Managerial versus Financial Transfer Pricing

Jan T. Martini

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Managerial versus financial transfer pricing

Jan Thomas Martini*

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Abstract: Transfer prices coordinate managerial decisions in decentralized firms. By allocating the group’s profit to its subsidiaries they also serve financial purposes, including taxation and profit distribution. Given that both managerial and financial purposes are commonly served by the same transfer price, it seems obvious that the optimal transfer price for the group induces a trade-off. Based on a model of a decentralized group with asymmetric information and specific investment, this paper shows that this conclusion does not hold in general. In fact, the group benefits from adding a managerial perspective when transfer pricing solely serves financial purposes. A policy of managerial transfer pricing, however, does not necessarily benefit from integrating financial aspects. The paper sheds light on the performance of various transfer pricing policies characterized by different types of decentralization and thereby on the competition of managerial and financial objectives in transfer pricing.

Keywords: Transfer Pricing, Decentralization, Management Control, Financial Accounting, Taxation

JEL classification: M41, L22, H25

*Bielefeld University, Department of Business Administration and Economics, P.O. Box 100131, D–33501 Bielefeld, Germany, tmartini@wiwi.uni-bielefeld.de
1 Introduction

Transfer prices are valuations of products and services within a firm and represent a common and important instrument in management accounting, financial reporting, and taxation. Transfer prices essentially perform two tasks, namely coordination and profit allocation. Coordination implies the alignment of delegated decisions with the goals of the decentralized organization. Vertically integrated profit centers are a typical application of transfer pricing. The coordinative effect arises because transfer prices value intermediates traded between the centers and thus determine their costs and revenues of such internal trade. The role of transfer prices for profit allocation is to quantify a subunit’s contribution to firm-wide profit. It is most important for external purposes such as financial reporting, profit taxation, and profit distribution. Thus, important stakeholders like the shareholders and tax authorities have a vital interest in the allocation of firm-wide profit. Coordination and profit allocation are tightly linked to each other, especially when the firm relies on a single transfer price for internal and external purposes. This case of a single set of books, however, is descriptive for business practice. Accordingly, Ernst & Young (2001, p. 6) report that 77 percent of 638 multinational parent companies use the same transfer price for both tax and management purposes. This paper deals with the optimal focus when setting transfer prices from the firm’s perspective. On the one side, transfer prices may concentrate on management, i.e., operational efficiency, and thus focus on pre-tax profitability. This approach reflects a policy aiming at optimal coordination disregarding issues of profit allocation. On the other side, the choice of transfer prices may be driven by financial aspects and thus minimize the organization’s tax burden and profits distributed to minority shareholders. The third approach is to integrate managerial and financial goals.

The research question seems trivial since the firm apparently should go for that transfer price which optimally trades off managerial and financial goals. Yet, Ernst & Young (2001, p. 6) report that 21 percent, respectively 26 percent, of 638 multinational parent companies primarily base their transfer prices on “management/operations”, respectively on tax considerations. 52 percent use a compromise. Furthermore, these different perspectives are reflected by the location of the transfer pricing authority within the organization. Accordingly, Ernst & Young (2001, p. 7) find, inter alia, that 65 percent, respectively 29 percent, of the parents relying on a single transfer price place the primary responsibility for setting transfer prices on the tax department, respectively on the business units leaders. This paper draws on the empirical evidence and proposes a model of asymmetric information and delegation which allows to answer the research question in a non-trivial way.

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1 For instance, Tang (2002, 32) and Tang (1993, 68) find that 88 percent of 95 Fortune 1000 companies and 92 percent of 143 Fortune 500 companies use transfer prices.
2 See, e.g., Tang (2002, 42) or Anthony and Govindarajan (2000, 201) for functions of (international) transfer prices and their empirical prevalence.
3 See, e.g., Horngren, Datar, and Foster (2006, ch. 22) or Milgrom and Roberts (1992) for decentralization and management control.
4 Ernst & Young (2003, 17) find a corresponding share of 80 percent.
5 See, for instance, Baldenius, Melumad, and Reichelstein (2004) for a corresponding model and result.
6 Respondents were allowed to give multiple answers.
The most salient result of the paper is that the performance of a decentralized firm’s transfer pricing system benefits from adding a managerial perspective but that managerial transfer prices do not necessarily benefit from adding a financial perspective. Therefore, besides a fully centralized policy, the efficient policies imply either to go only for managerial goals or to go for both managerial and financial goals. Roughly speaking, a decentralized organization should not solely put the tax department in charge of transfer pricing whereas doing without it may be optimal. Moreover, the firm’s optimal degree of decentralization decreases, respectively increases, in the optimal weight on financial goals, respectively on managerial goals. The results are mainly driven by the information asymmetry of the profit center organization so that there is no decision maker who has both the necessary information and the incentive to maximize the group’s net profit.

The analysis is based on a model of two vertically integrated subsidiaries of a multinational group generating a surplus from internal trade due to a specific investment into the reduction of production costs. In contrast and as a contribution to the literature this paper explicitly models a situation of asymmetric information in which the group responds to the competition of managerial and financial goals by transfer pricing policies implying different types and degrees of delegation. Delegation pertains to the transfer pricing authority as well as to the trade decisions, while the decision on the cost reduction investment stays with corporate management. Since the policies respond to the friction between managerial and financial goals in different ways it is possible to establish a link between this trade-off and the modes of delegation. In particular, the comparison of the policies shows for which parameter settings a given policy is the group’s best choice. Thereby it is possible to associate the importance of managerial versus financial goals with exogenous parameters such as the tax rates. The main part of the analysis assumes a single set of books. Two sets of books are discussed as an extension.


The next section develops the model. Section 3 motivates the different transfer pricing policies and derives the corresponding transfer price and trade decisions. Section 4 compares the policies from the group’s perspective. Section 5 extends the model with respect to a more or less restrictive bandwidth of arm’s length prices and a second set of books. Section 6 summarizes the results and concludes. All proofs are in the appendix.
2 Model description

We consider a model of two vertically integrated subsidiaries $U$ and $D$ of a multinational group. The upstream subsidiary $U$ produces an intermediate product and sells it either externally at positive market price $r$ or internally to the group’s downstream subsidiary $D$ at transfer price $t$. $D$ finishes the intermediate and sells the final product at market price $r_f$. In order to focus the analysis on transfer pricing issues, the subsidiaries’ production costs and the external markets are such that external trade generates zero contribution margin. Therefore, $U$’s variable unit costs amount to $r$ and $D$’s variable unit costs, exclusive of the intermediate’s costs, to $r_f - r > 0$.

In the line of Williamson (1985), the group may save on production costs by a specific investment. The investment is specific because it exclusively affects variable production costs of intermediates traded internally, i.e., between $U$ and $D$. It is either a success or a failure. A successful investment decreases $U$’s unit costs of producing and $D$’s unit costs of finishing the intermediate, whereas an investment failure increases these costs by the same amount. $e_u I$ denotes the magnitude of the symmetric effect on $U$’s costs where the nonnegative parameter $e_u$ reflects the efficacy of the nonnegative investment $I$ chosen at the corporate level. The corresponding effect on $D$’s costs is $e_d I$. The outlay associated with the investment amounts to $I^2$ on the group level and is fully borne by the subsidiaries. Let $a_u \in [0, 1]$ and $a_d = 1 - a_u$ denote the percentage of the investment outlay incurred by $U$ and $D$, respectively. An example of such an investment is the implementation of information technology aimed at the improvement of the supply chain management as deployed by Wal-Mart. Other examples are the redesign of products to better match the subsidiaries’ production technologies on the one hand and the redesign of production processes to better match the traded products on the other hand.

$p$ denotes the probability of a successful investment. It is the realization of a uniformly distributed random variable $P$ having expectation $1/2$ and range $[1/2 - \Delta, 1/2 + \Delta]$ with $\Delta \in [0, 1/2]$. The low cost probability $p$ is observed by the subsidiaries whereas the group’s corporate management $C$ only knows its distribution. Any other information is common knowledge within the group. Note that the range parameter $\Delta$ has two interpretations. First, it is a measure of information asymmetry between corporate management and the subsidiaries because it determines the range of possible realizations of the low cost probability which is privately observed by the subsidiaries. Second, it is a measure of the group’s cost saving potential. In order to minimize the expected production costs for given investment it is necessary not to trade internally iff an increase of production costs is expected for internal trade, i.e., iff the low cost probability $p$ is below $1/2$. Then the expected cost saving per unit before taxes amounts to $E(P(e_u + e_d)I - (1 - P)(e_u + e_d)I : P \geq 1/2) \cdot \operatorname{prob}(P \geq 1/2) = \Delta(e_u + e_d)I/2$ which is proportional to $\Delta$. Bringing together both interpretations shows that $\Delta$ is a measure of the value of cost information.

The cost information asymmetry between the subsidiaries and corporate management provides the argument that corporate management may set up a profit center or-

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7The assumption of symmetric upside and downside potentials of the investment is not crucial to the analysis but simplifies the presentation.
8See Chiles and Dau (2005) for the examples of Wal-Mart and Amazon.com.
9The limit case $\Delta = 0$ can be derived from the following analysis by letting $\Delta \to 0$. 
ganization and delegate the production and marketing decisions to the subsidiaries.\footnote{Other reasons for delegation involve motivation, complexity, and monitoring. See Grabski (1985) in addition to the references given in footnote 3.} It is important that the model’s linear costing and pricing setup is such that the level of internal trade captures all relevant production and marketing decisions. On the one hand, there is no profit associated with $U$’s external marketing or $D$’s external sourcing and marketing. Given the decision contexts of this model, on the other hand, no decision maker would trade internally and then not finish the intermediate and sell it. Note further that the optimal internal trade decision is either zero or equals capacity. Normalizing both subsidiaries’ capacities to one simplifies the exposition so that $q \in \{0, 1\}$ denotes the volume of internal trade.

Consistent with the information setting, corporate management $C$ has three tasks. First, it decides whether to introduce a profit center organization and to delegate the production and marketing decisions to the subsidiaries. The centralized planning policy applies if $C$ decides not to decentralize these decisions. Second, given delegated product decisions, $C$ decides on the delegation of the transfer pricing authority. Centralized transfer pricing leads to the integrated transfer pricing policy. For delegated transfer pricing we consider two options: The managerial transfer pricing policy implies that the subsidiaries take both the product and the transfer pricing decisions, whereas the financial transfer pricing policy delegates transfer pricing to the tax department $T$. These four transfer pricing regimes form the basis of the analysis and are explained in more detail in Section 3. $C$’s third task is to budget the cost reduction investment.

These three tasks also represent the first two steps of the model’s time line: 1) Choice of the transfer pricing policy, 2) budgeting of the investment $I$, 3) private observation of the low cost probability $p$, 4) choice of the constant unit transfer price $t$, 5) internal trade decision $q$, 6) production and marketing, and 7) preparation of financial statements and filing of tax declarations, taxation and distribution of profits.

All decision makers are assumed risk neutral. In line with the profit center organization and the information setting, each subsidiary seeks to maximize its expected profit after taxes on an a posteriori basis, i.e., given the low cost probability $p$. The corresponding profits before taxes of subsidiaries $U$ and $D$ are denoted by $\Pi_u$ and $\Pi_d$. They read

$$\Pi_u(I, p, q, t) = (t - p(r - e_u I) - (1 - p)(r + e_u I))q - a_u I^2$$

and

$$\Pi_d(I, p, q, t) = (r_f - t - p(r_f - r - e_d I) - (1 - p)(r_f - r + e_d I))q - a_d I^2$$

Both subsidiaries’ profits are given by the a posteriori expected contribution margin from internal trade less the subsidiary’s share of the investment outlay. The contribution margins consist of two parts: On the one hand, the terms $(2p - 1)e_u I q$ and $(2p - 1)e_d I q$ represent the expected cost reduction effects incurred by $U$ and $D$, respectively. On the other hand, the terms $(t - r)q$ and $(r - t)q$ equal the subsidiaries’
contribution margins before cost reduction. Note that the latter terms add to zero so that they reflect profit shifting between the subsidiaries. For \( t = r \), there is no profit shifting. For \( t > r \), in contrast, some of \( D \)'s expected cost reduction is allocated to \( U \) via the transfer price \( t \). For \( t < r \), profit is shifted from \( U \) to \( D \). Let \( \tau_u, \tau_d \in [0, 1] \) denote the subsidiaries’ profit tax rates. Then, assuming that the investment outlay is fully tax-deductible, the subsidiaries’ objective functions are \((1 - \tau_u)\Pi_u\) and \((1 - \tau_d)\Pi_d\).

Corporate management maximizes the group’s a priori expected net profit, i.e., the group’s expected profit net of profit taxes and profits distributed to minority shareholders without the observation of the low cost probability \( p \). It is given by \( w_u \mathbb{E}(\Pi_u) + w_d \mathbb{E}(\Pi_d) \) with weights \( w_s \in \left((1 - \tau_s)/2, 1 - \tau_s\right], s \in \{u, d\} \), which allow for subsidiaries not fully owned by the group.\(^{11}\) Profit allocation does not play a role for \( w_u = w_d \). Thus, asymmetric taxation, i.e., \( \tau_u \neq \tau_d \), is neither a necessary nor a sufficient condition for the relevance of profit allocation.\(^{12}\)

The tax department has the same information as corporate management and minimizes group taxes and profits distributed to minority shareholders given the trade decision. The corresponding objective function is \((1 - w_u)\mathbb{E}(\Pi_u) + (1 - w_d)\mathbb{E}(\Pi_d)\). For ease of presentation, the following analysis does not point out explicitly whether expectations are a priori or a posteriori.

Note that this simple model captures some important features relevant to transfer pricing: 1) Cooperation within the integrated group may be more profitable than trading with non-related parties. 2) The subsidiaries have superior information on operations. 3) The trade decisions and the transfer pricing responsibility may be delegated. 4) Decentralization is based on profit centers. 5) The group relies on a single set of books.\(^{13}\) 6) The allocation of group profit is relevant. Furthermore, the model operates on a constant unit transfer price. With such ‘simple contract’ it is not possible for corporate management to engage in the design of a truth-telling mechanism in order to extract the subsidiaries’ superior knowledge.

### 3 Investments, trade decisions, and transfer prices

This section explains and motivates the four transfer pricing policies and derives the investment level, the internal trade decision, and the transfer price applying for each of them. Table 1 gives a summary of the decisions.

The analysis focuses on inner solutions for the investment decision. Therefore, we assume that the parameters are such that the investment decisions stated below do not imply negative variable production costs for \( U \) and \( D \), i.e., the solutions satisfy \( e_u I \leq r \) and \( e_d I \leq r_f - r \). Furthermore, we focus on a scenario of a single set of books in which the bandwidth of arm’s length prices accepted by external stakeholders is assumed to be given by the interval \([r - 2\Delta e_u I, r + 2\Delta e_d I]\). See the end of Section 3.1 for more details on the bandwidth. Section 5 discusses a less or more restrictive bandwidth and scenarios involving two sets of books.

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\(^{11}\)It can be shown that linear compensations of subsidiaries’ managements can be integrated into the weights.

\(^{12}\)Accordingly, the model is not restricted to multinational groups. However, it is the most intuitive and most discussed application.

\(^{13}\)See Section 5.2 for a relaxation of this assumption.
<table>
<thead>
<tr>
<th>Policy</th>
<th>Decision</th>
<th>Transfer price $t$</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial TP</td>
<td>$\frac{(w_u + w_d)\Delta(e_u + e_d)}{8(w_u a_u + w_d a_d)}$</td>
<td>$r + \frac{(2p - 1)(w_u + w_d)\Delta(c_0^2 - c_0^2)}{16(w_u a_u + w_d a_d)}$</td>
<td>with $s, s' \in {u, d}, s \neq s'$</td>
</tr>
<tr>
<td>Financial TP</td>
<td>$\frac{w_s \Delta e_s}{4(w_u a_u + w_d a_d)}$</td>
<td>$r$</td>
<td>$w_s &gt; w_{s'}, e_{s'} = 0$</td>
</tr>
<tr>
<td></td>
<td>$\frac{\Delta(e_u + e_d)}{4(a_u + a_d)}$</td>
<td>$r$</td>
<td>$w_s &gt; w_{s'}, e_{s'} &gt; 0$</td>
</tr>
<tr>
<td></td>
<td>$r$</td>
<td>$w_u = w_d$</td>
<td></td>
</tr>
<tr>
<td>Integrated TP</td>
<td>$\frac{w_s^2 \Delta(e_u + e_d)^2}{4(w_s(e_s + 2e_{s'}) - w_{s'}e_{s'})(w_u a_u + w_d a_d)}$</td>
<td>$r + \frac{(w_u - w_d)w_s^2 \Delta^2 c_0^2 (e_u + e_d)^2}{2(w_s(e_s + 2e_{s'}) - w_{s'}e_{s'})^2 (w_u a_u + w_d a_d)}$</td>
<td>$w_s \geq w_{s'}$</td>
</tr>
<tr>
<td>Centralized planning</td>
<td>$\frac{(w_s - w_{s'})\Delta e_{s'}}{w_u a_u + w_d a_d}$</td>
<td>$r + \frac{2(w_u - w_d)\Delta^2 c_0^2}{w_u a_u + w_d a_d}$</td>
<td>$w_s \geq w_{s'}$</td>
</tr>
</tbody>
</table>

Table 1: Summary of decisions
3.1 Managerial transfer pricing

The managerial transfer pricing policy implies that the subsidiaries decide on both trade and the transfer price. Managerial transfer prices are freely negotiated by the subsidiaries at date 4, i.e., when they have learned the investment level \( I \) chosen by corporate management at date 2 and the low cost probability \( p \) realized at date 3. Subsequently, the subsidiaries make the internal trade decision at date 5 for given transfer price. Among the considered policies, managerial transfer pricing is characterized by the highest degree of decentralization. The idea is to let those decide who have the best information.

The analysis of managerial transfer pricing proceeds backwards starting with the trade decision to determine the profit consequences for a given transfer price. Two circumstances are fundamental to the analysis of the delegated trade decision: First, at date 4 the investment outlay is sunk and therefore does not have to be considered in the trade decision. The investment’s effect on production costs, however, will be reflected by the trade decision. Second, the internal trade decision is a joint decision of both subsidiaries so that both of them have to agree to trade internally.\(^\text{14}\) The trade decision under managerial transfer pricing is given by Proposition 1.

**Proposition 1 (Trade decision).** Under managerial transfer pricing, the subsidiaries agree on internal trade, i.e., \( q^m(I, p, t) = 1 \), iff the transfer price \( t \) satisfies \( t \in [r - (2p - 1)e_u I, r + (2p - 1)e_d I] \).

The price interval specified by the proposition reflects that the subsidiaries trade internally as long as they do not expect a loss from internal trade. In other words, the subsidiaries agree to trade internally iff internal trade is individually rational for both of them. For instance, \( U \)'s after-tax expected contribution margin from internal trade is nonnegative, i.e., \((1 - \tau_u)\Pi_u(I, p, 1, t) \geq -(1 - \tau_u)a_u I^2\), for transfer prices not lower than \( r - (2p - 1)e_d I \).

Obviously, proportional profit taxes do not play a role in this calculus, nor do minority shares. Therefore the subsidiaries’ trade decision is different from the one corporate management would take if it knew the low cost probability. More precisely, \( C \) would not only base its decision on the (weighted) expected cost advantage or disadvantage from internal trade but also on the gain or loss from shifting profits between the subsidiaries. Therefore, given a sufficiently large gain from profit shifting, corporate management would even find it profitable to trade internally if the expected production costs of internal trade exceeded those of external trade.\(^\text{15}\) The delegation of the internal trade decision, however, is a viable option due to the subsidiaries’ superior knowledge of expected production costs.

The following lemma provides further insights into the internal trade decision which turn out to be helpful for further derivations. The lemma connects the trade decision to the group’s expected pre-tax cost saving from internal trade which is given by

\[
S(I, p) = (2p - 1)(e_u + e_d) I.
\]

\(^\text{14}\)Due to the linear setting of the model, the joint decision equally can be interpreted as bilateral negotiations or as one subsidiary setting the quantity and the other accepting or denying the decision. Similarly, the timing of the transfer price and the trade agreement does not play a role either.

\(^\text{15}\)In such cases, \( C \) would further benefit from not finishing and marketing the internally traded intermediate.
The lemma uses the definition that an investment is called effective if it affects the group’s expected variable production costs, i.e., if $I > 0$ and $e_u + e_d > 0$ hold.

**Lemma 1 (Equivalences).** Under managerial transfer pricing, the following statements are equivalent: 1) There is a transfer price such that the subsidiaries agree on internal trade, 2) the group’s expected pre-tax cost saving from internal trade is nonnegative, and 3) the low cost probability is not less than $1/2$ for effective investments.

According to Lemma 1, the subsidiaries only trade if they do not expect a cost increase, i.e., $p \geq 1/2$. Furthermore, whenever the subsidiaries do not expect a cost increase there is a feasible transfer price they may agree upon. Proposition 2 gives the symmetric cooperative bargaining solution, i.e., the transfer price allocating the expected pre-tax cost saving from internal trade equally to the subsidiaries.

**Proposition 2 (Negotiated transfer price).** Under managerial transfer pricing with nonnegative expected pre-tax cost saving from internal trade, the subsidiaries agree on transfer price $t^m(I, p) = r + (2p - 1)(e_d - e_u)I/2$. For negative expected pre-tax cost saving, the subsidiaries do not negotiate.

We first note that the negotiated transfer price $t^m(I, p)$ lies within the assumed bandwidth of arm’s length prices. An intuitive property of the negotiated transfer price is that it varies with the investment efficacies $e_u$ and $e_d$ so that an increase (resp. decrease) of $e_d$ (resp. $e_u$) increases (resp. decreases) the transfer price. Remember that the low cost probability satisfies $p \geq 1/2$ due to Lemma 1, otherwise there would be no expected cost saving to share and at least one of the subsidiaries would not agree to internal trade. The idea of this dependency of the transfer price on the investment efficacies is that any individual benefit from cooperation is shared by both subsidiaries by means of the transfer price. Hence, for symmetric subsidiaries, i.e., for $e_u = e_d$, the subsidiaries agree on the intermediate’s market price $r$ because $U$ and $D$ expect to get the same benefit from the investment. A negative expected pre-tax cost saving from internal trade implies that the subsidiaries expect to lose from internal trade. Consequently, they do not negotiate and trade externally. In this case, we set the managerial transfer price to the intermediate’s market price, i.e., $t^m(I, p) = r$, for compatibility with Proposition 1.

Note that, analogous to the internal trade decision, the pricing agreement does not depend on taxes or profits distributed to minority shareholders. This is due to the fact that the transfer price cannot shift after-tax profits between the subsidiaries but only pre-tax profits. In terms of cooperative bargaining theory, this addresses the axiom that a bargaining solution should covary with positive affine transformations of utility. Here, proportional taxation represents such transformation. Note that the assumption of after-tax performance measures on the subsidiaries’ level is not in line with Ernst & Young (2001, p. 8) who report that some 75 percent of respondents use pre-tax measures. Due to the irrelevance of taxes, however, the actual choice of the performance measure has no effect on the subsidiaries’ decisions.

Putting together Propositions 1 and 2 and Lemma 1 we see that managerial transfer pricing realizes any nonnegative expected pre-tax cost saving from internal trade. Since corporate management would also realize any nonnegative expected pre-tax cost saving this policy implies the best coordination of the delegated trade decisions. In fact, $C$ might find it profitable to realize a negative expected pre-tax cost saving due to a gain from profit shifting. But such coordination is not feasible under the considered forms...
of delegation. In the following, we therefore may speak of coordination to be optimal iff any nonnegative expected pre-tax cost saving from internal trade is realized.

Turning to the investment decision, C’s objective function is given by the expected weighted sum of the subsidiaries’ expected pre-tax profits given the subsidiaries’ transfer pricing agreement \( t^m(I, p) \) and internal trade decision \( q^m(I, p, t^m(I, p)) \) derived in Propositions 1 and 2. The fact that the investment decision is based on C’s expectation of the subsidiaries’ reactions to alternative low cost probabilities reflects the cost information asymmetry. Exploiting Lemma 1 and the fact that the subsidiaries split the expected pre-tax cost saving equally leads to the following derivation of C’s objective function:

\[
E \left( \sum_{s \in \{u,d\}} w_s \Pi_s(I, p, q^m(\cdot), t^m(\cdot)) \right) = \sum_{s \in \{u,d\}} w_s \left( E(q^m(\cdot)S(I, p)/2) - a_s I^2 \right)
\]

\[
= \sum_{s \in \{u,d\}} w_s \left( \int_{1/2}^{1/2+\Delta} \frac{S(I, p)}{4\Delta} dp - a_s I^2 \right)
\]

\[
= \sum_{s \in \{u,d\}} w_s (\Delta (e_u + e_d) I^4/4 - a_s I^2).
\]

Apparently, the investment maximizing this objective function trades off the effect on the group’s expected net cost saving from internal trade to the investment’s net costs. It is given by the following proposition.\(^{16}\)

**Proposition 3 (Investment).** Under managerial transfer pricing, corporate management chooses investment

\[
I^m = \frac{(w_u + w_d) \Delta (e_u + e_d)}{8(w_u a_u + w_d a_d)}.
\]

The symmetry of \( I^m \) in the efficacy parameters \( e_u \) and \( e_d \) reflects the equal allocation of the expected pre-tax cost saving to the subsidiaries. Furthermore, corporate management finds it always profitable to invest unless investments are in vain in the first place, i.e., \( e_u = e_d = 0 \), because the managerial transfer pricing policy exploits the superior knowledge of the subsidiaries.

Some remarks on the assumed bandwidth \([r - 2\Delta e_u I, r + 2\Delta e_d I]\) of arm’s length prices conclude this subsection. Returning to Proposition 1, we observe that the transfer price interval allows for any allocation of the group’s expected pre-tax cost saving from internal trade to the subsidiaries. For any smaller bandwidth the subsidiaries do not fully dispose of the expected cost saving for some low but favorable low cost probability. Since the group’s profit center organization implies individual maximization of after-tax profits and bargaining (effectively) is unrestricted, managerial transfer prices as introduced above perfectly implement the arm’s length principle as codified amongst others in Article 9 of the OECD Model Tax Convention.\(^{17}\) Hence, the negotiated transfer price \( t^m(I, p) \) is the true comparable uncontrolled price (CUP).

Assuming that external stakeholders are less informed than corporate management

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\(^{16}\)The proof of Proposition 3 is omitted since the proposition follows from standard calculus.

\(^{17}\)See OECD (1999, ch. I, par. 1.5) for further remarks.
about the subsidiaries’ bargaining problems at dates 4 and 5, the true CUP is unknown to both corporate management and external stakeholders. In addition to the low cost probability \( p \), it is intuitive that external stakeholders have imperfect information on the range parameter \( \Delta \), on the subsidiaries’ bargaining powers, the investment efficacies \( e_u \) and \( e_d \), or the risk attitudes of the subsidiaries’ managers. They may even lack information on the kind of interplay, not only on the values, of the mentioned parameters, or on the subsidiaries’ business strategies.\(^{18}\) Thus, the assessment whether a specific price is at arm’s length typically is a matter of discretion depending on the information available to external stakeholders.\(^ {19}\)

To gain a better understanding of the assumed bandwidth we generalize the bandwidth of accepted transfer prices by

\[
[r + \Delta(e_d - e_u)I/2 - \delta \Delta(e_d + 3e_u)I/2, r + \Delta(e_d - e_u)I/2 + \delta \Delta(3e_d + e_u)I/2]
\]  

(2)

with exogenous parameters \( \delta, \bar{\delta} \geq 0 \) representing the degree of discretion admitted by external stakeholders.\(^ {20}\) \( \delta = \bar{\delta} = 0 \) says that external stakeholders only accept the expected value of the true CUP given equal bargaining powers, i.e., \( E(t^m(I, P)) \).

\( \delta = (e_d - e_u)/(e_d + 3e_u) < 1 \) and \( \delta = (e_d - e_u)/(3e_d + e_u) < 1 \) imply that external stakeholders accept any realization of the true CUP given equal bargaining powers. With \( \delta = \bar{\delta} = 1 \) external stakeholders additionally accept any distribution of bargaining powers. The setting \( \delta, \bar{\delta} > 1 \) corresponds to cases where external stakeholders are least strict. Note that, due to the lack of information, external stakeholders have imperfect information on how the accepted bandwidth actually relates to the subsidiaries’ transaction. For instance, external stakeholders holding a high estimation of \( \Delta \) may admit \( \delta = \bar{\delta} = 1 \) even if they are not willing to accept extreme distributions of bargaining power.

Section 3 is based on \( \delta = \bar{\delta} = 1 \) and thus on an intermediate degree of discretion. The corresponding bandwidth reads \( [r - 2\Delta e_u I, r + 2\Delta e_d I] \). It consists of all prices such that any two unrelated parties in the same situation as the subsidiaries would agree to trade with each other. Hence, the bandwidth corresponds with the price interval given in Proposition 1 for \( p = 1/2 + \Delta \). This bandwidth is chosen from a modeling perspective because it is the smallest interval such that the trade-off between the managerial and the financial perspective fully deploys under decentralization. Thus, it is ideal for the study of the economic determinants of the group’s policy choice. In Section 5.1, we sketch the effects of a more or less restrictive bandwidth on that choice.

### 3.2 Financial transfer pricing

The managerial transfer price negotiated by the subsidiaries does not consider taxes and minority shares. The idea of financial transfer pricing is to put a decision maker in charge of the transfer price who accounts for them.\(^ {21}\) It is assumed that the tax depart-

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\(^{18}\) Confer OECD (1999, pp. I-9) for factors determining the comparability of transactions.  
\(^{19}\) Note that discretion typically is not removed when transfer prices are based on empirical data due to the incompleteness of information and the heterogeneity of the sample.  
\(^{20}\) This approach is in line with previous literature. See, e.g., Smith (2002a). However, note that the explicit consideration of information asymmetry makes the analysis more involved.  
\(^{21}\) Strictly speaking, this policy would have to be called ‘financial and tax transfer pricing’ as the transfer price applies to both financial and tax accounting.
ment $T$ is such a decision maker. As an alternative, one might think of a joint decision of the tax department and the CFO. With respect to transfer pricing this policy is the opposite of managerial transfer pricing where transfer prices are set without any consideration of taxes and minority shares. In this policy, transfer prices are exclusively based on these considerations. Financial and managerial transfer pricing have in common that the production and marketing decisions are delegated to the subsidiaries. Hence, the internal trade decision in Proposition 1 also applies to this policy.

The minimization of payments to tax authorities and minority shareholders for given trade decision implies a maximal profit shift under the condition that the transfer price lies in the bandwidth of arm’s length prices. Hence, $T$’s optimal pricing choice is extreme and determined by the relative weights of subsidiaries’ pre-tax profits according to

$$t^f(I) = \begin{cases} r - 2\Delta e_ul & \text{if } w_u < w_d \\ r + 2\Delta e_dI & \text{if } w_u > w_d \end{cases}$$

Note that $t^f(I)$ depends on the investment level because the bandwidth of arm’s length prices does.

$C$’s optimal investment choice therefore anticipates both $T$’s transfer pricing choice and the subsidiaries’ internal trade decision in reaction to that transfer price. The corresponding objective function reads

$$E \left( \sum_{s \in \{u,d\}} w_s \Pi_s \left( I, P, q^u(I, P, t^f(I)), t^f(I) \right) \right).$$

The following proposition derives $C$’s and $T$’s decisions.

**Proposition 4** (Investment and transfer price). Under financial transfer pricing with unequal weights, i.e., $w_u \neq w_d$, corporate management’s investment choice is

$$I^f = \frac{w_s \Delta e_s}{4(w_u a_u + w_d a_d)}$$

for $e_s = 0$ and $w_s > w_s'$ with $s, s' \in \{u, d\}$ and $s \neq s'$. Otherwise corporate management does not invest. The transfer price equals the intermediate’s market price, i.e., $t^f(I^f) = r$.

We take the unilateral case $e_u = 0$ and $e_d > 0$ to explore the proposition. When $T$ values $U$’s pre-tax profit higher than $D$’s the transfer price equals the right corner of the bandwidth of arm’s length prices. For this transfer price, $D$ almost surely denies internal trade and no positive expected cost saving is realized. Hence, $C$ does not invest and the bandwidth of arm’s length prices collapses into the intermediate’s market price. For $w_u < w_d$, the intermediate is priced at the market price which is the left corner of the bandwidth. Both subsidiaries agree to internal trade at this transfer price whenever the expected cost saving is nonnegative. $C$’s incentive to invest is to increase this potential cost saving.

Proposition 4 does not cover the case $w_u = w_d$ because $T$ has no preferred transfer price if profit allocation does not matter. Consequently, an assumption on $T$’s decision behavior is necessary. We assume that the tax department chooses the intermediate’s market price $r$ as the transfer price if $w_u = w_d$ holds.
3.3 Integrated transfer pricing

Managerial transfer prices induce optimal coordination of trade with respect to the group’s expected pre-tax profit but ignore the group’s payments to tax authorities and minority shareholders. In contrast, financial transfer prices only account for profit allocation but do not consider coordination. The idea of integrated transfer pricing is to find a compromise between the generation of pre-tax profits on the one hand and its allocation to the subsidiaries on the other. Accordingly, C keeps the transfer pricing authority. Referring to Ernst & Young (2001, p. 7), one might also think of a joint decision of the tax department and the controller. The trade decisions stay with the subsidiaries in order to exploit the subsidiaries’ superior knowledge of expected costs. Consequently, the internal trade decision under managerial transfer pricing given in Proposition 1 also applies to this policy.

C’s objective function of the investment and transfer pricing decisions is

\[
E \left( \sum_{s \in \{u,d\}} w_s \Pi_s (I, P, q^m(I, P, t), t) \right)
\]

(3)

where the delegation of the trade decision is reflected by \(q = q^m(I, P, t)\). Evaluation of (3) yields

\[
E \left( (w_u - w_d)(t-r) + (w_u e_u + w_d e_d)(2P-1)I : q^m(I, P, t) = 1 \right) \cdot \text{prob}(q^m(I, P, t) = 1) - (w_u a_u + w_d a_d) I^2
\]

(4)

which is zero in case of no investment because then internal and external trade are equivalent and the only arm’s length price is the intermediate’s market price. Further evaluation for unilateral investment effect for \(D\), i.e., \(e_u = 0\) and \(e_d > 0\), yields

\[
\frac{(w_u - w_d)(t-r)}{2\Delta} \max \left\{ \Delta - \frac{t-r}{2e_d I}, 0 \right\} + \frac{w_d e_d I}{2\Delta} \max \left\{ \Delta^2 - \left( \frac{t-r}{2e_d I} \right)^2, 0 \right\}
\]

\[- (w_u a_u + w_d a_d) I^2
\]

(5)

for \(t \geq r\). For transfer prices below the intermediate’s market price, i.e. for \(t < r\), \(U\) does not agree to internal trade so that (5) equals the net investment outlays. Expression (5) allows to explore the driving forces of \(C\)’s optimal transfer price and investment choices.

Two effects have to be taken into account for the transfer price choice. On the one hand, the transfer price determines the extent of profit shifting which exploits the weight differential \(w_u - w_d\). The according expression (5) of this profit allocation effect is \((w_u - w_d)(t-r)\). With \(w_u > w_d\) (resp. \(w_u < w_d\)) corporate management wants to shift profit to \(U\) (resp. \(D\)) and therefore prefers high (resp. low) transfer prices. Note that the lowest arm’s length price for \(e_u = 0\) is \(r\). On the other hand, the transfer price affects the subsidiaries’ trade decision. The corresponding expression of this coordination effect in (5) is \(\Delta - (t-r)/(2e_d I)\). Since the subsidiaries realize any nonnegative expected cost saving from internal trade if the intermediate is priced at the market price, coordination is optimal for \(t = r\). Any increase of the transfer price increases the probability that \(D\)
refuses internal trade although the expected pre-tax cost saving from internal trade is nonnegative. For the highest arm’s length price, i.e., for \( t = r + 2\Delta e_d I \), \( D \) would only agree to internal trade if the low cost probability is maximal, i.e., \( p = 1/2 + \Delta \). The probability of this event is zero. Hence, managerial and financial goals are complementary for \( w_u < w_d \) and \( C \) chooses to value transfers at the market price. For \( w_u > w_d \), the two objectives are competitive and \( C \) has to find the optimal trade-off.

The investment decision involves three effects. First, the higher the investment the higher is the cost saving potential and thus the expected pre-tax cost saving from internal trade. The corresponding term in expression (5) is \( w_d e_d I \). Second, an increasing investment, for given transfer price \( t > r \), decreases the probability that \( D \) refuses to trade although the expected pre-tax cost saving is nonnegative. This again refers to the difference \( \Delta - (t - r)/(2e_d I) \) in (5). These two effects are complementary and have to be weighed against the third, namely the investment’s net costs.

The following proposition gives the group’s optimal investment and pricing choices for both unilateral and bilateral investment effects.

**Proposition 5 (Investment and transfer price).** Under integrated transfer pricing, corporate management chooses investment \( I^i \) and transfer price \( t^i \) according to

\[
I^i = \frac{w_u^2 \Delta (e_u + e_d)^2}{4(w_s(e_s + 2e_s') - w_d e_d)(w_u a_u + w_d a_d)}
\]

\[
t^i = r + \frac{(w_u - w_d)w_u^2 \Delta^2 e_u^2 (e_u + e_d)^2}{2(w_s(e_s + 2e_s') - w_d e_d)^2 (w_u a_u + w_d a_d)}
\]

for \( w_s \geq w_s' \) with \( s, s' \in \{u, d\} \) and \( s \neq s' \).

The proposition captures three intuitive properties of integrated transfer prices. First, profit allocation does not play a role for equal weights, i.e., \( w_u = w_d \), so that the transfer price then solely serves optimal coordination. Second, optimal profit allocation drives up (resp. down) the transfer price above (resp. below) the market price if \( C \) benefits from shifting profits to \( U \) (resp. \( D \)). Third, the assumed bandwidth of arm’s length prices never restricts the transfer price choice because coordination fully deploys within the assumed bandwidth and thereby limits profit shifting effectively. Put differently, any extension of the assumed bandwidth of arm’s length prices has no effect on \( C \)’s decisions as given in Proposition 5.

### 3.4 Centralized planning

The preceding policies all rely on delegation. This section deals with the option to centralize all considered decisions. Accordingly, in the centralized planning policy corporate management takes both the trade decision and the transfer price decision. The benefit of a centralized trade decision is that trade does not maximize anymore the group’s expected pre-tax profit but the group’s expected net profit due to the decision makers’ different objectives. The disadvantage of such a policy is that \( C \)’s trade decision is less informed than the subsidiaries’ decision because it does not react to the realized low cost probability.

Obviously, the optimal investment level without internal trade is zero yielding zero profit. Therefore, \( C \)’s optimization with respect to the investment and the transfer price
concentrates on the group’s expected net profit given internal trade which reads

\[
E\left( \sum_{s \in \{u,d\}} w_s \Pi_s (I, P, 1, t) \right) = (w_u - w_d)(t - r) - (w_u a_u + w_d a_d) I^2. \tag{6}
\]

Observe that there is no expected cost saving due to the information asymmetry. As a consequence, the benefit of internal trade solely relies on profit shifting reflected by the minuend of the right hand side of expression (6). Proposition 6 gives the optimal decisions.

**Proposition 6** (Investment, transfer price, and internal trade). Under centralized planning, corporate management opts for internal trade, i.e., \( q^c = 1 \), and chooses investment \( I^c \) and transfer price \( t^c \) according to

\[
I^c = \frac{(w_s - w_{s'}) \Delta e_s}{w_u a_u + w_d a_d}
\]

and

\[
t^c = r + \frac{2(\Delta e_s)^2}{w_u a_u + w_d a_d}
\]

for \( w_s \geq w_{s'} \) with \( s, s' \in \{u,d\} \) and \( s \neq s' \).

For equal weights profit shifting has no value and it is not worthwhile to invest. Maximizing the gain from profit shifting for \( w_u \neq w_d \) implies the same transfer pricing decision as under financial transfer pricing, namely \( t = t^f(I) \). Thus, the optimal investment level trades off the benefit from extending the bandwidth of arm’s length prices to its costs. With respect to the investment \( I^c \), the effect on the bandwidth is reflected by the parameter \( e_s \) whereas the cost effect shapes the denominator. The corresponding effects on the bandwidth can be easily seen from the definition of the transfer price \( t^c \).

### 4 Comparison of policies

The preceding analysis shows that the policies have different strengths and weaknesses. The advantage of managerial transfer pricing is that both the trade and the transfer price decision exploit the subsidiaries’ superior knowledge. This perfectly serves the managerial goal, i.e., the maximization of the expected pre-tax cost saving from internal trade, but ignores taxation and profit distribution. Financial transfer prices focus on group profitability but ignore the effect on the delegated trade decision. Integrated transfer prices are also set with respect to the maximization of the group’s expected net profit while the trade decision still benefits from the subsidiaries’ superior knowledge. Thus, the transfer price incorporates both managerial and financial aspects but the pricing decision lacks information. The decisions under the centralized planning policy all aim for the group’s expected net profit but completely do without the subsidiaries’ knowledge. This section concentrates on the relative performance of the different policies and identifies conditions of optimality.

The first step to identify \( C \)'s optimal policy choice for alternative parameter settings is to exclude the financial transfer pricing policy.

**Lemma 2** (Inefficiency of financial transfer pricing). From the perspective of corporate management, integrated transfer pricing dominates financial transfer pricing.
The efficiency result of Lemma 2 states that there is no parameter setting such that financial transfer pricing yields a higher expected net profit of the group than integrated transfer pricing and that there is some parameter setting such that financial transfer pricing actually does worse than integrated transfer pricing. The idea of this result is that, ceteris paribus, ignoring the coordination effect on the trade decision cannot be optimal. Thus, it is never detrimental to add a management perspective to financial transfer pricing. The financial transfer pricing policy therefore will be dropped in the following. Note that the result of the lemma is very robust. In particular, it holds for different degrees of discretion with respect to arm’s length prices.

The second step is Proposition 7 which calculates the expected net profit of the group for the remaining policies.\(^{22}\)

**Proposition 7** (Maximal net profits). The maximal expected net profit of the group reads

\[
\frac{(w_u + w_d)^2 \Delta^2 (e_u + e_d)^2}{64(w_u a_u + w_d a_d)}
\]

under managerial transfer pricing,

\[
\frac{w_s^4 \Delta^2 (e_u + e_d)^4}{16(w_u a_u + w_d a_d)(w_s (e_s + 2e_s') - w_s'e_s')^2}
\]

under integrated transfer pricing, and

\[
\frac{(w_u - w_d)^2 \Delta^2 e_{s'}^2}{w_u a_u + w_d a_d}
\]

under centralized planning for \(w_s \geq w_s'\) with \(s, s' \in \{u, d\}\) and \(s \neq s'\).

The following corollary gives a first insight into the relative performance of the policies by considering a knife-edge case where information has no value.\(^{23}\)

**Corollary 1** (No value of information). When there is no value of information, i.e., \(\Delta = 0\), all policies yield zero expected net profit of the group.

The idea of Corollary 1 is that there neither is a positive expected pre-tax cost saving from internal trade nor a gain from profit shifting if cost information has no value. There is no positive expected pre-tax cost saving because with \(\Delta = 0\) the low cost probability always equals \(1/2\) so that there is no potential for expected cost reductions. Profit shifting does not yield a gain because with \(\Delta = 0\) the bandwidth of arm’s length prices collapses into the intermediate’s market price.

The following corollary describes \(C\)’s preference over the policies which is depicted in Figure 1.\(^{24}\) The corollary implicitly shows that a positive value of information actually has no effect on corporate management’s preference. The value of information rather determines the magnitude, not the sign, of the difference in the policies’ expected net profit.

\(^{22}\)The proof of Proposition 7 is omitted since the proposition follows from straight evaluation of the group’s objective function for the decisions given in the preceding propositions.

\(^{23}\)The proof of Corollary 1 is omitted since it directly follows from Proposition 7.

\(^{24}\)The proof of Corollary 2 is omitted since it directly follows from Proposition 7.
Corollary 2 (Policy preferences). Corporate management prefers (resp. is indifferent between)

1. managerial transfer pricing to (resp. and) integrated transfer pricing iff
   \((w_u - w_d)(w_d e_d - w_u e_u) > (\text{resp. } =) 0\)

2. managerial transfer pricing to (resp. and) centralized planning iff
   \((w_u + w_d)(e_u + e_d) > (\text{resp. } =) 8(w_s - w_{s'})e_{s'}\)

3. integrated transfer pricing to (resp. and) centralized planning iff
   \(\frac{w_s^2(e_u + e_d)^2}{w_s(e_s + 2e_{s'}) - w_{s'} e_{s'}} > (\text{resp. } =) 4(w_s - w_{s'})e_{s'}\)

for \(\Delta > 0\) and \(w_s \geq w_{s'}\) with \(s, s' \in \{u, d\}\) and \(s \neq s'\).

An observation from Proposition 7 is that the performance of centralized planning depends on two factors. On the one hand, the (nonnegative) weight differential \(w_s - w_{s'}\) determines \(C\)'s marginal benefit of shifting the transfer price below \((w_u < w_d)\) or above \((w_u > w_d)\) the intermediate's market price. On the other hand, the efficacy parameter \(e_{s'}\) limits the effective discretion provided by the bandwidth of arm’s length prices, i.e., the maximal extent of an appropriate shift of the transfer price. Both factors are associated with profit allocation. Since centralized planning does without the subsidiaries’ information this policy is preferred to the others if the advantage from profit allocation outweighs the disadvantage of no coordination. From Figure 1 we arrive at the intuitive conclusion that this is the case if the efficacy parameter \(e_{s'}\) is sufficiently large compared to \(e_s\).

Managerial and integrated transfer pricing are candidates for optimality whenever managerial aspects are important relative to financial aspects. For equal weights profit allocation does not play a role and both policies coincide. It does not surprise that managerial transfer pricing is optimal for equal weights since the subsidiaries generically agree on internal trade maximizing the group’s expected pre-tax profit. According to Proposition 1, however, the same internal trade decision is induced by pricing the intermediate at the market price. Thus, corporate management also achieves optimal coordination by means of integrated transfer pricing. For differing weights the transfer prices under managerial and integrated transfer pricing serve both managerial and financial aspects and the policies’ performances differ. As an example, we compare the two policies for unilateral investment effect for \(D\), i.e., \(e_u = 0\) and \(e_d > 0\).

With \(w_d > w_u\) corporate management prefers low transfer prices with respect to profit allocation. The lowest arm’s length price is the market price for which \(C\) benefits from optimal coordination. Therefore managerial transfer pricing performs worse than integrated transfer pricing because the former allocates the group’s (nonnegative) expected pre-tax cost saving from internal trade equally to the subsidiaries whereas the latter fully allocates it to \(D\). This is an instance where it is advantageous to add a financial perspective to transfer pricing. This is not the case for \(w_u > w_d\). Under integrated transfer pricing any profit shift to \(U\) comes at the expense of coordination, i.e., a decrease of the expected pre-tax cost saving from internal trade. In order to replicate, at least in expectation, the equal cost saving allocation under managerial transfer pricing, corporate management suffers from efficiency losses due to suboptimal coordination. In contrast, managerial transfer pricing implies optimal coordination. Since managerial transfer pricing prevails for \(w_u > w_d\), we infer that profit shifting under integrated transfer pricing is too costly in terms of deteriorated coordination compared to the equal cost saving allocation and optimal coordination under integrated transfer pricing.
5 Extensions

This section considers extensions of the analysis with respect to the bandwidth of arm’s length prices as well as a second set of books.

5.1 More or less restrictive bandwidth

The previous analysis is based on the bandwidth \([r - 2\Delta e_d I, r + 2\Delta e_d I]\) of arm’s length prices as motivated in Section 3.1. In this subsection we sketch the effects of a less or more restrictive bandwidth with respect to the policies’ performances. We stick to the exclusion of financial transfer pricing on the basis of Lemma 2.

A less restrictive bandwidth leaves the policies with delegated trade decision unaffected because the previous bandwidth effectively does not restrict the transfer price choice. The centralized planning policy, however, benefits from softening the minimal (resp. maximal) arm’s length price condition for \(w_d > w_u\) (resp. \(w_u > w_d\)) due to extended profit shifting.

A more restrictive bandwidth is never favorable for integrated transfer pricing as well as for centralized planning because the restrictions on profit allocation become tighter. In contrast, the effect on managerial transfer pricing is ambiguous. On the one hand, a more restrictive bandwidth may harm coordination because the subsidiaries, depending on the narrowing of the bandwidth, may find themselves in a situation in which there is no feasible transfer price inducing internal trade although they expect a positive cost saving. On the other hand, a more restrictive bandwidth might let the subsidiaries agree on a transfer price allocating the expected pre-tax cost saving from internal trade unequally. Given an appropriate relation of the weights, this improves...
the performance of managerial transfer pricing due to a more favorable profit allocation. Hence, a group adopting the managerial transfer pricing policy eventually benefits from a more restrictive bandwidth of arm’s length prices and thus by less ex-post discretion.\(^{25}\)

We illustrate the positive effect of a more restrictive bandwidth on the performance of managerial transfer pricing by concentrating on the low cost probability \(p = 1/2 + \Delta\) given a positive investment with an asymmetric effect, i.e., \(I > 0\) and \(e_u \neq e_d\). For a non-restrictive bandwidth, i.e., \(\delta, \tilde{\delta} \geq 1\) in the bandwidth formulation (2), the subsidiaries agree on transfer price \(t = r + \Delta(e_d - e_u)I\), trade internally, and share the expected cost saving equally. Observe that the center of the bandwidth (2), i.e., the expected negotiated transfer price \(t = r + \Delta(e_d - e_u)I/2\), is above (resp. below) the negotiated transfer price for \(e_u > e_d\) (resp. for \(e_d > e_u\)). A restricted bandwidth is represented by \(\delta < 1\), \(\tilde{\delta} < 1\), or both. The negotiation result for such bandwidth depends on the specific solution concept.\(^{26}\) For \(e_u > e_d\) (resp. for \(e_d > e_u\)), however, there is a sufficiently small \(\delta\) (resp. \(\tilde{\delta}\)) such that the restricted bandwidth lies above (resp. below) the freely negotiated transfer price. For such restricted bandwidth, the subsidiaries agree, no matter which solution concept they apply, on some transfer price above (resp. below) the freely negotiated one. Thus, the expected pre-tax cost saving is split between the subsidiaries in favor of \(U\) (resp. \(D\)) which is favorable for corporate management if the weights satisfy \(w_u > w_d\) (resp. \(w_d > w_u\)). Consequently, the group’s expected net cost saving from internal trade increases which makes the investment more profitable and increases the performance of managerial transfer pricing.

### 5.2 Two sets of books

The analysis in Sections 3 and 4 is based on the assumption of a single set of books. When the group employs a second set of books the transfer price for external purposes optimally would be set in order to minimize group taxes and profits distributed to minority shareholders according to the scenario of financial transfer pricing. The internal transfer price then is not restricted anymore by a bandwidth of arm’s length prices and is freed from its profit allocation function.

However, a second set of books does not make the research topic of this paper obsolete because the optimal internal transfer price would induce decisions maximizing the group’s net profit on the part of the subsidiaries and thus indirectly account for profit allocation. Therefore neither negotiated nor administered internal transfer prices do a perfect job. The former imply informed trade decisions that do not maximize the group’s expected net profit, whereas the latter aim at the group’s expected net profit but ignore the subsidiaries’ superior information. Hence, the idea of the trade-off between managerial and financial transfer pricing as modeled in this paper remains.\(^{27}\)

Note that the model of this paper would have to be extended in order to capture this trade-off under two sets of books. In the present model with two sets books, corporate management would set the internal transfer price to the intermediate’s market price in order to induce the subsidiaries to trade internally whenever a nonnegative pre-tax cost saving is expected. Given the delegation of the trade decision, this is optimal for both

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\(^{25}\)See Smith (2002a) for the effects of ex-post discretion on the decisions of a centralized firm.

\(^{26}\)The corresponding bargaining problem exhibits the property that utility is not (freely) transferable.

\(^{27}\)See, e.g., Baldenius et al. (2004) for optimal transfer prices under two sets of books and full information.
the group’s expected pre-tax profit and its expected net profit. There are two remedies to this shortcoming. First, the subsidiaries’ optimal trade decision is not binary and reacts more to changes in the transfer price. Second, the sets of transfer prices inducing internal trade do not all overlap for all low cost probabilities. The remedies’ common consequence is that they establish a more effective information asymmetry between corporate management and the subsidiaries so that the former is not able to induce its most preferred delegated trade decision under partial information.

6 Conclusion

In this paper we examine a multinational group consisting of corporate management and two subsidiaries organized as profit centers in a setting of asymmetric information and specific investment. Asymmetric information pertains to the success of a cost reduction investment which is under the control of corporate management. An expected cost reduction has to be exploited by an appropriate trade choice. Corporate management employs a single transfer price for managerial and financial purposes which has to be at arm’s length. There are four transfer pricing policies available to corporate management.

Under managerial transfer pricing, financial transfer pricing, and integrated transfer pricing the trade decision is delegated to the subsidiaries. It is an informed decision due the subsidiaries’ superior knowledge, but depends on the transfer price. The first policy additionally delegates the transfer pricing authority to the subsidiaries who negotiate the transfer price. This price is set under full information and serves as the basis of the bandwidth of arm’s length prices. It is shown that the transfer price maximizes the group’s pre-tax profit so that any expected positive cost saving is exploited. The second policy implies a transfer price decision which is solely driven by financial considerations and thus minimizes group taxation and profits distributed to minority shareholders. The financial focus heavily impairs coordination, i.e., the subsidiaries’ trade decision. The third policy allows for a centralized transfer price decision which is made with respect to the group’s net profit after taxes and profit distribution but suffers from incompleteness of information and thus also deteriorates coordination. The fourth policy of centralized planning delegates neither the transfer price nor the trade decision. It does not realize any expected cost saving but only relies on profit shifting.

A first result of the comparative analysis is that financial transfer pricing is inferior to integrated transfer pricing. This result is intuitive because the former policy ignores coordination. A second, at first sight less intuitive result is that it may be optimal to choose managerial transfer pricing and thus ignore aspects of profit allocation. The idea of this result is that the disadvantage of impaired coordination under integrated transfer pricing outweighs the advantage from a better allocation of profit. Summing up, it is optimal to add a managerial perspective to transfer pricing but the advantage of adding a financial perspective depends on the underlying parameter setting. A third result is illustrated by Figure 2: The more the optimal perspective on transfer pricing is a financial one, i.e., the more important profit allocation, the lower is the optimal degree of decentralization. For instance, a group with the tax department in charge of transfer pricing relies on centralized decision making.

An extension shows that only centralized planning actually may benefit from a less restrictive bandwidth of arm’s length transfer prices due to a higher degree of feasible
profit shifting. As expected, a more restrictive bandwidth does not improve the performance of integrated transfer pricing but rather harms it. Yet, the effect on the performance of managerial transfer pricing is ambiguous. Accordingly, this policy benefits from tighter transfer pricing rules if they sufficiently improve profit allocation. Finally, we argue that a second set of books essentially implies the same reasoning as presented in the course of the analysis when choosing between managerial and integrated transfer pricing for internal purposes.

The analysis sheds light on the relative performance of various designs of delegation differing in their capabilities to coordinate and to allocate profit. The results may not only help business practitioners to choose an adequate transfer pricing policy but may also be consulted to comment on empirical findings. For instance, Ernst & Young (2001, p. 7) investigate where multinational parent firms using a single transfer price primarily locate the responsibility for setting transfer prices. The answer “BU Leader” (29 percent) easily links to the managerial transfer pricing approach whereas the answer “Tax Dept.” (65 percent) points at centralized planning. The answer “Controller” (29 percent) may be interpreted in terms of the integrated transfer pricing policy. The fact that respondents were allowed to give multiple answers indicates that transfer price authority may be shared which also relates to an integrated transfer pricing policy.

The paper does not cover administered transfer pricing with prior reporting by the subsidiaries. Truthful reports would require a more sophisticated management control system and transfer price than the one considered in this paper. Dikolli and Vaysman (2006) elaborate on this topic but do not account for issues of profit allocation.

References
Proposition 1
The agreement on internal trade is based on $U$’s and $D$’s individual rationality with external trade yielding after-tax profits of $-(1 - \tau_u)a_uI^2$ for $U$ and $-(1 - \tau_d)a_dI^2$ for $D$. $U$ does not benefit from external trade iff $(1 - \tau_u)\Pi_u(I, p, 1, t) \geq -(1 - \tau_u)a_uI^2$. $D$ cooperates for $(1 - \tau_d)\Pi_d(I, p, 1, t) \geq -(1 - \tau_d)a_dI^2$. The proposition gives the corresponding transfer prices such that these two inequalities hold.

Lemma 1
By Proposition 1, the first statement is equivalent to $r - (2p - 1)e_uI \leq r + (2p - 1)e_dI$ which is equivalent to $(2p - 1)(e_u + e_d)I \geq 0$. By the definition of $S(I, p)$, this condition coincides with the second and the third statement.

Proposition 2
The proof is based on cooperative bargaining theory according to which any bargaining solution should satisfy the axioms of Pareto efficiency, individual rationality, symmetry, and covariance under positive affine transformations. The last axiom allows to concentrate on expected pre-tax profits.

The status-quo point of negotiations is determined by external trade yielding expected pre-tax profits of $(\Pi_u(I, p, 0, t), \Pi_d(I, p, 0, t)) = (-a_uI^2, -a_dI^2)$. Given a non-negative expected pre-tax cost saving $S(I, p)$, there is a transfer price such that the subsidiaries trade internally, see Lemma 1. By Proposition 1, the set of such transfer prices is $[r - (2p - 1)e_uI, r + (2p - 1)e_dI]$. The corresponding expected pre-tax profits

$$\left\{ (\Pi_u(I, p, 1, t), \Pi_d(I, p, 1, t)) : t \in [r - (2p - 1)e_uI, r + (2p - 1)e_dI] \right\}$$

are Pareto efficient and individually rational. In addition, transfer prices $t \in [r - (2p - 1)e_uI, r + (2p - 1)e_dI]$ allow for any allocation of the cost saving $S(I, p)$ to the subsidiaries. Any symmetric bargaining solution allocates this surplus equally to the subsidiaries so that

$$\Pi_u(I, p, 1, t) - (-a_uI^2) = \Pi_d(I, p, 1, t) - (-a_dI^2) = S(I, p)/2$$

holds for the negotiated transfer price. $t^m(I, p)$ is the unique transfer price to satisfy this condition. Otherwise, i.e., for negative expected pre-tax cost saving, there is no expected gain from internal trade, the subsidiaries do not negotiate and trade externally yielding the status-quo point.

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See, e.g., Rosenmüller (2000, ch. 8) for details.
Proposition 4
For unilateral investment effects, the proof concentrates on \( e_u = 0 \). The case \( e_d = 0 \) can be derived in the same manner. \( T \) chooses transfer price \( t'(I) = r \) for \( w_u < w_d \) and \( t'(I) = r + 2\Delta e_d I \) for \( w_u > w_d \) to minimize the group’s tax burden and payments to minority shareholders for given internal trade and investment. The former pricing choice is identical to the corresponding case under integrated transfer pricing so that Proposition 5 gives the optimal investment level. Evaluation of (5) for the latter choice shows that any investment is unprofitable.

Similar to the unilateral case, (7) and (8) show that the pricing choice \( t'(I) \) makes any investment in the bilateral case unprofitable for \( w_u \neq w_d \).

Observe that in any case the transfer price in the optimum is \( t' = t'(I) = r \).

Proposition 5
The proof first concentrates on the case of a bilateral investment effect, i.e., \( e_u, e_d > 0 \), from which optimal decisions under unilateral investment effects can be derived. By (3), the expected contribution margin after taxes and profit distribution reads

\[
\frac{(w_u - w_d)(t-r)}{2\Delta} \max\left\{ \Delta - \frac{t-r}{2e_d I}, 0 \right\} + \frac{(w_u e_u + w_d e_d)I}{2\Delta} \max\left\{ \Delta^2 - \left( \frac{t-r}{2e_d I} \right)^2, 0 \right\} \tag{7}
\]

for \( t \geq r \) and

\[
\frac{(w_d - w_u)(r-t)}{2\Delta} \max\left\{ \Delta - \frac{r-t}{2e_u I}, 0 \right\} + \frac{(w_u e_u + w_d e_d)I}{2\Delta} \max\left\{ \Delta^2 - \left( \frac{r-t}{2e_u I} \right)^2, 0 \right\} \tag{8}
\]

for \( t \leq r \). Since \( \Delta < (r-t)/(2e_u I) \) for \( t \leq r \) and \( \Delta < (t-r)/(2e_d I) \) for \( t \geq r \) induce an expected loss and no investment implies zero expected profit for the group, the following search for the optimal transfer price and investment concentrates on \( \Delta \geq (r-t)/(2e_u I) \) for \( t \leq r \), \( \Delta \geq (t-r)/(2e_d I) \) for \( t \geq r \), and \( I > 0 \).

For \( w_u \geq w_d \), the transfer price maximizing (8) for given investment is \( t = r \). For \( t \geq r \), expression (7) applies. The first-order condition for the transfer price reads

\[
t = r + \frac{2(w_u - w_d)e_d^2 I}{w_u(e_u + 2e_d) - w_d e_d}.
\]

The first derivative of (7) with respect to \( I \) in combination with the marginal net investment costs yields the first-order condition

\[
I = \frac{w_u(e_u + e_d)}{2(w_u a_u + w_d a_d)\Delta} \left( \frac{t-r}{2e_d I} \right)^2 + \frac{w_u e_u + w_d e_d}{4(w_u a_u + w_d a_d)\Delta} \left( \Delta^2 - \left( \frac{t-r}{2e_d I} \right)^2 \right).
\]

The unique solution of these conditions is

\[
t' = \frac{w_u^2 \Delta (e_u + e_d)^2}{4(w_u(e_u + 2e_d) - w_d e_d)(w_u a_u + w_d a_d)}
\]

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and

\[ t^i = r + \frac{2(w_u - w_d)\Delta e_d^2 I^i}{w_u(e_u + 2e_d) - w_d e_d} = r + \frac{(w_u - w_d)w_u^2 \Delta^2 e_d^2 (e_u + e_d)^2}{2(w_u(e_u + 2e_d) - w_d e_d)^2(w_u a_u + w_d a_d)} . \]

\((t^i, I^i)\) proves to be the unique global maximizer of (3) for \(w_u \geq w_d\) taking into account that (7) and (8) coincide for \(t = r\) and that (7) is strictly concave in \((t, I)\) and tends to zero for \(I \to 0\). Due to the symmetry of (7) and (8) the proof for a bilateral investment effect with \(w_d \geq w_u\) is analogous to the case \(w_u \geq w_d\) and can be omitted here.

Also by symmetry, the proof for unilateral investment effects concentrates on \(e_u = 0\).

Internal trade requires \(t \geq r\) so that the corner solution \(t = r\) maximizes (7) for \(w_d \geq w_u\). Maximizing the right hand side of (7) less the net investment costs for \(t = r\) over \(I\) yields

\[ I^i = \frac{w_d \Delta e_d}{4(w_u a_u + w_d a_d)} . \]

The proposition covers this solution. It also covers the solution for \(w_u \geq w_d\) because the maximization of (7) for \(e_u = 0\) is a special case of the corresponding optimization problem in the case of a bilateral investment effect.

**Proposition 6**

The maximal net profit of the group for external trade is zero. Therefore, internal trade is optimal yielding at least zero profit by letting \(I = 0\) and \(t = r\).

Due to the symmetry of the objective function and the bandwidth of arm’s length prices it suffices to give the explicit proof for \(w_u \geq w_d\). C chooses \(t = r + 2\Delta e_d I\) for \(w_u > w_d\). Then

\[ I^c = \frac{(w_u - w_d)\Delta e_d}{w_u a_u + w_d a_d} \]

maximizes (6). The transfer price turns out to be

\[ t^c = r + 2\Delta e_d I^c = r + \frac{2(w_u - w_d)\Delta^2 e_d^2}{w_u a_u + w_d a_d} . \]

\(w_u = w_d\) makes any investment unprofitable and reduces the bandwidth of arm’s length prices to \(t = r\). The solution \(t^c = r\) and \(I^c = 0\) for \(w_u = w_d\) is included in the above expressions. Similarly, note that it is not necessary to analyze unilateral investment effects separately.

**Lemma 2**

Under both integrated and financial transfer pricing only the internal trade decision is delegated. Then the group’s optimization problem is to maximize the objective function (3) with respect to the investment \(I\) and the transfer price \(t\) under the bandwidth condition \(t \in [r - 2\Delta e_u I, r + 2\Delta e_d I]\). The unique optimal solution \((I^i, t^i)\) is realized under integrated transfer pricing, see Proposition 5. In contrast, under financial transfer pricing with \(w_u \neq w_d\), T sets the transfer price to a corner solution, i.e., \(t \in \{r - 2\Delta e_u I, r + 2\Delta e_d I\}\). Then C maximizes (3) with respect to \(I\). Obviously, the
corresponding solution \((I^f, t^f)\) is not optimal iff \((I^i, t^i)\) is an inner solution, i.e., \(t^i \in (r - 2\Delta e_u, r + 2\Delta e_d)\), because \((I^i, t^i)\) and \((I^f, t^f)\) coincide iff \((I^i, t^i)\) is a corner solution. By assumption, decisions made for \(w_u = w_d\) are the same under fiscal and integrated transfer pricing. \(\square\)