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Using information asymmetry to mitigate hold-ups in supply chains

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ABSTRACT

Realizing the maximum benefits from an inter-firm relationship often requires a level of cooperation that can be difficult to establish. We study how to encourage one party, herein the seller, to make a cooperative, relation-specific investment that will increase the trade profits to be shared by the buyer and seller (i.e., surplus). The seller, fearing he will be held up by a self-interested buyer, often refrains from investing or attempts to protect himself with costly, and sometimes ineffective, protection mechanisms such as vertical integration and contracts. We propose that information asymmetry, controlled by the seller, can help reduce the risk that the seller will be worse off after making the investment than before and, accordingly, encourages seller investment. Although self-interested behavior is usually assumed by extant hold-up research and is the crux of the hold-up problem, fair purchasing practices have also been documented. Accordingly, we examine the effectiveness of information asymmetry controlling for the non-investor purchasing practices and investigate whether trade offers expected by the sellers mediate the relationship between information asymmetry and the relation-specific investment.

To test our hypotheses, we conduct an experiment and find that aggregating the seller's investment and production costs encourages the seller to invest in relation-specific cooperative investments. Moreover, when buyers are expected to follow self-interested purchasing practices, the seller expects higher buyer offers when buyers possess aggregated seller's investment and production cost information than when they possess disaggregated information. Those expectations in turn impact sellers' decision of whether to make a cooperative investment. Finally, supplemental analysis shows that aggregating seller's cost information does not reduce trade efficiency; thus confirming that information asymmetry can help mitigate hold-ups in the supply chain.

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1. Introduction

Many business relationships require one party to make a relation-specific investment that, by definition, has little or no value outside the relationship. For instance, in the automotive industry, original equipment manufacturers (OEMs) often require suppliers to invest in expensive dies or other equipment to produce the parts they need. Once purchased by the suppliers, these dies or equipment cannot be used to fill orders of other OEMs. Similarly, principals might ask agents to invest in skills that are not transferable to other employers. Such investments are often socially optimal, meaning the investment increases the total surplus generated within the relationship (i.e., the trade profits to be shared by a buyer and a seller). However, the relation-specific investment also creates a bilateral monopoly whereby the investor risks losing the cost of his investment should trade not occur, while the non-

investor incurs no risk or cost. In other words, bargaining power resides with the non-investor once the investment has been made, creating a setting ripe for opportunistic behavior. Knowing the investment is a sunk cost of the investor, the non-investor has no inherent incentive to cover its cost during *ex post* trade offers. In the absence of a commitment from his counterpart to not appropriate the surplus that will be generated, the investor generally will not make the socially optimal relation-specific investment. This represents the classic hold-up problem (Klein et al., 1978; Williamson, 1975). In sum, the hold-up problem has two dimensions. The first lies with the non-investor who will likely appropriate the surplus created by any relation-specific investment. The second lies with the party who is considering making the investment: since he fears that he will be held-up during trade, he refrains from making this socially optimal investment. Thus, mitigating hold-ups encompasses both limiting the ability of the non-investor to hold the investor up during trade and encouraging investment in relation-specific assets.

Numerous investigations have sought remedies to the hold-up problem. Those remedies range from establishing formal gov-

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ernance structures that limit the risk of ex post opportunism (e.g., vertical integration, mutual exchanges of hostages, contracts (Shelanski and Klein, 1995)) to informal protection mechanisms such as controlling the flow of investment-related information (Gul, 2001). Not only are those remedies costly, they are also not always effective. Their effectiveness is particularly limited when investments are cooperative (i.e., investments that benefit the investor's trading partner) because such investments increase the bargaining power of the non-investor. Specifically, although incomplete contracts can be effective with selfish relation-specific investments (i.e., investments that benefit the investor, for instance by reducing the cost of the intermediary product manufactured by the seller), they are ineffective when investments are cooperative and parties have difficulty committing not to renegotiate (Baiman and Rajan, 2002a; Che and Hausch, 1999). Thus, the search for solutions continues (for a review see Coeurderoy and Quélin, 1997; Miller, 2012; Rindfleisch and Heide, 1997; Shelanski and Klein, 1995).

In this paper, we examine the hold-up problem associated with a cooperative investment in a supply chain setting. The cooperative investment involves a seller that must decide whether to make a relation-specific investment that will benefit a specific buyer. Common examples of cooperative investments include R&D efforts to enhance the quality of a customer-specific product, tailoring inventory systems, production equipment, or transportation systems to the buyer's needs, and customization of parts for specific customers. Baiman and Rajan (2002a) suggest that the compensation received by the seller might depend on the extent to which R&D work is successful, likely resulting in the buyer being unable to commit to paying a specific price and the contract being incomplete. Thus, cooperative investments not only increase the power of the non-investor (i.e., the buyer) relative to the investor (i.e., the seller), but they are also especially difficult to protect and encourage when price cannot be determined with certainty. As a result, they render the investor more vulnerable to opportunism by the non-investor.

We examine how sellers might protect themselves against buyers' potential opportunism. Specifically, building on Gul (2001), we propose that the seller can use information asymmetry to increase their bargaining power and thereby guard against the buyer's potentially opportunistic behavior ex post. Information asymmetry in the form of aggregated production and investment costs renders the buyer unable to identify the seller's marginal production costs and thereby makes it difficult for the buyer to reimburse only those costs. At the same time, aggregation of production and investment costs provides sufficient information for the buyer to calculate the total trade surplus. Being able to calculate the trade surplus is important because in the absence of such information, buyers do not have sufficient information to determine what represents a reasonable trade offer and trade inefficiency is likely to ensue. Should the seller consider making a cooperative relation-specific investment, we predict that using aggregated cost information will reduce the buyer's ability to make low offers, thus raising the trade offers sellers can expect to receive post investment and, as a result, encouraging sellers to make relation-specific cooperative investments. Furthermore, although hold-up problems stem from the non-investors' self-interest (Williamson, 1995), fair purchasing practices have also been documented (cf. Carr and Ng, 1995; Dekker, 2003). Buyers who follow fair purchasing practices allow sellers to earn a reasonable profit even if, theoretically, the buyer could extract more. Accordingly, we examine whether aggregation of cost information is an effective remedy to hold-ups controlling for the non-investor purchasing practices (self-interested or fair) and investigate the process by which this occurs.

To investigate the effectiveness of aggregation of cost information as a protection mechanism against hold-ups, we conduct an

experiment that focuses on the seller's decision of whether to make a cooperative investment in a relation-specific asset. We examine this decision under two forms of the seller's investment and production costs (i.e., disaggregated and aggregated) and two types of buyer purchasing practices (i.e., self-interested and fair). When controlling for the buyer's purchasing practices, we find that aggregating the seller's investment and production costs encourages the seller to make a relation-specific cooperative investment. Furthermore, we show that this positive relationship can be explained by the fact that aggregated cost information increases the amount sellers expect to obtain from trade when buyers are expected to follow self-interested purchasing practices, while not having any negative impact on trade expectations when buyers are expected to follow fair purchasing practices. A follow-up experiment, focusing on trade efficiency, examines the buyer's offer once the seller has made the relation-specific cooperative investment. This second experiment discussed in Section 4.4 of this manuscript shows that trade is efficient when buyers are provided aggregated cost information.

This paper not only addresses the important economic problem of hold-ups, but also makes three contributions to accounting research. First, we build on previous accounting research that investigates complex supply chain relationships (e.g., Gosman and Kohlbeck, 2009) and demonstrates that sharing of information offers both benefits and risks (e.g., Baiman and Rajan, 2002b; Cooper and Slagmulder, 2004; Drake and Haka, 2008). Information sharing can improve efficiency, but can also make the party doing the sharing vulnerable to the non-sharing party's misappropriation of that information. By investigating information asymmetry as a mitigating mechanism to hold-ups, we add to the existing research on improving performance and reducing appropriation concerns via informal control mechanisms such as trust, social norms, reputation, and trade partner selection (cf., Dekker, 2004; Dekker and Van den Abbeele, 2010).

Second, whereas most previous investigations have pursued solutions to hold-ups in the form of governance mechanisms such as vertical integration or contracts, we focus on how information asymmetry might alleviate hold-ups that are especially difficult to mitigate because they are associated with cooperative investments. That is, we not only add to the growing literature on this subject (cf. Gul, 2001; Sloof et al., 2007), but also introduce accounting information and its control as a potential remedy to the hold-up problem.

Third, the information asymmetry remedy we propose lies within the investor's control and does not hinder trade. The information loss that comes with the aggregation of the seller's cost information makes it impossible for the buyer to exploit their bargaining power for the purpose of misappropriating the surplus. However, unlike with the more extreme forms of information asymmetry that have been proposed (cf. Gul, 2001), there is still sufficient information for the buyer to determine the size of the surplus and for trade to take place. Overall, the aggregation of the seller's cost information reduces the odds that the seller will be taken advantage of, while still providing enough information for buyers to make offers to sellers that are likely to be acceptable.

The remainder of this paper is organized into four sections. Following this introduction, we analyze findings from relevant literature to propose hypotheses related to the seller's investment decision and the buyer's trade (i.e., offer) decision. In the third section, we introduce our experimental design and present our experimental materials. In the fourth section, we analyze the results of our experiment on the investment decision and present supplemental analysis related to the trade decision. In the fifth section, we present our discussion and conclusion.

2. Theory and hypothesis development

2.1. Hold-ups

In the context of the supply chain, buyers and sellers often find that their working relationships carry both benefits and risks (Anderson and Sedatole, 2003; Dekker, 2004). These relationships can range from a close alliance established over time to a “new” relationship wherein one party must take the risk of making an isolated relation-specific investment for the purpose of increasing the surplus available to both parties. We examine the latter type of relationship—that is, the “new” relationship wherein the investor cannot draw on prior experience with the non-investor to make their investment decision—and investigate how to encourage such investment.

Suppose an important automobile original equipment manufacturer (OEM) demands that a supplier locate their facility or a warehouse near their assembly plant or develop an information system that is compatible with the buyer's database (cf. Bensaou, 1999). This will increase the size of the surplus to be divided between the seller and the buyer ex post (i.e., after the investment has been made) whilst also rendering the seller captive of this relationship. Sellers need to decide whether they will enter into this type of relationship and invest in a relation-specific asset.¹ Their investment decision is influenced by the comparison of their share of the surplus with and without the investment. If the seller makes the relation-specific investment, it will create a source of monopoly power for the OEM who, during trade, could choose to appropriate the difference between the anticipated value of the investment within this relationship and its value outside the relationship (Joskow, 1985). An information system designed to be compatible with a specific OEM database or the relocation of the seller's facility near that specific OEM will have little to no value outside the relationship with this OEM. Thus, in the absence of the OEM's commitment to not appropriate the surplus generated by the seller's relocation or information system, the seller risks being worse off after his investment than before, having incurred the cost of the investment but derived no benefit from it. With this in mind, the seller, who has no incentive to invest, decides against making the relation-specific investment. This suboptimal decision caused by the expected self-interested trade behavior of the buyer constitutes the hold-up problem presented by transaction cost economics (Williamson, 1975, 1985).

Studies examining hold-ups and the associated commitment problem abound and are primarily supported by investigations from transaction cost economics. In general, these studies assume self-interested behavior by the non-investor and conclude that since vertical integration and contracts offer some protection to the investor during trade, they can help to remedy hold-ups (cf. Shelanski and Klein, 1995). Vertical integration and contracts, however, are costly remedies whose effectiveness varies with the type of relation-specific investment made. While contracts can be effective with selfish relation-specific investments, they are ineffective when investments are cooperative and parties cannot commit to not renegotiating (Baiman and Rajan, 2002a; Che and Hausch, 1999).

¹ Suppliers can attempt to limit the risk that buyers will appropriate the surplus by selecting buyers. Still, suppliers might need to invest in a relation-specific investment by necessity should they decide to enter into a relationship with a specific buyer. Should this be the case, it is even more important for them to be protected from a buyer's potential opportunistic behavior ex post, given that they may no longer be able to work with other buyers that have since engaged other sellers or that their product may not fit the need of those buyers.

Cooperative investments are common, but have received relatively little research attention. They include seller investments in R&D to improve the quality of a product, in human capital to help train the buyer's sales force, or in parts or transportation methods customized for the buyer. These investments can be critical to optimizing processes in the supply chain and increasing the total profits available to all parties (Drake and Haka, 2008). However, the seller is especially vulnerable after making such a cooperative investment because their relative bargaining power weakens, while the non-investor's position improves as he can derive the benefit from the seller's investment, but does not necessarily have to pay anything for it (Che and Hausch, 1999). Since formal incomplete contracts cannot protect the investor who has already made a cooperative investment, encouraging sellers to invest in cooperative assets is especially challenging.

In response to this challenge, we examine a remedy to hold-ups that occur with cooperative investments. Specifically, we investigate substitutes to commitment with a focus on curtailing buyer ex post opportunism. We propose that information asymmetry can affect the seller's perception of ex post trade offers to expect from the buyer. Accordingly, controlling for buyer purchasing practices, we investigate whether information asymmetry in the form of aggregated seller production and investment cost improves the likelihood that the seller will invest. Furthermore, we examine the process by which this takes place and posit that providing aggregated cost information to self-interested buyers improves sellers' trade expectations sufficiently to encourage investment in relation-specific assets. Aggregated cost information can encourage the seller to invest in cooperative assets because this informal control curtails the buyer's ability to appropriate the surplus generated by the seller's investment. Knowing this, sellers might expect offers high enough to cover their investment and production cost and might be more likely to make the relation-specific cooperative investment.

2.2. Information asymmetry through aggregation of cost information

Since the seller's desire to avoid a buyer's opportunistic behavior during trade is at the root of the hold-up problem, the seller's trade expectations will influence their investment decision and sellers are especially concerned by the hold-up problem when they expect to face self-interested buyers. That is, sellers will not invest unless they expect to be better off after the investment than in the absence of investment. The seller needs to attempt to predict how the buyer will behave ex post once the relation-specific investment has been made and negotiation takes place. Sellers are likely to be faced with uncertainty about whether buyers will follow self-interested or fair purchasing practices. We propose that aggregating seller's production and investment cost will help protect sellers against buyer's potential opportunism.

The buyer's power to determine how the surplus will be divided has several origins. First, as explained above, the seller's cooperative relation-specific investment renders him captive and increases the buyer's power relative to the seller. Second, information is a well-known source of power in negotiations. That is, the buyer who knows that a relation-specific investment was made and possesses the seller's detailed cost information composed of the cost of that investment and the seller's marginal production costs (i.e., disaggregated information) will be able to determine the size of the surplus and the seller's reservation price; they can then make low offers to the seller should they be so inclined.

A buyer who enjoys an information advantage relative to the seller's reservation price captures a larger share of the surplus than their counterpart (Seale et al., 2001). Restricting the information available to the buyer will reduce the buyer's ability to

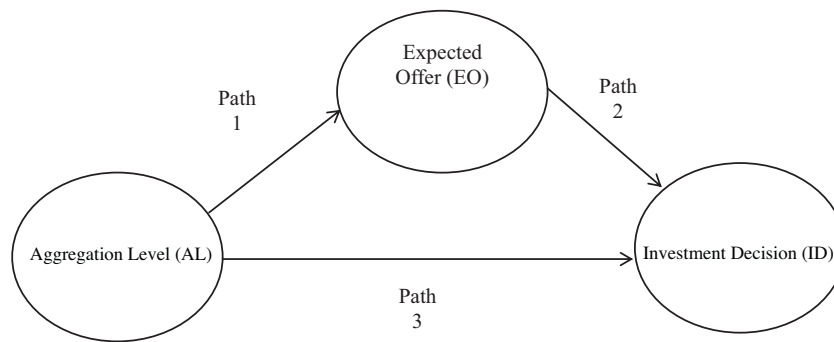


Fig. 1. Moderated Mediation Model.

This model is tested separately for the group in the self-interested purchasing practices condition and the group in the fair purchasing practices condition. The separation by purchasing practices tests whether the mediated model is moderated.

use that information to make low offers. Accordingly, negotiating parties who possess less detailed cost information are less fearful that this information might be misused (Drake and Haka, 2008; Kajüter and Kulmala, 2005). Furthermore, since sharing detailed information reduces an individual's incentive to invest (Baiman and Rajan, 2002b), limiting the information made available to the buyer might also increase the seller's incentive to invest in relation-specific assets. Extant research suggests that withholding information about the seller's reservation price will limit the buyer's ability to make low offers, thereby helping shift the balance of power to benefit the seller.

Although withholding information might reduce the risk of the buyer appropriating the surplus as discussed above, withholding too much information or the wrong information will not provide negotiating parties sufficient information to trade and will, accordingly, render trade inefficient. To that effect, Gul (2001) examines an extreme case of information asymmetry wherein the information the investor chooses to withhold relates to whether or not the investor made the relation-specific investment in the first place. Gul shows that investment in relation-specific assets increases when the investment is unobservable (that is, investment is efficient). However, the information loss is so extreme (i.e., the buyer does not know whether an investment took place) that the buyer can determine neither the size of the surplus nor the seller's reservation price. As a result, investment efficiency is followed by trade inefficiency (i.e., buyer and seller cannot agree on a price and trade fails).² Indeed, although buyers and sellers are accustomed to trade with some degree of uncertainty (Luft et al., 1998), information asymmetry that leaves the non-investor with insufficient information to establish either the size of the surplus or the investor's reservation price will hinder trade (Gul, 2001).

Baiman (1975, p. 13) suggests that, in a multiparty setting, "(t) he accountant, acting as a neutral agent of his firm, may in fact be acting in the firm's best interest by suppressing the additional information from the finer information system and letting the competition know that the information has been suppressed."³ We propose that aggregated production and investment cost is a less extreme example of information asymmetry than the one proposed by Gul. With this aggregated information, buyers will be able to calculate the surplus, thereby facilitating their ability to make an

acceptable offer to the seller ex post. Buyers who only know the seller's aggregated production and investment cost cannot identify the seller's sunk investment cost (and, as a result, cannot refuse to pay it if they intend for trade to take place). As such, buyers are faced with the following choice: They can make an offer significantly lower than this aggregated production and investment cost and capture most of the surplus should their offer be greater than the seller's production cost while running the risk that trade will not occur and earn nothing if their offer is lower than the seller's production cost. Alternatively, they can make an offer equal to or greater than this aggregated cost and capture a smaller part of the surplus, and increase the chances that their offer will be accepted. In sum, by making an offer significantly lower than the aggregated cost and attempting to be opportunistic, buyers cannot determine whether their offer covers production costs and risk earning a zero surplus. Conversely, should they make an offer that covers the aggregated cost, they can expect a positive surplus with certainty. We argue that sellers will expect that, all things being equal, on average, buyers will be more sensitive to the trades they will miss should their offer be lower than the seller's production cost than to the share of the profit they lose should their offer equal the seller's aggregated costs. Thus, it is reasonable for sellers to expect buyers with aggregated information to make higher offers than buyers with disaggregated information. The question then follows whether expected offers will be sufficiently high to motivate sellers' cooperative investment in relation-specific assets.

2.3. Seller's trade expectations and investment decision

We argue that the seller's investment decision is motivated by the size of the share of the surplus they expect to gain from trade. Importantly, expectation of a higher offer is not sufficient to lead to investment in relation-specific assets. That is, an offer that exceeds the seller's production cost, but only covers a small portion of the relation-specific investment made by the seller would leave the seller worse off than if the investment had not taken place. Conversely, an offer that covers the sum of production and investment costs would provide incentives for the seller to invest in the relation-specific asset. Such an offer can originate with a buyer who pursues fair purchasing practices and shares the surplus⁴ (cf. Dekker, 2004; Dekker and Van den Abbeele, 2010; Kumar, 1996) or result from the aggregation of the seller's cost information provided information asymmetry increases the seller's trade expectations sufficiently to cover the sum of production and investment costs.

² Gul (2001) demonstrates that one is able to achieve trade efficiency only if bargaining is costless and repeated.

³ Even with a coarse cost system, however, the aggregation of cost information is more likely to serve as a credible protection mechanism when the idiosyncratic investment is in either human capital or R&D than when it is in a piece of equipment with a well-known price. With investment in human capital or R&D, it will likely be too costly for the information system to disaggregate that information. Hence, even a powerful buyer might not be able to obtain the disaggregated cost information.

⁴ The hold-up problem goes away should the seller be assured that he will deal with a buyer who pursues fair purchasing practices.

Table 1
 Seller and buyer compensation under various scenarios.

	Seller's compensation	Buyer's compensation
If investment is made		
If trade occurs	$(\$40,000 + \text{buyer's offer} - \$40,000 - \$10,000)/10,000$	$(\$170,000 - \text{buyer's offer})/30,000$
If trade does not occur	$\$40,000 - \$40,000 = \$0$	\$0
If investment is not made	$\$40,000/10,000 = \4	NA

Note: Sellers are endowed with \$40,000 at the beginning of the experiment. They choose whether to make a \$40,000 investment in a cooperative relation-specific asset. Sellers incur a \$10,000 production cost if trade occurs.

Given aggregated information, the self-interested buyer might be inclined to make an offer that is lower than these aggregated costs to maximize their profit; yet should this offer not cover the seller's production costs, their offer will be rejected and trade will not occur leaving them with a zero surplus. Thus, it seems reasonable for sellers to expect that self-interested buyers' fear that a low offer will be rejected will encourage them to make offers that are equal to or greater than the aggregated investment and production costs. Accordingly, we posit that, on average, sellers will expect that self-interested buyers' offers will be equal or greater than the sum of the investment and production costs incurred by the sellers when buyers possess aggregated cost information. Conversely, given disaggregated information, the self-interested buyer knows the size of the production costs and sellers will expect buyers will make an offer that barely covers those production costs.

In sum, we argue that dealing with buyers following fair purchasing practices or with buyers who possess aggregated information improves sellers' trade expectations sufficiently to cover both sellers' production and investment cost and, as a result, encourages sellers to invest in relation-specific assets. To examine the process leading to the investment decision, we propose that the seller's offer expectations serve as a mediating variable between information aggregation and the investment decision. Additionally, this mediated relationship is moderated by the buyer's purchasing practices. When buyers follow self-interested purchasing practices, we predict that there will be a positive and significant relationship between the aggregation level of the seller's cost information and the offer expected by the seller (i.e., Path 1 in Fig. 1) and a positive and significant relationship between the offer expected by the seller and their investment decision (i.e., Path 2 in Fig. 1). In contrast, when buyers follow fair purchasing practices, seller's offer expectations will be uniformly "high" and not dependent on the level of aggregation of the seller's cost information. Thus, Path 1 in Fig. 1 will be insignificant, but Path 2 will be positive and significant. Overall, the mediation model is moderated by the buyer's purchasing practices. These predictions yield the following hypotheses:

H1: Sellers are more likely to make a cooperative investment in relation-specific assets when the seller's cost information provided to buyers is aggregated.

H2: Seller's offer expectations will (will not) mediate the relationship between seller's cost aggregation level and the seller's investment decision when sellers are facing buyers with self-interested (fair) purchasing practices.

To examine these hypotheses, we conduct an experiment to test how the level of aggregation of the seller's cost information affects the seller's decision to invest in the relation-specific asset, controlling for the buyer's purchasing practices.

3. Experimental design

3.1. Experimental materials

Participants are assigned the role of seller and are initially endowed with \$40,000. Participants are asked to decide whether to make a socially optimal, relation-specific cooperative invest-

ment (cf. Ellingsen and Johannesson, 2004, 2005; Sloof et al., 2007) valued at \$40,000. That is, sellers decide whether to purchase, on their firm's behalf, a relation-specific machine that will improve the quality of the parts they manufacture for a particular buyer. If sellers decide to invest and trade takes place, they incur production costs in the amount of \$10,000. Incentive compensation is calculated as a percentage of the seller's and buyer's share of the surplus, as detailed in Table 1.

Importantly, sellers make their investment decision given a certain information context (i.e., what type of cost information will be available to buyers and the buyer's expected purchasing practices), but before knowing the buyer's offer. Participants are further asked what they expect the buyer to offer them for the parts during subsequent trade.

To explain how the level of aggregation of the seller's cost information and the buyer's firm strategy might affect the investment and offer decisions, we provide participants with introductory materials detailing examples of seller and buyer potential shares of the surplus and their respective incentive compensation. Following these examples, the participants answer pre-experiment questions. These pre-experiment questions measure the participants' understanding of the experiment's key elements. Specifically, we measured whether participants properly understood the buyer's purchasing practices, how these practices might affect trade, and whether they properly understood the restrictions associated with making a relation-specific investment.

The results from participants who do not satisfactorily answer these questions are not included in the analysis.⁵ After they have made their investment decision, each participant completes a post-experiment questionnaire that includes manipulation checks and questions designed to capture their decision process and to eliminate alternative explanations.

3.2. Variables

We operationalize the level of aggregation of the seller's cost information according to whether the buyer knows the cost of the seller's relation-specific investment and their production costs (i.e., disaggregated condition) or whether the buyer knows only the sum of the seller's investment and production costs (i.e., aggregated condition).

We also manipulate the information sellers have regarding the buyer's purchasing practices to control for the effect of self-interested or fair purchasing practices. Importantly, it is critical to define to sellers what fair and self-interested purchasing practices consist of instead of leaving it to sellers' interpretation. This ensures that fair and self-interested practices have the same meaning for all participants and removes noise. Under the self-interested policy, sellers are informed there is a 75% chance they are dealing with

⁵ Fifty-four individuals participated in the experiment. Two of those individuals did not provide any trade expectations and two participants did not properly answer the pre-experiment questions, leaving us with a usable sample size of fifty participants. Including those participants in the analysis does not significantly modify our results.

a buyer who will make an offer covering only their marginal production costs. Under the fair policy, sellers are informed there is a 75%⁶ chance they are dealing with a buyer who will make an offer that shares the overall net cash evenly.⁷ Keeping in mind that past behaviors are not always indicative of future behavior (Bensaou and Anderson, 1999; Berg et al., 1995) and that the purchasing practices buyers pursue might differ between sellers (Krishnan et al., 2011), experimental instructions leave room for buyers to deviate from those practices.

The seller's investment decision constitutes the dependent variable and their trade expectations the mediator.

Sellers are randomly assigned to four conditions: two levels of information asymmetry (buyer has aggregated or disaggregated cost information) and two purchasing practices (fair or self-interested buyer purchasing practices). That is, before they make their investment decision, participants have complete knowledge of their costs and of the level of aggregation (i.e., disaggregated or aggregated) of the cost information provided to the buyer and know how likely the buyer will be to follow self-interested or fair purchasing practices.

Once sellers have made their investment decision and state the offer they expect from buyers, buyers' actual practices are selected from the distribution specified in the instructions. The sellers' share of the surplus is thereby determined and participants are subsequently compensated according to their share of the surplus.

3.3. Experimental data

Fifty MBA and undergraduate student subjects from a Midwestern university were assigned the role of seller, satisfactorily answered the pre-experiment questions, and made an investment decision. Participants did not significantly differ between conditions based on the demographics data collected (managerial accounting courses, gender, degree, and national origin).

4. Results

4.1. Manipulation checks

To measure the level of aggregation of the seller's cost information disclosed to the buyer, we asked participants post-experiment questions about their perceptions of the buyer's knowledge of the seller's exact marginal production costs. As detailed in Table 2, Panel A, participants rated the buyer's knowledge of the seller's exact production costs significantly higher in the disaggregated information condition than in the aggregated information condition.

Participants were also asked to state their understanding of the buyer's purchasing practices. As detailed in Table 2, Panel B, participants in the self-interested condition were significantly more likely than those in the fair condition to agree with the statement

⁶ We specify this distribution instead of leaving it to the interpretation of the participants to remove noise. Importantly, the main focus of this study is not whether sellers correctly predict the percentage of buyers who will deviate from their purchasing practices, it is whether they will decide to invest in a relation-specific asset based on the information they have about the buyer.

⁷ Our operationalization of self-interested purchasing practices is consistent with economic theories that assume that self-interested buyers only reimburse marginal production costs. Our operationalization of fair purchasing practices is consistent with prior literature which finds that a buyer with fair practices will reimburse suppliers for their marginal production costs and past investment cost, and share some of surplus created by the investment (cf. Kumar, 1996; Sako, 2004). Instructions suggest that buyers would share the surplus equally to remove noise (cf. Camerer and Loewenstein, 1993).

that buyers would offer just enough to cover the seller's marginal production costs.

4.2. Descriptive statistics

Since the reluctance to invest in cooperative relation-specific assets is due to expectations of self-interested behavior by the non-investor, we focus on describing whether what we observe is consistent with hold-up behavior. A buyer with self-interested purchasing practices⁸ will attempt to offer just enough to cover the seller's production costs, thus leaving the seller who made a relation-specific investment worse off than they were before the investment.

Consistent with prior hold-up research, sellers in the self-interested/disaggregated condition expect buyers to make offers that will not cover the sellers' combined investment and production cost of \$50,000: The expected offer mean of \$26,947 is significantly lower than the combined cost of \$50,000 (t -statistic = 2.72, $p < 0.02$) and is marginally larger than the sellers' production costs of \$10,000 (t -statistic = 2.00, $p = 0.07$). As such, it will leave the seller worse off after the investment than before (see Table 3, Panel A). In the self-interested/disaggregated information condition, Panel B of Table 3 shows that only two of the 14 sellers (or 14%) invest. These results are broadly consistent with economic predictions and provide evidence of the existence of hold-ups when the non-investor pursues self-interested purchasing practices and possesses disaggregated seller cost information.

Conversely, in the self-interested/aggregated information condition, sellers expect that self-interested buyers will cover the seller's combined investment and production costs (i.e., the expected-offer mean of \$51,218 is not significantly different from the combined cost of \$50,000, t -statistic = 0.243, $p = 0.812$). Panel B of Table 3 shows that ten of the 12 sellers (or 83%) invest. The mean number of sellers who invest is significantly greater in the self-interested/aggregated than in the self-interested/disaggregated condition (t -statistic = 4.68, $p < 0.001$).

Finally, in the fair condition, most sellers invest. There is no significant mean difference between the aggregated and disaggregated conditions for expected offers or the number of sellers who invest (t -statistic = 0.35, $p = 0.73$ and t -statistic = 0.91, $p = 0.37$, respectively).

4.3. Hypotheses tests

We test how the level of aggregation of the seller's cost information affects the seller's decision to invest in the relation-specific asset in two steps. First, we examine the effect of the level of aggregation of the seller's cost information on the sellers' investment decision while controlling for the buyer's purchasing practices (Hypothesis 1). Second, we examine whether seller's trade expectations mediate the relationship between aggregation of seller's information and the seller's investment decision when they are faced with self-interested buyers (Hypothesis 2).

4.3.1. Effect of the level of aggregation of the seller's cost information on seller's investment

Hypothesis 1 predicts that increasing the level of aggregation of the cost information provided to the buyer increases the likelihood that sellers will make a cooperative investment in a relation-specific asset. Results from a PROBIT estimation detailed in Table 4 indicate that, controlling for buyer's purchasing practices,

⁸ For simplicity sake, we refer to buyers with self-interested (fair) purchasing practices as self-interested (fair) buyers.

Table 2
Manipulation checks^a: Level of Aggregation of Seller Information and Buyer Purchasing Practices.

Panel A: Level of Aggregation of Seller Information			
Questions	Mean		t-statistic (one-tailed)
	Disaggregated	Aggregated	
Q: I believed Buyer B knew exactly what my expected production costs were.	7.78	3.96	6.66 ($p < 0.001$)
Q: Even if Buyer B's firm policy was to offer just enough to cover production costs, there was a chance I might get reimbursed for the cost of the machine I purchased (reverse coded).	7.11	5.09	2.74 ($p < 0.01$)
Q: I believed Buyer B knew the total of my expected production costs and machine costs but did not know my exact expected production costs (reverse coded).	5.93	3.13	4.08 ($p < 0.001$)
Panel B: Buyer Purchasing Practice			
Questions	Mean		t-statistic (one-tailed)
	Self-interested	Fair	
Q: Buyer B's firm purchasing strategy is to cover expected production costs.	6.08	3.60	4.17 ($p < 0.001$)
Q: Buyer B's firm purchasing strategy is to share the net cash evenly between both firms (reverse coded).	6.27	3.27	5.62 ($p < 0.001$)

Level of Aggregation of Seller Information:

Disaggregated information: Buyer knows both the seller's marginal production costs and investment cost.

Aggregated information: Buyer knows only the sum of the seller's marginal production costs and investment cost.

Buyer Purchasing Practices:

Self-interested practices: Buyer's purchasing practices are to cover the seller's marginal production costs.

Fair practices: Buyer's purchasing practices are to share the surplus equally with the seller and to cover both the seller's marginal production costs and investment cost.

^a We measured questions on a 9-point likert scale wherein 1 represents strongly disagree and 9 represents strongly agree.

Table 3
Descriptive statistics.

Panel A: Seller's Expected Offer—Mean (Standard Deviation)		
	Self-interested practices	Fair practices
Disaggregated information	\$26,947 (\$31,688) $n = 14$	\$82,250 (\$35,972) $n = 13$
Aggregated information	\$51,218 (\$17,340) $n = 12$	\$86,932 (\$27,902) $n = 11$
Marginal means	\$38,149 (\$28,403) $n = 26$	\$84,396 (\$31,926) $n = 24$
Panel B: Seller's Investment Decision—Frequency of Seller Investment		
	Self-interested practices	Fair practices
Disaggregated information	2/14 or 14% invest	12/13 or 92% invest
Aggregated information	10/12 or 83% invest	11/11 or 100% invest
Marginal means	12/26 or 46% invest	23/24 or 96%

Level of Aggregation of Seller Information:

Disaggregated information: Buyer knows both the seller's marginal production costs and investment cost.

Aggregated information: Buyer knows only the sum of the seller's marginal production costs and investment cost.

Buyer Purchasing Practices:

Self-interested practices: Buyer's purchasing practices are to cover the seller's marginal production costs.

Fair practices: Buyer's purchasing practices are to share the surplus equally with the seller and to cover both the seller's marginal production costs and investment cost.

Table 4
Determinants of Seller Investment Decision—Test of H1.

Predictor	Coefficient (Z value, p -value)
<i>Aggregation Level</i>	2.04 (3.43, $p = 0.001$)
<i>Purchasing Practices</i>	2.50 (3.82, $p < 0.001$)
Intercept	-1.07 (-2.59, $p < 0.01$)
N	50
Adjusted R ^{2a}	0.457
Chi-square (Pearson) ^b	39.13 (0.79)

Notes: Coefficients that are significant at $p < 0.05$ or better are boldfaced. Seller Investment Decision takes the value of 1 if the seller invests in the cooperative relation-specific asset and 0 otherwise. *Aggregation Level* takes the value of 1 when seller's production and investment costs are aggregated and 0 otherwise. *Purchasing Practices* takes the value of 1 when buyer's purchasing practices are fair and 0 when purchasing practices are self-interested.

^aBased on results from OLS. OLS results are consistent with the results from the PROBIT.

^bPearson goodness-of-fit test. A well-fitting model has an insignificant Chi-square statistic.

Aggregation level is significantly positively associated with Seller Investment Decision and provide support for Hypothesis 1.

Table 4 also shows that the Buyer's Purchasing Practices are significantly associated with Seller Investment Decision all things

being equal. That is, as expected, the likelihood of the seller investing in relation-specific asset increases when the seller expects the buyer to follow fair purchasing practices.

4.3.2. Moderated mediation model —understanding the effect of aggregation of seller's cost information

We now examine the process by which the level of aggregation of seller cost information encourages seller's investment in a cooperative relation-specific asset. Hypothesis 2 predicts that aggregating the seller's production and investment cost information provided to the buyer increases sellers' trade expectations sufficiently to improve the likelihood that a seller faced with a buyer with self-interested purchasing practices will invest in a cooperative relation-specific asset. Conversely, aggregating the seller's production and investment cost information does not significantly alter sellers' trade expectations when buyers are fair.

To investigate whether the seller's trade expectations mediate the relationship between accounting information and the seller's investment decision, we followed procedures outlined in Baron and Kenny (1986) and Preacher and Hayes (2004). As noted by Baron and Kenny (1986, p. 1176), three conditions must be met for a variable to be considered a mediator:

Table 5
Moderated mediation model-Test of H2.

Panel A: Self-Interested Practices Group				
	Path	Standardized coefficient	t-statistic	p-value
	AL to EO	0.43	2.36	0.013
	EO to ID	0.87	8.47	<0.001
	AL to ID	0.31	2.62	0.007
Indirect Effect	AL to ID via EO	0.37	2.28	0.016
Panel B: Fair Practices Group				
	Path	Standardized coefficient	t-statistic	p-value
	AL to EO	0.07	0.35	0.364
	EO to ID	0.50	2.69	0.006
	AL to ID	0.15	0.52	0.305
Indirect Effect	AL to ID via EO	0.04	0.35	0.365

Notes: Coefficients that are significant at $p < 0.05$ are boldfaced.

AL = Aggregation Level takes the value of 1 when seller's production and investment costs are aggregated and 0 otherwise.

EO = Expected Offer represents sellers' trade expectations.

ID = Seller Investment Decision takes the value of 1 if the seller invests in the cooperative relation-specific asset and 0 otherwise.

- 1 Variations in levels of the independent variable significantly account for variations in the presumed mediator,
- 2 Variations in the mediator significantly account for variations in the dependent variable, and
- 3 When the paths from 1. and 2. are controlled, a previously significant relation from the independent to the dependent variable is no longer significant, with the strongest demonstration of mediation being when the relationship goes to zero.

For practical considerations, Baron and Kenny (1986, p. 1176) suggest that for condition 3. "... a more realistic goal may be to seek mediators that significantly decrease [the relationship between the independent and dependent variable] rather than eliminating the relation altogether."

In our study, the independent variable is the Aggregation Level of the seller's cost information (AL), the proposed mediator is the buyer's Expected Offer (EO), and the dependent variable is the seller's Investment Decision (ID) as detailed in Fig. 1.

When we examined the relationship between AL and EO using the full sample (i.e., with both purchasing practices included), we found only a marginally significant relationship (correlation coefficient = 0.196, t -statistic = 1.38, $p = 0.086$). Given the pattern of results shown in Table 3, Panels A and B, we split the sample into two groups – sellers facing buyers with fair purchasing practices and sellers facing buyers with self-interested practices – to examine if the mediation model was moderated (i.e., the mediation model was different across the two groups). Thus, we are investigating whether there are conditional indirect effects as described in Preacher et al. (2007). In particular, we are examining whether there is a moderated mediation which is defined by Preacher et al. (2007, p. 193) as occurring when "... the strength of an indirect effect depends on the level of some variable, or in other words, when mediation relations are contingent on the level of a moderator." In our study, the moderator is the buyer's Purchasing Practices.

We first examine the group where sellers face buyers with self-interested purchasing practices. As shown in Panel A of Table 5, there is a significant relationship between AL and EO (condition 1 of Baron and Kenny (1986)) and a significant relationship between EO and ID (condition 2 of Baron and Kenny (1986)). In addition, the relationship between AL and ID was reduced when including the mediator (condition 3 of Baron and Kenny (1986)). Before adding the mediator, the AL to ID correlation was 0.69 (t -statistic = 4.68, $p < 0.001$). Including EO as a mediator results in a residual direct effect between AL and ID of only 0.31 (t -statistic = 2.62, $p = 0.007$).

As prescribed in Preacher and Hayes (2004), testing the significance of the indirect effect by use of methods such as the Sobel test is also warranted. Using this method, the indirect effect is significant (t -statistic = 2.28, $p = 0.016$) as shown in Panel A of Table 5. Overall, there is support for the mediation model when sellers are faced with buyers known to follow self-interest purchasing practices.

In contrast, when examining the group where sellers faced buyers with fair purchasing practices, the mediation model does not hold. As shown in Panel B of Table 5, there is not a significant relationship between AL and EO (condition 1 of Baron and Kenny (1986)) and the indirect effect is not significant (t -statistic = 0.35, $p = 0.365$). The only significant relationship is between EO and ID (t -statistic = 2.69, $p = 0.006$).

Given the results for the two groups, we find support for a moderated mediation model (Preacher et al., 2007). More specifically, the indirect effect of the Aggregation Level is significant for the self-interested group and insignificant for the fair group. Overall, the analyses show that the impact of information asymmetry on the decision to make a cooperative investment depends on the type of buyer the seller believes they are dealing with. In the case of self-interested buyers, sellers that know buyers only have access to aggregated cost information believe that the offers they will receive will be higher, leading to an increased likelihood that they will make the investment. In the case of fair buyers, sellers expect to receive relatively high offers regardless of the type of information buyers are provided with. These results suggest that sellers' trade expectations inform sellers about what the outcome of the potential investment might be and, accordingly, influence sellers' investment in cooperative relation-specific assets.

4.4. Supplemental analysis

While the above investment experiment provides evidence that aggregation of the seller's cost information improves investment efficiency, trade efficiency (i.e., agreement from trade) cannot be directly measured since no participant takes on the role of buyer in the trade task and sellers do not actually reject or accept offers. However, since trade efficiency is of concern because it has been proposed (cf. Gul, 2001) and observed (Sloof et al., 2007) that partial sharing of information impairs trade efficiency, we examine trade efficiency in an indirect manner.

Since the trade behavior of self-interested buyers is at the root of the hold-up problem and we show that providing aggregated cost information to the buyer increases sellers' trade expectations sufficiently to solve the hold-up problem when sellers are faced with self-interested buyers (i.e., investment is efficient), it is crucial to test whether trade efficiency is a concern when buyers are self-interested. Accordingly, we conduct a second experiment to examine the buyer's trade decision subsequent to the seller's relation-specific investment and focus our analysis on the trade behavior of buyers in the self-interested/aggregated condition. Like in the investment experiment, each participant completes a post-experiment questionnaire that includes manipulation checks and questions designed to capture their decision process and to eliminate alternative explanations.

In this experiment, participants are assigned the role of buyer. Their task consists of deciding how much to offer a seller who has made a socially optimal relation-specific investment. Recall that the main driver of the hold-up problem is the seller's expectation that the buyer will appropriate the surplus generated by the investment. Since the surplus from trade is fixed once the investment has been made, the buyer's offer serves as a measure of how the surplus will be divided. Accordingly, for this task, the buyer's offer constitutes the variable of interest. Each buyer learns that they will make an offer to purchase parts from a seller who has already made

Table 6
Supplemental analysis of trade experiment mean buyer offer (Standard Deviation).

	Self-interested practices	Fair practices	Marginal means	t-statistic (p-value)
Disaggregated information	\$16,857 (\$15,341) n = 14	\$107,500 (\$17,645) n = 12	\$58,692(\$48,815)n = 26	14.02 (p < 0.001)
Aggregated information	\$38,625 (\$19,609) n = 12	\$102,083 (\$19,477) n = 12	\$70,354(\$37,628)n = 24	7.95 (p < 0.001)
Marginal means	\$26,904 (\$20,348) n = 26	\$104,792 (\$18,385) n = 24	\$64,290(\$43,761) n = 50	
t-statistic (p-value)	3.18 (p < 0.004)	-0.71 (p = 0.48)		

a relation-specific cooperative investment. Buyers are randomly assigned to four conditions similar to the investment experiment's conditions: two levels of information asymmetry (disaggregated or aggregated) and two purchasing practices (fair or self-interested). Buyers learn the seller's cost information, either in disaggregated or aggregated form, and the revenue they can expect to obtain from selling the product to the outside market. They are instructed to use their firm's purchasing practices (i.e., self-interested or fair) to guide their offer.

Sellers are assumed to be self-interested. Accordingly, consistent with transaction cost economics, given that an idiosyncratic investment has already been made, any offer that is weakly greater than production costs should be accepted by suppliers. Thus, the minimum offer acceptable by a self-interested seller is \$10,000, i.e., the production costs, in this experiment. Therefore, any offer that is equal to or greater than \$10,000 will be deemed accepted and will, accordingly, result in efficient trade.

Fifty MBA and undergraduate students from a Midwestern university were assigned the role of buyer, satisfactorily answered the pre-experiment questions, and made an offer decision. Participants did not significantly differ between conditions based on the demographics data collected (managerial accounting courses, gender, degree, and national origin) and were similar to the participants in the investment experiment.

With aggregated cost information, \$30,000 is the modal offer observed and all but two offers are equal to or greater than \$30,000 when buyers are self-interested. Conversely, with disaggregated cost information, \$11,000 is the modal offer of self-interested buyers. Hence, the results of this experiment are consistent with efficient trade for the aggregated/self-interested condition despite information asymmetry.

Still, although trade is likely to be efficient, mean offers made by self-interested buyers who possess aggregated information (\$38,625) are marginally lower than \$50,000 or the sum of the seller's investment and production costs at traditional levels ($t = 2.01$, $p = 0.07$ two-tailed). As such, this observation can have potential detrimental effects on future collaboration should additional relation-specific investments be necessary. Mean offers by conditions are detailed in Table 6.

Our main analyses combined with this supplemental analysis provide evidence that, contrary to other forms of information asymmetry, information asymmetry that takes the form of aggregated cost information not only leads to investment efficiency, but also does not impair trade efficiency.

5. Discussion and conclusion

In this study, we examine how to encourage sellers' cooperative investment in relation-specific assets and thereby reduce the investment inefficiency that traditionally attends the hold-up problem. Hold-ups and the failure to make socially optimal relation-specific investments arise because the investor fears that the non-investor will be self-interested, have a short-term focus, and behave opportunistically. As a result, the investor fears the non-investor will exploit his monopoly power and appropriate the surplus generated by the seller's investment.

While, by and large, the extant literature focuses on using formal control mechanisms, such as vertical integration and contracts, to provide remedies to the hold-up problem, these remedies are costly or largely ineffective when it comes to cooperative investments that benefit the non-investor. Building on accounting investigations into inter-firm relationships, we examine whether information asymmetry in the form of aggregation of seller cost information (i.e., an informal control) can be used as remedy to the hold-up problem in the absence of a buyer's credible commitment to refrain from appropriating the surplus. We propose that the seller can increase his power by making less information available to the buyer (namely, creating information asymmetry). We argue that the existence of information asymmetry will reduce the potential for buyer opportunism and lead the seller to expect higher offers from self-interested buyers, thus encouraging the seller's investment in relation-specific assets.

The results from our experiment indicate that the aggregation of the seller's cost information increases the likelihood that sellers will make a cooperative investment in relation-specific assets controlling for the non-investor purchasing practices. This relationship can be further explained as follows: First, aggregation of the seller's cost information makes it impossible for the buyer to identify the seller's production costs and increases the seller's expectations that a self-interested buyer will make a higher offer during trade. Higher expected offers are, in turn, associated with increased likelihood that sellers will invest in relation-specific assets. In line with this reasoning, we document a positive indirect effect of information asymmetry on the seller's decision to make a cooperative relation-specific investment when buyers follow self-interested purchasing practices.

Our findings are informative for buyers and sellers who consider the costs and benefits of information sharing. Open book accounting, a form of information sharing, has been implemented by buyers with varied levels of success. On the one hand, open book accounting can lead to increased cost transparency and can provide insights into the management process (Agndal and Nilsson, 2010; Mouritsen et al., 2001). On the other hand, such information sharing can be risky for sellers in the absence of trust (Free, 2008). This cost/benefit analysis is further complicated when buyers and sellers must enter into trade transactions preceded by cooperative relation-specific investments. In those situations, buyers might want to refrain from forcing the seller to disaggregate the production and investment costs to encourage the seller to make a socially optimal cooperative relation-specific investment. As such, a given buyer may wish to waive the requirement that a seller use open book accounting, as this accounting control would enable the buyer to obtain disaggregated cost information and facilitate opportunistic behavior on their part, which, in turn, might reduce the seller's incentive to invest in the relation-specific asset. Still, even in the absence of an information sharing technology such as open book accounting, a seller runs the risk that the buyer will attempt to force the disaggregation of their cost information once the investment has taken place, unless the accounting system used simply cannot accommodate this request (Baiman, 1975). Thus, aggregation of the seller's cost information is most likely to serve as a remedy to the hold-up problem when the costs in question are not easily

disaggregated and take the form of investments in R&D or human capital.

Although this study has important implications for negotiations and firm behavior, it also has several limitations. First, reducing the transparency of the seller's cost information forces the buyer to pick up some of the seller's investment cost and thereby limits the buyer's ability to help the seller further reduce the cost of the intermediary product; this, in turn, might lead the buyer to charge more for the final product, possibly rendering the buyer less competitive in the outside market. As such, the information loss that provides incentives for the seller to invest and increases the size of the surplus may come at a cost to the buyer. Accordingly, we do not recommend that sellers aggregate their costs indiscriminately; rather, buyer and seller should weigh the potential costs and benefits of such aggregation, compare the share of the surplus they stand to gain from both aggregated and disaggregated cost information, and take the buyer's purchasing practices into account (cf. Agndal and Nilsson, 2010). They should also compare the size of the surplus they stand to gain, both jointly and individually, under the various methods aimed at mitigating hold-ups as well as the costs associated with these controls (e.g., vertical integration, contract terms, bilateral investments, aggregation of seller's cost information, buyer's reputation for fairness). Future research might want to explore further the costs and benefits associated with information sharing and identify boundaries to information sharing when relationships involve relation-specific investments.

Future research could also investigate other methods that can help suppliers protect themselves from the appropriation of the surplus by self-interested buyers using mechanisms such as reducing the quality of the products they provide to a self-interested buyer, refusing to share innovations with those buyers, or highlighting the long-term benefits the buyer can derive from not appropriating the surplus. Although our presentation of the hold-up has a short-term focus consistent with extant transaction cost economics research, we acknowledge that providing the buyer with long-term incentives can help mitigate hold-ups.

To better gauge how information asymmetry and the sunk relation-specific investment affect trade efficiency, scholars may wish to conduct actual buyer-seller negotiations. For instance, even though the economics literature suggests that sellers will accept any offer that covers their production costs alone, sellers may, in fact, fall prey to the sunk cost bias during negotiation and accept only offers that exceed the sum of their production and investment costs. It would also be interesting to investigate how effective, relative to other remedies, the remedies we propose are on the investment and trade decisions when both parties invest in the relation-specific asset (cf. Carmichael and MacLeod, 2003) or when exchanges are repeated. Finally, in addition to existing inter-firm decisions, hold-ups occur in intra-firm decisions—for example, resource allocation between divisions or principal-agent relationships—and one might also evaluate the effectiveness of the remedies presented herein in these settings.

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Appendix A.

Excerpt from Investment Instructions (Self-interested Practices)

You are assigned the role of Seller. The Seller manufactures parts and sells parts to buyers. You have an opportunity to undertake a project with a Buyer. This project could be mutually beneficial. This project requires you to purchase a machine to improve the quality of the parts you manufacture. If you purchase the machine, the Buyer will purchase the parts from you and assemble them into a final product sold to the outside market. You cannot sell these parts to another buyer and the Buyer cannot purchase these parts from another seller.

Your task is to decide whether to purchase the machine that improves the quality of the parts you manufacture for the Buyer. This machine is project-specific and can only be used to make the parts the Buyer needs. It has no value outside this project with the Buyer. Your goal is to maximize your firm's net cash, and thus your own compensation, by capturing as much of the net cash as possible. Your firm's net cash is calculated by deducting your costs from the amount the Buyer offers you for the parts.

You will work through some examples before making your investment decision.

...

Your task

Buyer B asked you to make a project-specific purchase decision. This project could be mutually beneficial. Here are further details about your prospective project with Buyer B. You have not worked with Buyer B before.

You believe that there is a 75% chance that Buyer B's firm purchasing strategy is to offer just enough to cover expected production costs. You believe there is a 25% chance that Buyer B's purchasing strategy is to make an offer that shares the overall net cash between Buyer and Seller firms evenly.

The amount of sales revenue that Buyer B can expect for the final product is contingent upon whether you purchase the project-specific machine:

Your machine cost	Buyer B sales revenue
\$0 (No purchase made)	\$0
\$40,000	\$170,000

If you purchase the machine—This machine has no value outside this project with Buyer B. In addition to the machine cost of \$40,000, you expect to incur production costs of \$10,000 if you accept Buyer B's offer.

If you do not purchase the machine—Your firm's net cash will be \$0.

...

Please make your investment decision

Select the cost of the machine you would like to purchase:

___\$0 (equivalent to no purchase made)

___\$40,000

How much do you anticipate Buyer B will offer you? _____

What is the lowest offer you would accept? _____

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