Investments in supplier-specific economies of scope with two different services and different supplier characters: two specialists

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Abstract

Firms have to choose their market positions. Suppliers can offer a wide range of services as generalists or they act as specialists by offering a small range of services. In this paper based on Chatain/Zemsky (2007) and Chatain (2011) we analyse how supplier-specific economies of scope generated by investments can compensate the loss occurring by a non-optimal organisational structure (resource configuration) of production. These considerations are modelled by a non-cooperative game with one buyer and two suppliers. We show how the buyer can gain from supplier-specific economies of scope. In this case, the buyer will never split the orders to both suppliers. But, if the investment costs of the suppliers are very high and/or the gains of the buyer are rather low, the pure strategy combination “no investments” for the two suppliers will become the unique Nash equilibrium, whereby the buyer places the two orders each to the supplier who is the specialist for it. Additional Nash solutions are dependent on the specific economies of scope. If the buyer has to place two different services he should order one supplier, if the tasks have similar characteristics and the investment costs of a supplier result in higher specific economies of scope relevant to the choice of the buyer.

1. Introduction

Investments to generate economies of scope as well as to reduce information asymmetries improve supply chain structures and buyer-supplier relationships. Frequently, it has to be assessed, which supplier has to be chosen by a buyer for specific jobs. The following considerations focus on the choice of potential suppliers and an intensification in the buyer-supplier relationship through investment possibilities of a supplier in order to enlarge his specialisation. These considerations raise the following question: under what conditions do economies of scope of a supplier motivate the buyer to place his different jobs to the same supplier, even so this supplier is only a specialist for one of the jobs and has to invest in his organisational structure (resource configuration) of production to produce also the other job with a little bit less, but still sufficiently high quality for the buyer? Thus, for example, the different company philosophies practiced by Oracle or IBM could serve as an example. On the one hand, a general product (service) is provided, while on the other hand a special product (service) is developed on demand.

It is demonstrated how the non-cooperative game theory resolves those conflicts between companies with respect to various aspects of economic production and demand. The concept of the non-cooperative Nash (1951) solution is employed in order to find all strategy combinations of the three parties (one buyer, two suppliers) which characterise an equilibrium for the game considered.

Possible economies of scope which are put into measurable terms in this essay for each supplier have been discussed by Chatain/Zemsky (2007) in a game. Panzar/Willig (1981) define these economies of scope as the cost savings for a company when it has two similar products manufactured by one supplier. This customer-specific value creation is taken up and discussed in Chatain (2011). He considers companies that obtained information about customers which is advantageous for the production of services for the customer, but appears not to be of use in other buyer-supplier relationships. At this point our game theoretical analysis starts. In contrast to Chatain (2011), who examines the behaviour between supplier and buyer with respect to customer-specific economies of scope that should exist, we determine here exact solutions of those decision situations. Chatain (2011) does not explicitly examine how economies of scope are attained through the production of two services, but rather defines the additional advantage through the sum of potential, specific knowledge and a coordination; different features of the suppliers are not discussed in his paper. For this reason our research departs from Chatain's considerations in (2011). Here, a model is established that combines investments in cooperation (see therefore among others Jia (2013) and Fandel/Trockel (2016)) and supplier-specific economies of scope. Then, the conditions can be discussed under which an investment of a specialist and the related supplying of two services generate a better market situation than when the buyer commissions two specialists for the particular service.

The present study is organised as follows. After an explanation of a basic model supplier-specific economies of scope will be introduced and the given market situation is formulated. In the following analysis different specialists in a supplier-buyer relationship who can perform the different investments are considered. It will be shown that the buyer never makes use of the economies of scope of both suppliers. Additionally, it will be seen that precisely the same Nash solution, where no one of the supplier invests, exists in all market situations and is independent of the supplier's technology of production. Additional Nash equilibria are, depending on the attributes and the investment levels, feasible and modelled.

2. Model Design and Analysis

2.1 Basic Considerations

In the following model two suppliers are supposed to take on two tasks, respectively, to produce two services A and B for a customer (buyer). In opposition to Chatain/Zemsky (2007) a barrier of entry to the market is not considered.

Each supplier i, $i = 1,2$, is characterised by his individual resource configuration (organisational structure of production) $D_i \in [0,1]$, by which ex-ante is determined how effectively he can perform the tasks A and B.

The value resulting from the adoption of one of the tasks is defined for the suppliers as $V^{\mathrm{A}}(D_i)$ for task A and $V^{\mathrm{B}}(D_i)$ for task B with

$$V^{\mathrm{A}}(D_i) = 1 - T{D_i}^2 \text{ or } V^{\mathrm{B}}(D_i) = 1 - T(1 - D_i)^2 \text{ with } 0 < T < 1 \text{ and } 0 \leq D_i \leq 1.$$

The parameter T specifies the marginal rate of transformation of the production technology which is identical for both suppliers. In the case of large T ($T \longrightarrow 1$) the production value decreases all the more drastically when there is a divergence from the optimal production design to provide the service to be produced (see Chatain/Zemsky (2007, 556)). If one employs the extremes for D_i, it becomes clear that independent of the tradeoff T for $D_i = 0$ task A and for $D_i = 1$ task B is most effectively manufactured.

The concept of added values, according to Brandenburger/Stuart (1996, 2007), signifies every additional value generated by a specific player in the strategy combinations of the game. In the following study added values for the companies only occur when suppliers decide to invest in their economies of scope, i.e. to realise with additional costs a resource configuration which allows them to produce also the task for which they are not the most effective producer, and when the customer makes use of these economies of scope by placing his two orders A and B as a package AB to the same supplier. If a supplier services the customer by taking on both tasks, customer-specific economies of scope may create an added value of $R_{i3} > 0$ for the customer through this specific supplier-buyer relationship. In the following it will be assumed that individual economies of scope can exist. By means of such an expansion of the model it can be analysed how different added values for the suppliers influence the result as well as of how far suppliers should invest in their own capability of attaining economies of scope.

Dyer/Singh (1998) show that the causes of competitive advantages that are generated through cross-company cooperation can originate in an extensive exchange of knowledge and information. A creation of this value is, however, only possible if both cooperating partners are open to disclosing this information and to making joint learning possible. To emphasise this mutual dependence the readiness of the client to provide reciprocity for the efforts of the supplier has some influence in the subsequent deliberations.

An existing market situation in which a buyer outsources two tasks is analysed. To simplify the analysis, an existing AB-buyer who has two different tasks A and B to allocate is assumed. Furthermore, the characters of the organisational structure of production of the firms are here taken into consideration, so that the capability of a supplier to produce one of the two tasks depends upon its structural form.

In the given market situation only the maximum of two suppliers has to be considered, since in the case of two tasks awarded by the buyer, a third supplier cannot realise any (added) value. A third supplier would only make sense if he were fundamentally different from the other two, for example, if sustainability aspects make a difference in the case of the third supplier. Let the suppliers be characterised only by the quality ‘specialist’. One can also analyse a market structure with ‘generalists’ being more effective in producing the package AB (for instance for $0 < D_i < 1$). Other types of organisational production structures are not possible for a supply chain with only one AB-buyer.

The question is now whether suppliers invest in their economies of scope and how these investments influence the stance of the buyer in making his decisions. To answer the question the decision situation is modelled by means of the use of a non-cooperative game in which simultaneously the optimal investment of the suppliers and the optimal allocation of the jobs to them by the buyer are determined in terms of the respective Nash solutions. For this purpose at first the possible added values for the players are calculated. In a second step the added values are transformed into payoffs so that the non-cooperative Nash solutions can be identified through comparisons of the payoff parameters. These comparisons are conducted by means of reaction correspondences.

2.2 An approach to the analysis of supplier-specific economies of scope in the case of two specialists

In order to describe and to analyse the non-cooperative game we assume without loss of generality that supplier 1 is a specialist for the task A and supplier 2 is a specialist for task B. So, with the resource configurations $D_1 = 0$ and $D_2 = 1$ the production values of the suppliers on the basis of their production technology are

- $V_1^A = 1 - T \cdot D_1^2 = 1$ if supplier 1 produces service A,
- $V_1^B = 1 - T \cdot (1 - D_1)^2 = 1 - T$ if supplier 1 produces service B,
- $V_2^{\mathrm{A}} = 1 - T \cdot D_2^2 = 1 - T$ if supplier 2 produces service A,
- $V_2^{\mathrm{B}} = 1 - T \cdot (1 - D_2)^2 = 1$ if supplier 2 produces service B.

Attainable added values av_1 or av_2 through economies of scope only accrue for supplier 1 or 2 if he invests in the appropriate resource configuration in order to be able to produce the job bundle AB or BA, respectively. The additional investment can also be used to produce only that job the supplier is not a specialist for. This means, supplier 1 or supplier 2 are also striving for to have a chance to get at least job B (A) instead of A (B). Whether these additional values essentially occur depends on how the buyer (*i*=3) allocates his jobs A and B to the suppliers. Four alternatives have to be considered in this respect.

(A/B): the buyer allocates the two jobs to the suppliers as they are the specialists for, i.e. job A is given to supplier 1 and job B is awarded to supplier 2,

$(\mathrm{AB}/-)$: the buyer gives both jobs to supplier 1; supplier 2 receives nothing,

$(-/\mathrm{BA})$: the buyer gives both jobs to supplier 2; supplier 1 receives nothing,

(B/A): the buyer allocates the two jobs to the suppliers they are not exactly specialists for.

The buyer only realises an additional value av_3 for himself if he makes use of the possible economies of scope of the suppliers in that way that he allocates both jobs to one supplier. In case that he places the two tasks to supplier 1 $((\mathrm{AB}/-))$ his benefit of making use of the economies of scope of supplier 1 may be R_{13} – in the opposite case $((-/\mathrm{BA}))$ the benefit may be R_{23}.

To be more formal let us denote by

S_1 = $\{\mathrm{I}, \mathrm{NI}\}$ the strategy set of supplier 1 with I expressing that he invests and NI that he does not,

S_2 $\{\mathrm{I}, \mathrm{NI}\}$ the strategy set of supplier 2 with analogous interpretations of I and NI,

S_3 = $\{(\mathrm{A}/\mathrm{B}), (\mathrm{AB}/-), (-/\mathrm{BA}), (\mathrm{B}/\mathrm{A})\}$ the strategy set of the buyer.

The following game tree results:

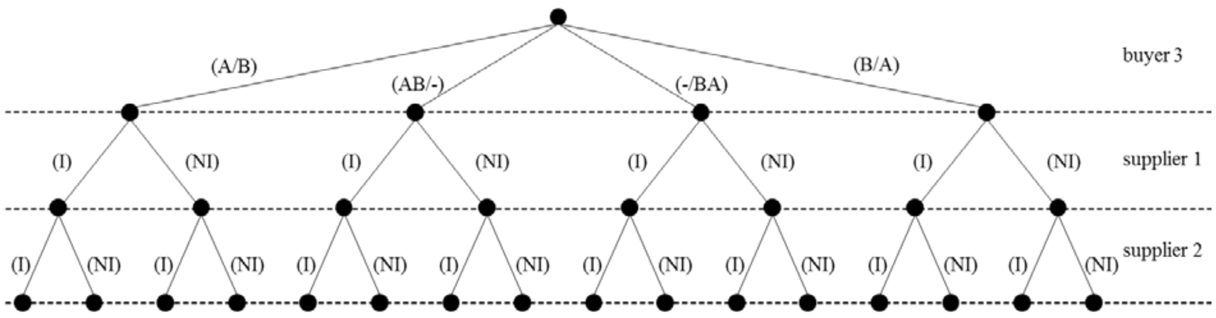

Figure 1: Extensive game tree of the supplier-buyer relationship

With $s_1 \in S_1$, $s_2 \in S_2$, $s_3 \in S_3$ the added values $av_i(s_1, s_2, s_3)$, $i = 1,2,3$, as described by the former explanations may be specified for the three players of the non-cooperative game by the polymatrix (see for the definition of a polymatrix Quintas (1989)) in figure 2. For the column vectors in the boxes of the polymatrix it holds

$$av = \big(av_1(s_1, s_2, s_3), av_2(s_1, s_2, s_3), av_3(s_1, s_2, s_3)\big).$$

$s_3 = (\mathrm{A/B})$

s_1 \ s_2	(NI)	(I)
(NI)	0 0 0	0 0 0
(I)	0 0 0	0 0 0

$s_3 = (\mathrm{AB}/-)$

s_1 \ s_2	(NI)	(I)
(NI)	0 0 0	0 0 0
(I)	$1-T$ 0 R_{13}	$1-T$ 0 R_{13}

$s_3 = (-/\mathrm{BA})$

s_1 \ s_2	(NI)	(I)
(NI)	0 0 0	0 $1-T$ R_{23}
(I)	0 0 0	0 $1-T$ R_{23}

$s_3 = (\mathrm{B/A})$

s_1 \ s_2	(NI)	(I)
(NI)	0 0 0	0 $1-T$ 0
(I)	$1-T$ 0 0	$1-T$ $1-T$ 0

Figure 2: Added value polymatrix of the two suppliers and the buyer

This added value polymatrix leads directly to the individual payoff polymatrix of the three strategic players based on the assumption that the investments of the suppliers entail costs R_1 and R_2 and the values for the executed tasks are one money unit each. The payoff columns in figure 3 can be read accordingly, i.e. $\pi(av) = \big(\pi_1(av), \pi_2(av), \pi_3(av)\big)'$ with $\pi\colon \mathbb{R}^3 \rightarrow \mathbb{R}^3$ as mapping function.

$s_3 = (\text{A/B})$

s_1 \ s_2	(NI)	(I)
(NI)	1 1 2	1 $1-R_2$ 2
(I)	$1-R_1$ 1 2	$1-R_1$ $1-R_2$ 2

$s_3 = (\text{AB}/-)$

s_1 \ s_2	(NI)	(I)
(NI)	1 0 1	1 $-R_2$ 1
(I)	$2-T-R_1$ 0 $2-T+R_{13}$	$2-T-R_1$ $-R_2$ $2-T+R_{13}$

$s_3 = (-/\text{BA})$

s_1 \ s_2	(NI)	(I)
(NI)	0 1 1	0 $2-T-R_2$ $2-T+R_{23}$
(I)	$-R_1$ 1 1	$-R_1$ $2-T-R_2$ $2-T+R_{23}$

$s_3 = (\text{B/A})$

s_1 \ s_2	(NI)	(I)
(NI)	0 0 0	0 $1-T-R_2$ $1-T$
(I)	$1-T-R_1$ 0 $1-T$	$1-T-R_1$ $1-T-R_2$ $2-2T$

Figure 3: Payoff polymatrix of the two suppliers and the buyer

The non-cooperative game is now described in details. Based on the assumption of pure strategies in the next step the best suppliers' responses are calculated given the buyer's action.

In the case of the suppliers' (non-)identical investment costs three Nash equilibria in pure strategies result in dependence on the amounts of R_i, $i = 1{,}2$. So, the Theorem 1 can be formulated.

Theorem 1:

For (non-)identical benefits of the economies of scope $R_{13}, R_{23} > T$, $R_{13} \neq R_{23}$, three Nash equilibria exist in pure strategies which depend upon the level of the investment costs. Furthermore, the buyer never simultaneously places orders to both suppliers. The Nash equilibria are in dependence on the costs R_i, $i = 1,2$, and economies of scope R_{i3}:

$s^{*1} = (\mathrm{NI}, \mathrm{NI}, (\mathrm{A/B}))$.

$s^{*2} = \big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big)$ for $1 > T + R_1$ and $R_{13} > R_{23}, T$.

$s^{*3} = (\mathrm{NI}, \mathrm{I}, (-/\mathrm{AB}))$ for $1 > T + R_2$ and $R_{23} > R_{13}, T$.

<u>Proof</u>:

To simplify the analysis, in a first step the reaction correspondences for the suppliers are determined in order to generate subsequently the buyer's best response to the previously determined reaction correspondences. As a finding of the first step the represented reaction correspondences $r_1(s_{-1})$ and $r_2(s_{-2})$ result in Proposition 1.

Proposition 1:

The suppliers' best responses are provided by:

$r_1(s_{-1})$:

$$
\begin{aligned}
& r_1\big(\mathrm{NI}, (\mathrm{A/B})\big) = r_1\big(\mathrm{I}, (\mathrm{A/B})\big) \\
&= r_1\big(\mathrm{NI}, (-/\mathrm{BA})\big) = r_1\big(\mathrm{I}, (-/\mathrm{BA})\big) \\
&= \mathrm{NI} \\
& r_1\big(\mathrm{NI}, (\mathrm{AB}/-)\big) = r_1\big(\mathrm{I}, (\mathrm{AB}/-)\big) \\
&= r_1\big(\mathrm{NI}, (\mathrm{B/A})\big) = r_1\big(\mathrm{I}, (\mathrm{B/A})\big) \\
&= \begin{cases} \mathrm{NI} & \text{for} \quad 1 < T + R_1 \\ \mathrm{I} & \text{for} \quad 1 > T + R_1 \end{cases}
\end{aligned}
$$

$r_2(s_{-2})$:

$$
\begin{aligned}
& r_2\big(\mathrm{NI}, (\mathrm{A/B})\big) = r_2\big(\mathrm{I}, (\mathrm{A/B})\big) \\
&= r_2\big(\mathrm{NI}, (\mathrm{AB}/-)\big) = r_2\big(\mathrm{I}, (\mathrm{AB}/-)\big) \\
&= \mathrm{NI} \\
& r_2\big(\mathrm{NI}, (-/\mathrm{BA})\big) = r_2\big(\mathrm{I}, (-/\mathrm{BA})\big) \\
&= r_2\big(\mathrm{NI}, (\mathrm{B/A})\big) = r_2\big(\mathrm{I}, (\mathrm{B/A})\big) \\
&= \begin{cases} \mathrm{NI} & \text{for} \quad 1 < T + R_2 \\ \mathrm{I} & \text{for} \quad 1 > T + R_2 \end{cases}
\end{aligned}
$$

<u>Proof</u>:

Given the response of the buyer by splitting the two tasks to two suppliers (A/B) independently of the action choice of supplier 2 supplier 1 always plays NI:

$$\pi_1\big(\mathrm{NI}, \mathrm{I}, (\mathrm{A/B})\big) = \pi_1\big(\mathrm{NI}, \mathrm{NI}, (\mathrm{A/B})\big) > \pi_1\big(\mathrm{I}, \mathrm{I}, (\mathrm{A/B})\big) = \pi_1\big(\mathrm{I}, \mathrm{NI}, (\mathrm{A/B})\big).$$

This also holds for supplier 2:

$$\pi_2\big(\mathrm{I}, \mathrm{NI}, (\mathrm{A/B})\big) = \pi_2\big(\mathrm{NI}, \mathrm{NI}, (\mathrm{A/B})\big) > \pi_2\big(\mathrm{I}, \mathrm{I}, (\mathrm{A/B})\big) = \pi_2\big(\mathrm{NI}, \mathrm{I}, (\mathrm{A/B})\big).$$

This results in the statement that for $s_3 = (\mathrm{A/B})$ the suppliers' best responses coincide in the strategy combination $s_{-3} = (\mathrm{NI}, \mathrm{NI})$.

Given the response of the buyer assigning tasks only to supplier 1, $s_3 = (\mathrm{AB}/-)$, the supplier 1 invests in economies of scope if and only if the inequality $R_1 < 1 - T$ holds, otherwise he always plays NI independently of the supplier 2's behavior:

For $R_1 < 1 - T$:

$\pi_1\big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big) = \pi_1\big(\mathrm{I}, \mathrm{I}, (\mathrm{AB}/-)\big) > \pi_1\big(\mathrm{NI}, \mathrm{NI}, (\mathrm{AB}/-)\big) = \pi_1\big(\mathrm{NI}, \mathrm{I}, (\mathrm{AB}/-)\big)$.

For $R_1 > 1 - T$:

$\pi_1\big(\mathrm{NI}, \mathrm{I}, (\mathrm{AB}/-)\big) = \pi_1\big(\mathrm{NI}, \mathrm{NI}, (\mathrm{AB}/-)\big) > \pi_1\big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big) = \pi_1\big(\mathrm{I}, \mathrm{I}, (\mathrm{AB}/-)\big)$.

Analogously the situation is presented by $s_3 = (-/\mathrm{BA})$ with the focus on supplier 2:

For $R_2 < 1 - T$:

$\pi_2\big(\mathrm{NI}, \mathrm{I}, (-/\mathrm{BA})\big) = \pi_2\big(\mathrm{I}, \mathrm{I}, (-/\mathrm{BA})\big) > \pi_2\big(\mathrm{I}, \mathrm{NI}, (-/\mathrm{BA})\big) = \pi_2\big(\mathrm{NI}, \mathrm{NI}, (-/\mathrm{BA})\big)$.

For $R_2 > 1 - T$:

$\pi_2\big(\mathrm{I}, \mathrm{NI}, (-/\mathrm{BA})\big) = \pi_2\big(\mathrm{NI}, \mathrm{NI}, (-/\mathrm{BA})\big) > \pi_2\big(\mathrm{NI}, \mathrm{I}, (-/\mathrm{BA})\big) = \pi_2\big(\mathrm{I}, \mathrm{I}, (-/\mathrm{BA})\big)$.

These considerations lead to the statement that for defined thresholds R_1 respectively R_2 the suppliers' best responses coincide in such strategy combinations that the given buyer's action to assign tasks only to one supplier leads to $\big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big)$ and $\big(\mathrm{NI}, \mathrm{I}, (-/\mathrm{BA})\big)$. The same considerations hold for the case $s_3 = (\mathrm{B/A})$. If and only if the inequalities $R_i < 1 - T$, $i = 1,2$, hold, the best response of supplier i is to invest in his organisational structure of production because of the relation:

$$\pi_1\big(\mathrm{I}, \mathrm{NI}, (\mathrm{B/A})\big) = \pi_1\big(\mathrm{I}, \mathrm{I}, (\mathrm{B/A})\big) > \pi_1\big(\mathrm{NI}, \mathrm{NI}, (\mathrm{B/A})\big) = \pi_1\big(\mathrm{NI}, \mathrm{I}, (\mathrm{B/A})\big)$$

and/or

$$\pi_2\big(\mathrm{NI}, \mathrm{I}, (\mathrm{B/A})\big) = \pi_2\big(\mathrm{I}, \mathrm{I}, (\mathrm{B/A})\big) > \pi_2\big(\mathrm{I}, \mathrm{NI}, (\mathrm{B/A})\big) = \pi_2\big(\mathrm{NI}, \mathrm{NI}, (\mathrm{B/A})\big).$$

Otherwise the best responses of the strategic player(s) is (are) not to invest (NI). q.e.d.

Hence the following Lemma 1 can be formulated, which economically summarises the above contents of the best responses.

Lemma 1:

- For each value $R_i \geq 0$, $i = 1,2$, and $s_3 = (\mathrm{A/B})$ the best responses of the suppliers coincide in $\big(\mathrm{NI, NI, (A/B)}\big)$.
- For $R_1 > 1 - T$ and $R_2 > 1 - T$ the suppliers' best responses coincide in $\big(\mathrm{NI, NI, (AB/-)}\big)$, $\big(\mathrm{NI, NI, (-/BA)}\big)$ and $\big(\mathrm{NI, NI, (B/A)}\big)$.
- For $R_1 < 1 - T$ and/or $R_2 < 1 - T$ the strategy combination $\big(\mathrm{I, NI, (AB/-)}\big)$, for $R_2 < 1 - T$ and/or $R_1 < 1 - T$ the strategy combination $\big(\mathrm{NI, I, (-/BA)}\big)$ also mutually represent the suppliers' best responses.
- Additionally for $s_3 = (\mathrm{B/A})$ four cases exist.

  $(\mathrm{I, I})$: for $1 > T + R_1$ and $1 > T + R_2$.

  $(\mathrm{I, NI})$: for $1 > T + R_1$ and $1 < T + R_2$.

  $(\mathrm{NI, I})$: for $1 < T + R_1$ and $1 > T + R_2$.

  $(\mathrm{NI, NI})$: for $1 < T + R_1$ and $1 < T + R_2$; this case is also described in the second statement.

The reaction behaviour of the two suppliers is now completely determined. On the basis of these deliberations the optimal behaviour of the buyer can be derived. Proposition 2 is then formulated.

Proposition 2:

$$
\begin{aligned}
r_3(\mathrm{NI, NI}) &= (\mathrm{A/B}) \\
r_3(\mathrm{I, NI}) &= \begin{cases} (\mathrm{A/B}) & \text{for } R_{13} < T \\ (\mathrm{AB/-}) & \text{for } R_{13} > T \end{cases} \\
r_3(\mathrm{NI, I}) &= \begin{cases} (\mathrm{A/B}) & \text{for } R_{23} < T \\ (\mathrm{-/BA}) & \text{for } R_{23} > T \end{cases}
\end{aligned}
$$

represent the buyer's mutually best response function based upon the suppliers' mutually best responses.

<u>Proof</u>:

If the non-complete strategy combination $(\mathrm{NI, NI})$ is given, the best response of the buyer is $(\mathrm{A/B})$, that dominates the other three possible actions:

$$(\mathrm{A/B}) \succ (\mathrm{AB/-}) \sim (\mathrm{-/BA}) \succ (\mathrm{B/A}), \text{ respectively}$$

$$\pi_3\big(\mathrm{NI, NI, (A/B)}\big) > \pi_3\big(\mathrm{NI, NI, (AB/-)}\big) = \pi_3\big(\mathrm{NI, NI, (-/BA)}\big) > \pi_3\big(\mathrm{NI, NI, (B/A)}\big).$$

If the non-complete strategy combination $(\mathrm{I, NI})$ is given, the buyer's best response is $(\mathrm{AB/-})$ if and only if $R_{13} > T$, otherwise the buyer selects both specialists separately:

$R_{13} > T$:

$\pi_3\big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big) > \pi_3\big(\mathrm{I}, \mathrm{NI}, (\mathrm{A}/\mathrm{B})\big) > \pi_3\big(\mathrm{I}, \mathrm{NI}, (-/\mathrm{BA})\big) > \pi_3\big(\mathrm{I}, \mathrm{NI}, (\mathrm{B}/\mathrm{A})\big)$.

$R_{13} < T$:

$\pi_3\big(\mathrm{I}, \mathrm{NI}, (\mathrm{A}/\mathrm{B})\big) > \pi_3\big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big) > \pi_3\big(\mathrm{I}, \mathrm{NI}, (-/\mathrm{BA})\big) > \pi_3\big(\mathrm{I}, \mathrm{NI}, (\mathrm{B}/\mathrm{A})\big)$.

These considerations result in the following dominance relationships:

$(\mathrm{A}/\mathrm{B}) \succ (\mathrm{AB}/-)$ for $R_{13} < T$ and $(\mathrm{AB}/-) \succ (\mathrm{A}/\mathrm{B})$ for $R_{13} > T$ and inefficient strategy combinations $(-/\mathrm{BA})$ and (B/A) given $(\mathrm{I}, \mathrm{NI})$.

The same considerations hold for $(\mathrm{NI}, \mathrm{I})$ and lead to the following results:

$(\mathrm{A}/\mathrm{B}) \succ (-/\mathrm{BA})$ for $R_{23} < T$ and $(-/\mathrm{BA}) \succ (\mathrm{A}/\mathrm{B})$ for $R_{23} > T$ and inefficient strategy combinations $(\mathrm{AB}/-)$ and (B/A) given $(\mathrm{IN}, \mathrm{I})$.

If the non-complete strategy combination (I, I) is given, the buyer's best response is $(\mathrm{AB}/-)$ if $R_{13} > R_{23}, T$, $(-/\mathrm{BA})$ if $R_{23} > R_{13}, T$ otherwise, given $R_{13} < T$ and $R_{23} < T$, the buyer selects both specialists separately using their special characteristics: $(\mathrm{A}/\mathrm{B}) \succ (\mathrm{B}/\mathrm{A})$. These calculations lead to the result that the buyer's strategy (B/A) given the non-complete strategy combinations of the suppliers is dominated in every case. These considerations result in proposition 2. q.e.d.

From this follows that $(\mathrm{NI}, \mathrm{NI}, (\mathrm{A}/\mathrm{B}))$, $\big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big)$ and $(\mathrm{NI}, \mathrm{I}, (-/\mathrm{AB}))$ are the Nash equilibria for different R_1, R_2 in identical terms of investment values and Theorem 1 is proved. $\big(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-)\big)$ is realised if $R_{13} > R_{23}, T$ holds. $(\mathrm{NI}, \mathrm{I}, (-/\mathrm{AB}))$ is instead the Nash solution if $R_{23} > R_{13}, T$ is given. q.e.d.

3. Concluding remarks

The above analysis disclosed the conditions under which investments in supplier-specific economies of scope would be profitable for suppliers and buyers. We followed an idea of Chatain/Zemsky (2007) and modelled the decision situation as a non-cooperative game. Thus we could analyse how a buyer can choose just the right suppliers for the production of two different services and possibly gain a competitive benefit by making use of the suppliers' economies of scope. Here, a three-person game with two different specialists and one AB-buyer was examined. For this game all Nash equilibria in pure strategies were determined. It turned out that the buyer, if he can make profitable use of economies of scope of suppliers, never distributes his jobs to the individual partners, but places them to only one (the most profitable) supplier – either $(\mathrm{I}, \mathrm{NI}, (\mathrm{AB}/-))$ or $(\mathrm{NI}, \mathrm{I}, (-/\mathrm{BA}))$ are then the Nash equilibria. If the buyer cannot profit and/or the suppliers do not invest in their economies of scope, because the investment costs are not covered by the value of the additional job they could receive, then $(\mathrm{NI}, \mathrm{NI}, (\mathrm{A}/\mathrm{B}))$ is the only Nash equilibrium. For certain values of the investment costs the Chatain/Zemsky's (2007) model is a special case of our model.

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