The make-or-buy choice in a mixed oligopoly: a theoretical investigation

Roberto Cellini
University of Catania

Luca Lambertini *
University of Bologna;
University of Amsterdam

ABSTRACT

We take a game theory approach to study the make-or-buy decisions of firms in a mixed duopoly. We assume that a managerial firm and a profit-oriented firm compete in a duopoly market for a final good, and they can choose whether making an intermediate input or buying it from a monopolistic upstream firm. We find that different equilibria may arise, depending on parameter constellations. In particular, if the technology used for the production of the intermediate input is too costly, then the internal organization of firms at equilibrium is mixed, creating a conflict with social preferences that would always privilege vertical integration to outsourcing.

[JEL Codes: C72, L13, L22]

* E-mail: cellini@unict.it ; luca.lambertini@unibo.it.

1. Introduction

A wide debate is currently taking place concerning the convenience for firms of making or buying intermediate goods to be used as inputs in the production process. This issue is closely related to choice between vertical integration and dis-integration, or, equivalently, with the opportunity of outsourcing.

From a historical perspective, the evolution of capitalism is characterised by different phases, in each of which the tendencies to vertical integration or vertical dis-integration are more or less intense. Even if we confine our attention to the last decades, the economic development of industrialised countries over the period of the so-called economic boom (the Fifties and Sixties) seemed to be characterised by high incentives towards vertical integration. On the opposite, the Eighties witnessed a strong tendency to dis-integration, often interpreted as a way to increase flexibility (see Tadelis, 2002, *inter alia*). What is happening today, in the years of (the third wave of) "globalisation" is not clear, and this is reflected by a large literature discussing the various aspects of this issue over the last twenty years.[1]

According to Grossman and Hart (1986), the failure of the internal incentive system, due to an incomplete assignment of property rights within the integrated firm, may provide an advantage for arm's length relationships. Additionally, the existence of a sufficiently competitive upstream market where firms may access intermediate inputs and raw materials at relatively low prices may lure more and more firms to choose outsourcing, with a remarkable bandwagon effect driving this process. If this effect is strong enough, then firm idiosyncratic levels of vertical integration within a given industry are unlikely to obtain at the equilibrium (see McLaren, 2000; Grossman and Helpman, 2002, 2005; Antras and Helpman, 2004; see also Yeats, 1998, for an empirical assessment on the significance of outsourcing and global production sharing).

On the other hand, it is by now part of the acquired wisdom that vertical integration can be considered as a remedy to the well known *hold-up* problem, with particular reference to situations where vertically related firms must rely on incomplete contracts to trade intermediate inputs whose quality (or performance) is unobservable and requires costly investments (Williamson, 1971; Grossman and Hart, 1986).

Several other factors may of course intervene to make the picture even more complicate, such as technological shocks, market integration, the co-existence of firms with different goals, and so on.

In this paper we examine one of these extensions, and propose a very simple theoretical model predicting that different outcomes can emerge when firms with different objective functions compete in an oligopoly market. In particular, we take into consideration a duopoly model in which a standard profit-oriented firm competes *à la* Cournot with a managerial firm, in the market for the final good. The production of the final good requires, on a one-to-one basis, an intermediate input which can be either made in house by the downstream firms or bought from a monopolistic upstream

[1] For an exhaustive account of the earlier literature on vertical integration, see Perry (1989).

firm. We characterise the optimal choice of firms as to the make-or-buy alternative, and prove that the equilibrium outcome is sensitive to the relative size of the market for the final good and the fixed cost of production associated to the intermediate input. In particular, our analysis shows that if the fixed cost required by the production of the intermediate input is low enough, then making the input *in house* is a dominant strategy for both firms, while otherwise the profit-seeking unit prefers outsourcing, giving thus rise to an industry with a mixed industry structure where vertical integration and outsourcing do coexist at equilibrium. By contrast, vertical integration is always socially preferable to outsourcing in view of its beneficial effect on the equilibrium price of the final good and therefore on consumer surplus.

Note that in the present paper we confine ourselves to a partial equilibrium framework. Of course, a general equilibrium perspective could lead to different conclusions and policy prescriptions (see, e.g., Feenstra and Hanson, 1996, on the relationship between outsourcing and wage inequality in the globalized world; Arora and Gambardella, 2006 and Bianchi et al., 2006 for recent analysis of the role of outsourcing in the “old” and “new” industrial policy).

The structure of the paper is as follows. Section 2 presents the layout of the model. Section 3 focuses on a comparative assessment of the alternative equilibria and a selection among them. Section 4 contains a few concluding comments.

2. The structure of the model

We consider a situation in which two firms, 1 and 2, compete on the market of a final good characterised by the following inverse demand function:

(1) $$P = a - Q, \quad a > 0,$$

Firms compete under complete and symmetric information *à la* Cournot, simultaneously setting the amount of production, q_1 and q_2 respectively.

Firm 1 is assumed to be managerial; in particular, following Vickers (1985), we assume that the managers aim at maximising a weighted average of profit and production, while the owners are able to write the contract for managers in such a way that the managerial incentive is “optimally” set so as to maximise their firm’s profits. Firm 2 is a standard profit-oriented firm. Hence, the objective function of the firms during the market subgame are, respectively:

(2) $$V_1 = \pi_1 + tq_1 = (a - Q)q_1 - C_1 + tq_1, \quad t \geq 0,$$

(3) $$V_2 = \pi_2 = (a - Q)q_2 - C_2$$

where π_i (i=1,2) denotes profits (that is, the difference between revenues and operative costs C_i); variable t (in eq. (2)) measures the managerial incentive, which has to be appropriately chosen by the firm's owners.

The production of one unit of output q requires one unit of an intermediate input, that can be either (i) produced by the same firms, or (ii) bought in the upstream input market. Its production entails a fixed cost k and a marginal cost of production c>0, irrespective of whether it is produced by firm 1 and/or 2 internally, or outsourced. However, in the latter case, its unit price is w>0.

This means that production cost under the case in which firm(s) 1 and/or 2 decide to make it (make-option) is

$$(4) \qquad C^m{}_i = cq_i + k, \quad c > 0, i = 1,2$$

while the cost function under the buy-option is

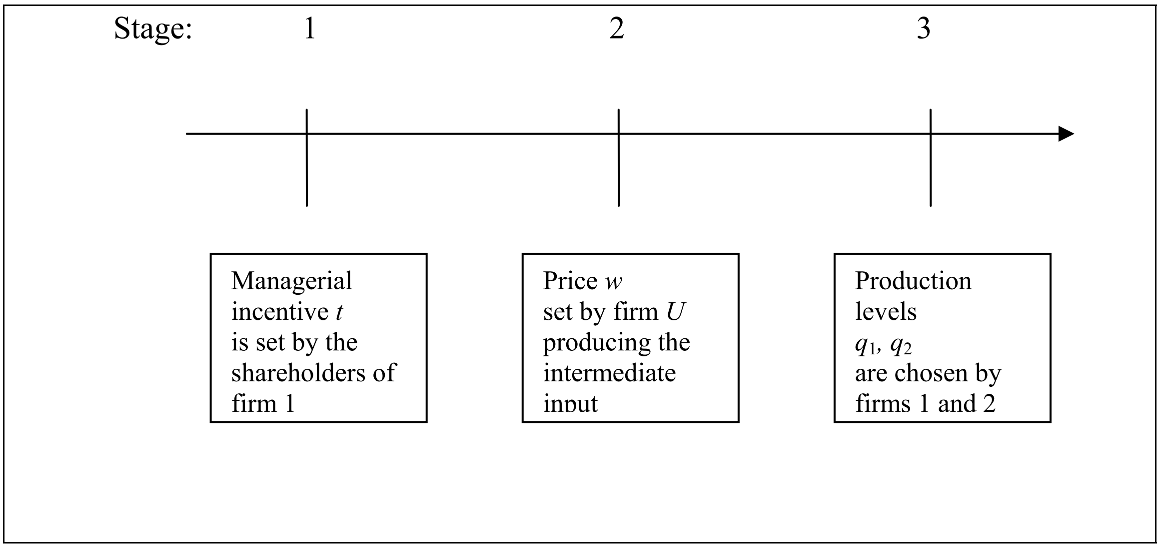
$$(5) \qquad C^b{}_i = wq_i \quad , i = 1,2$$

If the intermediate good is produced by a different firm (called firm U, standing for *upstream*), we assume that such a firm enjoys a monopoly power in the upstream market and sets the unit price w in order to maximise its profits.[2]

The stage-by-stage sequence of decisions along the time line of the game is represented in figure 1.

[2] For a model where downstream firms face a competitive upstream market, see Garvey and Pitchford (1995).

Figure 1. - The timing of decisions



At stage 1, the owners of firm 1 determine the incentive coefficient t; this variable has an "institutional" flavour, so that it is natural to assume that it is fixed at the outset.

At stage 2, the monopolistic firm (possibly) producing the intermediate input sets the unit price of its product; the price is set optimally in order to maximise profits, and looking ahead at the demand expressed by one or both firms operating in the market for the final good.

At stage 3, the duopolistic downstream firms noncooperatively and simultaneously choose their respective output levels, in order to maximise their objective functions.

We evaluate the results for firms and consumers, in the four cases corresponding to the choice of making or buying the intermediate input by each downstream firm. This amounts to saying that the decision on whether making or buying the input is taken at stage 0, and entails an irreversible commitment.

3. Solving subgames

3.1 Both firms make the intermediate input

We start by considering the case in which both firms decide to produce the intermediate input. This case is denoted by the *m* (make) or *mm* (make-make) appearing at the superscript of the relevant functions and variables. As usual, the game is solved by subgame perfection obtained through backward induction.

At the last stage of the game, firm 1 faces the problem:

(6) $$\underset{q_1}{Max}: V_1^m = [a - b(q_1 + q_2)]q_1 - cq_1 - k + tq_1 \ ,$$

while firm 2 solves the following problem:

(7) $$\underset{q_2}{Max}: V_2^m = [a - b(q_1 + q_2)]q_2 - cq_2 - k.$$

The first order conditions, $\partial V_1^m / \partial q_1 = 0$, $\partial V_2^m / \partial q_2 = 0$ give the reaction function system, whose intersection yields the Cournot-Nash equilibrium output levels:

(8) $$\begin{cases} q_1^{mm} = \frac{1}{3}(a - c + 2t) \\ q_2^{mm} = \frac{1}{3}(a - c - t) \end{cases}$$

The above expressions depend on the reservation price, parameter *a*, the marginal cost *c*, and *t*, which is perceived as given at this stage of the game. Notice in particular that the delegation extent, *t*, affects not only the level of production of the managerial firm, but also the production of his opponent, who finds it optimal to reduce the production as a reaction to the output expansion undertaken by firm 1, as it is usually observed in a Cournot market game with substitute goods.

In this case, no decision has to be taken by the firm producing the intermediate input, since it does not face any positive demand for its product.

Substituting the values of q_1^{mm} and q_2^{mm} in the profit function of firm 1 and simplifying, one may write the profit function of firm 1, and then select the value of *t* maximising it. This procedure yields the optimal extent of strategic delegation:

(9) $$t^{mm} = (a - c)/4.$$

In turn, it is immediate to find the corresponding value for individual production levels, profits, consumer surplus and social welfare (defined as the sum of firms' profits and consumer surplus):

$$
(10)\quad \begin{cases}
q_1^{mm} = (a-c)/2 \\
q_2^{mm} = (a-c)/4 \\
\pi_1^{mm} = \dfrac{(a-c)^2}{8} - k \\
\pi_2^{mm} = \dfrac{(a-c)^2}{16} - k \\
CS^{mm} = \dfrac{9}{32}(a-c)^2 \\
SW^{mm} = \dfrac{15}{32}(a-c)^2 - 2k
\end{cases}
$$

As expected, the firm whose owners delegate to a manager the decision about production can gain a higher profit with respect to a standard profit-seeking (entrepreneurial) firm, thanks to the expansion in the production level. This result is well known from the pioneering work of Vickers (1985) and Fershtman and Judd (1987), *inter alia*.

Note also that a (simple) parametric condition must be imposed on k, in order to ensure positive profits for both firms, i.e., $k < (a-c)^2/16$.

3.2 Both firms buy the intermediate input

If both firms commit themselves to buy the intermediate input, they face the following maximum problems:

$$
(11)\quad \underset{q_1}{Max} V_1^b = [a - b(q_1 + q_2)]q_1 - wq_1 + tq_1 \ ,
$$

$$
(12)\quad \underset{q_2}{Max} V_2^b = [a - b(q_1 + q_2)]q_2 - wq_2 .
$$

From the first order conditions, which are omitted for the sake of brevity, we derive the Nash equilibrium at the market stage, as follows:

$$
(13)\quad \begin{cases}
q_1^{bb} = \dfrac{1}{3}(a - w + 2t) \\
q_2^{bb} = \dfrac{1}{3}(a - w - t)
\end{cases}
$$

Also in this case, the managerial coefficient affects the choice of both the managerial firm and his opponents, in opposite directions.

The expressions appearing in system (13) also provide the total amount of the intermediate input to be bought from the upstream firm, provided that the input requirement is supposed to be one unit of input per unit of output.

Hence, the firm producing the intermediate input (firm *U*) faces the following profit function:

$$\text{(14)} \qquad \pi_U^{bb} = (w-c)(q_1^{bb} + q_2^{bb}) - k,$$

where *w* is the market price of the intermediate input, whose production entails in this case as well a fixed cost *k* and a marginal (constant) cost equal to *c*.

As firm *U* enjoys monopoly power, it can set the price of its output in order to maximise profits (14); in particular, note that its profit function appears to be concave in *w*, once the firm, correctly anticipating the demand for its good deriving from the downstream firms, has plugged outputs (13) into (14). The optimal pricing rule for the upstream monopolist is then summarised by the following condition:

$$\text{(15)} \qquad \frac{\partial \pi_0^{bb}}{\partial w} = 0 \Rightarrow \quad w^{bb} = \frac{2(a+c)+t}{4}.$$

By substituting (15) in (13) and then (13) in the profit function of firm 1, one obtains

$$\text{(16)} \qquad \pi_1^{bb} = (2a-2c-5t)(2a-2c+7t)/144$$

which is concave in *t*. The value of *t* providing the maximum profit is then

$$\text{(17)} \qquad t^{bb} = 2(a-c)/35$$

which measures – using the label suggested by Vickers (1985) – the optimal extent of the delegation of control to managers.

As a last step, we are now able to compute the price of the intermediate input set by the upstream monopolist producing the intermediate input, the level of production chosen by the duopolistic firms in the market for the final consumption good and the corresponding profits, consumer surplus and social welfare (defined as the sum of the profits of three firms, and the consumer surplus in the market for the final good):

(18)
$$\begin{cases} w^{bb} = (18a + 17c)/35 \\ q_1^{bb} = (a-c)/5 \\ q_2^{bb} = (a-c)/7 \\ \pi_1^{bb} = \dfrac{(a-c)^2}{35} \\ \pi_2^{bb} = \dfrac{(a-c)^2}{49} \\ CS^{bb} = \dfrac{72}{1225}(a-c)^2 \\ SW^{bb} = \dfrac{348}{1225}(a-c)^2 - k \end{cases}$$

A straightforward comparison between expressions (10) and (18) produces a number of interesting insights.

First of all, the levels of production of the final good are much lower in the case of a "buy" decision. Each firm shrinks its own production and consequently the aggregate production in the market of final good decreases of an amount equal to $Q^{bb}=(57/140)(a-c)$. Hence, the associated decrease in consumers' surplus amounts to $(8721/39200)(a-c)^2$. This means that consumers prefer a situation in which both firms decide to make the intermediate input, as compared to the situation in which both firms decide to buy it from the upstream monopolist. The economic intuition is as follows. In the buy-buy game, outsourcing entails (i) higher production costs for the final good, which bring about (ii) a decrease in aggregate output and clearly (iii) an increase in the equilibrium price. This chain of implications obviously implies that outsourcing ultimately hurts consumers.

Second, the variation in individual profits for the firms producing the final goods may take both signs, depending on the size of *k*; however, the difference between the profits of the two firms is smaller in the case of buy-buy as compared to the make-make situation.

Third, from a social perspective, $SW^{bb} - SW^{mm} = k - (7239/39200)(a-c)^2$ again may take both signs, depending on the relative size of *k* and $(a-c)^2$.

3.3 The managerial firm makes the intermediate input while the profit-seeking one buys it

In the mixed case in which the managerial firm decides to make the intermediate input internally while the standard neoclassical (profit-oriented) firm decides to buy it, the relevant objective functions are (6) and (12), respectively. The usual procedure to compute the first order conditions, to obtain the reaction functions, and then to compute the Nash equilibrium output levels leads to following result:

(19) $$\begin{cases} q_1^{mb} = \frac{1}{3}(a - 2c + 2t + w) \\ q_2^{mb} = \frac{1}{3}(a + c - t - 2w) \end{cases}$$

Also in this case, as one could expect from the outset, the extent of the managerial delegation positively affects the production level of the managerial firm, and negatively affects the production level of its opponent. More interestingly, the marginal production cost of the intermediate good, c, has a direct (and negative) effect on the production level of firm 1, and a (direct) positive effect on the production level of firm 2. Moreover, the market price level of the intermediate good, w, has a (direct) negative effect on the level of production of firm 2 and a (direct) positive effect on the production level of firm 1. However, one has to take into account that the production cost c clearly affects the price of the intermediate input set by the monopolistic upstream firm, so that the whole effects are not clear-cut *a priori*.

Note that q_2^{mb} in (19) also represents the demand function for the intermediate input faced by firm *U*, whose objective turns out to be

(20) $$\underset{w}{Max}\, \pi_U^{mb} = (w - c)(q_2^{mb}) - k = (w - c)(a + c - t - 2w)/3 - k.$$

The solution of firm *U*'s maximum problem is

(21) $$w^{mb} = (a + 3c - t)/4$$

Needless to say, the comparison between the levels of the input price provided by (18) and (21) is not a straightforward one, due to the fact that the upstream monopolist producing the intermediate input faces a different demand function in the case in the two alternative settings, with the inequality depending upon parameters a and c, as well as variable t. Of course, the effect of t on the input price is negative, since a higher extent of delegation entails a higher production for firm 1, and correspondingly a lower one for firm 2, which ultimately means that there will be a lower demand for the intermediate input provided by firm *U*.

The optimal value for t can be computed maximising the profits of firm 1. By substituting (21) into (19), and then (19) into (6), one finds that the profits of firm 1 in this case are

(22) $$\pi_1^{mb} = \frac{25(a - c)^2 + 10(a - c)t - 35t^2}{144} - k$$

from which it is immediate to find the optimal value of t, i.e.,

(23) $$t^{mb} = (a-c)/7$$

Then, substituting (23) back into all of the relevant variables and simplifying, one can fully characterise the equilibrium outcome of this setting:

(24) $$\begin{cases} w^{mb} = (3a+11c)/14 \\ q_1^{mb} = (a-c)/2 \\ q_2^{mb} = (a-c)/7 \\ \pi_1^{mb} = \dfrac{5(a-c)^2}{28} - k \\ \pi_2^{mb} = \dfrac{(a-c)^2}{49} \\ CS^{mb} = \dfrac{81}{392}(a-c)^2 \\ SW^{mb} = \dfrac{171}{392}(a-c)^2 - 2k \end{cases}$$

Interestingly enough, in this "mixed" situation, where firm 1 makes the intermediate input *in house*, while firm 2 buys it, firm 1 ends up producing the same amount of final good as in the case in which both firms make the input, and firm 2 produces the same amount of final good as in the case in which both firms buy the input. Thus, the aggregate production level of the final good lies between the cases in which both firms adopt the same decision whether to buy or make the intermediate input.

The viability condition in this setup consists in requiring that the equilibrium profits of the managerial firm be positive, i.e., π_1^{mb}. This is equivalent to imposing that $k<5(a-c)^2/28$. This obviously suffices to ensure that $SW^{mb}>0$ as well.

3.4 The managerial firm buys the input while the entrepreneurial one makes it

If firm 1 buys the intermediate input while his opponent decides to make it, firms' objective functions are defined as in (11) and (7), respectively. The Nash equilibrium at the market stage is:

$$(25)\qquad \begin{cases} q_1^{bm} = \frac{1}{3}(a+c+2t-2w) \\ q_2^{bm} = \frac{1}{3}(a-2c-t+w) \end{cases}$$

The qualitative properties of system (25), as far as the influence of a, c, t and w on output levels is concerned, are largely the same as in the previous cases.

Considering that q_1^{bm} in (25) represents the demand function for the intermediate input, the goal of firm U now writes:

$$(26)\qquad \underset{w}{Max}\, \pi_U^{bm} = (w-c)(q_1^{bm}) - k = (w-c)(a+c+2t-2w)/3 - k.$$

The solution is

$$(27)\qquad w^{bm} = (a+3c+2t)/4$$

In this case, in which the managerial firm buys the input, the higher the delegation extent t, the higher the price of the intermediate input. The intuitive explanation for this fact is that delegation makes the managerial firm richer as well as bigger than its rival; under full information, this feature is exploited by the upstream monopolist by driving the input price upwards.

Variable t can be computed taking into account profit of firm 1 once (27) is substituted in (25), and then in the profit function, which can be rewritten as:

$$(28)\qquad \pi_1^{bm} = \frac{(a-c-4t)(a-c+2t)}{36} = -\frac{2}{9}t^2 - \frac{1}{18}(a-c)\cdot t + \frac{1}{36}(a-c)^2$$

The above expression takes its maximum in correspondence of $t = -(a-c)/8$, and is decreasing in t for all positive values of t. This means that the optimal extent of delegation is t^{bm}=0 (that is, we explicitly exclude the possibility of writing output-reducing delegation contracts). The economic interpretation is very simple, as the owners of firm 1 are aware that managers find it optimal to expand the output (and therefore also the demand for the intermediate input which has to be bought in the market). This leads to lower profits if the intermediate input is outsourced. Accordingly, shareholders find it optimal to set the output expansion incentive to zero, entailing that the managerial firm indeed mimics the behaviour of a pure profit-seeking enterprise.

Substituting t=0 back into all the relevant variables and simplifying, we obtain

$$(24)\qquad \begin{cases} w^{bm} = (a+3c)/4 \\ q_1^{bm} = (a-c)/6 \\ q_2^{bm} = 5(a-c)/12 \\ \pi_1^{bm} = \dfrac{(a-c)^2}{36} \\ \pi_2^{bm} = \dfrac{25(a-c)^2}{144} - k \\ CS^{bm} = \dfrac{49}{288}(a-c)^2 \\ SW^{bm} = \dfrac{119}{288}(a-c)^2 - 2k \end{cases}$$

Here, the viability condition for the above equilibrium outcome to be admissible is π_2^{bm}>0, or equivalently k<25$(a-c)^2$/144. In this case, the profit of firm 2 is larger than her opponent's, for all $k < (7/48)(a-c)^2$. Note that this is necessarily the case, as the latter condition is milder than the viability condition.

Consumers surely prefer the opposite situation where firm 1 makes and firm 2 buys rather than the present one. This is motivated by the fact that the managerial firm is free to expand output when the intermediate input is made in house, and this factor has an obvious effect on aggregate output.

3.5 Comparison

Table 1 provides a detailed overview of the foregoing analysis, concerning equilibrium outputs, downstream firms' profits, consumer surplus and social welfare.

Table 1 – A summary of equilibrium outcomes

	mm	**bb**	**mb**	**bm**
q_1	$(a-c)/2$	$(a-c)/5$	$(a-c)/2$	$(a-c)/6$
q_2	$(a-c)/4$	$(a-c)/7$	$(a-c)/7$	$5(a-c)/12$
π_1	$\frac{(a-c)^2}{8}-k$	$\frac{(a-c)^2}{35}$	$\frac{5(a-c)^2}{28}-k$	$\frac{(a-c)^2}{36}$
π_2	$\frac{(a-c)^2}{16}-k$	$\frac{(a-c)^2}{49}$	$\frac{(a-c)^2}{49}$	$\frac{25(a-c)^2}{144}-k$
CS	$\frac{9}{32}(a-c)^2$	$\frac{72}{1225}(a-c)^2$	$\frac{81}{392}(a-c)^2$	$\frac{49}{288}(a-c)^2$
SW	$\frac{15}{32}(a-c)^2-2k$	$\frac{348}{1225}(a-c)^2-k$	$\frac{171}{392}(a-c)^2-2k$	$\frac{119}{288}(a-c)^2-2k$

From the consumers' standpoint, the best situation is the case in which both firms decide to make the input, followed by the case in which only the managerial makes, followed in turn by the case where only the profit-oriented firm decides to make. The worst situation is that where both firms decide do to buy. This is motivated by the fact that outsourcing by the entire industry ultimately involves the highest market price for the final good. This is summarised by

Lemma 1. $CS^{mm} > CS^{mb} > CS^{bm} > CS^{bb}$ always.

Now take the social perspective. A quick inspection of the equilibrium social welfare levels in the four alternative settings reveals:

Proposition 2. For all $k < (a-c)^2/16$, $SW^{mm} > SW^{mb} > SW^{bm} > SW^{bb}$.

That is, provided the fundamental viability condition is met, then social preferences fully reflect the ranking of consumer surplus levels stated in Lemma 1.[3] Note that Proposition 2 implies a non-trivial result, i.e., that the situation where one fixed cost is saved because of a generalised industry outsourcing decision, is not as appealing as it might look *ex ante*. That is, avoiding the duplication of the fixed component of the input cost is not a desirable achievement *per se*, since it involves the undesirable effect of inducing a price increase in the market for the final good. In other words, the make-make decision, even if entails fixed costs' duplication, turns out to be socially preferable to alternative situations where such a duplication does not occur, since it entails a larger level of final output and hence a higher consumer surplus.

[3] The condition whereby $SW^{bm} > SW^{bb}$ is $k < 0.284(a-c)^2$, which is surely met if $k < (a-c)^2/16$.

There remains to investigate the strategic interplay between firms 1 and 2 when it comes to choose whether to make or buy the input. Table 2 illustrates the reduced form of the make-or-buy game, from the downstream firms' viewpoint.

Table 2. The make-or-buy game between downstream firms

Firm 2 / Firm 1	M	B
M	$\frac{(a-c)^2}{8}-k$; $\frac{(a-c)^2}{16}-k$	$\frac{5(a-c)^2}{28}-k$; $\frac{(a-c)^2}{49}$
B	$\frac{(a-c)^2}{36}$; $\frac{25(a-c)^2}{144}-k$	$\frac{(a-c)^2}{35}$; $\frac{(a-c)^2}{49}$

Maintaining the hypothesis that the game is played once and firms are cannot bear negative payoff on this market, i.e., $k < (a-c)^2/16$, we see that M is always a strictly dominant strategy for the managerial firm (firm 1), while it is a strictly dominant strategy for the entrepreneurial firm (firm 2) as well if and only if $k < 0.042\,(a-c)^2$. Outside this parameter range, up to $k < (a-c)^2/16$, firm 2 prefers to buy if firm 1 makes, while it prefers to make if firm 1 buys. Note that, in the latter case, the 2x2 matrix can be reduced by deleting the second row (due to the fact that M is dominant for firm 1); this allows us to conclude that, on what remains of the original matrix (the top row), B is dominant for firm 2, for all $k \in (0.042(a-c)^2, (a-c)^2/16)$. Accordingly, we can state:

Proposition 3. For all $k < 0.042\,(a-c)^2$, (M,M) is the unique Nash equilibrium (in weakly dominant strategies). For all $k \in (0.042(a-c)^2, (a-c)^2/16)$, (M,B) is the unique Nash equilibrium (attainable by iterated dominance).

In words, this amounts to saying that for low levels of fixed cost of production the unique equilibrium entails that both firms choose to make the input *in house*. For higher levels of fixed costs, the equilibrium entails that the managerial firm produces the input in house while the profit-oriented firm resorts to outsourcing.

Propositions 2-3 immediately imply the following relevant corollary:

Corollary 4. For all $k < 0.042\,(a-c)^2$, there is no conflict between private and social incentives as to the make-or-buy decision. A conflict instead arises for all $k \in (0.042(a-c)^2, (a-c)^2/16)$, where (M,M) is socially preferred while (M,B) is privately selected.

A few comments are now in order. First, the option to buy the input (i.e., outsourcing) becomes attractive for the profit-seeking unit if the fixed cost is high enough, while it is never so for the managerial firm. The intuitive reason appears to be that strategic delegation makes a firm richer than it would be otherwise (all else equal) and therefore more keen on resorting to vertical integration no matter what the cost is, while the entrepreneurial unit is weaker (or, equivalently, poorer) and therefore more sensitive to any given increase in the cost of the upstream technology. This gives rise to the possibility of observing a divergence between private and social incentives as to the make-or-buy choice, given that vertical integration of the entire industry is always socially preferable to any other scenario because of its desirable consequences on consumer surplus.

Second, a related issue is that the arising of such a conflict opens a discussion on industrial policy instruments, as the conflict itself could be avoided by subsidising the profit-seeking firm so as to induce it to internalise the production of the input notwithstanding its high fixed-cost component. The appropriate amount of resources to be redirected to the profit-seeking firm as a subsidy could be raised (either alternatively or jointly) from taxes levied on consumers and/or from the profits accruing to the managerial firm.

4. Concluding remarks

We have modelled a Cournot duopoly where a profit-seeking firm and a managerial one coexist and must choose whether to make or buy an intermediate input which contributes to the production of the final consumption good.

The situation has been represented by a simple three-stage game. At the first stage, each firm has to commit herself either to produce in house the input or to buy it on the market. Then, the other choices are taken: in turn, the owners of the managerial firm set the managerial incentive; the independent upstream firm producing the input sets its price; each duopolist sets her production level. The game has been solved by backward induction, yielding several interesting results (under the assumption that the parameter constellation allows both firms to obtain positive profits).

Taking a partial equilibrium perspective, we have shown that consumers always prefer the situation in which both firms choose *in-house* input production. This is also the best outcome from a social welfare perspective at the market level. Unfortunately, this is the equilibrium choice of firms only under a specific parameter configuration; if such a parameter condition is not met, a conflict arises between private and social preferences. However, the divergence could be eliminated, in principle, by designing an appropriate subsidy scheme for the profit-seeking firm.

Two remarks are appropriate to conclude, as a note of caution, and as insights for possible future research. First, we have maintained the hypothesis that the costs of in house production of the input permit the duopolistic firms to obtain positive profits. Of course, the story could well go a different way, if a firm were *forced* to resort to outsourcing. Second, our analysis has been carried out in a partial equilibrium framework. Of course, different policy implications could emerge if a more general perspective were adopted.

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