	4.580

Notes: 1. Size – Firm size, GDPG – GDP growth, LNGDPPC – Natural log of GDP per capita, SupInt – Supplier integration, CusInt – Customer integration, CostImp – Cost emphaisis, QualImp – Quality emphasis, DeliImp – Delivery emphasis, FlexImp – Flexibility emphasis; 2. t-statistics are in parentheses below the coefficients; 3. †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 11. Moderation test results (profitability as DV)

Models	Model1	Model2	Model3	Model4	Model5
Data	IMSS-II	IMSS-III	IMSS-IV	IMSS-V	IMSSVI
DVs	Profitability	Profitability	Profitability	Profitability	Profitability
Intercept	330.907***	-8.542	1.873*	2.325*	2.689***
	(4.524)	(-0.848)	(2.184)	(2.562)	(6.584)
Size	7.765*	-0.149	-0.071†	-0.026	0.033
	(2.569)	(-0.221)	(-1.787)	(-0.868)	(1.596)
GDPG	2.124	0.580	0.005	0.046*	0.009
	(0.927)	(1.204)	(0.259)	(2.010)	(0.677)
LNGDPPC	-34.231***	1.754†	0.096	0.017	0.008
	(-4.611)	(1.860)	(1.319)	(0.201)	(0.210)
SupInt	0.726	-0.302	-0.007	0.020	0.012
	(0.120)	(-0.287)	(-0.115)	(0.343)	(0.244)
CusInt	11.168†	-0.272	0.077	-0.043	0.135**
	(1.740)	(-0.269)	(1.261)	(-0.740)	(2.752)
CostImp	-1.267	0.375	-0.057	-0.054	-0.083*
	(-0.274)	(0.492)	(-1.181)	(-1.110)	(-2.425)
QualImp	-2.713	3.031**	0.047	0.044	0.034
	(-0.418)	(2.913)	(0.712)	(0.690)	(0.677)
DeliImp	-5.124	-0.693	-0.087	-0.021	0.031
	(-0.845)	(-0.680)	(-1.375)	(-0.346)	(0.615)
FlexImp	-1.239	0.353	0.122*	-0.015	0.062
	(-0.253)	(0.450)	(2.469)	(-0.320)	(1.582)
SupInt × CostImp	-3.701	-1.057	-0.018	-0.034	-0.057
	(-0.693)	(-1.167)	(-0.324)	(-0.610)	(-1.362)
CusInt × CostImp	3.087	0.962	-0.042	-0.010	-0.016
	(0.617)	(1.098)	(-0.721)	(-0.191)	(-0.363)
SupInt × QualImp	14.210	-0.663	0.021	-0.031	-0.107†
	(1.643)	(-0.496)	(0.306)	(-0.402)	(-1.772)
CusInt × QualImp	-12.457	2.210	-0.062	0.076	-0.023
	(-1.319)	(1.578)	(-0.773)	(0.966)	(-0.362)
SupInt × DeliImp	11.884	2.086	-0.034	0.066	0.126†
	(1.412)	(1.643)	(-0.466)	(1.069)	(1.919)
CusInt × DeliImp	-12.627†	-3.912**	0.056	-0.063	-0.110†
	(-1.811)	(-2.856)	(0.723)	(-0.978)	(-1.754)
SupInt × FlexImp	-1.978	-0.180	0.101†	-0.015	-0.025
	(-0.363)	(-0.189)	(1.748)	(-0.322)	(-0.521)
CusInt × FlexImp	-3.291	0.784	0.073	-0.022	0.064
	(-0.610)	(0.776)	(1.136)	(-0.432)	(1.334)
R^2	0.189	0.128	0.059	0.026	0.078
Adjusted R^2	0.109	0.046	0.024	-0.009	0.056
F-value	2.360	1.559	1.674	0.736	3.524

Notes: 1. Size – Firm size, GDPG – GDP growth, LNGDPPC – Natural log of GDP per capita, SupInt – Supplier integration, CusInt – Customer integration, CostImp – Cost emphaisis, QualImp – Quality emphasis, DeliImp – Delivery emphasis, FlexImp – Flexibility emphasis; 2. t-statistics are in parentheses below the coefficients; 3. †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

Table 12. Summary of linear relationship testing

Performance Relationships	**IMSS II**	**IMSS III**	**IMSS IV**	**IMSS V**	**IMSS VI**
Supplier Integration – Quality Performance	Not Supported	Supported	Supported	Not Supported	Supported
Supplier Integration – Delivery Performance	Not Supported	Supported	Supported	Supported	Supported
Supplier Integration – Flexibility Performance	Not Supported	Supported	Supported	Supported	Supported
Supplier Integration – Cost Performance	Not Supported	Supported	Supported	Supported	Supported
Supplier Integration – Sales	Not Tested.	Supported	Not Supported	Not Supported	Not Supported
Supplier Integration – Profitability	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported
Customer Integration – Quality Performance	Not Supported	Not Supported	Supported	Not Supported	Supported
Customer Integration – Delivery Performance	Not Supported	Not Supported	Supported	Not Supported	Supported
Customer Integration – Flexibility Performance	Not Supported	Not Supported	Supported	Not Supported	Supported
Customer Integration – Cost Performance	Not Supported	Not Supported	Supported	Not Supported	Not Supported
Customer Integration – Sales	Not Tested	Supported	Not Supported	Not Supported	Supported
Customer Integration – Profitability	Not Supported	Not Supported	Not Supported	Not Supported	Supported

Figure 1. Moderation plots (sales as DV)

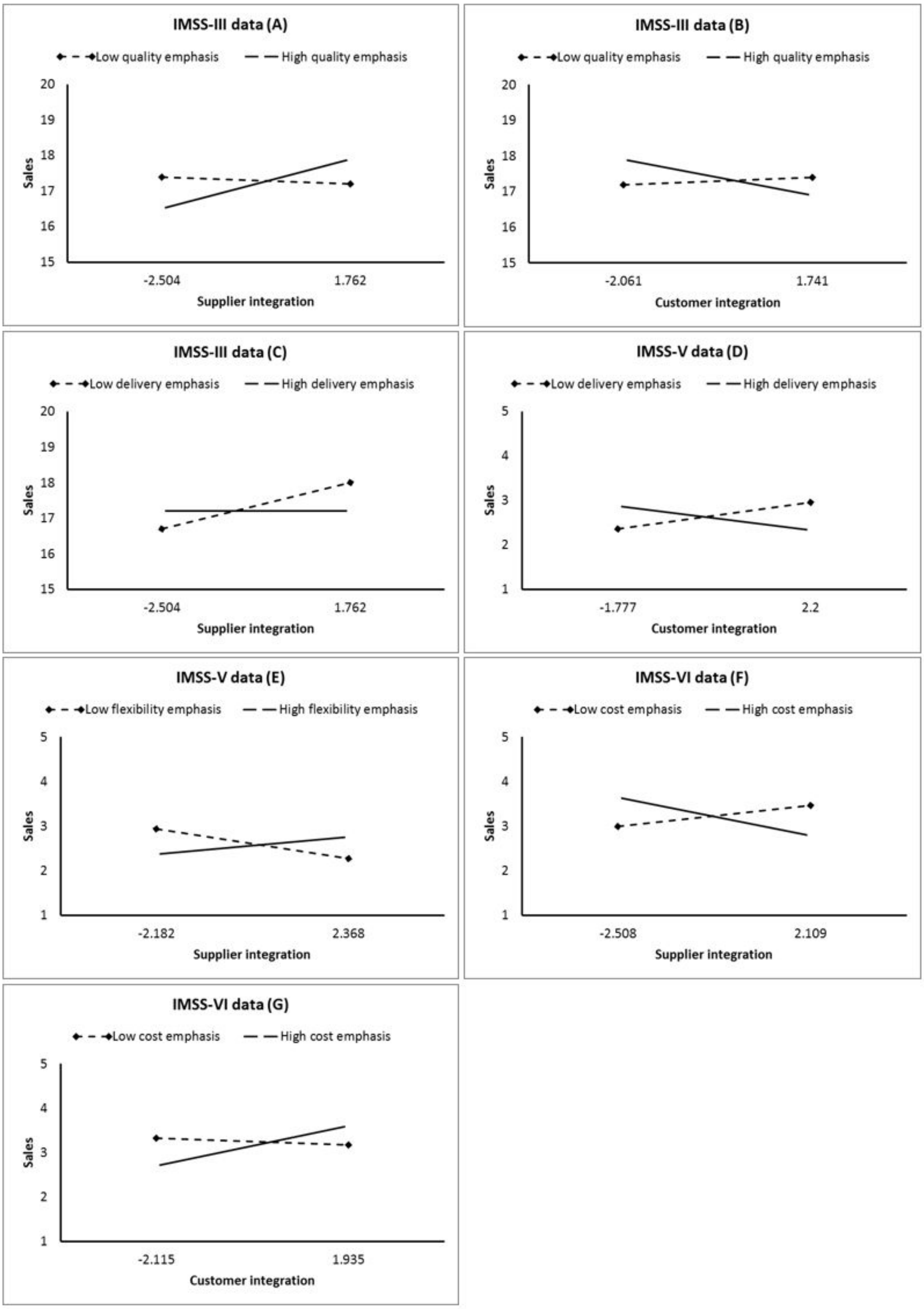

Figure 2. Moderation plots (profitability as DV)