

# INTERORGANIZATIONAL DEPENDENCE AND IOS ASYMMETRY

*Research-in-Progress*

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## **Abstract**

*Interorganizational information systems (IOS) have been considered a way to mitigate the agency problems of information asymmetry. By introducing a new construct of IOS asymmetry, the imbalance in transparency of SC partner's internal information related to SC cooperation via IOS, this study asserts that IOS may not mitigate the problems of information asymmetry. Instead, IOS can change the nature of information asymmetry from a supplier(agent)-advantage asymmetric information structure to a manufacturer(principal)-advantage asymmetric information structure. As an important antecedent of IOS asymmetry, this study identifies interorganizational dependence, which consists of two different dimensions: dependence asymmetry and joint dependence. Dependence asymmetry is rooted in the logic of power, whereas joint dependence is based on the logic of embeddedness. This study explores the counteracting forces at work, which underlie interorganizational relationships, suggested by the competing logic of power and embeddedness.*

**Keywords:** Interorganizational information systems (IOS) asymmetry, interorganizational dependence, interorganizational relationships

## Introduction

In supply chain (SC)-to-SC competition, SC transparency through interorganizational information systems (IOS) is an important determinant of supply chain competitiveness (Barratt et al. 2007; Kim et al. 2011). Various supply chain management (SCM) and information systems (IS) literature has addressed how IOS can mitigate the barriers in SC relationships such as information asymmetry and fears of partner opportunism (e.g., Kim et al. 2006, Zhu 2002). IOS may work as a channel for substantial information exchange and thereby reduce information asymmetry between SC partners.

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IOS does not inherently favor a party, either a supplier or a buyer; however, IOS itself is not neutral in SC relationships (Giddens 1979, Orlikowski and Baroudi 1991). IOS is the system manifestation of interorganizational relationships and institutionalizes asymmetric interdependency between organizations (Kumar and van Dissel 1996). When there is an asymmetric relationship in a supply channel, IOS can be influenced by the firm's status in the channel, according to whether it has relative power or relative dependence (Kim et al. 2011). IOS asymmetry within a supply channel refers to the imbalance in transparency of SC partner's internal information related to SC cooperation via IOS in either direction. Transparency of information refers to the degree of visibility and accessibility of information (Zhu 2004).

IOS asymmetry may introduce different problems than the typical principal-agent problem, where the agent possesses private information. Information asymmetry usually puts principals in a disadvantaged position and can lead to two main problems: (1) adverse selection and (2) moral hazard (Akerlof 1970). However, when IOS asymmetry is present, the powerful principal (not the agent) may possess an information advantage, making the agency problems irrelevant. Instead, the nature of information asymmetry changes with the implementation of IOS, in Lin et al.'s (2005) terms, from the 'seller[agent]-advantage asymmetric information structure' to the 'buyer[principal]-advantage asymmetric information structure'. Then, IOS asymmetry may strengthen the status quo of asymmetric dependency relationships and result in suboptimal, instead of maximizing, supply chain performance due to the lack of information sharing. Despite the importance of IOS asymmetry in SC performance, however, this construct has never been formally investigated in academic literature. Thus, the first objective of this paper is to elaborate on the novel construct of IOS asymmetry.

Regarding the antecedents of IOS asymmetry, the existing research on interorganizational relationships considers interorganizational dependence as a key variable determining the success of the relationship (Kumar et al. 1995, Ryu and Eyuboglu 2007). Several studies have attempted to explain the organizational motives for forming interorganizational relationships from a variety of theoretical perspectives, such as resource dependence theory (RDT) and relational view (Bensaou et al. 1996). A review of prior studies reveals that their theoretical backgrounds are rooted in one of two opposing views of interorganizational relationships -- namely, logic of power and logic of embeddedness (Gulati and Sytch 2007). According to the logic of power, sourcing inputs from outside a firm make the firm dependent on other firms for critical resources. The level of dependence on the partner is construed as a source of the partner's power. That is, unequal dependence would cause power imbalances likely to be detrimental for the weaker party. Meanwhile, when SC partners are mutually dependent, the logic of embeddedness leads them to a high level of mutual commitments and confers a number of unique advantages on dyadic exchanges. These advantages manifest themselves in increased levels of cooperation and courageous information exchange, all of which in turn have a positive impact on supply chain performance. Thus, the second objective of this paper is to explore the antecedents for IOS asymmetry simultaneously, suggested by the competing logic of power and embeddedness.

## Conceptual Background

Information asymmetry refers to a situation in which one party in a transaction has more or better information about the products, characteristics, and selling practices than the other one does (Pavlou et al. 2007). IOS asymmetry is related to information asymmetry in that the content which flows through IOS is information, and IOS asymmetry leads to information asymmetry. However, IOS asymmetry is unique in the following ways.

### ***Information Asymmetry and IOS Asymmetry***

IOS asymmetry refers to the asymmetry of access privileges to the other's internal information via IOS, while information asymmetry refers to the asymmetry of the magnitude and/or quality of the information itself. The assets residing in IOS are of a company-specific nature, which a firm would not reveal to outsiders. For example, corporate databases contain valuable strategic and product information. Making these IS assets available to outside firms may allow this private information to become public, thereby removing the firm's competitive edge over the others in the industry group (Kim et al. 2011). Further, IOS requires significant investments of IT resources from the participating firms in long-term relationships. IOS comprises system components such as SC execution software which is deeply intertwined with interorganizational processes. Thus, IOS asymmetry would be much more difficult to restore and may result in much higher operational risk than information asymmetry without IOS.

### ***Changes in Information Asymmetry due to IOS Asymmetry***

In most instances, information asymmetry favors the agent (supplier), who possesses more information than the principal (buyer), thereby leading to the agent's information advantage (Nayyar 1990). In a manufacturer-supplier relationship, the manufacturer (principal) delegates the work to the supplier (agent), who performs the work according to a mutually agreed contract (Eisenhardt 1989). Typically, there is a supplier(agent)-advantage asymmetric information structure, since the supplier has more information about the product's quality and the internal operations related to the delivery of the promised quality. IOS has the ability to work as a mechanism to mitigate agency problems that result from the agent's information advantage (Kumar et al. 1998). Exchanging information about product design, manufacturing schedules, quality inspection, inventory status and forecasting through IOS may reduce information asymmetry and monitoring costs, thus lowering the incentives of agents to behave opportunistically (Weill et al. 2002).

However, due to the imbalance of power among SC participants, IOS may not completely mitigate the information asymmetry problems; it can only mitigate the information asymmetry that favors the agent, but does not mitigate the information asymmetry that favors the principal. In the context of manufacturer-supplier relationships, the more powerful party (usually the manufacturer) can assume the leadership position and infuse asymmetry in terms of the scope and depth of the partner information that can be seen through IOS. Furthermore, a manufacturer who is afraid of a supplier's opportunistic behavior may intentionally limit the information flow to the supplier (e.g., blocking file downloads). Thus, in a power asymmetric relationship, the nature of information asymmetry changes with the implementation of IOS from a supplier-advantage asymmetric information structure to a manufacturer-advantage asymmetric information structure. Then, the agency problem of adverse selection and moral hazard resulting from the supplier-advantage asymmetric information structure becomes irrelevant. Recent research suggests that IOS can be used by dominant parties in supply chains to consolidate their dominance in the chain (Webster 1995) and remains a key feature in real supply chain relationships (Colombo et al. 1995).

### ***Changes in Information Asymmetry due to IOS Asymmetry***

#### **Logic of power**

Resource dependence theory views organizations as entities whose survival depends on their exchange of resources with multiple environmental constituents. Interorganizational dependence is defined as a phenomenon that "exists whenever one actor does not entirely control all of the conditions necessary for the achievement of an action or for obtaining the outcome desired from the action" (Pfeffer and Salancik, 1978: 40). If a firm is more dependent on its exchange partner, the resulting net-positive dependence on the partner is deduced as the source of the partner's power (Emerson, 1962). The bilateral deterrence theory asserts that the party with great power is more likely to use its relative power under conditions of higher asymmetric interdependence (Lawler et al. 1987).

Much of the research on interorganizational relationships among interdependent actors has been grounded in the interrelated notions of power and control. Pfeffer and Salancik (1978: 52) assert that "to the extent that the interests of one party cannot be achieved without other parties, concentration is necessary." In this view, interdependence between actors is considered a liability that needs to be managed because unequal dependence would cause power imbalances (e.g., Gulati and Sych 2007).

## **Logic of embeddedness**

Gulati and Sytch (2007) introduce a new term for studying interorganizational relationships, joint dependence, referring to the sum of dependence between actors in the relationship. They emphasize the importance of joint dependence in that “if two separate relationships are each perfectly balanced in terms of their actors’ dependence levels, they may have different behavioral implications if they are balanced at different levels of dependence” (37). Social psychological research has found that highly interdependent parties are more likely to interpret ambiguities in their partners’ behaviors in a positive rather than a negative light. Also a high level of mutual dependence may generate a high level of commitment to the relationship, thereby leading to the long term orientation, effective conflict resolution, and the willingness of parties to sacrifice immediate self-interest for the benefit of the relationship (Rusbult et al., 1991). Similarly, joint dependence can infuse SC relationships “with increased cohesiveness, and the resulting logic of embeddedness may then perpetuate relationships” (Gilati and Sytch 2007, 40). This mutualistic orientation is further reinforced by the “inexpensive and flexible yet penetrating” moral and social control stemming from highly dependent relationships (Larson, 1992: 96).

The logic of embeddedness suggests that higher levels of joint dependence necessarily increase the depth of economic interaction between SC partners, jumpstarting a stronger relational orientation (Zaheer and Venkatraman, 1995). The increased relational orientation in turn results in increased levels of joint action and a more advantageous information exchange in the dyad. Research Model

## **Research Model**

### ***Information Asymmetry and IOS Asymmetry***

Interdependence between SC partners can be defined as “their interest in maintaining a relationship to achieve their respective goals” (Ryu and Eyuboglu 2007, 460). They further identify two dimensions of interdependence: (1) joint dependence, that is, the overall magnitude of the two parties’ interdependence measured by the sum total of their need for each other (Eyuboglu et al. 2003) and (2) the asymmetry of the two parties’ interdependence.

### **Dependence asymmetry and IOS asymmetry**

Asymmetry of the two parties’ interdependence refers to “the difference between the firm’s dependence on its partner and the partner’s dependence on the firm”. Asymmetry means that one party is less dependent on the other and hence has relative power. Transaction cost economics assumes that the human agents in SC transactions tend to behave opportunistically when there is an asymmetric relationship between the parties. Further, the party with relative power is more likely to exercise its power as the asymmetry increases (Lawler et al. 1987). The more asymmetric power the manufacturer has over the supplier, the more the manufacturer can use its power to implement asymmetric IOS (Ryu et al. 2007a). The powerful manufacturer attempts to have a formal IOS that guarantees as much access to the supplier’s internal information as it needs, while limiting the dependent supplier’s access to its internal information. Hence, the following proposition:

*Proposition 1: Dependence asymmetry positively influences IOS asymmetry.*

### **Joint dependence and IOS asymmetry**

As interdependence between a manufacturer and its supplier increases, SC partners are more likely to be committed and are less likely to behave opportunistically (Gulati and Sytch 2007, Kumar et al. 1995). High levels of interdependence also signify that each party needs a lot of information from the other party to fulfill its own tasks and so as not to cause any disruptions in upstream and downstream activities.

Highly interdependent SC partners have little incentives to institute IOS asymmetry. A partner’s opportunistic behavior may result in gaining an information advantage in the short-term, but this exploitation is likely to cause other partners to behave opportunistically as well (Park and Ungson 2001). The probable result is that neither organization will contribute to the information exchange process through IOS. Thus, interdependent SC partners are more likely to continue their relationship to secure the large interest coming from the relationship (Lusch and Brown 1996) and likely to develop a norm of information sharing through IOS. Hence, we propose the following proposition:

*Proposition 2: Joint dependence negatively influences IOS asymmetry.*

### ***Moderating Effects of Control Mechanisms on IOS Asymmetry***

Since IOS grants access privileges for the focal firm's up-to-the-minute internal information to the SC partner, the potential risk resulting from a partner's opportunism is much greater than the information asymmetry without IOS. Thus, the SC partners interconnected through IOS need strong mechanisms to cope with opportunism. Dyer and Singh (1998) describe the two types of control mechanisms used by SC partners: formal safeguards, such as joint governance structure (Williamson 1975), and informal safeguards, such as interorganizational trust (Zaheer et al. 1998).

The interaction effects of dependence asymmetry and joint governance structure as a formal control mechanism on IOS asymmetry

A joint governance structure refers to the structures, processes and associated arrangements that IOS management must have in place to fully account for the management of systems and the services delivered. A joint governance structure is necessary to keep opportunistic behavior under control so that the ongoing information exchange through IOS can be sustained. The primary motive for forming IOS is the reduction of uncertainties in the supply chain, thereby gaining cost, cycle time, and quality advantages over competing supply chains in the industry (Kumar et al. 1996). With the appropriate IOS governance structure in place, investments into relation-specific capital can bear fruitful results in a cooperative long-term relationship in the following ways: (1) the formal joint governance structure may suppress the powerful party's opportunistic behavior, safeguarding the relation-specific investments from the dependent party and (2) when an appropriate joint governance structure is present, both partners can monitor unfair uses of IOS and thereby mitigate the uneven exercise of the power. Conversely, a lack of appropriate joint governance structure may encourage the powerful party's opportunistic behavior. Thus, we expect that the effect of dependence asymmetry on IOS asymmetry will be mitigated by the formal joint governance structure and, hence, the following proposition:

*Proposition 3: The interaction between dependence asymmetry and joint governance structure influences IOS asymmetry.*

#### **IOS asymmetry and SC performance**

Firms participating in a supply chain with highly visible IOS can have on-time access to the required information for their decision making so that they can make informed decisions about supply chain activities. In addition, when information about environmental changes is readily visible to supply chain partners through IOS, the entire supply chain can be prepared so as to adapt effectively to the changing environment and, thus, enhance supply chain agility.

Conversely, an asymmetric relationship in IOS visibility can work to the disadvantage of both buyers and suppliers. The relative withholding of information by a powerful manufacturer may reduce the overall effectiveness of a supply chain. For example, the "bullwhip" effect is a core problem in supply-chain management, because it distorts the demand information transmitted upstream in the supply chain (e.g., Lee et al. 1997). This supposedly happens when a supplier's demand forecast is made based on the order history of its immediate downstream partner (manufacturer), without knowing the sales information from the ultimate customers (Kim et al. forthcoming). One of the remedies for coping with the bullwhip effect is to share the ultimate sales information with the upstream SC partners through IOS. When there is IOS asymmetry, the relevant information does not flow to the upstream partners and all members of the supply chain cannot synchronize their operations. This may cause the SC participants to encounter increased overall SC inventory and costly duplicate practices, such as forecasting by multiple participants, which thereby decreases the joint profits of the supply chain participants. (Supply chain performance will be measured by supply chain agility and joint profit performance) Thus, we propose the following hypotheses:

*Proposition 5: IOS asymmetry negatively influences supply chain performance of the dyad.*

*P5a: IOS asymmetry negatively influences supply chain agility of the dyad.*

*P5b: IOS asymmetry negatively influences joint profit performance of the dyad.*

## ***Control Variables***

### **Environmental Uncertainty**

Environmental uncertainty refers to (1) the degree of change that is unpredictable in the external environment (Huber et al. 1987) and (2) the lack of information about environmental factors that affect decision-making (Kim et al. 2010). Highly uncertain environments develop a condition in which the information about the environment is asymmetrically distributed between the SC participants (Klein et al. 1990). This situation is a catalyst for IOS asymmetry, as the relevant information is not readily visible to the less informed party. Information asymmetry between SC participants may cause the better informed partner to engage in opportunistic behavior or dishonest, self-seeking behavior (Williamson 1975). The better informed party is inclined to maintain IOS asymmetry, because opportunism may allow for the immediate fulfillment of a partner's short-term goals without the need to face the uncertainty of long-term returns (Kim et al. forthcoming). The vulnerability resulting from a partner's self-seeking behavior increases as IOS asymmetry deepens (Park et al. 2001).

### **Strategic Importance**

Strategic importance refers to the significance of the alliance partner for a firm's future strategic development (Lunnan et al. 2008), due to the partners' complementary resource endowments. When SC participants consider their partners' resource bases to be strategically important, their common interests may motivate them to exchange important information through IOS in such a way that mutual gains are possible using each other's resources. Because certain resources, such as strategic information about market demand, are neither tradable nor imitable through external market mechanisms, information sharing through IOS becomes an important source of an alliance's competitive advantage (Dierickx et al. 1989; Kogut et al. 1992; Tsai 2000). Other things being equal, the higher the strategic importance between the two organizations, the less IOS asymmetry and the higher their incentives to exchange or share their important information resources through IOS.

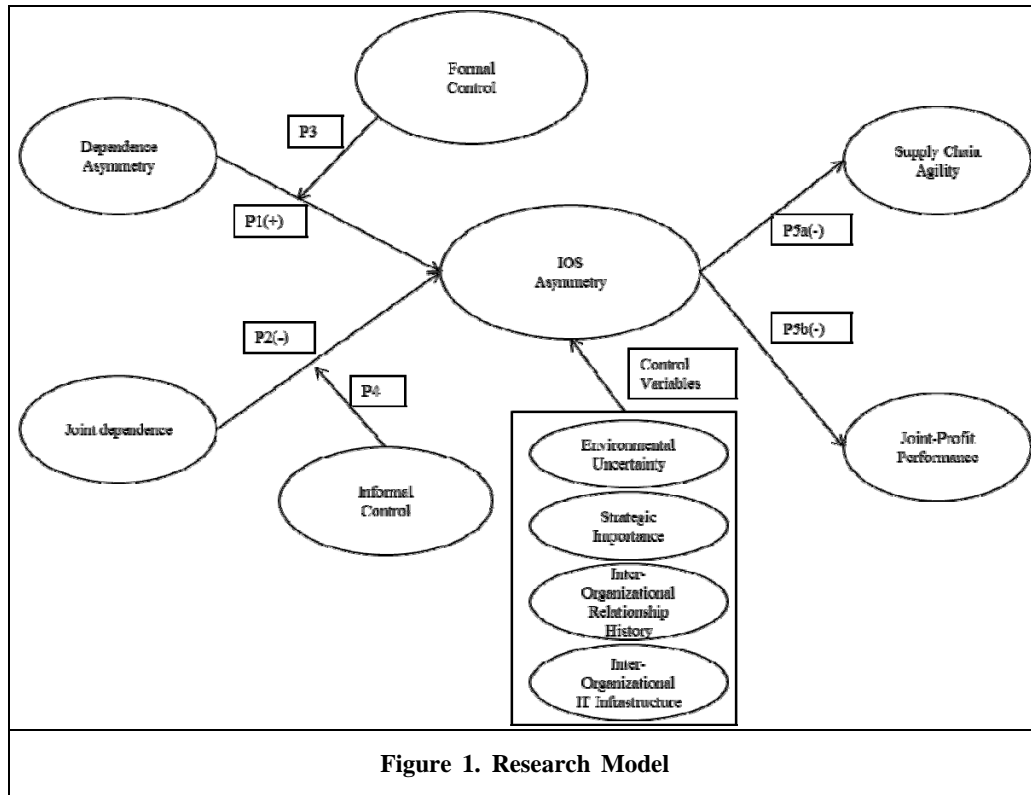
### **Interorganizational Relationship History**

An inter-organizational relationship adjusts over time. Accordingly, as the relationship period between partners increases, firms must adapt to one another, which increases the chances of cooperative relationships (Kim et al. 2010). As the relationship period becomes longer, an expectation that the relationship will continue in the future becomes more certain (Anderson et al. 1990). This expectation motivates a partner to promote a cooperative relationship (Lusch et al. 1996), leading to higher confidence and more receptive attitudes toward information exchange. This point also implies that a longer relationship period may enhance the level and range of information exchange through IOS so as to improve the interorganizational performance. Interaction over time may lead to commitments and to relationship-specific assets such as partners' knowledge about the other's procedures and values (Karande et al. 2008). According to Young-Ybarra and Wiersema (1999), shared experiences between firms can foster mutual commitments, resulting in more information exchange between them.

### **Interorganizational IT Infrastructure**

Interorganizational IT infrastructure may work as a channel for efficient information exchange. Compatible IT infrastructure reduces the cost of information exchange and leads to more confidence and receptive attitudes toward information exchange (Colombo et al. 1995). Thus, a unified interorganizational IT infrastructure will reduce the opportunity to use IOS for a specific partner's advantage and work as an inhibiting factor for IOS asymmetry.

For our empirical investigation, we propose the following research model (Figure 1).



## Expected Contributions

This study attempts to make a few important contributions to the SCM and IS literature. First, it explores a new construct of IOS asymmetry, distinguishing from information asymmetry. IOS asymmetry is about access privileges for the partner's up-to-the-minute internal information through IOS, while information asymmetry is about the magnitude and/or quality of information itself. IOS asymmetry introduces much higher transaction risks than information asymmetry, since IOS requires significant relation-specific capital and reveals the focal firm's strategic information to outsiders. Moreover, the impact of information asymmetry is limited to the intended transaction.

Second, IOS asymmetry introduces a new problem of information asymmetry, i.e., principal-advantage information asymmetry. Existing literature on IOS suggests that IOS mitigates the agency problems of information asymmetry, leading to a symmetric use of IOS. However, this study asserts that, reflecting the power asymmetry in a supply channel, IOS can change the nature of information asymmetry from a supplier(agent)-advantage asymmetric information structure to a manufacturer(buyer)-advantage asymmetric information structure. Thus, IOS does not completely mitigate the problems of information asymmetry, but consolidates the asymmetric relationship in a supply channel.

Third, this study attempts to examine whether IOS asymmetry results in suboptimal SC performance due to a lack of information sharing. Advances in information system technology enable SC partners to work in tight coordination, mainly through information sharing, and optimize the supply chain-wide performance. Underlying this argument is an assumption that relevant information should flow in both directions, not just from the dependent party to the powerful party. Indeed, bidirectional information sharing is a key component in advanced SCM programs such as collaborative planning, forecasting and replenishment (CPFR), which allows for the continuous updating of inventory and upcoming requirements through mutual IOS visibility. When this assumption of bidirectional information flow is not satisfied, the supply chain-wide performance can be suboptimal.

Fourth, this study identifies an important antecedent of IOS asymmetry, i.e., interorganizational dependence, based on the two competing logic: logic of power and logic of embeddedness. It also introduces a contingent variable, control mechanism, to identify which logic has more explanatory power under what conditions.

Furthermore, this study accommodates both partners' perspectives on IOS asymmetry, reflecting the reciprocal nature of an interdependent dyad. According to the bilateral deterrence theory, the party with great power is more likely to use its relative power under conditions of higher asymmetric interdependence (Lawler et al. 1987). The more asymmetric power the manufacturer has over the supplier, the more the manufacturer can exercise its power to implement asymmetric IOS (Ryu et al. 2007a). A powerful manufacturer attempts to have a formal control that guarantees as much access to the supplier's internal information as it needs, while limiting the dependent supplier's access to its internal information.



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## Appendix

**Table 1: Interorganizational Dependence Questions**

<b>Manufacturer and Supplier Dependence Measures*</b>	
Survey item	
1.	Manufacturer's switching cost ("It would require much trouble and expense for your firm to switch suppliers for this commodity.")
2.	Availability of potential suppliers ("There are enough potential suppliers to ensure adequate competition among the current suppliers" [reverse coded].)
3.	Availability of alternate sources of short-term supply ("There are satisfactory alternate sources of short-term supply available for this commodity" [reverse coded].)
4.	Percentage of manufacturer's component requirements procured from the supplier
5.	Supplier has technological advantage over other producers (7-point Likert scale with options ranging from 1 = "Strongly disagree" to 7 = "Strongly agree")
6.	Supplier has adapted its management methods to work effectively with your organization (7-point Likert scale with options ranging from 1 = "Strongly disagree" to 7 = "Strongly agree")
7.	Manufacturer has made significant relationship-specific investments (7-point Likert scale with options ranging from 1 = "Strongly disagree" to 7 = "Strongly agree")
8.	Percentage of supplier's total sales sold to the manufacturer
9.	Number of alternative buyers for supplier <sup>†</sup>
10.	Manufacturer's withdrawal cost for supplier ("The supplier would face a serious financial crisis if you withdrew your business from them.")
11.	Supplier has made significant relationship-specific investments (7-point Likert scale with options ranging from 1 = "Strongly disagree" to 7 = "Strongly agree")
12.	Total dollar volume of the commodity purchased from supplier <sup>‡</sup>
13.	Total dollar volume of all commodities purchased from supplier