Inventory management in supply chains: A bargaining problem

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Abstract

This paper is focused on supply chain management from the perspective of inventory management. The coordination of order and production policies between buyers and suppliers in supply chains is of particular interest. When a buyer of an item decides independently, he will place orders based on his economic order quantity (EOQ). However, the buyer’s EOQ may not lead to a favorable policy for the supplier. A cooperative order and production policy can reduce total cost significantly. Should the buyer have the dominant position to impose his EOQ on the supplier, then consequently no incentive exists for him to deviate from his EOQ in order to choose a cooperative policy. To induce the buyer to order in quantities more favorable to the supplier, the supplier could offer a cooperative policy associated by a side payment to the buyer. The research presented in this paper provides several bargaining models depending on alternative production policies of the supplier. With these bargaining models the offered cooperative policy and the offered side payment can be derived.

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1. Introduction

1.1. The problem of coordination: EOQ and ELS solutions

The term supply chain management refers to cooperative management of materials and information flows between supply chain partners, to reach goals that cannot be achieved acting individually. This paper focuses on the supply chain from the perspective of inventory management.

In contrast to multi-echelon inventory management, that coordinates inventories at multiple locations of one company, a joint inventory replenishment policy in supply chains involves coordination among multiple firms (Johnson and Pyke, 2001, pp. 794–795). Therefore, the coordination of order policy and production policy between
buyers and suppliers in supply chains is of special interest (Landeros and Lyth, 1989, pp. 146–147). When the buyer and supplier treat inventory problems singly under deterministic conditions, the economic order quantity (EOQ) formula or the economic lot size (ELS) formula gives an optimal solution. However, in general, an order policy based on the EOQ solution is undesirable to the supplier and likewise, a production and delivery policy based on the ELS solution is unacceptable to the buyer (Lu, 1995, p. 312).

1.2. JELS models with equal and unequal sub-batches

The problem of coordination between the order policy and the production policy of a buyer and a supplier has received considerable attention in recent years. Goyal (2000), Goyal and Gupta (1989), Joglekar and Tharthare (1990), Thomas and Griffin (1996), and Sharafali and Co (2000) give detailed reviews of integrated buyer–supplier inventory models. A number of authors, including Goyal (1976, 1988), Banerjee (1986b), Landeros and Lyth (1989), Chatterjee and Ravi (1991) and Agrawal and Raju (1996) demonstrate methods to gain cost savings. They suggest joint economic lot size (JELS) models where the objective is to minimize the joint total relevant costs for both the buyer and the supplier. It is shown that an integrated inventory replenishment policy is more desirable than individual optimal policies of the parties involved. While all models use the accepted EOQ formula to determine buyer’s individual optimal order policy, the distinguishing feature is the assumed production and delivery policy of the supplier. Goyal (1976) assumes an infinite production rate for the supplier. Banerjee (1986a) generalizes Goyal’s model by integrating a finite production rate, assuming that the supplier follows a lot-for-lot policy. Goyal (1988) further relaxes the lot-for-lot assumption by assuming that each production batch is dispatched to the buyer in an integer number of equal sized sub-batches. Landeros and Lyth (1989) further generalize these models by incorporating fixed delivery cost associated with each shipment to the buyer. However, these models assume that the whole production batch must be finished before any shipments from the batch can take place. Agrawal and Raju (1996) consider that the supplier may wish to ship a number of equal sized sub-batches before the whole production batch is finished. Based on a much earlier idea set out by Goyal (1977), Goyal (1995) shows the use of unequal sized sub-batches. This production and delivery policy involves successive shipments within a production batch so that the size of the sub-batches increases according to a geometric series. The ith sub-batch size within a production batch will be: (first shipment size)-(production rate/demand rate)\(^{(i-1)}\). Chatterjee and Ravi (1991) present an equivalent model considering fixed delivery costs associated with each shipment. Viswanathan (1998) shows that neither a policy with equal sized sub-batches nor a policy with unequal sized sub-batches dominates the other. Hill (1997), however, suggests a more general class of supplier’s production and delivery policies. The ith sub-batch size is given by: (first shipment size)\(y^{(i-1)}\), with \(1 \leq y \leq\) (production rate/demand rate). He shows that, at a fixed transportation cost per shipment, the total costs are smaller then using equal sized sub-batches. Another kind of delivery policy is shown in Goyal and Szendrovits (1986), Goyal and Nebebe (2000) and Goyal (2000). A certain number of unequal-sized sub-batches are combined with a number of equal sized sub-batches. However, one may identify two deficiencies of delivery policies with unequal sized sub-batches. First, the capacity of the handling, packing and shipping equipment must be at least equal to the largest sub-batch size and hence, becomes underutilized for smaller sub-batch sizes, which leads to idle-capacity costs (Goyal and Szendrovits, 1986, p. 204). On the other hand, if the size of a sub-batch exceeds the load-capacity of the transportation unit more then one shipment per sub-batch are necessary. Therefore, using unequal sized sub-batches, it is inappropriate to treat shipment costs as being independent of the sub-batch size (Szendrovits, 1978, p. 1018). Second, supply and receipt of unequal sized sub-batches associated with order intervals of different length cause a prohibitive operational planning and control effort for the supplier and the buyer (Agrawal and Raju,
Nevertheless, neither the models with equal-sized sub-batches nor the models with unequal-sized sub-batches consider the power structure in buyer–supplier relationships.

1.3. Models considering the power structure in buyer–supplier relationships

Should either party be in a position to impose his EOQ or ELS on the other party, consequently no incentive exists for this party to choose a cooperative policy. Essentially, the dominant party will be at a disadvantage if the JELS solution is adopted. However, by adopting the JELS solution the dominant party’s loss is more than offset by the gain of the weaker party (Banerjee, 1986a, p. 308). Thus, to provide an incentive to choose a joint policy the weaker party can offer a side payment to the dominant party. The order and delivery quantities and the side payment are determined through a bargaining process between the parties. The supplier’s problem to influence the buyer’s order policy by a price discount was analyzed by previous authors, including Monahan (1984), Banerjee (1986b), Lee and Rosenblatt (1986), Joglekar (1988) and Hill (1997). However, there are very few contributions dealing with the bargaining process between the buyer and the supplier. Side payment problems can be considered as two-person-nonzero-sum games in which the buyer and the supplier try to maximize their individual gains.

The research presented in this paper offers bargaining models, assuming that the buyer has the bargaining power to enforce his EOQ on the supplier in case of a break-down in negotiations. Therefore, the supplier has to offer a side payment that will certainly guarantee that the buyer accepts the contract. With these bargaining models optimal contracts can be derived.

2. Individual optimal order and production policies

2.1. Individual optimal order policy of the buyer

The discussion and analysis in this paper is restricted to the case of a single supplier (P) and single buyer (A) of a specific item. The demand rate, \( b \) [unit/period], for the item is assumed constant and deterministic. Shortages are not permitted at the buyer’s end, and the time horizon over which the item is ordered by (A) and supplied by (P) is infinite. The lead-time for (A) is zero. If (A) operates independently, his total relevant cost per period is given by

\[
K^A(x_A) = B \frac{b}{x_A} + \frac{x_A}{2} h_A
\]

with \( b \) being the buyer’s demand rate [unit/period], \( x_A \) the buyer’s order quantity per order [unit], \( B \) the buyer’s ordering cost per order [$], and \( h_A \) the buyer’s inventory holding cost [$/unit and period].

The objective of (A) is to minimize his total relevant cost per period. It is easy to identify that for an optimal policy every order is received precisely when the inventory level drops to zero (Bramel and Simchi-Levi, 1997, pp. 145–147). The EOQ and the minimum total relevant cost per period are given by

\[
x^*_A = \sqrt{\frac{2Bb}{h_A}}, \quad K^A(x^*_A) = \sqrt{2Bbh_A}.
\]
In case of lot streaming, assuming an uninterrupted production run, any shipments can be made from a production batch before the whole batch is finished. However, some suppliers cannot accommodate lot streaming because of regulations, material handling equipment, or production restrictions (Silver et al., 1998, p. 657). Without lot streaming the whole production batch must be finished before any shipments can be made from the batch (Hill, 1997, p. 493). The opportunity of lot streaming affects supplier’s average inventory. According to Goyal (1988) the average inventory without lot streaming will be \((x_{\text{PT}}/2)(I(1 + b/d) - 1)\) [unit]. With lot streaming, Hill (1997) and Agrawal and Raju (1996) show the average inventory to be \((x_{\text{PT}}/2)(I - 1 - Ib/d + 2b/d)\) [unit]. The supplier’s inventory holding cost is given by \(h_p\) [$/unit and period].

### 2.2.1. Individual optimal production and delivery policy without lot streaming

If (P) operates independently, without the opportunity of lot streaming, his total relevant cost per period is given by

\[
K^p(I, x_{\text{PT}}) = R_1 \frac{b}{I_{\text{PT}}} + R_2 \frac{b}{x_{\text{PT}}} + \frac{x_{\text{PT}}^2}{2} \left( I \left( 1 + \frac{b}{d} \right) - 1 \right) h_p. \tag{3}
\]

The objective of (P) is to minimize his total relevant cost per period. For a given value of \(I\) the optimum value of \(x_{\text{PT}}\) is given by

\[
x_{\text{PT}}^*(I) = \frac{2b(R_1/I + R_2)}{h_p(I(1 + (b/d) - 1))}. \tag{4}
\]

Substituting \(x_{\text{PT}}^*(I)\) in (3), the total relevant cost per period as a function of the integer number \(I\) of shipments per batch production run is given by

\[
K^p(I) = \sqrt{2bh_p \left( R_1 \left( 1 - \frac{b}{d} \right) - R_2 + R_2 \left( 1 - \frac{b}{d} \right) - \frac{R_1}{I} \right)}. \tag{5}
\]

It is easy to see that the optimal integer number \(I\) of shipments is \(I^* = 1\). Without lot streaming the individual optimal production lot size is identical to the individual optimal shipment quantity \((x_{\text{PT}}^* = x_{\text{PT}}^*)\). (P) follows a lot-for-lot policy, i.e. after finishing the production batch he ships the whole batch to (A). The individual optimal production and delivery policy and the total relevant cost per period are given by

\[
x_{\text{PT}}^* = x_{\text{PT}}^* = \sqrt{\frac{2d(R_1 + R_2)}{h_p}}, \tag{6}
\]

\[
K^p(I^* = 1, x_{\text{PT}}^*) = b \sqrt{\frac{2(R_1 + R_2)h_p}{d}}. \tag{6}
\]

### 2.2.2. Individual optimal production and delivery policy with lot streaming

If (P) operates independently, using the opportunity of lot streaming, his total relevant cost per period is given by

\[
K^p(I, x_{\text{PT}}) = R_1 \frac{b}{I_{\text{PT}}} + R_2 \frac{b}{x_{\text{PT}}} + \frac{x_{\text{PT}}^2}{2} \left( I - 1 - \frac{Ib}{d} + \frac{2b}{d} \right) h_p. \tag{7}
\]

Using lot streaming the optimum value of \(x_{\text{PT}}\) for a given value of \(I\) is given by

\[
x_{\text{PT}}^*(I) = \frac{2b(R_1/I + R_2)}{h_p(I - 1 - Ib/d + 2b/d)}. \tag{8}
\]

Substituting \(x_{\text{PT}}^*\) in (7) leads to

\[
K^p(I) = \sqrt{2bh_p(R_1/I + R_2)(I - 1 - Ib/d + 2b/d)}. \tag{9}
\]

The optimal integer number of shipments is given by the \(I^*\) that satisfies

\[
K^p(I^* - 1) \geq K^p(I^*), \tag{10}
\]

Substituting (9) into (10) and appropriately rearranging terms, (10) is equivalent to

\[
I^*(I^* + 1) \geq \frac{R_1(2b/d - 1)}{R_2(1 - b/d)} \Rightarrow I^*(I^* - 1). \tag{11}
\]

As can be seen from (11), the optimal integer number of shipments can only be determined for \(2b > d\). In case of \(2b \leq d\) a lot-for-lot policy will be assumed.
3. Integrated order and production policies

(P) delivers equal-sized sub-batches of \( x_{PT} \) [unit]. (A) orders quantities of \( x_A \) [unit]. So, in the JELS solution the sub-batch size corresponds to the order quantity, i.e. \( x_A = x_{PT} \). The joint total relevant cost per period for a joint order and delivery quantity \( x_G = x_A = x_{PT} \) without lot streaming is given by (Goyal, 1988, p. 237; Landeros and Lyth, 1989, p. 154)

\[
K^G(I_G, x_G) = \frac{b}{x_G} \left( B + \frac{R_1}{I_G} + R_2 \right) + \frac{x_G}{2} \left( I_Gh_p \left( 1 + \frac{b}{d} \right) - h_p + h_A \right).
\tag{12}
\]

The joint economic order and delivery policy is given by

\[
x_A = x_{PT} = x_G^* = \sqrt{\frac{2b(B + R_1/I_G^* + R_2)}{I_G^*h_p(1 + b/d) - h_p + h_A}},
\]

\[
x_{PP} = I_G^*x_G^*,
\tag{13}
\]

where the joint optimal integer number of shipments is given by the \( I_G^* \) that satisfies

\[
I_G^*(I_G^* + 1) \geq \frac{R_1(h_A - h_p)}{(B + R_2)h_p(1 + b/d)} \geq I_G^*(I_G^* - 1).
\tag{14}
\]

Fig. 1 shows the inventory cycles for (A) and (P) without lot streaming.

If (P) uses lot streaming, the joint total relevant cost per period for any joint order and delivery quantity \( x_G = x_A = x_{PT} \) [unit] can be derived as follows (Agrawal and Raju, 1996, p. 582):

\[
K^G(I_G, x_G) = \frac{b}{x_G} \left( B + \frac{R_1}{I_G} + R_2 \right) + \frac{x_G}{2} \left( I_G - 1 - \frac{I_Gb}{d} + \frac{2b}{d} \right) h_p + h_A.
\tag{15}
\]

Equivalent to the case without lot streaming, presented above, the joint economic order and production policy for both (A) and (P) is given by

\[
x_A = x_{PT} = x_G^*
\]

\[
x_{PP} = I_G^*x_G^*,
\tag{16}
\]

where the joint optimal integer number of shipments is given by the \( I_G^* \) that satisfies

\[
I_G^*(I_G^* + 1) \leq \frac{R_1(h_A + h_p(2b/d - 1))}{h_p(B + R_2)(1 - b/d)} \leq I_G^*(I_G^* + 1).
\tag{17}
\]

Fig. 2 shows the inventory cycles for (A) and (P) with lot streaming.

However, for \( x_A^* \neq x_{PT}^* \), obviously the most common case, the optimal joint order and delivery quantity \( x_G^* \) is situated in the interval between the individual optimal solutions, i.e. \( x_G^* \in [x_A^*, x_{PT}^*] \).

For any joint policy \( x_G \in [x_A^*, x_{PT}^*] \) the buyer’s
total relevant cost will be
\[
K^A(x_G) = B \frac{b}{x_G} + \frac{x_G}{2} h_A
= \frac{1}{2} \left( \frac{x_A^*}{x_G} + \frac{x_G}{x_A^*} \right) K^A(x_A^*)
\]
(18)

with
\[
\frac{1}{2} \left( \frac{x_A^*}{x_G} + \frac{x_G}{x_A^*} \right) > 1.
\]
(19)

If (A) behaves individually rational, he selects his individual optimal policy \(x_A^*\). Should (A) possess the dominant position to enforce his EOQ on (P), then no incentive exists for him to choose a joint policy \(x_G \in [x_A^*, x_{PT}^*]\). Essentially, relation (19) shows that (A) will make a loss if the JELS solution is adopted. Without bargaining, (P) must adapt the buyer’s order policy. For a given individual order policy \(x_A^*\) the optimal number of shipments is given by the \(I_A^*\) that satisfies
\[
K^P(x_A^*, I_A^* - 1) \geq K^P(x_A^*, I_A^*) \leq K^P(x_A^*, I_A^* + 1).
\]
(20)

With (20) follows
\[
I_A^*(I_A^* - 1) \leq \frac{2bR_1}{(x_A^*)^2 h_p(1 + b/d)} \leq I_A^*(I_A^* + 1)
\]
(without lot streaming)

and
\[
I_A^*(I_A^* - 1) \leq \frac{2bR_1}{(x_A^*)^2 h_p(1 + b/d)} \leq I_A^*(I_A^* + 1)
\]
(with lot streaming).
(21)

Nevertheless, from the supplier’s point of view, in comparison to the individual optimal order policy of (A), any joint policy \(x_G \in [x_A^*, x_{PT}^*]\) leads to lower total relevant cost. Therefore, to provide an incentive to choose a joint policy (P) can offer a side payment to (A), which compensates the increase in total relevant cost resulting from this policy. A side payment is defined as an additional monetary transfer between the parties involved that is used as an incentive for deviating from the individual optimal policy (Rubin and Carter, 1990, p. 22). (P) must determine the offered delivery quantity, the offered side payment and his production policy simultaneously.

4. The bargaining game

The bargaining game belongs to the class of two-person-nonzero-sum games in which (A) and (P) try to maximize their individual gains. The game can be described as follows:

- (A) has the power to enforce his EOQ on (P) in case of a break-down in negotiations. The threat point, realized in the case of a break-down in negotiations (Eichberger, 1993, p. 238), is given by \((K^A(x_A^*), K^P(I_A^*, x_A^*))\).
- (P) offers a joint policy \(x_G\) [unit] with an associated side payment \(z\) [$/period]. He makes a take-it-or-leave-it-offer. In the first stage (P) makes an offer, and then, in the second stage, (A) can either accept or reject. The game is immediately terminated after acceptance or refusal by (A) (Eichberger, 1993, pp. 55–57).
- (P) has complete information about the cost function of (A).
- The feasible cost combinations are given by \((K^A(x_G) - z, K^P(I, x_G) + z)\).

The objective of (P) is to minimize his total relevant cost per period. The following non-linear minimization problem has to be solved:
\[
\min \ K^P(I, x_G, z) = K^P(I, x_G) + z
\]
\[
s.t.
K^A(x_G) - z \leq K^A(x_A^*),
\]
(22)
(23)

\(x_G, z \geq 0, \quad I \in \mathbb{N}\)
(24)

Condition (23) ensures individual rationality: it must be attractive for (A) to accept the offer. For a given value of \(I\), the optimization problem with constraints can be transformed to the following unconstrained minimization problem:
\[
\min L(x_G, z) = K^P(I, x_G) + z
- \lambda(K^A(x_A^*) - K^A(x_G) + z).
\]
(25)

As the cost functions \(K^P(I, x_G)\) and \(K^A(x_G)\) are strictly convex in \(x_G\), the Karush–Kuhn–Tucker-(KKT-) conditions are sufficient to derive an
optimal solution:

\[
\frac{\partial L}{\partial x_G} = \frac{\partial K^P(I, x_G)}{\partial x_G} + \lambda \frac{\partial K^A(x_G)}{\partial x_G} \geq 0, \quad (26)
\]

\[
x_G \frac{\partial L}{\partial x_G} = x_G \left( \frac{\partial K^P(I, x_G)}{\partial x_G} + \lambda \frac{\partial K^A(x_G)}{\partial x_G} \right) = 0, \quad (27)
\]

\[
\frac{\partial L}{\partial z} = 1 - \lambda \geq 0 \quad \text{and} \quad z \frac{\partial L}{\partial z} = z(1 - \lambda) = 0, \quad (28)
\]

For \(x_G \neq x_A^*\) follows \(z > 0\). From \(z > 0\) and (28) follows \(\lambda = 1\). For \(\lambda = 1\) and (29) follows

\[
z = K^A(x_G^*) - K^A(x_G) = \left( \frac{1}{2} \left( \frac{x_A^*}{x_G} + \frac{x_G}{x_A^*} \right) - 1 \right) \sqrt{2Bbh_A}. \quad (30)
\]

(P) will compensate exactly the increase in cost of (A), induced by deviating from the individual optimal order policy. Condition (23) is fulfilled. The theoretical side payment (30) leads to the buyer being just indifferent between accepting and rejecting the supplier’s offer. To create a practical side payment a small extra incentive of \(\delta \ [\$/\text{period}]\) should be added. If (A) behaves individually rational, he accepts an offer associated with a side payment \(z + \delta \ [\$/\text{period}]\) and realizes \(K^A(x_G) - z - \delta < K^A(x_A^*)\). It remains to be solved, which joint policy \(\hat{x}_G\) will be offered by (P). From \(\lambda = 1\), (27) and \(x_G > 0\) follows

\[
\frac{\partial K^P(I, x_G)}{\partial x_G} + x_G \frac{\partial K^A(x_G)}{\partial x_G} = 0. \quad (31)
\]

At first, the case where (P) cannot use lot streaming will be analyzed. From (31), \(x_G = x_A = x_{PT}\), (1) and (3), follows

\[
\hat{x}_G(I) = \sqrt{\frac{2b(B + R_1/I + R_2)}{Ih_p(1 + b/d) - h_p + h_A}}. \quad (32)
\]

Substituting (32) and (30) into (22), the total relevant cost per period of (P) is given by

\[
K^P(I) = \sqrt{2b(B + R_1/I + R_2)(Ih_p(1 + b/d) - h_p + h_A)}
\]

\[
- \sqrt{2Bbh_A}. \quad (33)
\]

Minimizing of (33) is achieved by minimizing \(K^P(I) = (B + R_2)lh_p(1 + b/d) + \frac{R_1}{I}(h_A - h_p)\).

\[
(34)
\]

The optimal integer number of shipments is given by the \(\hat{I}\) that satisfies

\[
K^P(I - 1) \geq K^P(\hat{I}) \leq K^P(\hat{I} + 1). \quad (35)
\]

Substituting (34) into (35) and appropriately rearranging terms, (35) is equivalent to (14). (P) offers exactly the joint economic policy (13), presented in the preceding section, associated with a (theoretical) side payment in accordance with (30).

In the case of lot streaming, with (31), \(x_G = x_A = x_{PT}\), (1) and (7) follows

\[
\hat{x}_G(I) = \sqrt{\frac{2b(B + R_1/I + R_2)}{(I - 1 - lh/d + 2b/d)h_p + h_A}}. \quad (36)
\]

Using the opportunity of lot streaming, comparable to the case without lot streaming, (P) offers the joint economic policy (16), presented in the preceding section, associated with a side payment in accordance with (30). In both cases, (P) behaves like a master planner and selects the joint economic order and production policies. A fundamental principle is illustrated here: if the two parties negotiate cooperatively with complete information, a side payment will lead to a joint economic order and production policy (Rubin and Carter, 1990, p. 25). This result will be illustrated by a numerical example.

5. A numerical example

5.1. The bargaining situation

Consider the following information for both (A) and (P) displayed in Table 1.
The individual optimal policy of (A), i.e. five orders per period of $x/C^3_A = 300$, leads to total relevant cost of $K_A(I_A, x_A^*) = 6883.33$. The absolute cost penalty of (P) is 2883.33 [$/period], i.e. an increase of 72.08 percent. Adopting the JELS solution, 558.36 units, would result in a cost penalty of 597.73 [$/period] on the part of the buyer, i.e. an increase of 19.92 percent. Therefore, (A) has no incentive to choose the JELS solution. But, adopting the JELS solution, (P) saves 988.96 [$/period]. Thus the buyer’s loss is more than offset by the supplier’s gain. If (P) offers a side payment of 597.73 [$/period] and persuades (A) to change his order policy from 300 to 558.36 units, the increase in total relevant cost of (A) will be compensated exactly by (P). If (A) accepts the offer (P) gains 391.23 [$/period].

5.3. Bargaining solution with lot streaming

These results change in case of using lot streaming on supplier’s side (see Table 3). The individual optimal policy of (P) leads to $K^P(I^*_P, x^*_P) = 3577.71$. If (A) enforces his EOQ on (P); his absolute cost penalty is 588.95 [$/period], i.e. 16.46 percent. Adopting the JELS solution, 398.34 units, would result in a cost penalty of 102.5 [$/period] on the part of the buyer and at the same time, the supplier saves 261 [$/period]. If (P) persuades (A) to change his order policy from 300 to 398.34 units, offering a side payment of 102.5 [$/period], (P) gains 158.5 [$/period]. With lot streaming, (P) can react more flexible on a given order policy of the buyer. The cost penalty of adopting the buyer’s individual optimal order policy, and likewise, the gain induced by the bargaining solution are smaller than without lot streaming.

6. Conclusion

In this paper a joint order and production policy is developed as a bargaining solution assuming that the buyer has the dominant position. The paper presents an analytical approach to determining the terms of a supplier-oriented optimal side payment scheme. It is shown that the joint
optimal policy with an according side payment results from negotiations. Adopting the bargaining solution, the gain of the supplier depends on his production policy, i.e. if the supplier has the opportunity to use lot streaming or not. With lot streaming the supplier is provided with more flexibility to react on buyer’s individual optimal order policy. The supplier realizes a lower cost penalty with lot streaming than without lot streaming. Nevertheless, in both cases, with or without lot streaming, the supplier benefits from the presented bargaining solutions. This raises a crucial practical issue. In order to determine the side payment the supplier must obtain the numerical estimates of buyer’s ordering cost per order and buyer’s inventory holding cost. While the buyer’s periodical demand can be anticipated from the past ordering behavior of the buyer, it is very difficult to estimate buyer’s holding and ordering costs. This is true unless the buyer is willing to disclose the true values of his cost parameters (Landeros and Lyth, 1989, p. 313). However, the buyer’s holding cost can be specified as an implicit function of his ordering cost and his EOQ and, likewise, the buyer’s ordering cost can be specified as an implicit function of his holding cost and his EOQ. The relative insensitivity of \( z = K^A(x_G) - K^A(x_A) \) to measurement errors permits the establishment of a “good” side payment. Therefore, a bargaining solution succeeds if (P) estimates the cost structure of (A) with sufficient accuracy.

References


