

# A MULTIPLE PRICE APPROACH TO LIMITING TRANSFER PRICING NEGOTIATIONS

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## ABSTRACT

The paper addresses the core transfer pricing issue of allowing source and receiving divisions or companies to maintain autonomy and profit from transfers in such a way that sub-optimal output levels are avoided. It develops a pragmatic-analytical model by introducing multiple transfer prices and shows that the proportion of contribution over which negotiation is required can be made negligible. Combining multiple transfer prices and interdivisional negotiation can assure economically optimal solutions while maintaining divisional autonomy and avoiding excessive negotiations. In intragroup relationships and situations in which unrelated companies have an overriding concern for the maintenance of trust, this model provides a mechanism for a 'fair' division of contribution without the need for potentially costly and trust-destroying negotiation. The model is particularly suitable for large corporations which, previously centralized, now seek a middle ground of significant decentralization but without the consequences of unconstrained market forces. This applies internationally to a number of privatised industries and is especially relevant in transitional economies.

**Keywords:** Profit maximisation; Supply chain management; Management research; Pricing; Decision making.

## 1. INTRODUCTION

Transfer pricing, one of the fundamental problems in accounting and economics, was first considered by Hirshleifer (1956) and has been widely studied over a long period of time. Stated simply, the problem arises out of dividing a single enterprise into two or more units. In such a scenario a transfer price greater than the marginal cost to the 'upstream' unit can distort the profit maximizing pricing and

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volume decisions of the ‘downstream’ unit, thereby reducing the profitability of the enterprise as a whole. However, centralizing the decisions about quantities traded and the price at which transfers of goods or services are made will potentially remove the behavioural benefits, related to divisional autonomy, which are the motivation for divisionalization in the first place.

Although many works have been devoted to resolve the problem, no completely satisfactory solution is known in the absence of a perfect market for the intermediate goods. Vancil (1979) concluded that “the issue remains a perennial puzzle for academicians, while practitioners continue to cope” (p. 142). Tomkins (1990) brought these two perspectives together in his pragmatic-analytical model which incorporated both a ‘cost-plus’ approach and the process of negotiation. Our objective in this paper is to extend that model by addressing the problem of excessive, and consequently destructive, negotiation over quantities and prices at the margin. The introduction of more than one transfer price into the negotiation-based model broadens its applicability by limiting the proportion of inter-unit trade which is subject to the potentially destructive process of negotiation.

In Section 2, below, we explain the basic transfer pricing problem and relevant prescriptions in the literature. Section 3 considers the advantages of negotiation and potential problems arising out of unconstrained negotiation. Section 4 outlines the contexts which give our model contemporary relevance. Thereafter Section 5 provides a detailed exposition of Tomkins (1990) and its principal limitations. This is followed, in Section 6, by an explanation of our multiple transfer price model, and provides a schedule to be used in applying it. Finally, the paper ends with a brief summary and acknowledgement of limitations.

## **2. THE TRANSFER PRICING CONUNDRUM AND PRESCRIPTIONS PROPOSED IN THE LITERATURE**

A number of approaches to resolving the transfer pricing conflicts are documented<sup>1</sup>. For example, goods can be transferred between the divisions at variable cost with contribution (and profit) for the source division being provided by an additional periodic charge; however, this two-part transfer price system has a serious disadvantage because “the source division has no incentive to seek the optimal production level as it earns no profit on transactions made *during* the period” (Tomkins, 1990, p. 202). Another approach is based on sharing the group profit earned on the transferred goods, but its shortcomings include problems with the book-keeping and the interpretation of the divisional profit figures. Also, a more advanced dual-rate transfer pricing system has been proposed in which the prices used for accounting purposes are different from those used for managerial evaluation of the profitability of divisions. However, this system has diminished credibility and potentially leads to confusion.

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<sup>1</sup> The purpose of this paper is not to provide a comprehensive review of the transfer pricing literature; authoritative evaluations of this field may be found in Abdel-Khalik and Lusk (1974), Emmanuel and Mehafdi (1994), Grabski (1985), McAulay and Tomkins (1992), McAulay et al. (2001), Thomas (1980), Ewert and Wagenhofer (2006), and Göx and Schiller (2007). authoritative evaluations of this field may be found in Abdel-Khalik and Lusk (1974), Emmanuel and Mehafdi (1994), Grabski (1985), McAulay and Tomkins (1992), McAulay et al. (2001), Thomas (1980), Ewert and Wagenhofer (2006), and Göx and Schiller (2007).

Borkowski (1988), Kaplan and Atkinson (1989) and Wu and Sharp (1979) pointed out that the transfer price based on full-cost plus profit predominates but that it should not be used because such a system lacks economic validity and leads to incorrect decisions. Surveys of transfer pricing practice (Abu-Serdaneh, 2004; Borkowski, 1990) showed that the ‘cost-plus’ methods are indeed widely used, and therefore consideration should be given to developing explanatory theories for that approach. McAulay et al. (2001, p. 88) note that “Tomkins (1990) addresses the issue of the use of absorption costing by practitioners through a model which explains how this technique can lead to an approximate maximization of short-term profits. ... The old cry, which privileged marginal costing over absorption costing, is almost silenced, but concern for optimization, and the respective merits of alternative technical approaches, retains its potency.”

Few, if any, models satisfactorily resolve the core problems of allowing both the source and receiving divisions to be autonomous and earn a profit on transfers during a period in such a way that sub-optimal output levels are avoided. Back in 1969, Samuels proposed a transfer price schedule instead of just a single transfer price; however this model has a number of disadvantages discussed in the next section. A practical outcome of the transfer pricing ‘puzzle’ is that many multidivisional enterprises have ‘sacrificed’ economic optimality and adopted the approach of allowing divisions to negotiate ‘at arm’s length’ as if they were completely independent entities. In recognition of this Tomkins (1990) built on Samuels’ model and outlined a pragmatic-analytical transfer pricing approach which combines a single cost-plus transfer price and the process of negotiation<sup>2</sup>. The important feature is that approximate short-run optimality may be retained and the transfer prices are acceptable for management purposes. Tomkins’ intention was to justify the pragmatic approach that many companies seem to adopt whereby a cost-plus transfer price is adopted for some of the volume transferred. In addition, his approach effectively mitigates the deviation (caused by the price being above marginal cost) from economic optimality, by allowing negotiation between divisions about extra quantities at negotiated prices lower than the initial cost-plus price.

### **3. NEGOTIATION AND ITS POTENTIAL PROBLEMS**

The transfer pricing behaviour of Tomkins’ partial negotiation model is good when the target contribution for the source division is ‘small enough’. However, the practical value of his approach is limited if the source division’s target contribution is ‘close’ to half of the maximum group contribution, because in this case the scale of the negotiation needed is excessive, time-consuming and expensive. Furthermore, the managers of the source and receiving divisions usually have unequal power and the possibility of exploiting such power difference is substantial.

Also, in practice there are operational situations where divisions do not wish to get involved in negotiations, or there is a real concern about fairness. The issue of fairness is indeed important. According to Paz-Vega (2007, p.232) perceived fairness affects organizational variables such as “commitment, intention to turnover,

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<sup>2</sup> A more detailed comparison of Samuels’ policy and Tomkins’ model is given in Section 5.

organizational citizenship behaviours, trust in management, productivity, and job satisfaction”. Applying the work of Husted and Folger (2004), he argues that “unfair transfer-pricing policies and practices generate important agency and transaction costs that jeopardize the expected outcomes of international strategies of vertical integration.” (Paz-Vega, 2007, p.221)

In certain circumstances, a high level of negotiation may be contrary to the organizational culture and, as Paz-Vega (2007) points out, many companies still adopt the criterion of centralized profit maximization imposed by mandatory policies. This may be particularly appropriate in companies situated in the transitional economies, where head offices may still want to exercise greater control over their divisions. In collectivistic cultures, equality for within-group distributions is often an objective. In order to maintain fair social relationships “collectivistic cultures prefer procedural rules are based on mediation, compromise, and negotiation.” (Paz-Vega, 2007, p.231)

Additionally, a high level of negotiation and potential variability of transfer prices may be contrary to strategic imperatives; for instance when the group for some particular reasons would like to keep both divisions going profitably for the long term. The model of Edlin and Reichelstein (1995) explains the common use of negotiated transfer pricing. However, they highlight that the cost of bargaining (‘haggling’) may be an issue and in some cases (with incomplete information) a system of negotiated transfer pricing will not be efficient and an administered pricing policy may overcome this problem. They also argue that, in cases where it is difficult for parties to sign a prior contract, negotiated transfer pricing may lead to an underinvestment problem<sup>3</sup>.

So, it can be seen that, in various contexts, protracted negotiation has serious limitations. Indeed, it can lead to a conflict between the divisions and also to sub-optimal economic, strategic and behavioural decisions. But the accounting literature (e.g. Tomkins (2001), Johansson and Baldvinsdottir (2003), Chenhall (2008)) shows that in the current climate of alliances and networks there is significantly more interest in organizational collaboration (both within large corporate groups and between companies) and a recognition of the potential benefits of trust between parties. To this end, and to promote communication and collaboration, there is great emphasis on negotiation. Kraus and Lind (2007, p.281) urge companies to invest in trust building activities and explain that this can be done “by holding regular meetings, establishing performance measures that can be used to divide the benefits of the relationship.” So, while there may be benefit in limiting negotiation and thereby promoting fairness, it is essential that the divisions retain an opportunity to negotiate some level of output transferred. Voice, which is the possibility of expressing opinions and feelings during the process of decision making, and participation are recognized as the key determinants of procedural justice perception in many different cultures (Greenberg, 2001; Morris and Leung, 2000 cited by Paz-Vega, 2009). Therefore, an appropriate compromise is to allow some participation in the transfer-pricing process in order to “achieve enhanced perceptions of procedural fairness”. (Paz-Vega, 2009, p.228)

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<sup>3</sup> They recognize that a cost-based transfer pricing rule may ameliorate the underinvestment problem but “if the cost-based rule is administered by H.Q., and not subject to renegotiation, it may lead to quantity transfers that are ex-post inefficient”. (Edlin and Reichelstein, 1995, p.288)

#### **4. A PRACTICAL WAY FORWARD: IMPOSED TRANSFER PRICES SUPPLEMENTED BY NEGOTIATION**

In this paper, we extend Tomkins' pragmatic-analytical model by introducing multiple transfer prices. As we shall show, by using just a few transfer prices, it is possible to guarantee that the proportion of group contribution over which negotiation is required is kept very low and consequently the arrangement reduces the risk of managers taking advantage of unequal power. Our 'most typical' transfer price schedule consists of just two transfer prices. This analytical improvement overcomes the disadvantages of the process of negotiation, while still keeping its attractive features. Thus, our method motivates divisional managers to make optimal economic decisions without undermining divisional autonomy, and provides a reasonable measure for evaluating the managerial and economic performance of the source and receiving divisions, while also being acceptable for taxation purposes<sup>4</sup>.

It should be noted that our model is particularly suitable for large corporations which, previously centralized, now seek a middle ground of significant decentralization but without the consequences of unconstrained market forces. This applies internationally to a number of privatised industries and is especially relevant in transitional economies. According to the empirical study of 40 multinational headquarters for Central and Eastern Europe carried out by Brenner (2008), the great majority of multinationals in that region govern their subsidiaries centrally.

The model also has relevance to situations in which the relationship, for specified supply chains, between free-standing independent companies is equivalent to that between fellow subsidiaries or divisions. "Increasingly, business alliances ... involve collaboration over development and investment and not just trading on the basis of existing goods. Negotiation then needs to be supported by revised requests for information and revised calculations of costs and benefits to each party. ... each party will not participate in the project unless it sees the prospect of fair rewards" (Tomkins, 2001, p. 163). Kraus and Lind (2007) recommend that with moderate levels of specificity of 'intermediate product' and of uncertainty "an inter-organisational relationship can be anticipated, as alternative controls are needed to protect the transaction from an opportunistic breach of contract." (p.283) In appropriate circumstances they urge a "bureaucracy based pattern linked to specified norms, standards and rules, and the measurement and evaluation of performance." (p.284) In such circumstances, with mutual dependencies, there may be an imperative, as the basis for ongoing collaboration, that the sharing of contribution is 'fair' (within some agreed boundaries) and that the relationship is 'in good faith' not marred by negotiation or 'bullying' by the more powerful party<sup>5</sup>. They refer to networks found by Mouritsen and Thrane (2005) in which transfer prices "distributed the financial gains arising from each relationship according to rules laid down at the outset." (Kraus and Lind, 2007, p.288). This is the arrangement that we envisage in our model which we explain in the following two sections.

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<sup>4</sup> National tax authorities may not accept marginal cost transfer prices.

<sup>5</sup> The issue of relational versus transactional relationships and their implications for performance measurement systems is explored in Broadbent and Laughlin (2009). In the former "the ends and means are deliberately subject to a discourse between stakeholders ... the specific focus will be less like a defined project, less short-term in nature and more concerned with the long term survival and sustainability" p. 289.

## 5. THE BASIS AND LIMITATION OF THE TOMKINS' MODEL

We assume that Division A produces goods and transfers them to Division B, i.e. there is no intermediate market<sup>6</sup>, and Division B, after further processing, sells the goods to an external market. The divisionalized structure implies that head office seeks the benefits of decentralization such as increased motivation, local knowledge, faster decisions etc. However, it will generally wish to do this while maintaining accountability and control via monitoring divisional profit performance. Furthermore, it will aim to minimize deviation from the group's economically optimal quantity and product pricing decisions.

Suppose that one wants both Division A and Division B to earn a profit on transfers in order to motivate them to optimally produce and transfer goods. To achieve this Samuels (1969) proposed the use of a schedule of transfer prices. He suggested that there should be numerous transfer prices to encourage the supplying division (A) to produce and transfer a quantity near to the optimal level ( $q$ ) at which A's variable cost ( $VC_A$ ) equates to B's net marginal revenue ( $NMR_B$ ). As an incentive he proposed awarding a bonus to A on top of a given basic transfer price per unit. The bonus would increase with each unit transferred by Division A up to the optimal level and then fall with each unit produced beyond that level.

Tomkins (1990) points out a number of disadvantages of Samuels' model. The most serious trouble is that "one needs to know the optimal level of production and the amount to be transferred before one can see what point the pricing schedule needs to pass through" (Tomkins, 1990, p. 203). This model has not been widely adopted in industry – perhaps it is too complex to use, and therefore a simpler approach is often adopted. An improvement was given by Tomkins (1990) which combines a single transfer price and the pragmatic process of negotiation, as illustrated in Figure 1. The basic idea is that a company fixes a transfer price  $t$  by a cost-plus method for an output level  $f$  such that the following (first) condition is satisfied: "The transfer price line projected horizontally to the right must not cut through B's net marginal revenue schedule if sub-optimal output levels are to be avoided." (Tomkins, 1990, p. 207)

The transfer price  $t$  must be fixed in such a way that A's fixed costs are covered and, moreover, a 'reasonable' profit is provided to A; see Figure 1. The area of negotiation (between  $f$  and  $q$ ) is where the transfer price  $t$  is no longer applicable, i.e. A and B should negotiate further transfers. The scale of negotiation must satisfy the following (second) condition: "The cost-plus transfer price must be applicable to a sizeable proportion of the optimal amount of output to be transferred in order to limit the scale of negotiation needed." (Tomkins, 1990, p. 207)

### Figure 1. Tomkins' pragmatic-analytical cost plus transfer pricing approach.

Thus, the objective is to maximize the proportion of optimal output, denoted by  $x$  [ $x = (f/q)$ ], for which the cost-plus transfer price can be applied, subject to the first

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<sup>6</sup> The assumption that there is no external market is made only for analytical convenience. It is easy to prove that the model applies equally, with limited modification, where an imperfect intermediate goods market exists.

condition and the requirement that A's fixed costs are covered and A's profit is provided. Let  $c$  stand for source division's target contribution as a proportion of maximum group contribution.

Under certain assumptions (see Section 6 below) Tomkins (1990) proved that, for a given  $c$ , the value of  $x$  can be found by solving the following quadratic equation:

$$2x(1-x) - c = 0.$$

In fact,  $x$  is the upper root of the above equation, i.e.  $x = 0.5 + \sqrt{0.25 - 0.5c}$ . The relationship between  $c$ ,  $x$  and  $n$  is shown in Table 1 below, where  $n$  is a proportion of group contribution over which negotiation is still required.<sup>7</sup>

**Table 1. An illustration of the required negotiation, under the single transfer price model, given different divisions of total contribution.**

For example, if A's target contribution is 18% of the total maximum group contribution, then the corresponding cost-plus transfer price can be applied to 90% of the optimal output to recover A's target contribution. As can be seen in Table 1, the proportion of group contribution over which negotiation is required is only 1%, so the negotiation practically makes no difference. However, if A's target contribution is close to 50% of the total maximum group contribution, then the proportion of group contribution over which negotiation is required becomes substantial. For instance, if  $c$  is equal to 50%, then negotiation is required over 25% of the group contribution, and the cost-plus transfer price can be applied to only 50% of the optimal output. Tomkins comments on this extreme case as follows:

“First, it would still leave A and B to negotiate a price applicable to 50 per cent of the optimal output level and agree by negotiation a split of 25 per cent of the group contribution on that product. The costs of negotiation are likely to be too high if negotiation is required over half the volume produced and the possibility of taking advantage of unequal power will be quite substantial if 25 per cent of the contribution is involved. This limits the practical value of this transfer pricing approach.” (Tomkins, 1990, p. 208)

The implications of Tomkins' model for deriving a value for  $t$ , the transfer price that will lead to the desired value of  $c$  (target contribution) are obtainable from the formula:

$$t = 2p(1-x),$$

where  $p$  is the net average revenue corresponding to the output  $q$ .

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<sup>7</sup> The value of  $n$  can be found by the formula (Tomkins, 1990, p. 211):

$$n = \frac{c(1-x)}{2x}.$$

In summary, it can be seen that transfer pricing behaviour of Tomkins' model is excellent when  $c$  is 'small' enough, but its practical value is limited if  $c$  is 'close' to 50%, and also since the model does not accommodate values of  $c$  over 50%.

We will see in the next section that, by introducing just a few transfer prices, it is possible to guarantee that the proportion of group contribution over which negotiation is required does not exceed 1%. This modification of Tomkins' approach overcomes the above disadvantage but retains the simplicity and the attractive features of his model.

For convenience, let us summarize the notation introduced in this section:

- $q$  The optimal level of output to be produced by Division A and transferred to B.
- $VC_A$  Division A's variable cost.
- $NMR_B$  Division B's net marginal revenue.
- $p$  B's net average revenue corresponding to the output  $q$ .
- $pq$  The maximum contribution, which the entire group can earn.
- $c$  The target contribution for A as a proportion of maximum group contribution.
- $t$  The transfer price.
- $f$  B's chosen output level corresponding to the transfer price  $t$ .
- $x$  Maximum proportion of optimal output for which the cost-plus transfer price can be applied.
- $n$  Proportion of group contribution over which negotiation required.

## 6. THE MULTIPLE TRANSFER PRICE MODEL

In this section, we show how Tomkins' pragmatic-analytical model can be enhanced by introducing multiple transfer prices. For simplicity and consistency with this model, we assume the following:

- Division A transfers goods to Division B, i.e. there is no intermediate good market.
- All A's and B's costs are fixed. (The assumption that all the costs are fixed is made for analytical convenience. Later in the paper we will show how to adjust the formula to take into account variable costs.)
- The net average revenue curve for the final product is linear.

Our model is applicable to situations where the level of  $c$  is agreed in advance by divisional managers or head office. It also applies in relational alliances (see, for instance, Dyer and Singh, 1998) between two independent companies. In contexts of trust, information on the cost and revenue functions of A and B are known by both parties. Furthermore, owing the 'relational' nature of their alliance both divisions (companies) recognize the long term strategic benefits that can be derived from having



an agreed sharing of aggregate contribution. A consequence of this is that potentially costly negotiation over prices and quantities envisaged by the Tomkins model is replaced by limited negotiation over the magnitude of  $c$ .

Let  $q$  be the optimal level of output to be produced by A and transferred to B, and let  $p$  denote the net average revenue corresponding to the output  $q$ , i.e.  $q$  units will be sold at a net average revenue of  $p$ . Thus, the maximum contribution, which the entire group can earn, can be represented as the area  $pq$ , and the maximum group profit is  $pq$  minus A's and B's fixed costs.

The Division A's target contribution can be represented as a proportion  $c$  of the maximum group contribution  $pq$ . The transfer price schedule for a specified proportion  $c$  will consist of transfer prices  $t_i$ , and the corresponding points  $f_i$  of the optimal output  $q$ , where  $1 \leq i \leq k$ ;  $k$  being the number of transfer prices to be applied. This schedule means that the first transfer price  $t_1$  should be applied to the output between 0 and  $f_1$ , and the  $i$ -th transfer price  $t_i$  should be applied to the output between  $f_{i-1}$  and  $f_i$ . The schedule with three transfer prices is illustrated in Figure 2. A's target contribution  $c$  is obviously equal to the area of the three rectangles  $R_1$ ,  $R_2$  and  $R_3$  divided by  $pq$ . Note that the first rectangle  $R_1$  will be 'optimally' constructed according to the technique used by Tomkins (1990), and all the rectangles are congruent by construction, because the aim is to maximize the proportion of optimal output for which the transfer prices are applied.

**Figure 2. An illustration of how a three transfer price arrangement would work**

For  $1 \leq i \leq k$ , let us denote

$$y_i = t_i/p,$$

i.e.  $y_i$  is a proportion of  $p$  corresponding to the  $i$ -th transfer price  $t_i$ . Let  $x_i$  be a proportion of the optimal output to which that transfer price should be applied, i.e.

$$x_1 = f_1/q,$$

and for  $2 \leq i \leq k$ ,

$$x_i = (f_i - f_{i-1})/q.$$

As explained above, all the rectangles  $R_i$  are congruent and so  $x_1$  can be actually used as a ratio in a formula for determining  $x_i$ . More precisely, for  $2 \leq i \leq k$ ,  $x_i$  is equal to the 'remaining proportion' of  $q$  multiplied by  $x_1$ :

$$x_i = \left(1 - \sum_{j=1}^{i-1} x_j\right) x_1 = \left(1 - \sum_{j=1}^{i-2} x_j\right) x_1 - x_{i-1} x_1 = x_{i-1} - x_{i-1} x_1 = x_{i-1} (1 - x_1).$$

Thus,

$$x_i = x_{i-1} (1 - x_1) = x_{i-2} (1 - x_1)^2 = \dots = x_1 (1 - x_1)^{i-1}.$$

Let us find a formula for  $y_i$ . It is well-known in microeconomics that the slope of  $\text{NMR}_B$  is twice that of  $\text{NAR}_B$ , i.e.  $\text{NMR}_B$  bisects any horizontal line between the vertical axis and  $\text{NAR}_B$ .<sup>8</sup> It follows that  $\text{NAR}_B$  and  $\text{NMR}_B$  meets the vertical axis at point  $2p$ . Using the equation of the line  $\text{NMR}_B$ , we obtain

$$t_1 = 2p - \frac{2p}{q} f_1,$$

and hence

$$y_1 = t_1 / p = 2 - \frac{2}{q} x_1 q = 2(1 - x_1).$$

Therefore, using  $y_1$  as a ratio in the recursive definition of  $y_i$ , we have

$$y_i = \frac{y_{i-1}}{2} y_1 = \frac{y_1^i}{2^{i-1}} = 2(1 - x_1)^i.$$

Thus  $c$ , the target contribution for A, is as follows:

$$c = \sum_{i=1}^k x_i y_i = 2x_1 \sum_{i=1}^k (1 - x_1)^{2i-1}.$$

With  $c$  specified in advance,  $x_1$  can then be found from the above formula. In fact, for  $0 \leq c \leq 0.66$ ,  $x_1$  is one of the roots of the polynomial:

$$2x_1 \sum_{i=1}^k (1 - x_1)^{2i-1} - c = 0.$$

More precisely,  $x_1$  is the ‘upper’ root out of two roots between 0 and 1, because we want to maximize the proportion of optimal output for which the transfer prices are applied. If  $k = 1$ , then this polynomial is exactly the Tomkins quadratic equation:

$$2x_1(1 - x_1) - c = 0,$$

and  $x_1$  is the ‘upper’ root  $0.5 + \sqrt{0.25 - 0.5c}$ , which maximizes the proportion of optimal output for which the transfer price is applied. However, if  $k$  is greater than 1, it is more difficult to find such a root. For convenience, the values of  $x_1$  for different values of Division A’s target contribution  $c$  are given in Table 2. This table shows the minimum number of transfer prices ( $k$ ) that are required, for every value of  $c$  up to 66%, within the constraint of keeping  $n$  (the proportion of contribution requiring negotiation) less than 1%<sup>9</sup>. It has been compiled by iteratively increasing the value of  $c$

<sup>8</sup> Let the net average revenue line be given by  $\text{NAR}_B(f) = a - bf$ , where  $a > 0$  is the intercept and  $b > 0$  is the slope of  $\text{NAR}_B$ . The total revenue, denoted by  $\text{TR}$ , is  $\text{TR}(f) = af - bf^2$ . Therefore, the  $\text{NMR}_B$  schedule is  $\text{NMR}_B(f) = \frac{\partial \text{TR}}{\partial f} = a - 2bf$ , i.e. the slope of  $\text{NMR}_B$  is twice that of  $\text{NAR}_B$ . Substituting  $q$  for  $f$  into the  $\text{NAR}_B$  and  $\text{NMR}_B$  schedules, we obtain  $p = a - bq$  and  $0 = a - 2bf$ , respectively. It follows that  $a = 2p$ .

<sup>9</sup> The choice of 1% is arbitrary – a similar table could be created showing the numbers of transfers prices required for given levels of  $c$  if a higher proportion of negotiation (e.g. 2%) was acceptable.

with a given number of transfer prices ( $k$ ) until the value of  $n$  (negotiation proportion) exceeds 1% which then requires one extra transfer price.

**Table 2.** The values of the basic parameters of the modified model.

The proportion of the optimal output for which the transfer prices are applied is denoted by  $x$  and is calculated as follows:

$$x = \sum_{i=1}^k x_i = x_1 \sum_{i=1}^k (1 - x_1)^{i-1}.$$

Recalling that  $n$  is the proportion of group contribution over which negotiation is possible, it is easy to see that

$$n = \frac{1}{2}(1 - x)y_k = (1 - x)(1 - x_1)^k.$$

The number of transfer prices  $k$  is defined as the minimum integer which will insure that  $n$  does not exceed 1%. It is not difficult to prove that, provided  $c$  does not exceed 66%,  $k \leq 4$ . It appears that negotiation over  $n$  is optional because this proportion of group contribution never exceeds 1%, and the transfer price for this negligible part of output can effectively be set to zero.

In this section we have shown how the Tomkins model is enhanced, in terms of substantially reducing the required level of negotiation over quantities and prices. In addition, it can be seen that the enhanced model is more generally applicable since it can accommodate values of  $c$  (the source division's target share of group contribution) greater than 50%; up to 66% as shown in Table 2.

### 6.1. Transfer Price Schedule

Now, it is straightforward to produce the transfer price schedule consisting of transfer prices  $t_i$  and the corresponding thresholds  $f_i$  of the optimal output  $q$ , where  $1 \leq i \leq k$ . Indeed, since  $t_i = py_i$ , we obtain

$$t_i = 2p(1 - x_1)^i.$$

Note that the first transfer price  $t_1$  coincides with the transfer price proposed by Tomkins (1990), see Section 5. Using the equation of the line  $NMR_B$ , we have

$$t_i = 2p - \frac{2p}{q} f_i.$$

Therefore, for  $1 \leq i \leq k$ , the thresholds are:

$$f_i = q(1 - (1 - x_1)^i). \quad (1)$$

Thus, the first transfer price  $t_1$  should be applied to the first  $\lfloor f_1 \rfloor$  units of the output, the second transfer price  $t_2$  should be applied to the next  $\lfloor f_2 \rfloor - \lfloor f_1 \rfloor$  units and so on.

In other words, when the output reaches the threshold  $f_i$ , the next transfer price  $t_{i+1}$  should be applied. Of course, when  $f_k$  is reached, we should apply either the price agreed by negotiation, or zero transfer price  $t_{k+1}$ , which is more preferable.

Notice that if A's variable cost is a non-zero constant, then it is not difficult to see that the following formula should be used to calculate the transfer prices:

$$t_i = 2(p - VC_A)(1 - x_1)^i + VC_A, \quad (2)$$

where  $1 \leq i \leq k$ , and  $t_{k+1}$  is equal to A's variable cost if no negotiation is assumed. The above Formula 1 for the thresholds remains unchanged. Moreover, the precise meaning of  $c$  becomes slightly different: it is A's target contribution less A's total variable costs as a proportion of maximum group contribution less A's total variable costs. Division A's target contribution as a proportion of maximum group contribution is given by the following formula:

$$c + VC_A \frac{1-c}{p}. \quad (3)$$

For example, if  $VC_A/p=0.2$ , then Formula 3 can be written as  $0.8c+0.2$ . Furthermore, if we want to make sure that A's target contribution is 40%, then  $c$  can be found from  $0.8c+0.2=0.4$ , i.e.  $c=0.25$ . Thus, from Table 2,  $x_1=0.857$ ,  $k=2$ , and we can use Formulae 1 and 2 to determine the transfer price schedule.

## 7. CONCLUSION

This paper has revisited the fundamental pragmatic-analytical model proposed by Tomkins (1990) and produced an approach to reduce the process of negotiation over prices and quantities which, in some contexts, may have serious limitations. By introducing multiple transfer prices, it can be guaranteed that the proportion of group contribution over which negotiation is required does not exceed 1%. Equally, the model could be applied assuming a requirement to limit this proportion to a different level, such as, for instance, 3%. This improvement thereby overcomes the potential disadvantage of the process of negotiation, while still keeping the attractive features of Tomkins' model. The use of the new approach is straightforward. Indeed, using Formula 3 one can determine  $c$  and then from Table 2 find  $x_1$  and  $k$ . The transfer prices and the corresponding thresholds are calculated by Formulae 1 and 2.

Thus, in a single-group scenario, the proposed method will motivate divisional managers to make optimal economic decisions without undermining divisional autonomy, and provide a reasonable measure for evaluating the managerial and economic performance of the source and receiving divisions, while being equally acceptable for taxation purposes. Furthermore, in situations where, along specified supply chains, unrelated companies have an overriding concern for the maintenance of trust, this model provides a mechanism for a 'fair' division of contribution without the need for potentially costly and trust-destroying negotiation.

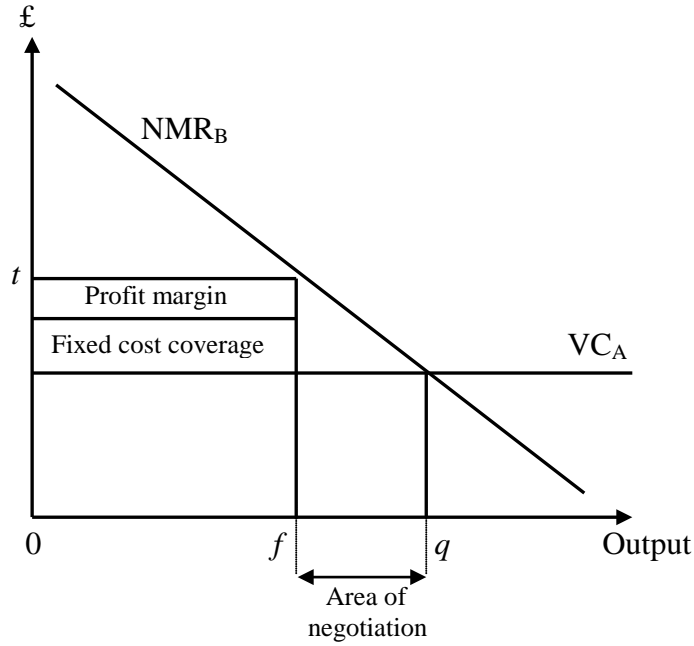
We recognize that the analysis underlying this proposal is not without limitations: the model covers only a single period, not multiple periods; it is restricted

to a one-product scenario in a simple group structure, and uncertainty is not incorporated. In addition we have assumed linearity of net average revenue curves. There is scope for further research to develop the model by relaxing each of these four assumptions. Nevertheless, the model provides the basis for a way forward which assures approximate economic optimality while preserving some divisional autonomy and without requiring significant levels of potentially destructive negotiations.

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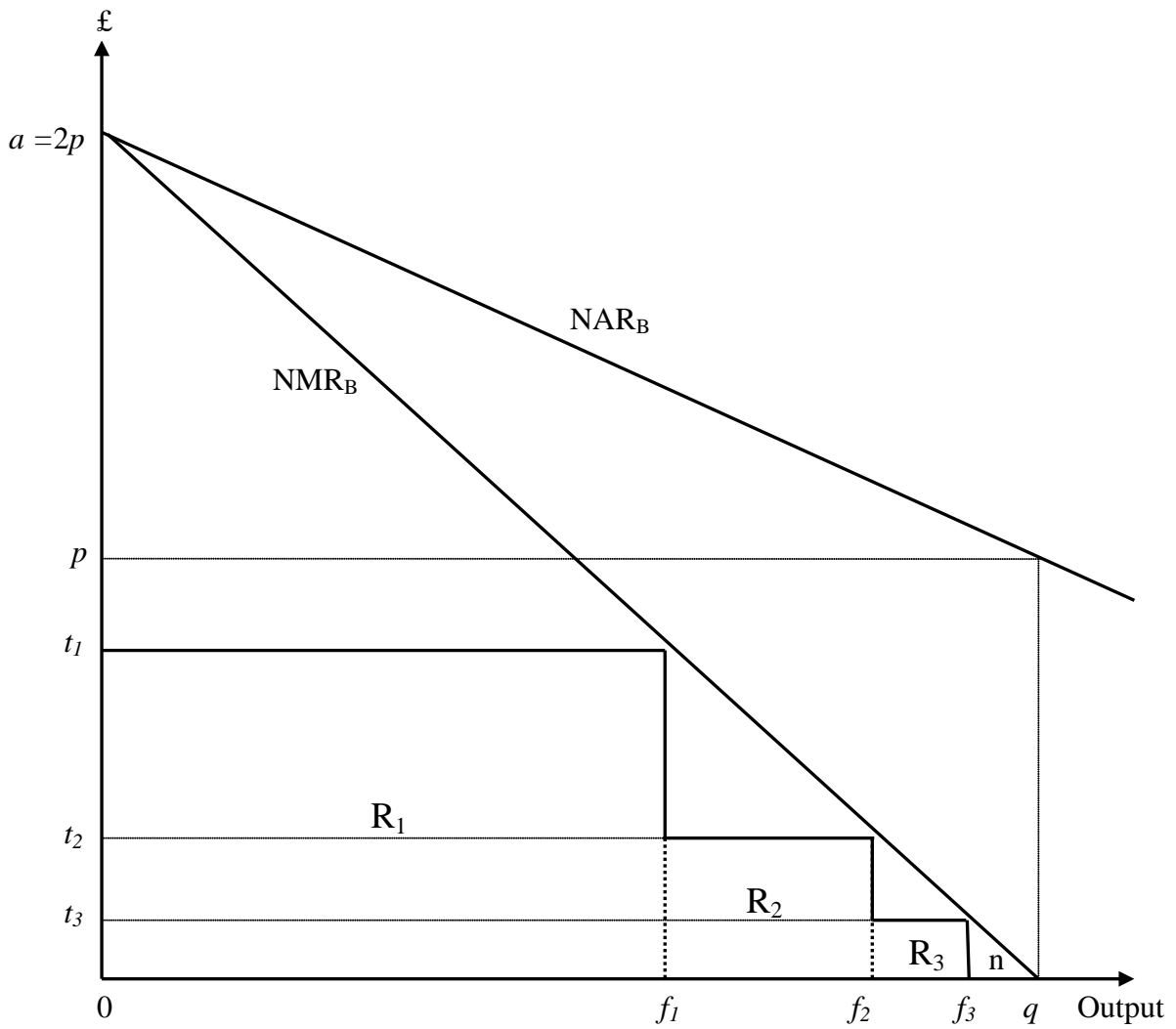
**Figure 1. Tomkins' pragmatic-analytical cost plus transfer pricing approach.**

**Table 1. An illustration of the required negotiation, under the single transfer price model, given different divisions of total contribution.**

Target contribution for source division as a proportion of maximum group contribution (c)	Maximum proportion of optimal output for which the cost-plus transfer price can be applied (x)	Proportion of group contribution over which negotiation is still required (n)
0.50	0.50	0.250
0.48	0.60	0.160
0.46	0.64	0.129
0.42	0.70	0.090
0.38	0.74	0.065
0.32	0.80	0.040
0.26	0.85	0.024
0.18	0.90	0.010
0.09	0.95	0.002
0.00	1.00	0.000







**Figure 2. An illustration of how a three transfer price arrangement would work.**

**Table 2. The values of the basic parameters of the modified model.**

Target contribution for source division as a proportion of maximum group contribution ( <i>c</i> )	Number of transfer prices to be applied ( <i>k</i> )	Proportion of optimal output for which the first transfer price is applied ( <i>x</i> <sub>1</sub> )	Proportion of optimal output over which the transfer prices are applied ( <i>x</i> )	Proportion of group contribution over which negotiation is still required ( <i>n</i> )
0.66	4	0.505	0.940	0.004
0.65	4	0.516	0.945	0.003
0.64	4	0.528	0.950	0.002
0.63	4	0.539	0.955	0.002
0.62	3	0.545	0.906	0.009
0.61	3	0.556	0.912	0.008
0.60	3	0.567	0.919	0.007
0.59	3	0.578	0.925	0.006
0.58	3	0.589	0.931	0.005
0.57	3	0.599	0.936	0.004
0.56	3	0.609	0.940	0.004
0.55	3	0.619	0.945	0.003
0.54	3	0.629	0.949	0.003
0.53	3	0.638	0.953	0.002
0.52	3	0.648	0.956	0.002
0.51	3	0.657	0.960	0.002
0.50	3	0.666	0.963	0.001
0.49	3	0.675	0.966	0.001
0.48	3	0.684	0.968	0.001
0.47	2	0.689	0.903	0.009
0.46	2	0.698	0.909	0.008
0.45	2	0.707	0.914	0.007
0.44	2	0.716	0.919	0.007
0.43	2	0.724	0.924	0.006
0.42	2	0.732	0.928	0.005
0.41	2	0.741	0.933	0.004
0.40	2	0.749	0.937	0.004
0.39	2	0.757	0.941	0.003
0.38	2	0.765	0.945	0.003
0.37	2	0.772	0.948	0.003
0.36	2	0.780	0.952	0.002
0.35	2	0.787	0.955	0.002
0.34	2	0.795	0.958	0.002
0.33	2	0.802	0.961	0.002
0.32	2	0.809	0.964	0.001
0.31	2	0.816	0.966	0.001
0.30	2	0.823	0.969	0.001
0.29	2	0.830	0.971	0.001
0.28	2	0.837	0.973	0.001
0.27	2	0.844	0.976	0.001
0.26	2	0.850	0.978	0.001
0.25	2	0.857	0.980	0.000
0.24	2	0.864	0.982	0.000

0.23	2	0.870	0.983	0.000
0.22	2	0.876	0.985	0.000
0.21	2	0.883	0.986	0.000
0.20	2	0.889	0.988	0.000
0.19	2	0.895	0.989	0.000
0.18	2	0.901	0.990	0.000
0.17	1	0.906	0.906	0.009
0.16	1	0.912	0.912	0.008
0.15	1	0.918	0.918	0.007
0.14	1	0.924	0.924	0.006
0.13	1	0.930	0.930	0.005
0.12	1	0.936	0.936	0.004
0.11	1	0.942	0.942	0.003
0.10	1	0.947	0.947	0.003
0.09	1	0.953	0.953	0.002
0.08	1	0.958	0.958	0.002
0.07	1	0.964	0.964	0.001
0.06	1	0.969	0.969	0.001
0.05	1	0.974	0.974	0.001
0.04	1	0.980	0.980	0.000
0.03	1	0.985	0.985	0.000
0.02	1	0.990	0.990	0.000
0.01	1	0.995	0.995	0.000
0.00	1	1.000	1.000	0.000