Exploring the effect of business environment on supply chain integration and financial performance: An environment–system–performance paradigm

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Abstract

This study develops and tests a primary conceptual model of the direct effects of business environment on supply chain integration (SCI), and an alternative moderation model to better understand the role of the environment in developing integration and financial performance improvement. Structural equation modelling and moderated regression are used to analyse survey data collected from manufacturing firms in China. The results reveal significant positive relationships between environmental dynamism and all three dimensions of SCI, and between environmental hostility and internal integration. The results also indicate that internal integration fully mediates the relationships between environmental hostility and both customer and supplier integration. Supplier integration is significantly and positively associated with financial performance, whereas internal and customer integration are not significantly associated with performance. Importantly, through the test of an alternative model, environmental hostility and environmental dynamism are shown to affect SCI directly, rather than moderating the SCI–performance relationship. This study provides useful guidelines for managers to develop integrated supply chains to improve financial performance under dynamic and hostile environments.

Keywords Business environment; Supply chain integration; Performance; Contingency theory

Managerial relevance statement

This study provides managerial guidance on when and how limited resources should be devoted to particular SCI dimensions to improve financial performance. Environmental contexts should be considered by managers when developing integration initiatives. Firms that operate in hostile and/or dynamic environments should concentrate on internal integration efforts to materialize and potentiate their external integration efforts. To enhance firm financial performance, supplier integration should be implemented; furthermore, if the environment is hostile, then internal integration should also be pursued. In hostile environments, robust internal integration capabilities must be in place to fully leverage information flows from suppliers.

1. Introduction

Modern business environments are more uncertain, dynamic, and challenging than ever [1]. The retail sector is in upheaval as technological change is affecting market share and asset values due to changing methods of production, distribution, and exchange (e.g. increasing automation and integration of supply chains), and evolving consumer habits and expectations. Firms in traditional outsource locales such as South Korea and China are transferring operations to the US, as exemplified by Samsung's appliance manufacturing in South Carolina and Fuyao's glass manufacturing in Ohio [2]. Furthermore, the US-China trade war and the recent COVID-19 pandemic have caused firms to re-evaluate their supply chains in terms of strategic responsiveness and resilience. These events are having dramatic impacts on logistics, as supply routes and modes are being redesigned [3]. In a logical response to changes in the business environment, firms have sought to increase SCI to counter the rising uncertainty [4]. In fact, it has been argued that to compete successfully in the current environment, manufacturers need to build SCI capabilities [5, 6, 7]. Because of SCI's strategic importance, it is key to understand whether business environment affects financial performance through SCI, e.g. as a resource leveraging or synchronizing mechanism, or whether its impact is amplified / attenuated by SCI. This is particularly relevant now since there is limited research examining the *direct* effects of business environment on SCI [8]. Furthermore, prior research has mostly conceptualized the business environment as a unidimensional construct and examined its moderating effect [9]. As such this study seeks to illuminate how business environment influences SCI and financial performance.

The present study develops a primary conceptual model of the *direct* effects of business environments on SCI, and an alternative *moderation* model to better understand the role of the environment in shaping SCI and firm performance, which will help advance knowledge in SCI [10, 11]. More specifically, we conceptualize business environment as a multidimensional construct (i.e. in terms of environmental hostility and dynamism) [12]. Disaggregating the business environment into its constituent parts clarifies different environmental circumstances under which SCI strategies can be more effective, thus providing valuable insights for both managers and academics.

Similarly, in accordance with the SCI literature (e.g. 5, 9, 10, 13), we disaggregate SCI into its three dimensions: internal, customer, and supplier. The presence of multiple dimensions

recognizes that managers must make effective resource allocation decisions to gain or maintain competitive advantage [4, 13]. Managers are faced with questions of whether investments should emphasize internal, customer, or supplier integration, especially if SCI efforts are not always beneficial. Specifically, it has been suggested that firms must first develop internal integration capabilities before they can engage effectively in external integration with trading partners [13, 14]. Consistent with Resource Orchestration Theory (ROT), this argument suggests that internal integration may act as an important mechanism or mediating variable that enhances external integration [15]. ROT stresses the importance of *how* (rather than *what)* resources can be used to create competitive advantage [16]. While previous studies (e.g. 4) have conceptually described the relationships between internal and external integration, empirical work investigating such relationships offer limited evidence and insight [14, 17], and often consider SCI as an integrated construct. Thus, consistent with ROT, the present study disaggregates SCI into its constituent dimensions, to better clarify the complementarities between them.

The contingency view offers a potential explanation for the lack of consistency in prior results concerning environmental influences on SCI effectiveness. Specifically, as a response to the business environment, internal integration may enable changes in supply chain operations [18]. In other words, business environments can have direct impacts on SCI [19]. For instance, Kim & Chai [8] examined the direct effect of business uncertainty on three dimensions of SCI, while other studies investigated the moderating effect of business environment (e.g. 9, 20). The perspectives of business environment as an antecedent to or moderator of SCI have furthered understanding of SCI. However, tensions remain in the literature, therefore testing mediation and moderation models may facilitate a clearer understanding of the relationships and their boundary conditions [11, 21]. Furthermore, meta-analytical studies (e.g. 22) revealed inconsistent findings on the integration–performance relationship, and suggested that failure to consider mediating and moderating variables could hamper the ability to draw insights from existing SCI research [9, 23, 24]. To the best of our knowledge, no investigation has simultaneously analysed mediation and moderation models within the same SCI study. Thus, our study extends prior research (e.g. 8, 9) by investigating the mediating role of internal integration on the relationship between business environment and external integration, and the moderating role of business environment on the SCI–financial performance link.

Our study considers the Environment–System–Performance model from the Contingency Theory (CT) perspective. CT characterizes organizations as open systems, and posits that effective strategies in some contexts may not be effective in others [25]. CT suggests that organizations will adjust their structure to maintain a profitable "fit" with the contexts in which they operate [26]; "fit" is categorized as moderation, mediation, matching, gestalt, profile deviation, and covariation [27]. CT concentrates on how circumstances and environmental factors affect a relationship, rather than *why* or *how* certain relationships exist [28]. ROT stresses the importance of *how* resources can be used to create competitive advantage [16], and has been used to conceptualize SCI (e.g. 29). Thus, to explain the mediating effect of internal integration, and complement the CT and the Environment–System–Performance model, we employ ROT. We test the frameworks in a manufacturing context ensconced within an emerging market economy, China. As a BRICS country, China has a critical role in global supply chains, and its manufacturing industry is experiencing increasing levels of competition and dynamism [1]. Therefore, our study offers fresh insights on SCI practices in an emerging and dynamic market. The present study addresses:

1) The *direct* effects of business environment on SCI, more specifically the mediating effect of internal integration on the business environment–external integration link (i.e. the primary mediation model); and
2) The *moderating* effect of business environment on the SCI–financial performance link (i.e. the alternative moderation model).

By testing the mediation and moderation effects, the present study clarifies whether the role of the business environment is that of an antecedent factor (e.g. 8) or moderator (e.g. 9), and answers not only how but also under which circumstances SCI positively affects financial performance. Moreover, our study positions CT and ROT as complementary theories explaining SCI phenomena. In terms of practice, our study aims to provide useful managerial guidance, enabling decision making targeting the commitment of limited resources to particular SCI dimensions to achieve superior financial performance.

2. Theoretical background and conceptual development

2.1. Theoretical framework

CT provides a framework for understanding the topics of the environment and integration. The premise of CT is that there is no universally optimal approach to achieve maximum performance [30]. This suggests context will influence structural choices [31]. CT suggests that organizations adjust structures to maintain a profitable fit with the context in which they operate [32]. Hofer [33] pointed out that, as well as improving the choice of the strategy made by the organization, better fit should help improve performance. Thus, typical frameworks in the contingency research tradition focus on the contingent relationship between a contextual variable and other variables, or on the relationship between the dependent and independent variables in a certain type of context [34]. Fundamentally, CT suggests that the fit between structure and context governs performance. A full CT model has three types of variables: practices, performance, and contingency factors [35]. These should be categorized into one of two classes: goals or environmental [36].

Despite its popularity and widespread acceptance, some argue that CT is an orientation strategy rather than a theory in itself, leaving researchers with the tasks of identifying, conceptualizing, and explaining contingency factors for given phenomena [28]. Specifically, CT concentrates on the circumstances affecting variables or under which circumstances a relationship is stronger/weaker, rather that *why* or *how* certain relationships exist [28]. ROT stresses the importance of *how* rather than *what* type of resources can be used to create competitive advantage [16]. A firm could possess key resources (i.e. external and internal integration); however, competitive advantage will ultimately stem from how resources are managed and orchestrated. More specifically, orchestrating resources refers to three distinct dimensions: structuring a portfolio of resources, bundling resources to build capabilities, and leveraging and synchronizing those capabilities [37, 38]. The latter dimension is regarded as key in value creation, and generating competitive advantage [39]. We argue that internal integration could act as a leveraging and synchronising mechanism for external integration.

Accordingly, we draw from the environment–system–performance paradigm expressed in ROT and CT to build the primary and alternative conceptual frameworks. We draw upon ROT to present the primary conceptual framework (Figure 1), representing that internal integration acts as a mediating mechanism (i.e. resource leveraging and synchronizing mechanism) for the

business environment–external integration link. Since there is tension in the SCI literature as to whether the role of business environment is that of an antecedent (e.g. 8) or moderator (e.g. 9), we test the competing moderating model (Figure 2). In sum, ROT is used to complement the CT argument to better explain how the business environment affects SCI and financial performance.

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2.2. Supply chain integration (SCI)

SCI is defined as "the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organizational processes" ([5], p. 59). It includes integrating key business processes, developing relationships, and connecting entities through shared information and resources in order to achieve effective and efficient flows of material, information, and money, to create value for customers [4, 5]. SCI is a multidimensional construct, often conceptualized in terms of internal integration, customer integration, and supplier integration [5, 40]. Thus, for the purposes of this study, we similarly use a three-dimensional conceptualization of an integrated supply chain. This conceptualization of SCI is consistent with suggestions that a greater contribution to the literature can be achieved by using distinguishing variables, as this enables insight into the most effective designs or responses; stated differently, greater granularity yields greater insight [35].

Internal integration entails developing coordination and collaboration across functional areas within the firm so that they operate as a cohesive process [5]. It involves data and information system integration, information sharing between internal functions, strategic cross-functional cooperation, and working together across different functional departments [13, 14]. *Customer integration* encompasses the flow of goods, services, and information between a focal firm and its customers [9]. One of its goals is increasing the competitiveness of the customer, which entails committing resources toward understanding the interaction of products and processes with the customer's business, and helping the customer become more competitive [40]. *Supplier integration* entails a cooperative relationship between a focal firm and its suppliers in managing cross-firm business processes [9, 41]. The important themes of supplier integration include sharing information and decision-making activities, and involving suppliers in the development of new products and services [9]. Supplier integration focusses on improving supply chain performance between a firm and its supply base [4].

2.3. Business environment

The business environment consists of large numbers of uncontrollable variables, inclusive of economic, socio-cultural, technological, demographic, and political-legal issues [42], posing both threats and opportunities for companies [43]. The number and dynamic nature of the variables results in continual changes to the environment, requiring firms to continually adapt [44, 45]. As such, scholars view the environment as an important source of organizational contingencies.

The dimensions of hostility, dynamism, and complexity are commonly used to characterize business environments [46, 47]. Of these three dimensions, environmental hostility and dynamism are of primary concern to manufacturers, especially in an emerging market context [48]. Thus, following previous work (e.g. 12, 48), this study focuses on the effects of hostility and dynamism, and does not include an environmental complexity scale which refers to the degree of heterogeneity within a firm's industry. The lack of focus on the complexity dimension by prior researchers may be due to the divisionalization of firms as a response [12, 47]. As such, the complexity dimension is found to be insignificant when attempts are made to measure it [47]. Hostile environments intensify challenges to companies, and often complicate them. *Environmental hostility* is characterized by the degree of price competition, rising business costs, profit margins, regulatory intervention, resource availability, and demographic trends; hostile environments offer few opportunities to exploit [47]. *Environmental dynamism* refers to volatility or unpredictability of change within an industry or factors affecting it [46]. These changes can arise from many sources, including the degree of innovation in the company's principal industries, introduction rate of new products and services, and the uncertainty or unpredictability of competitors' actions and customers' preferences [30]. Companies operating in dynamic environments must contend with rapid changes in technology, customer needs and preferences, as well as competitor actions [47]. Therefore, greater effort must be devoted to understanding and mastering environmental threats.

Several studies characterized the business environment in the context of operations management (e.g. 12, 48). Consistent with these studies, we use conceptualizations and measures of business environment that include environmental hostility and dynamism. The environmental hostility construct includes measures pertaining to the rising cost of inputs in the manufacturing

process, keen competition, and low industry profit margins (e.g. 47). The environmental dynamism construct includes measures addressing the rate at which products and services become outdated, rate of innovation in products and the processes producing them, and the rate of change in consumer preference (e.g. 12).

3. Research hypotheses

3.1. Direct effect of business environment on SCI

Many business environments are highly dynamic and competitive, requiring firms to constantly adapt to fast-changing circumstances [1, 9]. Examples include the computer industry [49], wherein technological innovation requires rapid product updates. Over the last decade a similar scenario has been evident in the smartphone industry, where the convergence of multiple technologies has forced firms to dramatically change product architecture and features [50]. The increase in competition and advances in technology in the general e-commerce context are increasing uncertainty in all sectors, and few managers feel prepared to address it, in part because there is limited understanding of customer needs. Dynamism in the business environment has profound implications for firm performance [51], stimulating radical changes in the competitive hierarchy [52], and forcing firms to change resource allocations in order to cope [53].

One result of these environmental changes is the drive to form inter-organizational relationships to gain access to valuable information [50]. Specifically, firms strive to capture information and knowledge that can lead to economies of scope or scale [54] and improve coordination [55]. Once captured, disseminating this information and/or knowledge within firms requires internal integration [56]. Specifically, SCI is more likely to occur in industries with rapid changes in technology, demand, or competition than in more stable environments [9, 57] because integration functions as an effective mechanism to manage environmental turbulence [13, 58]. Prior research suggests that the environment can influence customer and supplier relationships [59] and internal integration efforts [9].

Environmental hostility encourages supplier alliances within industries, and the exchange of timely and accurate information so suppliers can organize production more quickly [59]. For example, Compaq found that strong and strategic relationships with customers were effective and necessary to cope with such environments [60]. Conversely, small and medium size

enterprises (SMEs) trying to gain competitiveness through cost leadership in hostile and competitive environments may not be interested in exploiting long-term cooperative relationships [61]. Instead, SMEs often prefer more flexible cooperative relationships characterized by efficiencies and effectiveness. These actions are consistent with CT, and thus environmental hostility affects integration practices. As such, developing an integrated supply chain can be effective in a dynamic environment [9, 59]. In highly dynamic environments, the formation of internal cross-functional integration enables sharing and leveraging of valuable information and development of new skills and resources [9]. Additionally, environmental characteristics such as dynamism stimulate customer integration and overall information flow among trading partners [62].

China provides a useful context for understanding the nature of hostile and dynamic environmental impacts on SCI capabilities because its manufacturing industry is rapidly evolving and plays an essential role in global supply chains [1, 14]. Chinese manufacturers face challenges characterized by hostile and dynamic environments, such as low profit margins, technological change, rising business costs, and changing consumer preferences. The Chinese manufacturing environment has become even more hostile and dynamic since the 2008 global financial crisis [63] and the current COVID-19 outbreak. To cope with dynamic and competitive environments, managers may choose to develop various SCI capabilities [64]. Based on the above arguments and examples, which are consistent with CT, we hypothesize that:

H1: Environmental hostility has a positive direct effect on (a) customer integration, (b) internal integration, and (c) supplier integration.

H2: Environmental dynamism has a positive direct effect on (a) customer integration, (b) internal integration, and (c) supplier integration.

The previous argument presents CT as a theoretical lens to explain the effects of environmental hostility and dynamism on SCI. However, the interrelationships between the different dimension of SCI, and its effect on performance will be explained in the following sections using ROT as a complementary theory to the contingency perspective.

3.2. Effect of internal integration on external integration

Internal and external integration entail the exchange of information and knowledge between a focal organization and external partners [65]. Fawcett & Magnan [66] stated that

supply chain relationships and cooperation are important foundations for moving towards SCI. Cooperation activities are seen as a first step towards more strategic partnering orientations, such as SCI [67]. Such integration is characterized by inter-organizational information flows and information sharing [5]. Given that integration entails the exchange and synthesis of information, the principles of organizational learning may be informative. Cohen & Levinthal [68] suggested that the ability to assimilate and beneficially use new information is a function of the existing information within the firm. Carlile & Rebentisch [69] suggested extending this to consider the effectiveness with which the information is organized from within. Accordingly, information must be accessible and exchanged within an organization before it can be amended or modified by new information from external sources [13, 14]. In essence, internal integration can be seen as a key antecedent of external integration, which is consistent with the first two distinct dimensions of ROT [37, 38]: internal integration can structure information resources and bundle those resources to build external integration capabilities. Accordingly, we expect that as internal integration increases, external integration will also increase. We thus hypothesize that:

H3: Internal integration has a positive direct effect on (a) customer integration and (b) supplier integration.

3.3. Mediating effect of internal integration on the business environment–external integration link

Research suggests that internal integration contributes toward developing external integration [13, 14], because the latter is a logical extension of internal functional group mechanisms for understanding and navigating markets. Therefore, an organization must first develop internal integration capabilities before it can engage effectively in external integration with trading partners [13]. The ability to process information thus results from internal integration capabilities [70], and the ability to absorb and share information across functions enables firms to process external information more effectively [18]. Ultimately, internal integration capability enables firms to develop and recalibrate operations in response to a changing business environment [18]. A synthesis of the above suggests that internal integration is a leveraging mechanism that enhances external integration practices. The skills required to effectively collaborate with others are developed within the organization, and their absence may inhibit information transfer from external sources [71]. This interpretation is consistent with the

third distinct dimension of ROT: leveraging capabilities [37, 38]. Thus, consistent with ROT, we suggest that information coming from the business environment is absorbed, synchronized, and leveraged internally to potentiate external integration efforts. We therefore offer the following hypotheses, which are implied by H1–H3, but their specific inclusion facilitates a clearer discussion:

H4: Internal integration mediates the effect of environmental hostility on (a) customer integration and (b) supplier integration.

H5: Internal integration mediates the effect of environmental dynamism on (a) customer integration and (b) supplier integration.

3.4. Effect of SCI on financial performance

The acquisition of intra- and inter-organizational information is posited to help companies better align with the environment, thus aiding the attainment of a competitive advantage [72]. There has been growing evidence that higher levels of inter-functional coordination and external integration with suppliers and customers are indeed associated with greater firm performance [5, 13, 41, 64]. However, there are studies expressing mixed support to this assertion [10]. These ambiguous and inconsistent empirical findings in the SCI literature require additional exploration regarding the relationship between SCI and performance [41]. Thus, we propose:

H6: (a) Customer integration, (b) internal integration, and (c) supplier integration are positively related to financial performance.

3.5. Moderating effect of business environment on the SCI–financial performance link

Calls have recently been made for investigations into the context or circumstances under which SCI is more appropriate [10, 22]. Environmental uncertainty and hostility create the need to obtain information from the environment and as such the collection, dissemination, and processing requires integration mechanisms [9]. This suggests an interaction between the environment and SCI. Thus, in addition to the hypothesized direct effect, we test an alternative interaction (moderating) model (Figure 2) which considers the role of environmental uncertainty as a moderator of the relationship between SCI and performance (e.g. 9). Consistent with CT, we argue that the greater the environmental hostility and dynamism, the stronger the positive effects of SCI on financial performance. Testing this relationship will help resolve tensions in the

literature about whether business environment is an antecedent factor (e.g. 8) or a moderator (e.g. 9). We thus propose the following hypotheses:

H7. Environmental hostility positively moderates the relationships between (a) customer integration, (b) internal integration, and (c) supplier integration and financial performance.

H8. Environmental dynamism positively moderates the relationships between (a) customer integration, (b) internal integration, and (c) supplier integration and financial performance.

4. Methodology

4.1. Sampling and data collection

The data for this study were gathered from a survey of Chinese manufacturing companies in 2011. Consistent with similar studies (e.g. 7), key regions of China were sampled, specifically Beijing and Hebei province (north China), Henan province (central China), Zhejiang provinces (east China), and Guangdong province (south China). To obtain a representative sample, we randomly selected firms from the China Telecom Yellow Pages, and identified key informants holding titles such as CEO, president, director, general manager, supply chain manger, operations manager, and marketing/sales manager. Most of the respondents had more than five years in their present position, which suggests they are qualified to address the issues under investigation.

We attempted to maximize the response rate and minimize response bias by using techniques suggested by studies on survey research (e.g. 73). The questionnaires were sent to 736 manufacturing firms accompanied by a cover letter indicating the purpose of the study and potential contributions. The letter assured complete confidentiality to the respondents and promised a summary of the findings. Follow-up calls were made to encourage completion and return of the questionnaires, and to clarify any questions or concerns among potential participants. A total of 221 questionnaires were received. Seven returned questionnaires were discarded due to incomplete information, leaving 214 usable responses. The effective response rate was 29.1%. A profile of the respondents is presented in Table 1. Respondents represent different ownership structures, including Chinese-owned firms, joint ventures, and wholly foreign-owned firms. Some of the survey data has been used in prior studies (e.g. 13, 41, 71)

different in character from the present study, but none of the previous studies examined the direct effect of business environment on SCI.

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4.2. Non-response and common method bias

To assess non-response bias in this study we used two-tailed t-tests on demographic characteristics to compare early and late responders [74]. We found no significant statistical difference at the 0.05 level. Thus, non-response bias did not appear to be a concern. Previous research has suggested different ways to test for non-response bias, including comparing non-responders and responders [74]; however, this was impractical as we were unable to obtain sufficient non-respondent information. This is a common limitation in survey-based studies, especially those collecting survey data in China [73].

We used multiple approaches to check for common method bias. First, confirmatory factor analysis (CFA) was applied to Harman's single-factor model [75, 76]. The model fit indices of χ^2/df (1842/350) = 5.263, CFI = 0.469, and RMSEA = 0.141 were unacceptable and worse than the measurement model suggesting that common method bias was unlikely. Second, we used a latent factor to capture the common variance among all observed variables in the measurement model [76]. The resulting model fit indices did not vary significantly from the measurement model (e.g. CFI improved by less than 0.01), and item loadings remained significant. Third, we used the marker-variable technique [75, 77] by including a method variance marker, a three-item scale that measured labour shortage [12] (Cronbach's alpha = 0.802), which was theoretically unrelated to at least one scale in the analysis. We used the lowest positive correlation (r = 0.002) among the variables (see Table 3) as a proxy for marker variable to adjust the correlations [77]. Results in Table 3 indicate there was no difference between adjusted and unadjusted correlations. Given these results, we concluded that common method bias is unlikely to be a concern for this study.

4.3. Measures and questionnaire design

The study measures are displayed in Table 2. Seven-point Likert scales were used for all constructs. The measures for SCI, adapted from Flynn et al. [5], focused on inter-functional coordination and strategic collaboration with customers and suppliers. All the SCI items were

measured on seven-point scales from 1 (not at all) to 7 (extensively). The measures for environmental hostility and dynamism were adapted from Ward et al. [12]. The hostility construct included measures pertaining to the rising labour, material, transport costs, and low profit margin and the dynamism construct included measures addressing the rate of product and process innovation and changing consumer preferences. Conducting research with objective measures of business performance in China can be very challenging, partly because accurate accounting data is difficult to attain [73]. Therefore, self-reported measures of financial performance were adapted from Flynn et al. [5]. Consistent with previous studies respondents were asked to assess financial performance over the prior three years relative to their main competitors using a seven-point scale (ranging from 1 "much worse" to 7 "much better"). As shown in Table 2, some items were dropped from their corresponding constructs due to low factor loadings, which did not meaningfully influence the coverage of the domain of the corresponding reflective constructs [74].

Firm size, ownership, and industry type were used as controls (see Table 1). Firm size (measured by number of employees) was controlled because larger firms may have more resources to invest in supply chain assets, and thus possess more robust SCI. As a result, they may achieve a higher level of SCI and performance than smaller firms [14]. Firm ownership was controlled because firms with different ownership structures may develop different levels of SCI for performance improvement [7]. Industry type was controlled because firms in the different manufacturing industries may develop different levels of SCI in response to uncertain environments, and thus achieve different levels of performance. As shown in Table 1, a wide variety of manufacturing industries were represented. The dummy variable Industry1 refers to electronics and electrical; Industry2 refers to equipment manufacturing; Industry3 refers to food, beverage and alcohol; Industry4 refers to metal, mechanical and engineering; and Indusrry5 refers to textiles and apparel. They are the five largest industries in the data. The base group is other industries [7].

For the translation of the scales into Chinese, a back-translation process was employed to ensure equivalence [9, 14]. Some questions were reworded slightly to improve accuracy and relevance to practices in China. Even though the scales used were demonstrated to be valid originally, we took extra steps before administering the survey to determine content validity. Specifically, two academics from the field of operations and supply chain management reviewed

the initial measurement scales and provided feedback. A pilot-test was conducted with two directors and one president of Chinese manufacturing firms, to ensure that the questions were clear and relevant [73]. Minor changes to the scales were made based on their feedback.

4.4. Unidimensionality, reliability, and validity

We followed the parameters stipulated by Hair et al. [74] to address the unidimensionality, reliability, and convergent validity of the scales. We assessed the unidimensionality of the constructs with a CFA. Results in Table 2 reveal the model was acceptable and unidimensionality confirmed. Cronbach's alpha and composite reliability were used to quantify reliability. As shown in Table 2, the Cronbach's alpha and composite reliability exceeded the recognized criteria of 0.70 for all constructs, indicating adequate reliability for the measurement scales.

---------- Insert Table 2 ----------

As shown in Table 2, all items had statistically significant ($p < 0.001$) factor loadings greater than 0.50, suggesting convergent validity. Additionally, with regard to average variance extracted (AVE), only environmental hostility (AVE = 0.466) fell marginally below the recommended minimum value of 0.50. Based on these results, we concluded the constructs and scales had convergent validity.

To assess discriminant validity, two approaches were employed. First, we conducted the Chi-square difference test by comparing the constrained model, in which the correlations between the paired latent constructs were fixed to 1.0, with the original model wherein the correlations among constructs were freely estimated. The results indicate that the χ^2 differences between the fixed and unconstrained models were significant, providing evidence of discriminant validity between each measurement scale [78]. Second, we checked the square root of AVE for all constructs, to ensure that it was greater than the correlation between any pair of them [79]. The results are reported in Table 3, and provide further evidence of discriminant validity.

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4.5. Endogeneity

We tested for endogeneity, since this study employed a cross-sectional research design. Endogeneity might arise from measurement error and/or omitted variables [80]. In this study, we took multiple steps to address the potential endogeneity concerns.

First, we tried to minimize measurement error that might threaten the validity of the relationships between the measures when designing the questionnaire survey. Appropriate arrangements for the order of questionnaire items can reduce respondents' consistency motivation to a certain extent, which decreases the common method bias in self-reporting. As such, when designing the questionnaire, we adopted different instructions for different scales, and created separate sections between the independent and dependent variables, which should reduce the occurrence of endogeneity due to measurement error [76].

Second, a possibility exists that SCI may be endogenously affected by financial performance, which may result in biased and inconsistent results [80]. To address this potential problem, we performed a two-stage least squares (2SLS) regression analysis with instrumental variables [29, 81]. The results are reported in Table 4. Firm size and firm ownership were used as instrumental variables, because they were not significantly related to financial performance (see Table 7). We further chose government laws and regulations as an instrumental variable, because this variable is not directly related to firm performance, but it is significantly associated with SCI [7].

In conducting the test, we first regressed SCI (internal, customer, and supplier integration) on all assumed instrumental variables and control variables. Models 1, 2, and 3 in Table 4 show that the R^2 of the regressions were 0.386, 0.415, and 0.332 (respectively). These values were significantly higher than the R^2 of the regressions with only control variables, indicating that firm size, firm ownership, and government laws and regulations could be treated as instrumental variables for SCI [29, 81]. In the second stage, the predicted values of the assumed endogenous variables were calculated and used to test the relationship between SCI and financial performance [81]. Model 4 in Table 4 indicates that the relationships between the predicted value of internal and supplier integration and financial performance were significant and positive. As shown in Table 4, the 2SLS results were consistent with the structural equation modelling (SEM) results reported in Table 5, and the moderated regression results reported in Table 7.

Additionally, we conducted a Durbin-Wu-Hausman test of endogeneity via an augmented regression, which added the error term generated from the first stage of the 2SLS [81]. The results show that the path coefficients of the error term of SCI were not significantly positively associated with financial performance, and thus the null hypothesis that the variables are exogenous cannot be rejected [29]. Hence, we concluded that our results were unlikely to be unduly influenced by endogeneity.

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5. Data analysis and results

The proposed model (Figure 1) was compared with the alternative model (Figure 2) to ascertain which model best fits the data.

5.1. Proposed structural model

SEM using AMOS 25 was employed to test the conceptual frameworks. The results are reported in Table 5. Although firm size, industry type, and firm ownership were included as control variables in the structural model, none had a significant effect on financial performance. The overall fits of the primary structural model were good [74], and indicated significant positive paths from environmental hostility to internal integration ($\beta = 0.216$), and environmental dynamism to customer integration, internal integration, and supplier integration (β's = 0.160, 0.294, and 0.319 respectively). Hence, as shown in Table 5, H1b and H2a-c were supported. However, the structural model analysis found no significant path from environmental hostility to either customer integration or supplier integration (β's = -0.106 and -0.068 respectively). Hence, H1a and H1c were rejected. The results also revealed that internal integration had a significant positive effect on both customer and supplier integration, lending support for H3a and H3b. Supplier integration was positively and significantly associated with financial performance ($\beta = 0.296$), which provided support for H6c. However, the analysis found no significant relationship between customer and internal integration and performance. Hence H6a and H6b were rejected.

---------- Insert Table 5 ----------

Bias-corrected bootstrapping (10,000 resamples) was employed to test for the mediating role of internal integration in the relationship between environments and external integration (H4 and H5). The results (Table 6) indicate that the direct effect of environmental hostility on

customer integration was not significant (β = -0.106). However, the indirect effect via internal integration was positive and significant (β = 0.139, $p < 0.05$; 95% confidence interval: lower bounds = 0.005, upper bounds = 0.337). The results suggest that internal integration acts as a full mediator of the relationship between environmental hostility and customer integration. In addition, the Sobel test (z = 2.384, $p < 0.05$) provided further support for the full mediation. Thus, H4a was supported. Similarly, internal integration also fully mediated the relationship between environmental hostility and supplier integration, thus supporting H4b, and partially mediated the relationships between environmental dynamism and both customer and supplier integration, thus supporting H5a and H5b.

---------- Insert Table 6 ----------

5.2. Competing model

Much previous research has considered fit in the form of moderation (e.g. 31). However, it is recommended that when fit by moderation is hypothesized, the moderation results should be compared to the system results [82]. This extra step allows for the determination of fit at an overall system level, rather than at an individual variable level, in case the moderation effect is not significant [35]. Consequently, an alternative model (Figure 2) was tested.

The alternative model was also tested using SEM and its fits were not acceptable (CFI=0.844 and IFI=0.854). Also, the AIC was substantially higher than the proposed model (4069.7 vs. 1049.4), thus the proposed model was determined to be the best fitting. This suggests that fit by moderation [27] is ruled out. However, rather than rely exclusively on model fits and AIC, we took the additional step of testing the moderating effects of environmental hostility and dynamism presented in the alternative model using moderated regression [74]. The multiple methods (SEM and regression analysis) have been used in previous survey-based studies (e.g. 14). The impact of the moderator variable was assessed using a three-stage regression: (1) control variables, (2) main effect variables, and (3) moderating variables. Financial performance was the dependent variable in the analyses. Table 7 provides the results of the analysis. To minimize the threat of multicollinearity, we orthogonalized the interaction terms by regressing each interaction term on its composing variables, using the residuals in the main regression [83]. Table 7 indicates that in all models the variance inflation factor (VIF) values were less than 3, which conforms to the level suggested by Mason and Perreault [84], thus indicating that

multicollinearity was not a concern. As shown in Table 7, the coefficients of all six interaction terms were not significant, indicating that environmental hostility and dynamism did not moderate the relationships between SCI and financial performance. Thus, H7 and H8 were rejected.

Thus, we conclude that the proposed model is the best-fitting model, with the implication that environmental hostility and dynamism significantly affect SCI *directly*, rather than moderating the SCI–performance relationship. Thus, the proposed model is the basis for all of the conclusions drawn.

---------- Insert Table 7 ----------

6. Discussion and implications

6.1. Findings and theoretical implications

6.1.1. Moderation versus mediation models

The findings of this study support the conceptual framework presented in Figure 1 (mediation model) which illustrates the direct effects of business environment on SCI and financial performance, but reject the alternative model presented in Figure 2 (moderation model) which examines the moderating effect of business environment on the relationship between SCI and financial performance. This is an important finding, as to our knowledge this is the first research testing mediation and moderation models within the same study to explore the important role of business environment [27]. Thus, the present study is unique in that it developed both a primary conceptual model of the direct effect of business environment, and a competing model of moderation to investigate the environment–integration–performance relationship (and more specifically, the moderating role of environment and the mediating role of internal integration). Our findings contribute to clarifying inconsistent findings on the integration–performance relationship in previous studies and answer recent calls to consider mediating and moderating variables in the SCI literature [10, 24]. We note that for resolving the tension in the literature pertaining to the role of business environment (antecedent or moderator), the present study tested a model similar to that of Kim & Chai [8], and the results of the direct effects are similar between the two studies. However, our study considered a different sample context, e.g. developing versus developed economy, and used different measures of integration. Further, the alternative moderation model extends the work of Kim & Chai [8] by adding

robustness and greater generalizability to our findings. Developing and empirically testing the two models (moderation vs. mediation) extends the boundaries of current understanding by examining how, when, and why relationships arise between constructs central to theory [11, 21]. Thus, the present study clarifies the environment–system–performance framework of CT and ROT as it pertains to SCI, the environment, and performance. The main findings of the mediation model are discussed below.

6.1.2. The direct effects of business environment on SCI

One important finding from the study was that environmental hostility has a significant positive impact on internal integration, which is consistent with CT. The environmental hostility construct included measures of keen competition, low profit margins, rising labour, material and transformation costs. An interpretation of this finding is that Chinese manufacturers may pay more attention to internal integration practices than customer and supplier integration when faced with elevated levels of competitive intensity. China's manufacturing industry is becoming ever more competitive, especially since the 2008 global financial crisis. China's manufacturing industry has been hurt by economic problems in the EU and the US, implying its heyday may be coming to an end. Rising labour, material, and transformation costs, and fluctuating exchange rates are all adding to the cost of business in China. Specifically, China's advantage in labour costs has diminished since labour legislation issued in 2008 [63]. The results of this study show that these increasing costs would be best addressed by emphasizing internal integration, since cross-functional integration may be less costly and risky than external integration. It thus seems that managers of Chinese firms prefer to concentrate on acquiring or sharing resources and building internal capabilities to better compete in hostile environments, even though firms that concentrate on external integration may find improved performance.

The 2019 China-US trade war provides additional explanation of these findings. Tariffs directly affect competitiveness and uncertainty and may push manufacturers to first find operational solutions internally (i.e. cost leadership) to further build and reshape capabilities to compete in changing environments. Government interventions such as tariffs restrict the scope of market opportunities to exploit and thus oblige local manufacturers to find innovative operational solutions to remain in the market [85]. This finding is consistent with the work of Huo et al. [86], who found that manufacturers' operations in China are still internally oriented, especially when it

comes to high competitiveness. Cost superiority is one important evaluation criteria used by customers to make supplier selection decisions, and thus an internally oriented view in hostile environments is a natural first step taken by Chinese manufacturers to remain attractive to foreign customers [86]. Agency effects might be another possible rationale for these findings. Managers of Chinese firms may be concerned with becoming overly exposed to opportunistic behaviour of external partners, which may begin acting like competitors in hostile and competitive markets. Thus, firms operating in hostile environments may choose to keep strategic information to themselves rather than risk exploitation by trading partners [87]. Finally, another possible interpretation of the results is that environmental changes may not be sufficiently long-lasting, thus adjusting the company's external integration strategy and investments accordingly may not be realistic [88].

Another important finding was that environmental dynamism had a significant positive effect on each SCI dimension. As environmental dynamism increases, manufacturing companies in China are challenged by an increasing need for product and process innovation, quicker product development cycles, and difficulty in forecasting consumer preference [63]. The results highlight that firms subject to high environmental dynamism develop SCI strategies focused on both internal and external integration. In the face of increasing dynamism, it is possible that managers seek greater awareness of and better preparation for new products and technologies that could enter the market. Integrating internally in such uncertain environments can facilitate the dissemination of information, and the development of new skills and capabilities to respond to external demands [9]. Integrating externally with trading partners can provide better visibility to market changes and may lead to capturing innovation more fully or quickly, given that innovation is increasingly coming from the supply base [89]. Integration with suppliers may enable firms to benefit from unique or highly mature and specific expertise [90]. Integration may be undertaken to maintain the flow of potentially scarce materials or offer increased awareness of potential shortfalls, which could then be acted upon by using additional suppliers, or through creating a dominant presence at a particular supplier. Customer integration may also facilitate gaining knowledge that can be used for competitive advantage. Essentially, to survive in a dynamic environment, managers in Chinese firms rely upon integration with trading partners to address the requirements of local and foreign markets.

In summary, hostile environments seem to invoke an inward-focused response, whereas dynamic environments stimulate efforts to connect with partners as well as internally. The nature of our study does not allow for answering the question of why this is the case with certainty. We argue that it could be a cultural, or a purely logical response. Managers of Chinese firms may be adjusting to environmental hostility by addressing things that they can control, e.g. labour costs; on the other hand, they may adjust to dynamic environments, which offer little opportunity to exert any degree of control, by collaborating with partners. This collaboration may create a modicum of stability in itself, or may offer additional resources to cope with change. Hence, the results highlight the contingency perspective of SCI and provide greater insight into the fit between characteristics of the environment and organizational structures [30]. Furthermore, by disaggregating the business environment into hostile and dynamic, our study clarifies different environmental circumstances that encourage effective SCI strategies, thus contributing to a better understanding of SCI phenomena.

6.1.3. The effects of internal integration

The study results reveal that internal integration is an enabler of integration with both customers and suppliers, and that internal integration is a mediator of the relationships between business environments and external integration. The results support ROT. Internal integration appears to act as an information processing platform, synchronising and leveraging information coming from the business environment, and thus enabling firms to exchange and process external information in response to the business environment [18]. Specifically, our findings suggest an indirect effect of environmental hostility on customer and supplier integration through internal integration. Environmental hostility encourages internal integration, which in turn acts as a leveraging integration mechanism for supplier and customer integration. Internal integration is thus a prerequisite for building strategic collaboration with supply chain partners in hostile environments. To survive in hostile environments, companies may progress from internal integration toward effective management of external integration efforts. Beginning integration initiatives with an internal focus may stem from the need to gain control over internal matters before attention can turn to building strategic cooperation with partners. Pragmatically, there is little value to coordinating the flow of materials with partners if the firm cannot manage materials effectively internally. Additionally, managers may be more predisposed to internal

integration investments because they may be viewed as more certain in terms of expected outcomes in addition to offering a higher level of control. Internal integration was also found to partially mediate the relationships between environmental dynamism and both customer and supplier integration. Environmental dynamism appears to encourage external and internal integration strategies while being complemented by internal integration practices. Thus, while SCI seems to be an effective response to the environment, internal integration seems to further encourage external integration. The finding of a mediating role for internal integration adds to the understanding of the relationships among internal and external integration and the environment, consistent with ROT complementing CT for the study of SCI.

6.1.4. The effects of SCI on financial performance

By investigating the SCI–performance relationship, this study provides explanations for the inconsistent results reported in the literature. While supplier integration was positively associated with financial performance, our findings found no statistically significant relationship between internal/customer integration and financial performance, which may seem counter-intuitive in the context of previous research (e.g. 64). A potential explanation for this is that building collaborative relationships with suppliers may help manufacturers reduce internal mistakes and waste through information sharing and joint planning. Conversely, developing customer integration requires that companies invest heavily in supply chain and logistics processes (e.g. information systems, customer relationship management, and human resources) for process coordination, yet in dynamic environments there may be insufficient time to realize a return on these investments. Alternatively, cost-related capabilities may have an internal focus that are a function of the firm's internal knowledge, and thus not related to external customer integration efforts [91].

6.2. Managerial implications

The study suggests that environmental contexts should be considered by managers when developing integration initiatives. The findings show that hostile environments encourage internal integration, which should be seen by managers as a mechanism to develop external integration capabilities. In other words, hostile environments require first the creation of internal integration capabilities, which can then be followed by external integration. Dynamic

environments seem to encourage internal and external integration in tandem, whereas internal integration is instrumental to developing external integration. Thus, managers that operate in hostile and/or dynamic environments should concentrate on internal integration efforts to enhance their external integration efforts.

To enhance firms' financial performance, supplier integration should be employed. Furthermore, if the environment is hostile, then internal integration should also be pursued. In fact, *ceteris paribus*, greater returns are available to resources allocated to supplier integration than those allocated to customer integration in the context of the Chinese economy.

Another consideration for managers should be the goals that they seek. This research has shown a path to financial performance, but if one considers the topic from a dynamic capability standpoint, other goals may be sought such as access to a particular ecosystem (e.g. skills and technology). This study suggests that in hostile environments robust internal integration capabilities must be in place to fully leverage such information flows.

7. Conclusions and limitations

This study advances existing SCI research, first by investigating both mediation and moderation effects of environment within the same study. The analysis of the competing model revealed that business environment was an antecedent directly affecting SCI, rather than a moderator of the SCI–performance relationship. Therefore, our findings inform the theoretical understanding of the environment–integration–performance paradigm. Second, through employing CT and ROT, this study filled another gap in the extant literature by examining the relationship between internal and external integration. Further, by conceptualizing environment and SCI as multidimensional constructs, this study identified the differing relationships among the theoretical constructs, and thus clarified prior empirical findings that were inconclusive. The findings also provide empirical evidence supporting Skinner's [92] conceptual arguments suggesting that companies are generally forced to make trade-offs to survive in an increasingly hostile and dynamic environment.

There are some limitations to this study which create opportunities for future research. An important limitation of this study is that the environmental dimensions investigated are not exhaustive. Most notably, future efforts might include measures which capture environmental complexity. Another limitation is the cross-sectional properties of the data. As such, a

longitudinal research design could yield additional insights. Additionally, this study does not examine the effects of environmental shifts on how manufacturing firms change their emphasis on differing SCI dimensions, which leaves this area open for future research. Further, while China manifests attributes consistent with other developing economies, generalization is cautioned regarding the extrapolation of these results. Future research in other contexts, particularly other BRICS economies, could broaden the generalizability of the findings. Additionally, the data set comprises responses from 214 companies, which is a small number compared to the total number of firms in China. As such, sampling error may be present. Related to the sample, a final limitation relates to the single respondent design. Lastly, it does not definitively answer the question of why the different environments invoke different managerial responses and outcomes, rather we leave this as a point for further study.

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Table 1: Demographic characteristics of respondents

	Percent (%)		Percent (%)
Industries		**Annual sales (in million Yuan)**	
Arts and crafts	1.4	Below 10	20.6
Building materials	7.5	10-50	26.2
Chemicals and petrochemicals	8.4	50-100	14.0
Electronics and electrical	10.3	100-500	17.3
Equipment manufacturing	11.7	500-1,000	7.9
Food, beverage and alcohol	11.2	1,000-2,000	4.7
Jewellery	0.9	2,000-5,000	3.7
Metal, mechanical and engineering	12.6	Above 5,000	5.6
Pharmaceutical and medical	7.0	**Number of employees**	
Publishing and printing	2.8	1-99	11.2
Rubber and plastics	6.1	100-199	15.4
Textiles and apparel	11.7	200-499	21.0
Toys	1.9	500-999	18.2
Wood and furniture	6.5	1,000-4,999	15.9
Firm ownership		5,000-9,999	9.3
Chinese-owned firms	82.7	10,000 or more	8.9
Joint ventures	10.7		
Wholly foreign-owned firms	6.5		

Table 2: CFA results – construct reliability and validity analysis

Variables	Factor loadings	*t*-values	Reliability and validity
Environmental hostility			α = 0.805; CR = 0.812; AVE = 0.466
Rising labour cost	0.685	–	
Rising material cost	0.755	9.036	
Rising transport cost	0.670	8.258	
Keen competition in local markets	0.719	8.732	
Low profit margins	0.570	7.187	
Keen competition in foreign markets	×		
Environmental dynamism			α = 0.841; CR = 0.849; AVE = 0.590
Rate at which products become outdated	0.699	–	
Rate of innovation of new products	0.904	11.526	
Rate of innovation of new processes of production	0.843	11.140	
Rate of change in taste and preferences of consumers	0.586	7.959	
Rate of changes in information technology	×		
Customer integration			α = 0.794; CR = 0.799; AVE = 0.501
The level of sharing of market information from our major customer	0.654	–	
Our major customer shares Point of Sales (POS) information with us	0.754	8.884	
Our major customer shares demand forecast with us	0.783	9.109	
We share our available inventory with our major customer	0.627	7.706	
We share our production plan with our major customer	×		
Internal integration			α = 0.869; CR = 0.871; AVE = 0.576
Enterprise application integration among internal functions	0.644	–	
Integrative inventory management	0.778	9.393	
Real-time searching of the level of inventory	0.804	9.623	
Real-time searching of logistics-related operating data	0.810	9.671	
Real-time integration and connection among all internal functions from raw material management through production, shipping, and sales	0.748	9.120	
Supplier integration			α = 0.874; CR = 0.878; AVE = 0.548
The participation level of our major supplier in the design stage	0.560	–	
Our major supplier shares their production schedule with us	0.805	8.278	
Our major supplier shares their production capacity with us	0.757	8.000	
Our major supplier shares available inventory with us	0.783	8.153	
We share our production plans with our major supplier	0.790	8.193	
We share our demand forecasts with our major supplier	0.719	7.763	
We share our inventory levels with our major supplier	×		
Financial performance			α = 0.842; CR = 0.846; AVE = 0.587
Growth in sales	0.522	–	
Growth in profit	0.766	7.474	
Return on investment (ROI)	0.914	7.936	
Growth in return on investment (ROI)	0.808	7.662	
Growth in market share	×		
Model fit statistics: χ^2/df (525.695/335) = 1.569; RMSEA = 0.052; CF1 = 0.932; IFI = 0.933; TLI = 0.923; SRMR = 0.055			

Note: × Removed items with low factor loadings.

Table 3: Descriptive statistics and correlations

	Mean	S.D.	1	2	3	4	5	6
1. Environmental hostility	5.756	0.889	**0.683**	0.272**	0.126	0.257**	0.156*	-0.096
2. Environmental dynamism	4.756	1.106	0.273**	**0.768**	0.293**	0.291**	0.393**	0.203**
3. Customer integration	4.669	1.193	0.128	0.294**	**0.708**	0.544**	0.581**	0.168*
4. Internal integration	5.342	1.035	0.258**	0.292**	0.545**	**0.759**	0.457**	0.228**
5. Supplier integration	4.544	1.168	0.158*	0.394**	0.582**	0.458**	**0.740**	0.286**
6. Financial performance	4.488	0.959	-0.094	0.205**	0.170*	0.230**	0.287**	**0.766**
7. Method variance marker (labour shortage)	5.051	1.412	0.265**	0.131	-0.107	0.002	0.102	0.148*

Note: n = 214; square root of AVE is on the diagonal; unadjusted correlations appear below the diagonal; adjusted correlations for potential common method variance appear above the diagonal.
** $p \leq 0.01$; * $p \leq 0.05$. (2-tailed).

Table 4: 2SLS model testing for endogeneity

	Customer integration	Internal integration	Supplier integration	Financial performance
	Model 1 (OLS)	**Model 2 (OLS)**	**Model 3 (OLS)**	**Model 4 (2SLS)**
Industry1	0.092	0.041	0.040	0.052
Industry2	-0.047	0.046	0.040	0.094
Industry3	0.038	-0.011	0.004	-0.070
Industry4	0.014	0.046	-0.051	0.032
Industry5	-0.041	0.011	0.030	0.040
Firm size[a]	0.040	0.117*	-0.019	
Ownership1[a]	0.101	-0.014	-0.029	
Ownership2[a]	0.249**	-0.027	0.112	
Government laws and regulations[a]	0.167**	0.214***	0.189**	
Customer integration		0.340***		-0.064
Internal integration	0.413***		0.296***	0.167*
Supplier integration		0.132†		0.217*
Environmental hostility	-0.033	0.162**	-0.005	-0.210**
Environmental dynamism	0.090	0.033	0.220***	0.142†
R^2	0.386	0.415	0.332	0.160
Adjust R^2	0.349	0.377	0.292	0.119
F-value	10.512***	10.921***	8.323***	3.866***

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$; † $p \leq 0.10$.
Note: [a] Variables used as instruments for the assumed endogenous variable.

Table 5: Results of hypotheses tests using SEM

Structural paths	Standardized coefficient	t-value	Hypothesis test
Environmental hostility → Customer integration (H1a)	-0.106	-1.391	Not supported
Environmental hostility → Internal integration (H1b)	0.216**	2.577	Supported
Environmental hostility → Supplier integration (H1c)	-0.068	-0.919	Not supported
Environmental dynamism → Customer integration (H2a)	0.160*	2.105	Supported
Environmental dynamism → Internal integration (H2b)	0.294***	3.522	Supported
Environmental dynamism → Supplier integration (H2c)	0.319***	3.858	Supported
Internal integration → Customer integration (H3a)	0.645***	6.090	Supported
Internal integration → Supplier integration (H3b)	0.455***	4.799	Supported
Customer integration → Financial performance (H6a)	0.061	0.545	Not supported
Internal integration → Financial performance (H6b)	0.047	0.387	Not supported
Supplier integration → Financial performance (H6c)	0.296**	2.911	Supported
Control variables			
Firm size → Financial performance	0.037	0.530	
Industry1 → Financial performance	0.014	0.200	
Industry2 → Financial performance	0.087	1.203	
Industry3 → Financial performance	-0.073	-0.977	
Industry4 → Financial performance	0.022	0.306	
Industry5 → Financial performance	0.041	0.561	
Ownership1 → Financial performance	0.041	0.379	
Ownership2 → Financial performance	-0.060	-0.566	
Variance explained (R^2)	R^2		
Customer integration	0.475		
Internal integration	0.172		
Supplier integration	0.386		
Financial performance	0.153		
Model fit statistics: χ^2/df (793.365/538) = 1.475; RMSEA = 0.047; CF1 = 0.917; IFI = 0.920; TLI = 0.903; SRMR = 0.066			

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$.

Table 6: Results of bootstrapping and Sobel tests for mediation

Hypothesis	Direct effect	Indirect effect	SE of indirect effect	95% CI for indirect effect	Sobel test	Hypothesis test
EH→II→CI	-0.106	0.139*	0.082	0.005–0.337	z=2.384*	H4a: Full mediation
EH→II→SI	-0.068	0.098*	0.058	0.008–0.245	z=2.277*	H4b: Full mediation
ED→II→CI	0.160†	0.190***	0.056	0.089–0.312	z=3.064**	H5a: Partial mediation
ED→II→SI	0.319**	0.134***	0.047	0.056–0.246	z=2.846**	H5b: Partial mediation

Note: EH = environmental hostility; ED = environmental dynamism; CI = customer integration; II = internal integration; SI = supplier integration; SE = bootstrap standard error; CI = bootstrap confidence interval; Standardized effects; 10,000 bootstrap samples.

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$; † $p \leq 0.10$.

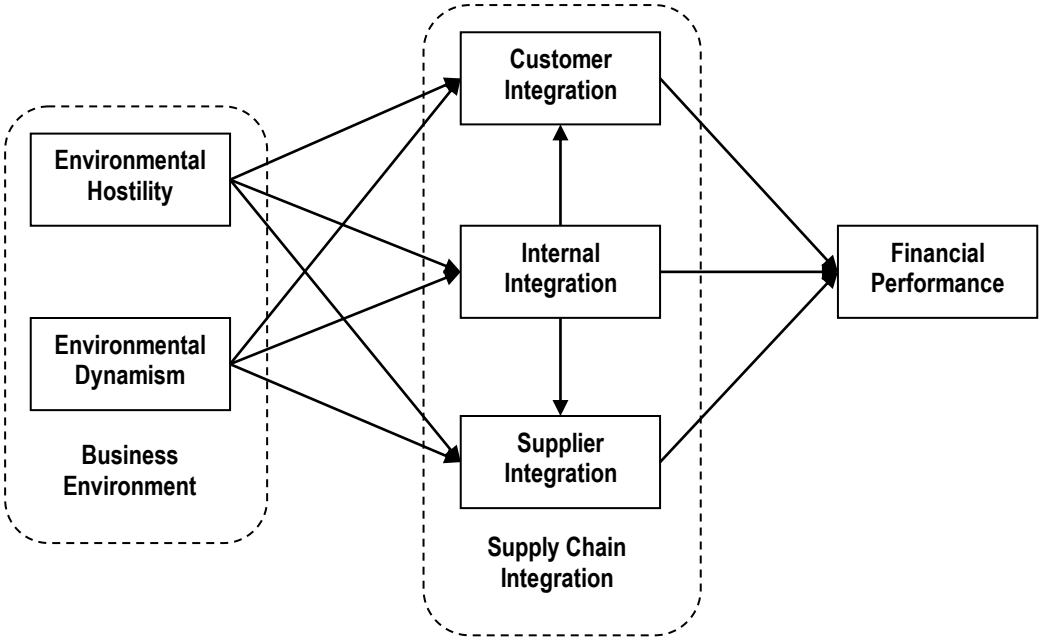
Table 7: Results of moderated regression analysis of alternative model

	Model 1	Model 2	Model 3
Control variables			
Firm size	0.065 (0.910[a], 1.073[b])	0.036 (0.532, 1.114)	-0.002 (-0.036, 1.160)
Industry1	0.076 (1.047, 1.129)	0.045 (0.637, 1.174)	0.057 (0.828, 1.229)
Industry2	0.132 (1.802, 1.131) †	0.093 (1.337,1.152)	0.074 (1.093, 1.180)
Industry3	-0.032 (-0.426, 1.215)	-0.072 (-1.000, 1.236)	-0.075 (-1.060, 1.293)
Industry4	0.019 (0.259, 1.136)	0.033 (0.475, 1.170)	0.024 (0.357, 1.187)
Industry5	0.061 (0.829, 1.164)	0.035 (0.497, 1.174)	0.031 (0.448, 1.190)
Ownership1	0.078 (0.713, 2.563)	-0.002 (-0.019, 2.685)	0.011 (0.110, 2.725)
Ownership2	0.053 (0.490, 2.447)	-0.072 (-0.673, 2.703)	-0.054 (-0.521, 2.747)
Independent variables			
Customer integration		-0.052 (-0.589, 1.901)	-0.092 (-0.985, 2.238)
Internal integration		0.159 (1.933, 1.614) †	0.161 (1.967, 1.702) †
Supplier integration		0.224 (2.635, 1.737) **	0.256 (2.916, 1.967) **
Environmental hostility (moderator)		-0.209 (-3.022, 1.149) **	-0.220 (-3.219, 1.192) **
Environmental dynamism (moderator)		0.149 (1.996, 1.339) *	0.176 (2.406, 1.367) *
Interaction effect			
Customer integration × Environmental hostility			-0.038 (-0.387, 2.411)
Internal integration × Environmental hostility			-0.181 (-2.131, 1.836) *
Supplier integration × Environmental hostility			-0.080 (-1.003, 1.608)
Customer integration × Environmental dynamism			-0.150 (-1.733, 1.914) †
Internal integration × Environmental dynamism			0.101 (1.287, 1.585)
Supplier integration × Environmental dynamism			0.126 (1.548, 1.702)
R^2	0.034	0.165	0.241
Adjust R^2	-0.004	0.111	0.166
F-value	0.895	3.044***	3.239***

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$; † $p \leq 0.10$.

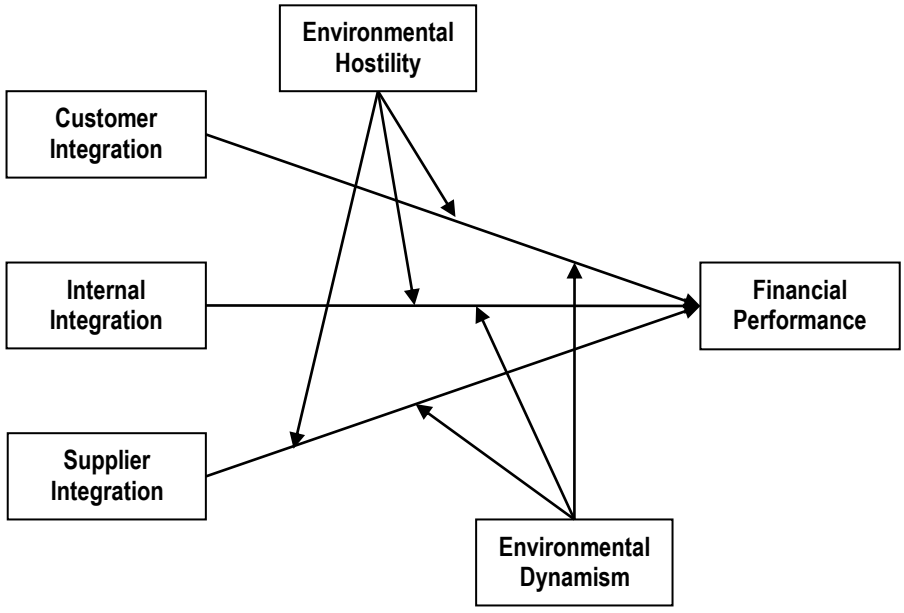
Note: The numbers in parentheses are: [a] t values and [b] variance inflation factor (VIF). Dependent variable is financial performance.

Figure 1: Primary model



Note: All relationships are proposed to be significant positive (+)

Figure 2: Alternative model



Note: All relationships are proposed to be significant positive (+)