

Internal Pricing in Supply Chains

Kenneth Fjell and Kurt Jörnsten¹

¹ The Norwegian School of Economics and Business Administration, Helleveien 30, N-5045 Bergen

Abstract: A supply chain is two or more parties linked by a flow of goods, information and funds. Since this means that supply chain management concerns environments in which there are multiple decision makers, which may be different firms or different divisions within a single firm, attention has to be focused on methods or mechanisms that improve system efficiencies. The reason for this is that in a supply chain setting, behaviour that is locally rational can be inefficient from a global perspective.

In this paper we will focus on the use of a negotiated two-part tariff for internal pricing as a means to achieve “channel co-ordination”. The two-part internal pricing scheme can be thought of both as a means of handling risk sharing within a supply chain and to avoid the problem of double marginalization.

1 Introduction

A supply chain is two or more parties linked by a flow of goods, information and funds. Since this means that supply chain management concerns environments in which there are multiple decision makers, which may be different firms or different divisions within a single firm, attention has to be focused on methods or mechanisms that improve system efficiencies. The reason for this is that in a supply chain setting, behaviour that is locally rational can be inefficient from a global perspective. One way of achieving improved system efficiency is through contractual arrangements.

In the *first-best* case total expected supply chain profits is maximised. This can be achieved if all decisions are made by a single decision-maker with access to all available information. This corresponds to a supply chain with centralised control. However, in a supply chain, this situation is highly unlikely to occur since normally none of the parties involved is in a position to control the entire supply chain. Thus we are left with a situation in which the supply chain control is decentralised and where each party involved in the supply chain has private information and individual objectives.

In the case where the total profit encountered through decentralised control is lower than the total profit for the first best solution, the decentralised control mechanism used is regarded as inefficient. There are several objectives that are of importance in the design of the control mechanisms in a supply chain. One objective is risk sharing, where contracts are focused on how the total system profit should be allocated among the supply chain parties. The reason for calling this focus a risk-sharing objective is that it provides means for the parties to share the risks arising from various sources of uncertainty.

Other contracts are more focused on reducing the difference between the total profit in a decentralised system and the total profit in the first-best solution. Contracts in which this is the main emphasis are said to focus on system wide performance and the normal terminology for the objective used is channel co-ordination.

In the excellent survey article by Tsay et al. (1999), the means for achieving channel co-ordination and/or risk sharing are used to classify the literature on supply chain contracts. This classification uses the following categories.

- specification of decision rights
- pricing
- minimum purchase commitments
- quantity flexibility
- buyback or return policies
- allocation rules
- lead time
- quality

In this paper we will focus on internal pricing as a way to achieve supply chain co-ordination. We will suggest the use of negotiated two part tariffs to achieve the co-ordination goal which is in line with the suggestions made by Moorthy (1987) in his comment on the article by Jeuland and Shugan (1983). However, the idea on how the two part tariffs to be used in the pricing scheme are to be derived is based on an idea by Lantz (2000). In Lantz negotiation scheme the prices to be used among the parties are decided by negotiations on a two-part tariff. Lantz has shown that this negotiation scheme may converge to a situation in which the seller sets the linear part of the two-part tariff to the marginal cost of production and the fixed fee of the tariff allocates the profit among the participants according to their negotiation power. Hence, the scheme may result in a situation in which the problem of double marginalization is avoided and the profits are distributed in a “fair” way. The reason for using the statement “may converge” is that the results of negotiations are dependent upon the starting conditions, i.e. the transfer pricing scheme used in the outset of the negotiations.

2 Pricing as a contract clause in supply chain co-ordination

In the early literature on inventory control, the pricing scheme to be used in order to co-ordinate the chain is not subject to negotiations among the parties involved. However there exists a substantial literature on the use of quantity discounts as a means to achieve better channel co-ordination. Monahan (1984, Lee and Rosenblatt (1985, 1986), Parlar and Wang (1995), Lal and Staelin (1984) and Gupta and Kini (1995), just to mention a few. In most of these articles the profit is solely allocated to the seller with the exception of the article by Rosenblatt and Lee (1985), in which both parties benefit from the discount schedule. In the marketing literature, the paper by Jeuland and Shugan (1983) presents a two-member channel and shows how a discount-pricing scheme can be used to achieve channel co-ordination. However, in a comment to the Jeuland and Shugan paper, Moorthy argues that the channel co-ordination suggested by the authors can be achieved by the use of a two part tariff and that this co-ordination scheme is simpler and hence easier to implement. Also, Moorthy shows that the two-part tariff separates the co-ordination problem from the profit sharing problem. Since Moorthy’s ideas in some sense form the basis for our suggestion, we will further comment on Moorthy’s co-ordination scheme.

In the more recent literature on pricing and supply chain contracts, several extensions of the classical models have been presented. Weng (1995, 1997) extends the Jeuland Shugan model in several directions and shows among other things that a quantity discount scheme for the buyer along with a franchise fee paid to the supplier is sufficient to achieve channel co-ordination. Hence, Weng suggests a fixed fee

element to be used together with a quantity discount scheme. One of the drawbacks with most of the pricing schemes presented in the literature is that most of them focus on a supply chain consisting of two members; a buyer and a supplier.

In the recent paper by Lee and Whang (1999), the authors present a number of properties that are of interest when designing co-ordination mechanisms in supply chains. These are the cost conservation property, the incentive compatibility and the informational decentralizability property. The cost conservation property states that the accounting system built into a co-ordination scheme should trace all costs to the individual sites. The incentive compatibility property means that the scheme should eliminate potential misalignment problems. Finally, the informational decentralizability property states that the scheme should be implementable using site information only. Using these desired properties, we argue that a negotiated two-part tariff co-ordination scheme might be the answer. One of the reasons for this is its simplicity, which makes it possible to use in situations where the supply chain consists of more than two parties and hence most of the co-ordination schemes suggested in the literature becomes too complicated or are not applicable.

3 Moorthy's comment on the Jeuland Shugan article

In his comment on the Jeuland and Shugan article, Moorthy states that there are several pricing schemes that can be used to achieve channel co-ordination. The necessary and sufficient conditions for channel co-ordination is that the manufacturer's pricing policy makes the retailers effective marginal cost curve cut his marginal revenue curve from below at the channels optimal quantity. Hence, the manufacturer's pricing scheme need not even be a quantity discount scheme. Moorthy shows that by using a two-part tariff in which the manufacturer charges his true marginal costs in the linear part of the tariff, channel co-ordination is achieved and the fixed fee is used only to determine the profit sharing. Jeuland and Shugan criticised the two-part tariff suggested by Moorthy on the grounds that if, because of some short term problem of scheduling production, the manufacturer delivers only a fraction of what the retailer wishes to purchase, then the manufacturer suffers no penalty at all. However, Moorthy clearly states that this criticism is non-valid since it is easy to negotiate a protection from shortfall of production clause into the contract. Moorthy suggests the following clause " if the manufacturer fails to supply the ordered quantity in any month, then the retailer will be entitled to a refund of the fixed payment in an amount sufficient to maintain the retailers share of the channel's profit plus any accrued interest on the excess amount already paid".

In our scheme we suggest that this clause can be replaced by a negotiated two-part tariff working in the other direction than the first one does. What we mean by this is that the first negotiated two-part tariff stipulates the selling price, the linear part of the tariff preferably set as the marginal cost of the manufacturer, whereas the fixed fee in this tariff gives the profit sharing among the parties. This tariff is in use in the normal situation when the ordered quantities are promptly delivered. The second negotiated transfer price tariff works in the short fall situation. Here it is important that the manufacturer gets the information of the true short fall costs for the retailer, i.e. the retailer's true shortage cost. This is the preferred linear part in the second negotiated two-part tariff. The fixed fee in this tariff serves the purpose of redistributing the channel profit among the parties according to who is to blame. However, like the former fixed fee, it will also reflect the negotiation skills/powers of the parties.

The multiple two-part tariff scheme suggested can easily be generalised to a situation in which the supply chain has more than two members.

4 Lantz' negotiation scheme

In his thesis, Lantz suggests that negotiated two-part tariff should be used as internal prices. The way the negotiation works is that starting from a given position with a fixed and neutral internal pricing tariff, each of the involved parties can suggest a new two-part tariff. The new suggested tariff is announced to the other party in terms of a fixed fee, F , a linear unit price part, p , and an order quantity, Q . The suggestion of the new tariff is based on the suggesting party's private information. This means that the new tariff is certainly favourable to him in comparison with the former tariff. The responding party can accept or reject the suggested tariff. If the new tariff is accepted it must be favourable also to the other party. The negotiations continue until no further change in the two-part tariff is suggested. A rejection of a suggested tariff means that the parties involved for the moment stick to the old tariff.

Lantz has tested the negotiation scheme by letting students negotiate a two-part tariff in a situation in which the manufacturer has private information on his cost structure and the retailer has private information regarding the demand structure. In his experiments the results are promising and the negotiations lead to a better channel co-ordination.

We have done the same type of experiments with students in the production and logistics courses at NHH with the same type of results.

5 The suggested use of two-sided negotiated two-part tariffs

Since we, apart from the two-part tariff negotiation scheme suggested by Lantz, also make use of a reverse negotiated two-part tariff in order to handle shortfall in delivery problems, we are able to handle situations in which the parties involved have different attitudes towards risk. Agrawal and Seshardi have shown that a two-part tariff can be used for risk intermediation in a supply chain. Our two-part tariff scheme works as follows.

Starting from a neutral position in terms of tariffs used for deliveries and backorders, the parties negotiate as in Lantz' scheme, but now negotiating *two* different two-part tariffs.

1. Each of the involved parties can suggest a new two-part tariff to be used for deliveries from the manufacturer to the retailer consisting of a fixed fee, F , a unit price, p , and an order quantity, Q . The other party may accept or reject the proposal.
2. Each party may also suggest a new two-part tariff to be used in terms of shortfall. This new two-part tariff consists of a fixed fee, Φ , and a unit shortage price, π , to be used when the ordered products are not delivered promptly.

This system of negotiated two-part tariffs can easily be generalised to a situation where the supply chain consists of more than two parties. Furthermore, the suggestions for new tariffs are made using private information only and each party can, given the tariffs to be used, base their decisions on the tariffs and their own private information.

6 Conclusions and future research

We are currently constructing a negotiation game consisting of a supply chain with three parties where the retailer in the chain faces uncertain demand. This will be used in testing if the participants in the game can reach a situation that co-ordinates the channel based on the two types of two-part tariffs suggested in this paper. Apart from this, we will also analyse how our scheme works in situations where other pricing schemes have been suggested in the literature and try to determine the pros and cons of the suggested pricing scheme.

References

- Agrawal V. / Seshadri S. (1995):** Risk intermediation in supply chains *IIE Transactions* 32 pp 819-831 2000
- Gupta O.K. / Kini R.B. (1995):** Is price-quantity discount dead in a just-in-time environment? *International Journal of Operations Management* Vol. 15 No. 9 pp. 261-270
- Jeuland A. / Shugan S. (1983):** *Managing Channel Profits*. *Marketing Science* 2 pp. 239-272
- Lal R., Staelin R. (1984):** An approach for developing an optimal discount pricing policy. *Management Science* Vol 30 No 12 pp. 1524-1539
- Lantz Björn (2000):** *Internprissättning med effektiva incitament*. Ph.D thesis Handelshögskolan i Göteborg, Bokförlaget BAS
- Lee H.L. / Rosenblatt M.J. (1986):** A Generalized Quantity Discount Pricing Model to Increase Supplier's Profits. *Management Science* 30 pp. 1179-1187
- Lee H. / Whang S. (1999):** Decentralized Multi-Echelon Supply Chains: Incentives and Information. *Management Science* 45/5 pp. 633-640.
- Monahan J.P. (1984):** A Quantity Discount Pricing Model to Increase Vendor Profits. *Management Science* 30 pp. 720-726.
- Moorthy K.S. (1987):** Managing Channel Profits: Comment. *Marketing Science*. Vol. 6. No. 4. pp. 375-379
- Moses M. / Seshadri S. (2000):** Policy Mechanisms for supply chain co-ordination. *IIE Transactions*. 32 pp 245-262.
- Parlar M. / Wang Q. (1995):** A game theoretical analysis of the quantity discount problem with perfect and incomplete information about the buyer's cost structure. *Recherche operationelle* Vol. 29 No. 4 pp 415-439
- Rosenblatt M.J. / Lee H.L. (1985):** Improving Profitability with Quantity Discounts under Fixed Demand. *IIE Transactions* 17/4 pp. 388-395
- Tsay A.A. / Nahmias S. / Agrawal N. (1999):** Modeling Supply Chain Contracts: A Review. In S. Tayur et al *Quantitative Models for Supply Chain Management*. Kluwer
- Weng Z.K. (1995):** Channel Coordination and Quantity Discounts. *Management Science*, 41 pp. 1509-1522
- Weng Z.K. (1997):** Pricing and Ordering Strategies in Manufacturing and Distribution Alliances. *IIE Transactions*, 29 pp. 681-692