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ORIGINAL RESEARCH

Corporate choice and individual values: using accounting to align incentives

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Abstract Corporate choice is expected to reflect rational behavior and yet there is much anecdotal evidence suggesting the opposite. Often the accounting system plays a major part in such stories. Aligning incentives has always been one of the main concerns of the accounting system. Accounting control has been discussed intensively as one of the purposes of the management accounting system. Furthermore, accounting for stewardship has been important to the financial accounting debate. Goal congruency issues are central to this discussion. In particular, conflicting interests have been transparent in the transfer pricing literature. The development of the transfer pricing literature is used to illustrate the development of how the accounting system is a vehicle to align incentives in the organization. In conclusion, it is argued that the accrual accounting system more generally serves the purpose of aligning incentives.

Keywords Individual rationality · Corporate choice · Transfer pricing · Accrual accounting · Organizational design · Decentralization

1 Introduction

Corporate choice is expected to reflect rational behavior and yet there is much anecdotal evidence suggesting the opposite. We would like to think of our firms as being rational as the opposite suggests that there is room for improvement and that management has not done their jobs well. Also, most quantitative research in business and economics makes the fundamental assumption that the decision makers act rational. In the absence of such assumption, any result could be obtained

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leaving the research having no descriptive or prescriptive value. However, as empirical or experimental evidence suggests that some deviations from rational behavior have also been documented. Thus, irrationality in some forms has found its way into formalized modeling of organizational behavior. Modeling various degrees of irrationality requires a set of clever assumptions to ensure that the descriptive validity of the research remains such that the results are not simply assumed. An alternative way is to limit the information set available to decision makers. From the perspective of full information, the decision makers then appear irrational. The route taken in this paper is to assume that the firm acts rational but taking the available information into consideration.

Our notion of rationality is often closely tied to rationality of a single individual and Von Neumann and Morgenstern mapped out the axiomatic description of such rationality. Later, Savage (1954) gave an axiomatic approach to decision making when confronted with subjective uncertainty. This required a set of axioms describing the beliefs of the decision maker. As decision making in most firms is a multi-person endeavor, the Savage axioms are only rarely satisfied for the entire decision process. That is only the case when the organization can be characterized as a team as demonstrated by Wilson (1968). It requires very strong assumptions for a multi-person group to act as one rational decision maker as they have to have similar preferences or identical beliefs. Demski (1973) extended Wilson's analysis to also covering the acquisition of information systems. The point is that a group of decision makers or an organization hardly acts as rational decision makers in the Savage sense. When there are multiple decision makers, conflict of interests is likely to occur and then a Nash equilibrium is useful, and the agency model is an appropriate model for the analysis, Holmstrom (1979) has made a pathbreaking study of the moral hazard case.

A second layer of this discussion is added when the dispersion of information is brought into the analysis. Organizations are found in all firms and different parts of the organizations are collecting and processing different pieces of information. Thus, the units are to be seen as decision units making both operative and information decisions. In a perfect world, it would be optimal to collect all information centrally and then make joint optimal decisions for the firm. The world is not that perfect—few organizations have unlimited information processing capabilities—and as a consequence decisions are decentralized to decision units. This opens the door for conflicts of interests as the decision units are headed by individuals with individual preferences, which might divert from the preferences of the firm. The roots of such diversion might be in the individual preferences of the decision maker, but it might also be due to information issues. Following the goals of the firm requires information about how they translate to a specific decision situation, as it is not a priori given what is the corporate optimal choice in every conceivable situation. The problem is even more complicated because corporate headquarters also have limited information about the actions of the subunits. Moral hazard is an issue to be addressed in the design of an organization.

Often the accounting system plays a major part in such stories. Accounting is the formal information system of the organization simultaneously serving as a basis for making decisions and for keeping a scorecard for the units of the organization.

Consequently, aligning incentives has always been one of the main concerns of the accounting system. Accounting control has been discussed intensively as one of the major purposes of the management accounting system. Furthermore, accounting for stewardship has been important to the financial accounting debate. Goal congruency issues are central to this discussion. In particular, conflicting interests have been transparent in the transfer pricing literature. The development of the transfer pricing literature is used to illustrate the development of how the accounting system is a vehicle to align incentives in the organization.

The purpose of this paper is to analyze the relation between individual rationality and optimal corporate choice and in particular to study the role of accounting accruals in engineering this connection. The development in the transfer pricing literature is used to demonstrate the complexity of the problem. Initially, the transfer pricing literature was only concerned about the use of internal prices to simulate the outside market. Later reporting incentives were added and now the problem is seen as an aggregation of accounting information used for control. It is argued that accounting accruals play a major role in forming an accounting system which is well suited for the task. As pointed out this is just a part of the larger question of organizational design. However, the accrual accounting plays a role in this as the information system of the organization.

The paper will be organized as follows. In Sect. 2, the difference between individual rationality and optimal corporate choice is addressed and the link between the two is briefly discussed. In Sect. 3, the classical textbook recommendation for the determination of transfer prices is described. This will demonstrate the experienced complexity of the problem. In Sect. 4, I will review the classical analysis of this problem establishing the general rule of setting the price equal to outlay cost plus opportunity cost. Within the classical framework, Ronen and McKinney (1970) and Groves and Loeb (1979) have later scrutinized this result and they established a link between transfer pricing and performance evaluation. The analysis is in Sect. 5 taken to the modern economic analysis as economics of uncertainty and moral hazard issues are introduced. This opens the door to the complex nature of the inter-organizational control when divisions are not independent. Within this framework, the allocation of profit among divisions is scrutinized. Next the attention is directed to the alternative possible information structures in the decentralized firm and it is demonstrated that a transfer pricing solution with delegated accounting choices might dominate other structures. In Sect. 7, the balance between corporate control and individual rationality is analyzed where accruals are used in maintaining control in organizations. This is found to be the origin of the vague recommendation of textbooks as several concerns have to be balanced. The final Sect. 8 points to the limitations of this study as it is pointed out that the transfer pricing problem is part of the larger question of organizational design. This leads to a set of brief concluding remarks.

2 Individual rationality and corporate choice

The concept of rationality to be used here is that of Savage (1954). That means that each decision maker satisfies the Savage axioms of rational behavior. Then, the decision maker's preferences can be represented via a utility function such that the decision maker is maximizing his utility. Furthermore, the Savage axioms conceptualize the uncertainty the decision maker is facing such that it is the personal beliefs that are taken into account when decisions are made. Given the independence axioms the decision maker's preferences can be represented as an expected utility. To keep the analysis simple, it is always assumed that the decision maker has utility for the payment he gets from working for the firm and the effort variable describes the discrepancy of the utility of the decision maker compared to the firm. The simple interpretation of the effort variable is a personal cost that the decision maker incurs to implement the chosen decision. More fundamentally it catches the fundamental difference in goals of the decision maker compared to the goals of the firm.

If the firm were a single person entity the story would end with the expected utility representation of the owner of the firm. However, today's firms are more complex operations involving several decision makers. Each decision maker is given authority over a set of decisions, which are organized as a division. As mentioned there is a divergence in preferences between the decision maker and the firm. The response of the decentralized firm to the challenge created by multiple decision makers is to establish performance centers with individual performance measures. The performance measurement is often found in the accounting system and this is accounting for divisional control. The fundamental economic problem is called an agency and was extensively analyzed by Holmstrom (1979). The basic agency model is shown below:

$$\begin{aligned} &\text{Max} E(x - I(x,y)) \\ &\text{s.t.} \quad E(U(I(x,y),a^*)) \geq \bar{M} \\ &a^* \in \arg\max E(U(I(x,y),a)). \end{aligned}$$

For the purpose of this paper, the fundamental finding of Holmstrom is that a variable y that contained information about the chosen act is of value in the performance evaluation of the agent. Such a variable is useful in incentivizing the chosen act and reduces the risk premium that has to be given as part of the incentive payment. In the classical management accounting text, this is called controllability accounting, cf. Horngren et al (2015). The conventional wisdom in the divisional performance measurement is that an agent should be held accountable for only the accounting variable he could control, i.e., could influence via his choice of action. Antle and Demski (1998) added a more precise interpretation called conditional controllability. The refined notion is that an agent should be held responsible for variables which contain additional information in addition to the information already included in the performance measure, or conditional on other information sources.

When the private information on part of the decision maker is also included in the analysis, the finding of Christensen (1981, 1982) suggests that also information

about the private decision relevant information of the agent should be included in the performance information of the agent.

This problem is part of the more comprehensive problem of organizational design. Roberts (2004) is insightful on this. How is the firm partitioned into separate decision units? One idea is to confine the control problem to such units and then deal with the coordination problems later. Some coordination problems are dealt with centrally as the center steps in and makes decisions or collects information. In other cases, the divisions are left to themselves to sort out the coordination. This includes both the transfer of resources and the accompanying compensation in the form of entries into the accounting system. This is called the transfer pricing problem.

3 The transfer-pricing problem: the textbook prescriptions

Often when there are multiple divisions in a firm, there is some interaction between such divisions. That is, inter-organizational trade is often found in organizations. When that is the case the question of how to design the performance evaluation of the involved divisions emerges. Resources transferred from one division to another obviously change the performance evaluation of both divisions and the question arises as to how to account for such inter-organizational trade. One solution is introduction of a pricing mechanism which accounts of such trade. According to Horngren et al. (2015), the criteria for evaluating a transfer pricing solution are that it should promote goal congruence, influence managers' behavior to work hard, support optimal performance evaluation of divisions, and preserve autonomy of subunits.

There are three classes of transfer prices, which are commonly observed in organizations. These are market-based transfer prices, cost-based transfer prices, and hybrid transfer prices. The market-based transfer prices are as the name suggests based on the market prices. Thus, such prices use existing markets of similar products to determine the prices, which adjust the performance measure for both the receiving and delivering unit. Now the firm is an organization, where markets as well as market prices do not exist. When no proxy for a market price exists, the firm might turn to using a cost statistic for a transfer price. Finally, firms might use a combination of market and cost information as basis for the transfer price. Such prices are named hybrid prices.

The question is how all these suggested transfer prices can be optimal in inducing optimal transfer choices and optimal incentives, especially the cost alternative seems hard to justify. This question is the core of the balance between individual rationality and optimal corporate performance.

4 The classical setting

The interest in the transfer-pricing problem grew as the companies increasingly experienced issues related to coordination of activities and a demand for divisional performance measures. The path breaking formal analysis was found in the work of Hirshleifer (1956). The analysis is cast in a classical economic setting under certainty, however, with the twist that divisions have private and exclusive information about their division.

The performance evaluation for the divisional manager is their local profit, which is adjusted by the transferred resources multiplied by the transfer price. Hirshleifer (1956) showed that there exists a transfer price such that it is optimal for all divisions to transfer the overall optimal amount and such that the decision to decentralize the transfer decision to the divisional managers can be done without loss in the overall profit.

The problem can be formulated as a profit maximizing organization, total revenue minus distribution cost minus manufacturing cost:

$$\pi(q) = TR(q) - C_D(q) - C_M(q).$$

With the optimality condition:

$$\frac{\partial TR}{\partial q}(q^*) = \frac{\partial C_D}{\partial q}(q^*) + \frac{\partial C_M}{\partial q}(q^*)$$

In the decentralized organization, the divisional performance measures are defined as local profit adjusted for the transfer:

$$\begin{aligned}\pi_D(q_D) &= TR(q_D) - C_D(q_D) - Tq_D \\ \pi_M(q_M) &= Tq_M - C_M(q_M).\end{aligned}$$

Basically, the transfer price is defined to equal the marginal cost of the producing division or the marginal net revenue of the selling division at the optimal quantity. Then, both divisions will find the identical optimal solution to their divisional problems:

$$T = \frac{\partial TR}{\partial q}(q^*) - \frac{\partial C_D}{\partial q}(q^*) = \frac{\partial C_M}{\partial q}(q^*).$$

This insight led to the normal recommendation for setting the transfer price equal to the outlay cost plus the opportunity cost. Here, it is assumed that the cost is linear and that there might be scarce resources in the producing division leading to an opportunity cost. Looking at the empirical evidence for setting the transfer price, this general rule is not always followed. There must be more dimensions to the problem, which is not included in the Hirshleifer analysis.

In the analysis, it is implicitly assumed that the divisions have private information about their productivity or rather their cost and revenue functions. Thus, the information is decentralized and not directly accessible for the headquarters of the firm. Determination of the "market clearing" price requires the information to be centralized and consequently the information has to be communicated to headquarters for the optimal price to be determined.

Christensen and Obel (1978) analyzed this information exchange as they modeled it to follow a Dantzig–Wolfe decomposition algorithm. They used data from an LP model of a Danish slaughterhouse. It turned out that the decomposition algorithm was not an efficient way of communicating the private information; the convergence was way too slow.

More important is the fact that the divisions are placed in monopoly positions with respect to their information advantage. As they are instructed to optimize their performance measure, i.e., their local profit, they will act strategically when instructed to reveal their private information. This is known as the double-marginalization problem (Tirole 1988). Even disregarding such incentives, it is questionable whether this procedure could form the basis for a decentralization of the resource allocation in the firm. The headquarters has to solve the total planning problem in order to determine the optimal transfer price. Then, headquarters could just as well use the information to dictate the resource transfer and then the interrelation in the performance evaluation problem would disappear. The divisional autonomy is hardly in existence in this environment.

Ronen and McKinney (1970) realized this as they suggested an alternative transfer pricing procedure. Their goal was to find a mechanism, which resulted in an accurate performance evaluation of the divisional managers, created goal congruence between divisional managers and the total firm, and allowed the divisional managers autonomy in making decisions. The mechanism was described in 7 steps. The divisions reported a demand/supply schedule for the two divisions, respectively, as a function of the transfer price; implicit in this is the optimal response production/sales schedule as a function of the transfer price. This allowed headquarters to determine average cost and revenue functions. The average revenue function was given to the supplying division as a transfer pricing schedule and the average cost function was given to the receiving division as a transfer price. Equipped with these transfer prices, the divisions were allowed to determine their respective production and sales plans. That means that the divisions were charged with the transfer price, which equaled the reported average cost/revenue. For the two divisions in the Hirshleifer case, the following performance measures were obtained.

$$PE_D(q) = TR(q) - C_D(q) - AC_M^* \cdot q$$
$$PE_M(q) = ATR_D^* \cdot q - AC_D^* \cdot q - C_M(q)$$

Thus, the performance evaluation function of the divisional manager is equal to the local profit plus the transferred amount multiplied by the transfer price. In a more general case, this is equal to the local profit plus the expected profit of the other division (the relevant part marked by a^*) or rather the expected profit of the entire company. At the reporting stage, it is rather obvious that both of the divisions are interested in sending a report which leads to maximizing the total expected profit rather than the local profit as in the classical Hirshleifer setting. In fact, it is a Nash equilibrium to report truthfully about the production schedules.

Note the twist in the performance measure. It consists of the actual local profit and the reported profit from the other divisions. Thus, any inefficiencies in the

implementation of the plans in other divisions are not influencing the performance measure of the division in question. This is in the spirit of the controllability principle as such influence would not be controllable by the manager in question and that would only increase the risk in the performance measure.

The mechanism suggested by Ronen and McKinney is almost identical to the Groves mechanism, which is described in Groves and Loeb (1979) for the transfer-pricing problem. The main difference is that in the Groves mechanism it is the center that makes the final resource allocation decision. With this change, it is a dominant strategy for each of the divisions to report truthfully. In the Ronen and McKinney mechanism, it is optimal for the two divisions to collude in a subtle way and that way boost their respective performance measures and at the same time resulting in a lower corporate profit. This was demonstrated by Groves and Loeb (1979).

With this alignment of incentives for reporting of local private information as induced by the performance evaluation function, it is time to consider the connection between the performance evaluation function and the incentive function. It has to maintain the balance between the local incentive (in form of the local profit) and the coordination incentives (in form of the transfer pricing component). Otherwise, the reporting incentives will get lost again. Given the way the problem is formulated here and as the firm is the residual claimant to the profit of the total firm the mechanism is a question of profit sharing at least at the reporting stage. The present formulation of the problem includes no notion of private costs to the divisional manager. He is indifferent among the possible decisions. Consequently, there is no need to provide motivation and the optimal weight on the performance evaluation measure is 0. In fact, there is no use of the performance evaluation as the model is formulated in the classical setting.

The easy extension of the model formulation includes a personal cost component in the utility function of the manager, who continues to be risk neutral (the risk was absent in the Hirshleifer setting). The personal cost is associated with additional outcome (profit) of the division and it is an additive component of the divisional profit. In addition, a local noise term is added, which is uncorrelated with the other division's noise terms. As before the profit has two components, revenue and cost. Combined it results in the following specification:

$$\pi_i = R_i - C_i + a_i + \varepsilon_i$$

Optimizing the resource allocation problem requires truthful reporting and that requires balancing the weight on the local profit and the profit from other divisions such that the divisions are induced to be indifferent between letting the resources be allocated to other divisions instead of remaining in his division. The Groves scheme suggests the following performance measure.

$$PE_i = R_i - C_i + \sum_{j \neq i} \left[R_j^* - C_j^* \right] + a_i + \varepsilon_i.$$

The effort side of the optimization problem is equally simple. Obtaining first best effort level requires marginal cost being equal to marginal revenue. The revenue is part of the local profit function whereas the cost is personal to the manager. Thus,

obtaining first best requires that the manager receives the full compensation for his provided effort or that the incentive weight on the performance measure (at least on the margin) is equal to 1.

Combining the two problem components leads to the conclusion that a first best solution to the combined resource allocation problem and the incentive problem of the manager requires that the manager gets a weight of 1 attached to his performance measure. Essentially that means that each divisional manager should get a payment which is equal to the profit of the entire firm or rather the reported profit. This has to be the case for all divisions. With n (≥ 2) divisions, the residual to be accrued by headquarters is $(1 - n)$ multiplied by the profit of the firm, again at the margin. This leads the firm to seek to minimize the profit. There must be something I have lost in my investigation of this problem. Holmstrom reports a similar result for moral hazard in teams, Holmstrom (1982).

The demand for a local profit measure stems from the incentive problem of the manager, which again is rooted in a conflict of interests or a goal conflict. Without such incongruence, the incentive weight on the performance measure should be set to zero. With such incongruence, the local profit measure is important and must be given a large weight in the performance evaluation. If we aim at first best in the resource allocation problem, the profit of all divisions must be weighted equally, otherwise incentives for misreporting are induced. The point is that the incentives for reporting and the incentives for effort must be balanced to address the two problems simultaneously. If the resource allocation problem is important it calls for balanced weights of the divisions in the performance measure and if the effort incentives are important the firm must put a higher weight on the local profit measure. There is a tradeoff between these two extremes and that is the center for the attention in the next sections. Furthermore, this formulation does not account for the information which is revealed to the center at some point in the game. Thus, important elements of the problem are left out in the above analysis. A more comprehensive model is called for.

5 Profit allocation among divisions

In the previous analysis, the focus was on the dilemma between incentives for reporting and incentives for effort. Now take that analysis one step further and analyze the allocation of profit between divisions by means of the transfer price. As it became obvious in the previous study, the analysis has to take place in a comprehensive model. The model follows Christensen and Demski (1998). Headquarters is risk neutral and has only utility for money. The two divisions have negative exponential utility and have utility for money and effort. The utility functions are specified as:

$$U_m(z_m, a_m) = -\exp[-r_m(I_m - k_m a_m)],$$

where r_m is the risk aversion, I_m is the payment to the manager, k_m is a personal cost parameter, and a_m is the effort supplied by division m. There is constant absolute risk aversion. The output follows the pattern displayed below:

$$
\begin{aligned}
&x_1 = a_1 - cq + \varepsilon_1,\\
&x_2 = a_2 + pq + \varepsilon_2,\\
&\varepsilon \sim N(0, \sigma^2), \quad \operatorname{cov}(\varepsilon_1, \varepsilon_2) = \operatorname{cov}(\varepsilon_m, c) = \operatorname{cov}(\varepsilon_m, p) = 0,\\
&p_0 < c_1 < p_1 < c_0,\\
&q = 1 \quad \text{when} \quad c = c_1 \quad \text{and} \quad p = p_1 \quad \text{otherwise} \quad q = 0.
\end{aligned}
$$

For each of the divisions, there is a standard agency problem of a simple type if the possible transfer of resources is disregarded. The actions chosen can either be *H* or *L*. It is assumed that management prefers *H*. There is a local hidden action and a noise term with an additive specification. The noise terms are independently distributed such that there is no interference between the divisions on that account. To avoid problems regarding existence of solutions, limited liability is assumed throughout.

First assume that a transfer is not possible. Then, the performance evaluation of the compensation function for each division is independent of the performance of the other division as the local agency problems can be addressed independently. That is x_2 does not enter the performance evaluation of division 1. The settings are kept as simple as possible.

Add to this setting a possibility for a transfer of resources from division 1 to division 2. The benefit accruing in division 2 from such transfer is pq. The cost is accruing in division 1 as cq. q is either 0 or 1. Given the size of p and c a transfer is only optimal when $c = c_1$ and $p = p_1$. Otherwise the firm wants $q = 0$. The problematic issue is that the cost and benefit information is private to division 1 and 2, respectively. The setting is closely related to the classical setting.

A centralized solution would call for communication of the private information to the center and letting center decide on the transfer. This could be set up with honest revelation of the private information and the means to do that is to make compensation/input lotteries which makes it attractive to accept the employment offer, reveal honestly the private information, and to perform $a = H$. The optimal compensation arrangement would in this case have division 1's compensation be based upon x_1 and the influence of the trade would be neutralized such that c_1 (as revealed by the manager) would be added to x_1, when c_1 is reported and a transfer takes place. Similarly, will the compensation for division manager 2 be based upon $x_2 - p_1$ when p_1 is reported and a transfer and otherwise x_2.

A decentralized solution would leave it to the divisions to sort out all the details. That is the communication would only take place between the divisional managers. Thus, the choice of q would also have to be decentralized. The center continues to want the optimal transfer policy to be implemented, i.e., transfer when $c = c_1$ and $p = p_1$. Center only observes the reported divisional profit as measured by a specified profit allocation procedure in addition to the total profit of the firm, $x_1 + x_2$. The center might allow a transfer of profit from division 2 to division 1, which might be interpreted as a transfer price T to be paid from division 2 to division 1. If $q = 0$ the combined profit measures (x_1, x_2) are reported and if $q = 1$ the combined profit measures ($x_1 + T$, $x_2 - T$) are reported. The profit measures are observed by the center and can be used in contracting. If it is assumed that only division m's profit measure is used for the compensation of division m, then there must be a

positive weight associated with the profit measure to induce the manager to select high effort. Furthermore, the transfer price T would be such that $c_1 < T < p_1$. Thus, the transfer price would compensate the delivering division more than the cost of producing the resource and the receiving division would pay less than its net revenue from the resource. This is as intuition would suggest.

More interesting is the fact that the derivative of the transfer price T with respect to the second managers personal cost parameter k_2 is positive, $\partial T/\partial k_2 > 0$. Figure 1 shows T as a function of k_2 in a parameterized setup.

The Interpretation of this finding is as follows. The higher the personal cost parameter k_2 is the harder it is to incentivize manager 2 to provide high effort. The risk premium, that is part of the compensation, increases as the incentive problem gets harder. It becomes more expensive to motivate the high action. As k_2 increases the transfer price T approaches p_1 such that all the additional profit which is due to the transfer of resources is allocated to division 1, the delivering division. As k_2 approaches 0, all the additional profit is placed in the receiving division 2. Thus, the relative difficulty of the incentive problem determines where the additional profit from the transfer is placed. In fact, the additional profit pollutes the incentive problems of the two divisions as it adds noise to the performance measures. Harder incentive problem means that the optimal pollution through the transfer price is reduced. This result is of cause closely related to the setup of the problem. The effort is only associated with the local profit measure and there is no interaction with the result of the transfer of resources. Were that the case a different and less clear-cut result would emerge, as the transfer than also would be a source of information about the action chosen and thus it would be valuable in the performance evaluation.

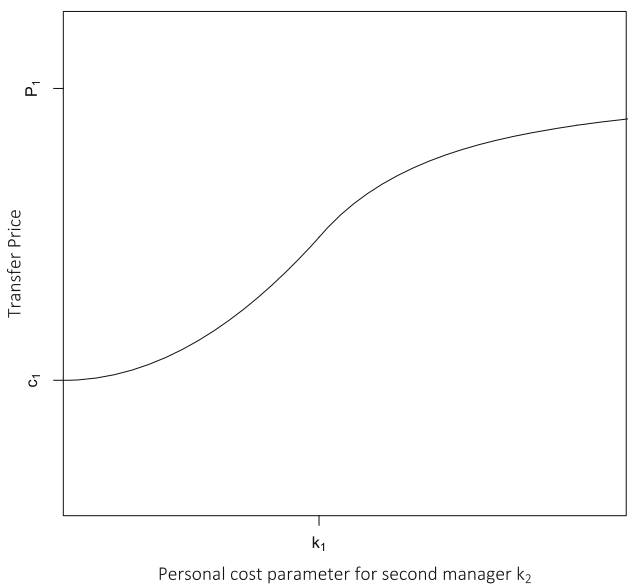

Fig. 1 The optimal transfer price as a function of the difficulty of the incentive problem in division 2

6 Alternative information structures

The above analysis is constructed to analyze the interaction between the transfer price and the performance evaluation of the two divisions. The allocation of profit was the center of the analysis. Another and related question is whether the introduction of the accrual in form of the transfer price is beneficial to the performance evaluation or alternatively should the performance evaluation of a divisional manager be based upon both the realized outputs in the form of the primitive accounting measures.

The setting is now transformed into a set of discrete outcomes. This will allow a comparison of different information structures. The outcome is confined to the set 10, 11, or 12. The action space is *H* or *L* and *H* is preferred uniformly. If *H* is performed there is a .5 probability that there is a successful transfer possibility for that division. Both have to have a favorable signal regarding transfer possibility. Thus, there is a .25 probability that a successful transfer can take place. Note the transfer is only emerging as a possibility when both managers are performing high. In the previous setting, the possibility of transfer was not tied to the action choice. The very highly specified setting allows for a comparison of alternative information structures. The setting is identical to the one in Christensen and Demski (2003b).

The owner of the firm is risk neutral and has the utility for income net of payment to the divisional managers. Both the divisional managers have negative exponential utility with a risk aversion parameter of .0001. The outside certainty equivalent is 10,000 and the personal cost of high action is 5000 in monetary units. Low action is costless. The basic parameters are displayed in Table 1.

Note that a resource transfer results in a lower output from division 1 as the outcome distribution for *H* without transfer first-order dominates (Rothschild and Stiglitz 1970) the outcome distribution with a transfer. Likewise, the option with transfer first-order dominates the option without transfer for division 2, so division 2 would prefer transfer if the payment schedule is increasing.

First consider the case when the transfer option is not an option. In that case, the two divisions are compensated using only the accounting output from their own division. The result from the other division is pure noise and will not enter the performance evaluation. This is as suggested by the controllability principle. Furthermore, the payment schedules are identical for the two divisions of obvious reasons. Everything is symmetrical. The optimal compensation is given in Table 2 and the expected total pay is 21,082 to enforce high in both divisions. Note that the center wants low expected total pay to the managers as all other parameters are kept constant in the cases considered.

Next introduce the option of having a transfer. The setting is decentralized such that center does not make the transfer decision and only observes the reported profits/outputs. The only observable and thus contractible information is the reported local outputs of the two divisions in addition to the total profit of the firm. Note the information about the possibility of the transfer is private to both divisions and only if they both get a positive signal the transfer is an option. Thus, it is

Table 1 Outcome distribution as functions of action choices

Division 1 action $i = 1$	$q_1 = 10$	$q_1 = 11$	$q_1 = 12$
a_H and no transfer	.16	.48	.36
a_H and transfer	.40	.60	.00
a_L	.36	.48	.16
Division 2 action $i = 2$	$q_2 = 10$	$q_2 = 11$	$q_2 = 12$
a_H and no transfer	.16	.48	.36
a_H and transfer	.00	.00	1.0
a_L	.36	.48	.16

Table 2 Pay for performance when no transfer

$E[I\|a_H] = 21,082$	Output (q_i)		
q_i	10	11	12
$I(q_i)$	3851	10,943	12,978

necessary to open up a private information channel between the two divisions. Suppose the firm wants to confine the performance evaluation of division m to the accounting measure of division m. The decision to transfer is in the hands of the divisions and only if they agree there is a transfer. They are allowed to transfer a unit of output in return for a resource transfer. The "transfer price" is confined to a unit of output as that is consistent with the constrained information of the center. Setting the transfer price at 0.5 unit would be equivalent to reporting that a transfer has taken place; that option will be discussed below. In setting up the program to determine the compensation, both divisions have a reservation wage and are incentivized to select high, report truthfully about the transfer possibility and to agree to transfer when both have the possibility. The optimal compensation for this case is given in Table 3. Note transfer of one unit in return for a transfer of resources for division 1 is identical to replacing the lottery of 4437, 10,418, and 11,837 (probabilities .16, .48, .36) with a lottery of 10,418, and 11,837 (probabilities .4, .6), and again here is a first-order stochastic dominance and as the payments are increasing the division manager of division 1 would be in favor of such transfer. It is a bit different for the manager of division 2. He is replacing a lottery of 4085, 11,035, and 11,466 (probabilities .16, .48, .36) with a fixed payment of 11,035. This is also preferred by the second manager and consequently the desired incentives are in place. Without the side payment in form of the transfer price, the first manager would never agree to trade.

Confining the payment of manager m to the accounting result of division m seems consistent with the idea of a transfer price. However, there is also information about the managers action choice in the other division's accounting result. Allowing both

Table 3 Pay for performance with transfer and adjusted outcome

$E[I\|a_H] = 20,614$	Output (q_i)		
q_i	10	11	12
$I(q_1)$	4437	10,418	11,837
$I(q_2)$	4085	11,035	11,466

accounting results, which are observable to the center, to be included in the compensation function for both managers results in a slightly cheaper compensation. There is indeed information about manager 1 action choices in the output from division 2. This is conditional controllability at work. This is evident in the discrete setup used in this example. The new payment schedule is displayed in Table 4.

Even more interesting is the case when the transfer is not accounted for in the accounting system. Suppose that it is not allowed to transfer a unit of output from division 2 to division 1 as a compensation (in the accounting system) for the resource transfer. The question is then whether it continues to be possible to incentivize the transfer. The payment schedule below will do exactly that. Here, it is imperative to use the result from both divisions in the compensation of manager 1 as he otherwise would have no incentives to engage in a transfer of resources as noted previously. High output in division 2 is very likely if a transfer takes place and that is used accordingly in the incentive pay for manager 1. The compensation of division 2 is independent of the output of division 1. Division 1's output contains no useful information for the evaluation of manager 2 in addition to division 2's output. Again we make use of the conditional controllability criterion. Furthermore, the fact that the transfer is only possible when high effort is delivered implies that the output of division 2 with the transfer possible is more informative than the output when the transfer is not possible. The likelihood of output 12 is higher in this case compared to the initial case when high effort is delivered.

Next compare this case to the case in which the center makes no use of accounting transfer price above. In fact, the use of the accounting transfer price or the perturbed accounting measures result in an expected pay to the managers of $E[I|a_H] = 20,614$ which is superior (smaller than) to basing the performance evaluation on both output measures in untransformed form as that leads to an expected payment of $E[I|a_H] = 20,662$ to the managers. Thus, there is returns to the introduction of accrual accounting and at the same time restrict the performance measure to the local profit. The net result is more informative accounting measures. This is the case even when the accrual accounting process is decentralized to the managers along with the resource allocation decision. The accounting control of central management is confined to the total profit of the firm such that the sum of the reported accounting profits is equal to the profit of the total profit of the firm that is sufficient to make the mechanism work (Table 5).

The final part of the example demonstrates the consequence of allowing the two divisions to report when they engage in a transfer of resources. The result is displayed in Table 6. Such a revelation is very informative as suggested by the

Table 4 Pay for performance using both divisions with transfer and adjusted outcome

$E[I\|a_H]$ 20, 599	Output (q_i)								
q	(10,10)	(10,11)	(10,12)	(11,10)	(11,11)	(11,12)	(12,10)	(12,11)	(12,12)
$I(q_1)$	4595	4595	4595	9734	10,847	9734	11,378	12,007	11,378
$I(q_2)$	4202	9721	11,446	4202	10,891	11,446	4202	11,392	11,446

Table 5 Pay for performance using both divisions with transfer and unadjusted outcome

$E[I\|a_H]$ 20, 662	Output (q_i)								
q	(10,10)	(10,11)	(10,12)	(11,10)	(11,11)	(11,12)	(12,10)	(12,11)	(12,12)
$I(q_1)$	2151	2151	10,923	9652	9652	11,693	11,758	11,758	11,758
$I(q_2)$	4986	9749	11,905	4986	9749	11,905	4986	9749	11,905

Table 6 Pay for performance using both divisions with transfer and transfer revealed

$E[I\|a_H] = 20,518$	Output (q_i)			
q	10	11	12	Transfer
$I(q_1)$	5082	9752	11,287	12,365
$I(q_2)$	5082	9752	11,287	12,365

expected incentive pay $E[I|a_H] = 20,518$. This is the best of the considered information structures. A transfer can only happen when both have delivered H. In case of no transfer, the pay schedule is equal to the pay schedule when the transfer was not an option. Note that allowing the accounting adjustment to be equal to .5 is informationally equivalent to this because an output of 10.5 or 11.5 would reveal the transfer perfectly. There are many ways to convey the same information. In the present case, the transfer is a source of information which can be used to provide incentives whereas in the setting of the previous section the transfer was only a source of noise which made the incentive problem more difficult and more expensive.

7 Balancing coordination and incentives using accrual accounting

Transfer pricing is a fascinating subject. At first glance, it is just a question of setting up an internal market for transfer of resources between divisions in a decentralized firm. Then, autonomous divisions are free to act and to interact. The first attempt suggests that the divisions should just maximize local profit, which is consistent with casual observation. This leads to a view that the transfer pricing problem is merely a question of simulating a market between the divisions of the

firm and then the solution would be to look toward the equilibrium between economic agents that leads to having the transfer price equal to the marginal cost and marginal benefits. This is the classical Hirshleifer (1956) solution and leads to the classical transfer price equal to cost plus opportunity costs.

The consequence of establishing profit centers evaluated based upon local accounting profit is that the divisional managers act strategically. That is the expectation. In the coordination game, the divisional managers have private information and with only the internal market they act as monopolists. That means that they will attempt to get the information rents which is associated with their private information. The firm might want to counter that by inducing cooperative behavior in the organization and one way to do that is to replace the focus on the local profit with a focus on the global profit. This is done in a form consistent with the principle of controllable performance as it is constructed as the sum of the local profit and the planned profit for the remaining divisions. However, coordination is only an induced incentive problem. If there is no fundamental goal conflict, a weight of zero will make the strategic behavior disappear. The fundamental incentive problem is buried in the conflicting goals of central and decentral management. That is modeled as the effort variable at the simplest level.

The divisions do not own their local profit and consequently it constitutes no direct income for the managers. The local profit is the information source used for evaluation of the performance of the manager and that is used by the organization to alleviate the conflict of goals between the local and the global management. The use of local profit measures creates a narrow focus and the transfer pricing mechanism appears to be an easy fix to provide a global perspective for the manager. The question is how to adjust the local profit measure to create a global perspective such that the firm is well coordinated and locally incentivized.

The fully decentralized solution to the problem is to let the divisions manage their interrelations. That means that they are free to trade and they can use the accounting system to make the appropriate compensation. That is, they agree on a transfer and simultaneously they agree on a transfer of accounting income between the divisions. Centers control is placed in having the local profits add up to the total profit, which lends itself to auditing. This would be a negotiated transfer price. The freedom to trade implies that if there are alternative outside options, the transfer price must be closely connected to the outside market. The analysis suggests that this type of solution would only be optimal if the relative size of the items traded is minor in relation to the total local profit. In sum the optimal transfer pricing arrangement depends on the information in the hands of the decision makers and the information which is useful in contracting between management and divisions.

If the trade happens on a regular basis the negotiations will be too frequent, and it might be better to base the transfer price on an accounting construct, which is then negotiated. Then, the optimal pricing arrangement would take the form of a system. Again, contractible information becomes the key. It might be derivatives of cost, cost plus, or the revenue associated with the transfer. Economics of the negotiation process enter the problem. That has not been analyzed in the literature or in this paper but follows as an extrapolation of the present analysis.

The choice of transfer pricing mechanism would be different if the object in question is valuable or if the resource allocation decision is vital to the firm. In the latter case, the above analysis suggests that the transfer is flagged and entered separately into the performance evaluation instead of being aggregated via a transfer price. If the item is very valuable (high cost) and not directly associated with the control problem of the two divisions, it might also be beneficial to flag the transfer separately as suggested in the previous analysis.

Behavioral economics often find that individuals behave irrationally as they include considerations of fairness and reciprocity and other phenomena in their decision process. Ghosh (2000) reports on this from a transfer pricing experiment. His findings suggest that the managers are taking a more global perspective when acting in a decentralized organization. In the setting of this paper, this means that the conflict in goals between management and divisions is more complex than the effort variable used in the models. However, the problem remains as the accounting system has to be constructed to balance the incentives between the local and global behavior. Even when the divisional managers hold a global perspective an adjustment might be called for as they also are only partially informed. As suggested from the above analysis, the global/local balance is unique to the firm under consideration and the incentives of the unit manager have to reflect this by adjusting his initial bias.

This paper has only considered a set of simple relations between two or more divisions concerning transfer of resources. The interrelationship could be more complicated if the downstream (producing) division is making investments that will reduce the production cost of the items being transferred. Incentives to make such investments are scarce as the investment cost is only partially recovered through the internal pricing of the transferred products and results in underinvestment in assets. This is called the hold-up problem and has been analyzed extensively by Edlin and Reichelstein (1995) and Baldenius (2008). Other concerns are associated with the risk sharing among the divisions as suggested by Kanodia (1979), or issues related to cost-based transfer pricing as analyzed by Vaysman (1996). A comprehensive analysis of the economics-based transfer pricing literature is provided by Göx and Schiller (2007). Also, the negotiating skill would enter the price as well as the extent of the "trade" as in Baldenius (2000) to add another dimension to the stew of transfer pricing.

The theme of this paper has been how the transfer pricing is useful in bridging individual rational behavior and corporate choice if the mechanism is well designed. This is part of a larger problem addressing the usefulness of accrual accounting. This also includes inter-period accounting allocations such as depreciation procedures. Such accruals are often self-reported as they are based upon private information of local management. Here, the manager is deciding on the allocation over time of the income and the control of the center is restricted to the convention that in the long run the accounting profit should equal the cash flows. The information revelation of hard evidence in the accounting system as time is passing is used to control the reporting of management such that the resulting accruals are useful in incentivizing management. In the process, the firm is restricting the information set available and the result is an illusion of irrational corporate

decisions. The individual rational choices of management lead to corporate decisions and not all components of the choice appear rational. Antle and Eppen (1985) provide one example. Slack in organizations is often considered inefficient; however, it might be a rational response to the existence of private information by divisional management. Christensen and Demski (2003a) demonstrate that the optimal choice of a reimbursement mechanism in some cases leads to a seemingly irrational and unexpected choice pricing.

8 The game of organizational design

The construction of the accounting system including the design of accruals is a response to the organization of the firm as suggested by Demski (2008). At the next level, there is the question of the organizational design. It is a design issue to decide how the responsibility and decisions of the firm should be organized and what level of autonomy should such units be granted. At first glance (with the above analysis in mind), the organization should strive for an organization which minimizes the interrelations among the divisions. This might be countered by creating a control environment which allows the center to induce goal congruent behavior. Auditor quest for separation of duties or dual controls comes to mind here. In such cases, the interrelations between decision makers are maximized rather than minimized, cf. Demski (2008). Thus, the organization design becomes also an act of balancing the control with efficient decision making as observed by Holmstrom and Tirole (1991) and Roberts (2004). The two complement each other. Other insightful variations on the interrelation between accounting and organizational structure are provided by Anctil and Dutta (1999), and Baldenius and Michaeli (2017).

9 Conclusion

At first glance, the textbook recommendations on transfer pricing appear too simplistic and too diverse as a precise recommendation is not made. There is often a list of different options that are used in practice. The point is that the problem contains numerous dimensions which all influence the optimal mechanism. First is the control problem which is found in the divisions. Second is the private information of the divisions. Third is the information that is made available for the performance evaluation in the accounting system and how much the organization wants to use. The transfer pricing solution is used to reduce the dimensionality of the information structure of the firm. Thus, the transfer pricing choice reflects a delicate balance among the individual incentives, the demand for coordination, and the complexity of the information structure. The choice might appear irrational from an economic point of view if only the market between the units is considered; however, a closer look might tell a different story. This is part of a delicate balance between individual rationality of the divisional managers and the optimal corporate decisions.

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