Strategic Delegation and the Shape of Market Competition[1]

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Abstract

Which shape market competition is likely to exhibit? This question is addressed in the present paper, where ¯rms can choose whether to act as quantity or price setters, whether to move early or delay as long as possible at the market stage and ¯nally whether to be entrepreneurial or managerial. Moreover, ¯rms can endogenously determine the sequence of such decisions. It is shown that in correspondence of the (unique) subgame perfect equilibrium of the game, all ¯rms ¯rst decide to delay, then to act as Cournot competitors, and ¯nally stockholders decide to delegate control to managers. Hence, sequential play between either managerial or entrepreneurial ¯rms, as well as simultaneous play between entrepreneurial ¯rms are ruled out.

Running head: Delegation and Market Competition

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1 Introduction

Which way can we expect ¯rms to play oligopoly games? Are they to behave as quantity or price-setters? Will they move simultaneously or sequentially? And, ¯nally, which kind of internal organization will they choose to adopt, given the other choices they have to make? The way ¯rms can be expected to conduct oligopolistic competition has represented a relevant issue in the economists' research agenda for a long time, and a great deal of e®ort has been made in several directions.

The earliest literature in this ¯eld treated a relevant feature such as the choice between simultaneous and sequential moves as exogenous (Stackelberg, 1934; Fellner, 1949). Later contributions investigated the preferences of ¯rms over the distribution of roles in price or quantity games (Gal-Or, 1985; Dowrick, 1986; Boyer and Moreaux, 1987a,b). The preference for leadership (respectively, followership) in quantity (price) games can be established on the basis of the slope of ¯rms' reaction functions or, likewise, resorting to the concepts of strategic substitutability or complementarity between products (Bulow et al., 1985). A few contributions have taken into account the possibility that cost asymmetry or uncertainty may lead to Stackelberg equilibria (Ono, 1982; Alb½k, 1990).[1] Finally, some authors have analysed the choice between price and quantity as a strategic variable, taking into account only simultaneous equilibria (Singh and Vives, 1984; Cheng, 1985). Their ¯ndings point to the conclusion that ¯rms should behave as Cournot players since setting output is a dominant strategy. Friedman (1988) investigates a duopoly model where ¯rms choose both prices and quantities. Three cases are described. When both variables are set at the same time, there exists no pure-strategy non-cooperative equilibrium. When ¯rms choose ¯rst prices (respectively, quantities) and then quantities (prices), the pure-strategy equilibrium is Bertrand (respectively, Cournot). Another direction taken by several authors in the Cournot-Bertrand debate is that of capacity constraints under price competition (Levitan and Shubik, 1972; Kreps and Scheinkman, 1983; Osborne and Pitchik, 1986; Davidson and Deneckere, 1986). Their results can be summarized as follows. If unit production costs are symmetric, then (i) if each ¯rm's capacity su±ces to serve the whole market, the standard Bertrand outcome emerges; (ii) if capacity constraints are binding, the Cournot outcome obtains, notwithstanding ¯rms' price-setting behaviour. Otherwise, if unit production costs are asymmetric up to capacity, Cournot outcomes need not arise at equilibrium.[2] The intuitive explanation is that the relevant model to describe duopolistic interaction is alternatively Bertrand or Cournot depending upon how steep is the marginal

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[1] The choice between Bertrand and Cournot behaviour under uncertainty has been dealt with by Klemperer and Meyer (1986, 1989), through a supply curve approach, of which setting a speci¯c quantity or price level appears as a special case.

[2] The endogenous emergence of price leadership by a dominant ¯rm under capacity constraint is analysed by Deneckere and Kovenock (1992).

cost curve (cf. Tirole, 1988, p. 224). In a recent contribution, Deneckere and Kovenock (1996) prove that, under cost asymmetry, there exists an incentive for the more e±cient ¯rm to drive the rival out of business. This prevents the market from reaching a Cournot equilibrium.

Recent literature explicitly models the strategic choice of timing, which is often possible in reality. Robson (1990a) proposes an extended duopoly model where price competition takes place in a single period, preceded by ¯rms' scattered price decisions, which cannot be altered. Only Stackelberg equilibria emerge from such a game. In an in°uential paper, Hamilton and Slutsky (1990) investigate the endogenous choice of roles, i.e., the endogenous arising of Stackelberg or Cournot equilibria, in noncooperative two-person games (typically, duopoly games), by analysing an extended game where players (say, ¯rms) are required to set both the actual moves or actions and the time at which such actions are to be implemented. Their approach is close in spirit to Robson's, though they also consider Cournot competition and the mixed case where one ¯rm sets her price and the other ¯rm decides her output level. When ¯rms choose to act at di®erent times, sequential equilibria obtain, while if they decide to move at the same time, simultaneous Nash equilibria are observed. The choice of the timing occurs in a preplay stage which does not take place in real time, so that there is no discounting associated with waiting and payo®s are the same whether ¯rms choose to move as soon as possible or to delay as long as they can. The decision to play early or at a later time is not su±cient per se to yield sequential play, since an analogous decision taken by the rival leads to simultaneous play.

Hamilton and Slutsky (HS, henceforth) show that a Stackelberg equilibrium with sequential play is selected as a subgame perfect equilibrium of the extended game with observable delay if and only if the outcome of sequential play Pareto-dominates the outcome associated with simultaneous play (HS, 1990, Theorems III and IV). Otherwise, if ¯rms are better o® playing simultaneously rather than accepting the follower's role, the subgame perfect equilibrium involves simultaneous play (HS, 1990, Theorem II).[3] Summing up, the subgame perfect equilibrium of the extended game with observable delay involves sequential moves if and only if the basic game exhibits at least one Stackelberg equilibrium that Pareto-dominates the simultaneous Nash equilibrium (Lambertini, 1997a).

Pal (1996) explicitly takes into account mixed strategies. He considers an extended quantity-setting game with two identical ¯rms and two production periods before the market-clearing instant. He shows that in such a setting only three outcomes are possible: (i) both ¯rms produce in the second period, so that a simultaneous Cournot equilibrium obtains; (ii) ¯rms produce in di®erent period,

[3]HS (1990, section IV) also consider an extended game with action commitment in the spirit of Dowrick (1986), where each ¯rm must commit to a particular action irrespectively of the rival trying to lead or follow. This yields multiple equilibria where either both ¯rms play immediately or one moves immediately while the other delays.

yielding a Stackelberg-like equilibrium (see also Robson, 1990b); (iii) Stackelberg warfare may arise when ¯rms produce in the ¯rst period, but both produce more than in the Cournot-Nash equilibrium.

Finally, as to the interplay between market competition and the internal organization of the ¯rm, we avail of several contributions where it is shown that in order to acquire the Stackelberg leader's position in the product market, ¯rms' stockholders delegate the control over their assets to managers who end up maximizing an objective function consisting in a weighted sum of pro¯ts and sales (Vickers, 1985; Fershtman and Judd, 1987; Sklivas, 1987; Fershtman et al., 1991; Polo and Tedeschi, 1992; Barcena-Ruiz and Paz Espinoza, 1996). These authors stress that the delegation of control to managers in Cournot settings can be advantageous in that it may give rise to Stackelberg leadership even though ¯rms move simultaneously. The equilibrium arising in delegation games where ¯rms are Cournot players indeed involves both ¯rms delegating control in order to try and achieve a dominant position. All ¯rms would prefer the rivals not to delegate, and the equilibrium is a®ected by a prisoner's dilemma.[4]

Summing up, all these branches of the literature on oligopoly theory convey information as to how ¯rms should conceivably conduct market competition, but none of them provides an exhaustive answer. If ¯rms are required to take a number of decision concerning the type of competition they will conduct on the market, as well as their internal organization, and these decisions are likely to interact with each other, then what is the equilibrium of such a game, if there exists any, and if so, is it unique? These are the questions addressed in this paper, where a linear duopoly model is adopted, and any capacity constraints or cost asymmetries are assumed away. I shall investigate all the conceivable settings that can arise in a duopoly market where ¯rms choose between (i) being entrepreneurial or managerial; (ii) setting prices or quantities; (iii) moving as early as possible or delaying; and, ¯nally (iv) proceed to optimize in the market competition stage. As to the choice between price and quantity, I will conform to the view of Singh and Vives, where the decision is not in°uenced by technological constraints. The order of the ¯rst three stages is subject to permutations, and the two ¯rms may not take these decisions according to the same sequence. This obviously gives rise to a wide number of asymmetric games. The model allows to derive several of the results obtained in the previous literature in this ¯eld, and shows that a few of them are not robust and cannot be expected to be observed in equilibrium. The analysis below shows that the equilibrium of the game envisaged here is unique and involves managerialization of both ¯rms, after their respective owners have decided to move as late as possible and act as quantity-setters (if

[4] Recently, Basu (1995) has extended the basic model due to Vickers (1985), Fershtman and Judd (1987) and Sklivas (1987), in order to explicitly model the owner's decision to hire a manager in a Cournot duopoly. This allows to show that a Stackelberg equilibrium may arise, with just one ¯rm delegating, even though the cost of hiring an agent is the same across owners.

goods are substitutes).

The remainder of the paper is structured as follows. The basic setting is described in section 2. Section 3 is devoted to the analysis of market subgames. The nature of the equilibrium associated with the whole game tree is then investigated in section 4. Finally, section 5 contains concluding remarks.

2 The model

I adopt a simplified version of the linear duopoly model introduced by Dixit (1979) and then used by Singh and Vives (1984) and many others. Two symmetric firms compete on a market for differentiated products, supplying one good each. The inverse demand function faced by firm i is

$$p_i = 1 - q_i - \gamma q_j; \tag{1}$$

where $j \neq i$ denotes i's rival, and $|\gamma| \leq 1$. When $\gamma \in [-1; 0)$; the two goods are complements, while in the range where $\gamma \in (0; 1]$ they are substitutes. In the remainder of the paper, I shall confine to the latter case, since once one avails of the results pertaining to substitute goods, a simple reversion gives those pertaining to the case of complements. From (1), the direct demand function for firm i can be easily obtained:

$$q_i = \frac{1}{1+\gamma} - \frac{1}{1-\gamma^2} p_i + \frac{\gamma}{1-\gamma^2} p_j. \tag{2}$$

Finally, in the mixed setting where, say, firm i is a quantity-setter and firm j is a price-setter, demand functions look as follows:

$$p_i = 1 - q_i + \gamma(\gamma q_j + p_j - 1); \; q_j = 1 - p_j - \gamma q_i. \tag{3}$$

I assume firms operate with the same technology, characterized by a constant marginal production cost which, without loss of generality, can be normalized to zero. Consequently, profits coincide with revenues, $\pi_i = p_i q_i$. The assumption concerning marginal cost can be interpreted as follows. When marginal cost is symmetric and everywhere flat, firms have the possibility of choosing endogenously the market variable without being influenced by technological constraints, such as capacity.

Firms can choose whether to move at the same time or scatter their respective decisions. If they decide to move simultaneously, no matter whether early or late, a Nash equilibrium in prices or quantities (or mixed) obtains. If, conversely, they move sequentially, then a Stackelberg equilibrium is observed. This is what Hamilton and Slutsky (1990) define as an extended game with observable delay. In order to illustrate this concept, consider the simplest extended game where firms can set a single strategic variable (e.g., price or quantity) and must choose between moving first or second. I shall adopt here a symbology which largely replicates that in HS (1990, p. 32). De¯ne ¡^{1} = (N; §^{1}; ¦^{1}) the extended game with observable delay. The set of players (or ¯rms) is N = fA; Bg, and ® and ¯ are the compact and convex intervals of R^1 representing the actions available to A and B in the basic game. ¦^{1} is the payo® function. Payo®s depend on the actions undertaken in the basic (market) game, according to the following functions, a : ® £ ¯ ! R^1 and b : ® £ ¯ ! R^1. The set of times at which ¯rms can choose to move is T = fF; Sg, i.e., ¯rst or second. The set of strategies for player i is §^1_i = fF; Sg £ ©$_i$, where ©$_i$ is the set of functions that map T £ ¯(or ®) into ®(or ¯). If both ¯rms choose to move at the same time, they obtain the payo®s associated with the simultaneous Nash equilibrium, ($a_n; b_n$), otherwise they get the payo®s associated with the Stackelberg equilibrium, e.g., ($a_l; b_f$) if A moves ¯rst and B moves second, or vice versa. The game can be described in normal form as in matrix 1 (cfr. HS, 1990, p. 33).

		B: F	B: S
A	F	$a_n; b_n$	$a_l; b_f$
	S	$a_f; b_l$	$a_n; b_n$

Matrix 1

Moreover, ¯rms' stockholders may decide whether to delegate control to managers who are not interested in pro¯t maximization as such, as they own no share, but rather in sales, so that in case of managerialization ¯rm i's maximand modi¯es as follows:

$$M_i = ¼_i + µ_i q_i; \quad (4)$$

where parameter $µ_i$ identi¯es the weight attached to the volume of sales, and is optimally set by the stockholder in the employment contract, in order to maximize pro¯ts (Vickers, 1985).[5]

The basic structure of the game I shall investigate in the remainder of the paper can be illustrated as follows. The game involves four decisions, namely, (i) whether to move simultaneously or sequentially in the market stage,[6] (ii)

[5]Considering a linear contract is known to be restrictive, but it is in line with most of the existing literature. The approach due to Vickers (1985) is formally equivalent to that adopted by Fershtman and Judd (1987), where the manager's objective is de¯ned by a linear combination of pro¯t and revenue. I adopt the former for the sake of simplicity.

[6]Notice that this decision only concerns the sequence of moves during market competition. Extending the possibility of choosing a particular timing at any stage would obviously enlarge to a considerable extent the game tree.

whether to set a price or a quantity level, (iii) whether to be managerial or entrepreneurial; and finally (iv) the optimal action at the market stage. Provided (iv) is always the last to be taken, the permutations of the previous three decisions, taking into account the possibility for firms to distribute them according to different sequences along the game tree, give rise to 21 games, out of which 15 are asymmetric. What discriminates is the fact that, in locating the delegation choice along the decision tree, stockholders indeed determine which decisions are delegated to the manager and which are not. For instance, if the owner of firm i locates the delegation stage at the end of his own decision three, this means that the delegation contract gives the manager the right to decide only upon the firm's behaviour in the market stage, and he has a contractual obligation, say, to move first and to be a Cournot agent. Conversely, if delegation takes place at the first stage, then it gives the manager the right to decide both whether to try and become leader or follower, and whether to play a price or a quantity strategy, besides obviously the final decision at the market stage. It is worth stressing that (i) all decisions which are taken by stockholders are unobservable until the eventual delegation, if any takes place, or the market stage is reached, in the opposite case; and (ii) if owners decide whether to move early or late and only after that they proceed to delegate, nonetheless the actual move is up to the manager: in other terms, in such a situation the decision upon the timing is up to the owner, while its implementation at the market stage is delegated to the manager. As a relevant consequence, this entails that the permutation of such decisions does not affect the equilibrium payoffs.

3 Market competition subgames

In this section I provide a review of the three market subgames which can arise, namely, (i) the subgame observed when no firm has delegated control to an agent, so that competition takes place between entrepreneurial firms aiming at profit maximization; (ii) the subgame arising when both firms are managerial; and, finally, (iii) the subgame which obtains if one firm is managerial while the other is entrepreneurial. All three involve the choice of the timing of moves as well as the strategic variable.

3.1 The subgame played by entrepreneurial firms

This is a setting which has been deeply analysed in several existing contributions (e.g., Singh and Vives, 1984; Boyer and Moreaux, 1987b), so I can confine my attention to the equilibrium payoffs, without dealing with their derivation. To begin with, when both firms act as quantity-setters, one obtains the following equilibrium payoffs:

$$\pi_{ee}^{CN} = \frac{1}{(2+\gamma)^2};\ \pi_{ee}^{Cl} = \frac{(2-\gamma)^2}{8(2-\gamma^2)};\ \pi_{ee}^{Cf} = \frac{(4-2\gamma-\gamma^2)^2}{16(2-\gamma^2)^2}; \tag{5}$$

where superscript CN, Cl, and Cf stand for Cournot-Nash, Cournot leader and Cournot follower, respectively, while subscript ee indicates that both firms are entrepreneurial.

The Bertrand game yields the following payoffs:

$$\pi_{ee}^{BN} = \frac{(1-\gamma)}{(2-\gamma)^2(1+\gamma)}; \; \pi_{ee}^{Bl} = \frac{(1-\gamma)(2+\gamma)^2}{8(1+\gamma)(2-\gamma^2)}; \; \pi_{ee}^{Bf} = \frac{(1-\gamma)(4+2\gamma-\gamma^2)^2}{16(1+\gamma)(2-\gamma^2)^2}. \tag{6}$$

The meaning of the superscripts appearing in (6) is analogous to (5), mutatis mutandis.

Finally, in the mixed game where one firm optimize w.r.t. quantity, while the other maximize profits w.r.t. price, one gets

$$\pi_{ee}^{QN} = \frac{(\gamma-2)^2(1-\gamma^2)}{(3\gamma^2-4)^2}; \; \pi_{ee}^{Ql} = \frac{(2-\gamma)^2}{8(2-\gamma^2)}; \; \pi_{ee}^{Qf} = \frac{(1-\gamma)(4+2\gamma-\gamma^2)^2}{16(1+\gamma)(2-\gamma^2)^2}; \tag{7}$$

$$\pi_{ee}^{PN} = \frac{(\gamma-1)^2(\gamma+2)^2}{(3\gamma^2-4)^2}; \; \pi_{ee}^{Pl} = \frac{(1-\gamma)(2+\gamma)^2}{8(1+\gamma)(2-\gamma^2)}; \; \pi_{ee}^{Pf} = \frac{(4-2\gamma-\gamma^2)^2}{16(2-\gamma^2)^2}. \tag{8}$$

Equation (7) displays the payoffs accruing to the quantity-setter in the three possible situations where firms play simultaneously or sequentially. The same holds for the price-setter in equation (8). Obviously, it appears that $\pi_{ee}^{Cl} = \pi_{ee}^{Ql}$; $\pi_{ee}^{Cf} = \pi_{ee}^{Pf}$; $\pi_{ee}^{Bl} = \pi_{ee}^{Pl}$ and finally $\pi_{ee}^{Bf} = \pi_{ee}^{Qf}$. These equalities imply that in any sequential play, both firms are just indifferent as to whether the follower acts as a price or a quantity-setter.

In the case of substitutability between products, the above payoffs can be ranked according to the following sequence of inequalities:

$$\pi_{ee}^{Cl} = \pi_{ee}^{Ql} > \pi_{ee}^{CN} > \pi_{ee}^{QN} > \pi_{ee}^{Cf} = \pi_{ee}^{Pf} > \pi_{ee}^{Qf} = \pi_{ee}^{Bf} \geq \pi_{ee}^{Bl} = \pi_{ee}^{Pl} \geq \pi_{ee}^{BN} \geq \pi_{ee}^{PN} \tag{9}$$

Accordingly, I can state

Lemma 1 (Singh and Vives, 1984; Boyer and Moreaux, 1987b) *When goods are substitutes (respectively, complements), i.e., $\gamma \in]0,1]$ ($\gamma \in [-1,0[$), setting quantity (price) is a weakly dominant strategy.*

and

Lemma 2 (Boyer and Moreaux, 1987b; Denicolò and Lambertini, 1996) When goods are substitutes (respectively, complements), i.e., $\gamma \in]0;1]$ ($\gamma \in [-1;0[$), setting quantity (price) as early as possible is a strictly dominant strategy.

The first Lemma is what leads Boyer and Moreaux (1987b, Proposition III, p. 223) to claim that the strategy space dominates the distribution of roles, in the sense that if goods are substitutes (complements) both firms are better off being quantity-setters (price-setters). The second Lemma states that, once firms have ruled out the dominated strategy, be that price or quantity, they realize that it is rational to move at the earliest occasion available.

Finally, from (9) it emerges a further set of results, summarized in

Lemma 3 (Hamilton and Slutsky, 1990) When goods are substitutes (respectively, complements), i.e., $\gamma \in]0;1]$ ($\gamma \in [-1;0[$), the subgame perfect equilibria of the extended (sub)games where (i) both firms are Cournot players; (ii) both firms are Bertrand players; and (iii) one firm is a price setter while the other is a quantity setter, involve respectively (a) simultaneous (sequential) play; (b) sequential (simultaneous) play; and (c) sequential play, with the quantity (price) setter in the leader's role.

3.2 The subgame played by managerial firms

Let me now turn to the setting where both firms' stockholders delegate control over their assets to managers interested in the volume of sales, so that their objective function at the market stage is as in expression (4).

I shall briefly resume what happens when firms compete simultaneously in a Cournot fashion (Vickers, 1985). Managers set quantities so as to maximize (4). The first order condition for firm i is

$$\frac{\partial M_i}{\partial q_i} = 1 - 2q_i - \gamma q_j + \theta_i = 0; \qquad (10)$$

yielding

$$q_i = \frac{2 + 2\theta_i - \gamma - \gamma\theta_j}{4 + \gamma^2}; \qquad (11)$$

when $\gamma = 1$, i.e., goods are perfect substitutes, (11) simplifies to $q_i = (1+2\theta_i - \theta_j)$, which obviously coincides with Vickers' findings (Vickers, 1985, p. 142). By substituting and rearranging, I obtain

$$\pi_i(\theta_i) = \frac{1}{4-\gamma^2}\left(2 - 2\theta_i - \gamma - \gamma\theta_j + \gamma^2\theta_i\right)(2 + 2\theta_i - \gamma - \gamma\theta_j); \qquad (12)$$

which is the objective function that stockholders maximize by optimally setting θ_i. The first order condition is

$$\frac{\partial \pi_i}{\partial \theta_i} = \frac{1}{4-\gamma^2}\left[\left(\gamma^2 - 2\right)(2+2\theta_i-\gamma-\gamma\theta_j) + 2\left(2-2\theta_i-\gamma-\gamma\theta_j+\gamma^2\theta_i\right)\right] = 0; \tag{13}$$

yielding

$$\theta_{mm}^{CN} = \frac{\gamma^2(2-\gamma)}{\gamma^3-4\gamma^2+8}. \tag{14}$$

Equilibrium profits are thus

$$\pi_{mm}^{CN} = \frac{2(2-\gamma^2)}{(\gamma^2-2\gamma-4)^2} \tag{15}$$

where subscript mm reveals that both firms are managerial. Notice that the profit in (15) is smaller than the equilibrium profit associated with the Cournot-Nash equilibrium without delegation (5) in the range where products are substitutes, and conversely when they are complements.

In the case where firms take their output decisions sequentially, the equilibrium profits are

$$\pi_{mm}^{Cl} = \frac{(2-\gamma^2)(8-4\gamma-4\gamma^2+\gamma^3)^2}{2(\gamma-2)^2(\gamma+2)^2(3\gamma^2-4)^2};\quad \pi_{mm}^{Cf} = \frac{(\gamma^2+2\gamma-4)^2}{4(\gamma^2-4)(3\gamma^2-4)^2} \tag{16}$$

with $\theta_{mm}^{Cl} = 0$; which entails that the leading firm's stockholders decide not to delegate, since, provided they are to move first, they cannot do any better by delegating control to a manager.

The setting where firms optimize w.r.t. prices can be quickly dealt with. The equilibrium profits are

$$\pi_{mm}^{BN} = \frac{2(1-\gamma)(2-\gamma^2)}{(1+\gamma)(\gamma^2+2\gamma-4)^2};\qquad \pi_{mm}^{Bf} = \frac{(1-\gamma)(\gamma^2-2\gamma-4)^2}{4(\gamma-2)(1+\gamma)(2+\gamma)(3\gamma^2-4)^2}$$

$$\pi_{mm}^{Bl} = \frac{(1-\gamma)(2-\gamma^2)(\gamma^3+4\gamma^2-4\gamma-8)^2}{2(\gamma-2)^2(1+\gamma)(2+\gamma)^2(3\gamma^2-4)^2} \tag{17}$$

where, as in the Cournot setting, in case of sequential play the leading firm is de facto entrepreneurial, i.e., her stockholders set $\theta_{mm}^{Bl} = 0$. Moreover, when firms move simultaneously, it is worth stressing that $\theta_{mm}^{BN} < 0$ for both firms, i.e., contrarily to what happens under Cournot competition, delegation is an anti-competitive device in that it can used to restrict output and thus raise prices. As a result, managerialization closely resembles collusion.

Finally, when a firm optimize w.r.t. price and the other w.r.t. quantity, the equilibrium profits are

$$\pi^{QN}_{mm} = \frac{2(\gamma - 1)^2(2 - \gamma^2)(\gamma^2 - 2\gamma - 4)^2}{(16 - 20\gamma^2 + 5\gamma^4)^2}; \quad \pi^{PN}_{mm} = \frac{2(\gamma^2 - 1)(\gamma^2 - 2)(\gamma^2 + 2\gamma - 4)^2}{(16 - 20\gamma^2 + 5\gamma^4)^2} \tag{18}$$

when both delegate and move simultaneously;

$$\pi^{Ql}_{mm} = \frac{(2 - \gamma^2)(8 - 4\gamma - 4\gamma^2 + \gamma^3)^2}{2(\gamma - 2)^2(2 + \gamma)^2(3\gamma^2 - 4)^2}; \quad \pi^{Pf}_{mm} = \frac{(\gamma^2 + 2\gamma - 4)^2}{4(\gamma^2 - 4)(3\gamma^2 - 4)} \tag{19}$$

when the quantity-setter leads (and, again, decides not to delegate, so that $\theta^{Ql}_{mm} = 0$);

$$\pi^{Pl}_{mm} = \frac{(1 - \gamma)(2 - \gamma^2)(\gamma^3 + 4\gamma^2 - 4\gamma - 8)^2}{2(\gamma - 2)^2(1 + \gamma)(2 + \gamma)^2(3\gamma^2 - 4)^2}; \quad \pi^{Qf}_{mm} = \frac{(1 - \gamma)(\gamma^2 - 2\gamma - 4)^2}{4(\gamma^2 - 4)(1 + \gamma)(3\gamma^2 - 4)} \tag{20}$$

when the price-setter moves first (and, again, decides not to delegate, setting $\theta^{Pl}_{mm} = 0$).

Summing up, when goods are substitutes, the equilibrium profits can be ordered as follows:

$$\pi^{Pf}_{mm} = \pi^{Cf}_{mm} > \pi^{CN}_{mm} > \pi^{PN}_{mm} > \pi^{Cl}_{mm} = \pi^{Ql}_{mm} >$$

$$\pi^{Pl}_{mm} = \pi^{Bl}_{mm} \geq \pi^{Bf}_{mm} = \pi^{Qf}_{mm} \geq \pi^{BN}_{mm} \geq \pi^{QN}_{mm} \tag{21}$$

Among the inequalities appearing in (21), a few deserve to be evaluated in isolation. Observe that $\pi^{Cf}_{mm} > \pi^{CN}_{mm} > \pi^{Cl}_{mm}$, i.e., the Nash equilibrium breaks as usual the sequence of the payoffs associated with the Stackelberg equilibrium, though the latter are reversed as compared to the setting where no delegation takes place (see above). The leader cannot do any better than she is already doing, in that delegation does not add anything to the position acquired by moving first, given that the two decision are observationally equivalent. A graphical illustration is provided in figure 1.

Consider first the usual leader's problem in a game played by profit-maximizing firms. The Cournot-Nash equilibrium is represented by point N. Using the additional information provided by the opponent's reaction function, the leader can adjust the output level so as to "locate" in the tangency point between his own

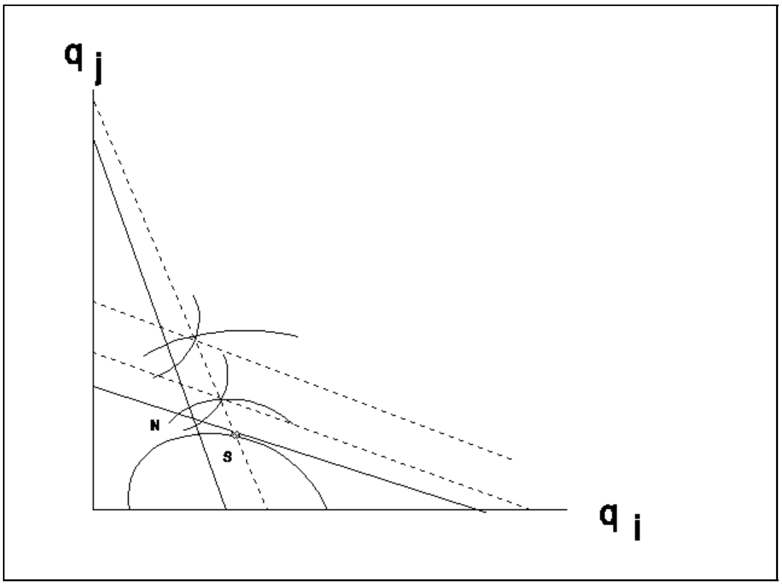

Figure 1: The Cournot Game

system of isoprofit curves and the rival's reaction function (point S in figure 1). Likewise, when firms set their output levels at the same time, the leader's profit can be attained through delegation, in which case point S is reached through an outward shift of the leader's reaction function, due to the appropriate choice of μ: It now appears clearly that delegation and the ability to move first are observationally equivalent, or, borrowing the terminology from demand theory, perfect substitutes. This implies that these instruments cannot be used jointly, but only alternatively. Hence, if the owner, say, of firm j, anticipates that his manager is going to move first in the market subgame, he also knows that there is no reason to use delegation to achieve the very same goal. The latter consideration can be interpreted in two ways, namely, that $\mu_j^* = 0$ means either that the delegation contract allows for no output expansion at all, forcing the manager to maximize profit only, or that there is no delegation at all and the firm is entrepreneurial. Consider now the follower's behaviour. If, say, the owner of firm i knows that his manager is going to move late in the market stage, he finds profitable to use the delegation device so as to shift his own reaction function outwards to such an extent that the Stackelberg equilibrium point becomes S', where the above profit sequence applies. This entails that delegation becomes a free-riding device to the avail of the follower, who ends up producing more and gaining higher profits than the leader.[7]

[7] As far as the timing of moves is concerned, a more detailed analysis of stockholders' and managers' incentives is in Lambertini (1997b), where it is shown that the potential conflict of

As to the price-setting game, $\pi^{Bl}_{mm} > \pi^{Bf}_{mm} > \pi^{BN}_{mm}$: Once again, the payoffs emerging from sequential play are reversed as compared to the usual sequence. The intuition underlying this result is largely analogous to the previous case. Finally, in the mixed case, $\pi^{Ql}_{mm} > \pi^{Qf}_{mm} > \pi^{QN}_{mm}$ and $\pi^{Pf}_{mm} > \pi^{PN}_{mm} > \pi^{Pl}_{mm}$: Hence, if, say, firm j selects a quantity strategy, then firm i finds it optimal to imitate the rival, and move as late as possible; moreover, when firm j decides to move at the earliest occasion, then firm i moves late, independently on the strategic variable being set. In none of the situations depicted above the leader chooses to exploit the possibility of delegation, in that it would add no further advantage. On these grounds, I can state

Lemma 4 The subgame where both firms have the possibility of delegating control to managers exhibits no dominant strategy. Under sequential play, the leader never delegates, so that delegation is observed on both sides only if firms move at the same time.

3.3 The subgame between an entrepreneurial and a managerial firm

As a final step towards a comprehensive picture of the whole game, a last case remains to be investigated, namely, the subgame arising when one firm delegates control to a manager, while the other remains entrepreneurial.

I shall first consider the case of Cournot competition. When firms move simultaneously, their profits are

$$\pi^{CN}_{me} = \frac{(2-\gamma)^2}{8(2-\gamma^2)};\quad \pi^{CN}_{em} = \frac{(4-2\gamma-\gamma^2)^2}{16(2-\gamma^2)^2}; \tag{22}$$

where subscript me means that the firm in question is managerial (while her rival is entrepreneurial), and conversely. Evidently, $\pi^{CN}_{me} = \pi^{Cl}_{ee}$ and $\pi^{CN}_{em} = \pi^{Cf}_{ee}$, which is the result obtained by Vickers (1985), i.e., that unilateral delegation is observationally equivalent to acquiring Stackelberg leadership, although firms move at the same time.

When instead firms play sequentially, profits are

$$\pi^{Cl}_{em} = \frac{(2-\gamma^2)(8-4\gamma-4\gamma^2+\gamma^3)^2}{2(\gamma-2)^2(2+\gamma)^2(3\gamma^2-4)^2};\quad \pi^{Cf}_{me} = \frac{(2\gamma+\gamma^2-4)^2}{4(\gamma^2-4)(3\gamma^2-4)}; \tag{23}$$

when the entrepreneurial firm is leading, while $\pi^{Cl}_{me} = \pi^{CN}_{me}$ and $\pi^{Cf}_{em} = \pi^{CN}_{em}$, in the opposite case, in that the owner of the candidate managerial firm actually decides not to hire a manager.

interests that may arise under this respect is irrelevant, in that the choice of timing by managers entails the same profits owners would attain by specifying the timing in the delegation contract.

the outcome of simultaneous play in prices is fairly intuitive, in that again the managerial firm is de facto in the leader's position, so that $\pi_{me}^{BN} = \pi_{ee}^{Bl}$ and $\pi_{em}^{BN} = \pi_{ee}^{Bf}$. As to sequential play, one obtains

$$\pi_{em}^{Bl} = \frac{(1-\gamma)(2-\gamma^2)(4\gamma^2+\gamma^3-4\gamma-8)^2}{2(1+\gamma)(\gamma-2)^2(2+\gamma)^2(3\gamma^2-4)^2}; \quad \pi_{me}^{Bf} = \frac{(1-\gamma)(\gamma^2-2\gamma-4)^2}{4(1+\gamma)(\gamma^2-4)(3\gamma^2-4)}; \tag{24}$$

when the entrepreneurial firm is leading, while in the opposite case the leader does not delegate and $\pi_{me}^{Bl} = \pi_{me}^{BN}$ and $\pi_{em}^{Bf} = \pi_{em}^{BN}$.

Finally, it comes to the case where one firms sets an output level while the rival sets a price level. The outcomes of simultaneous play are straightforward, since they observationally correspond to sequential play outcomes in complete absence of delegation: when the managerial firm is a quantity setter, we have $\pi_{me}^{QN} = \pi_{me}^{Ql}$ and $\pi_{em}^{PN} = \pi_{em}^{Pf}$; while in the opposite situation when the entrepreneurial firm is leading, we have $\pi_{me}^{PN} = \pi_{me}^{Pl}$ and $\pi_{em}^{QN} = \pi_{em}^{Qf}$. Likewise, it can be easily determined that $\pi_{me}^{Ql} = \pi_{me}^{CN} = \pi_{ee}^{Cl}$; $\pi_{em}^{Pf} = \pi_{ee}^{Pf} = \pi_{em}^{CN}$ and $\pi_{me}^{Pl} = \pi_{ee}^{Pl}$; $\pi_{em}^{Qf} = \pi_{ee}^{Qf}$; etc., when the candidate managerial firm takes the lead (and does not delegate). When instead it is the entrepreneurial firm to play the leader's role, we get $\pi_{em}^{Pl} = \pi_{em}^{Bl}; \pi_{me}^{Qf} = \pi_{me}^{Bf}$ and $\pi_{em}^{Ql} = \pi_{em}^{Cl}; \pi_{me}^{Pf} = \pi_{me}^{Cf}$.

Given the above equalities, in the case of substitutes ($\gamma \in]0;1]$), the payoffs pertaining to this specific subgame can be synthetically ranked as follows:

$$\pi_{me}^{Cl} = \pi_{me}^{CN} = \pi_{me}^{QN} = \pi_{me}^{Ql} > \pi_{me}^{Cf} = \pi_{me}^{PN} = \pi_{me}^{Pf} > \pi_{em}^{Cl} = \pi_{em}^{QN} = \pi_{em}^{Ql} > \pi_{em}^{Bl} = \pi_{em}^{Pl}$$

$$> \pi_{em}^{Cf} = \pi_{em}^{Pf} = \pi_{em}^{PN} > \pi_{me}^{Qf} = \pi_{me}^{Bf} > \pi_{em}^{Qf} = \pi_{em}^{BN} = \pi_{em}^{Bf} > \pi_{me}^{BN} = \pi_{me}^{Bl} \tag{25}$$

This leads to

Lemma 5 When only one firm has the possibility of delegating while the other is entrepreneurial, both firms have the same weakly dominant strategy, which consists in being Cournot agents and move at the earliest occasion.

Moreover, together with the results obtained in the previous subsection, the above analysis yields

Lemma 6 A candidate managerial firm does indeed exploit the possibility of delegating control if and only if she does not move earlier than her rival, independently of the internal organization of the latter.

4 The ¯ve-stage game

I am now in a position to illustrate what happens in the manifold epiphanies of the whole game tree. In order to simplify the exposition, I shall (i) resort to the normal form representation; (ii) con¯ne to one symmetric game (the reasons at the basis of its choice will become clear below); and (iii) consider only the case of substitutability.

The overall number of payo®s arising from downstream market subgames is sixteen. This is due to the fact that, from the observational point of view, the possible equilibrium outcomes are ten, of which four are symmetric, namely, those associated with simultaneous Bertrand or Cournot equilibria, with and without delegation on both sides.

The presence of three di®erent stages, before market competition takes place, gives rise to 21 di®erent games, of which six are symmetric, namely those where both ¯rms distribute their decisions according to one of the following sequences:

a) F/S; C/B; D/ND
b) F/S; D/ND; C/B
c) C/B; D/ND; F/S
d) C/B; F/S; D/ND
e) D/ND; C/B; F/S
f) D/ND; F/S; C/B,

where F/S represents the choice pertaining to the timing of moves, i.e., play early (¯rst) or late (second); C/B represents the choice between being a quantity or a price setter; and ¯nally D/ND represents the choice between delegating control to a manager or not. Where the latter appears at the end of the sequence, no decision except the optimal price/quantity behaviour is delegated to the manager. Hence, the game presents, overall, ¯ve stages, of which three (those above) can be combined in several sequences. The ¯rst stage of the game is actually a meta-stage, in that it involves the draft of one such sequence out of the six available, by each ¯rm. The ¯fth stage is the actual market game.

I focus on game (a), where indeed it is the case that, if delegation occurs, is such that the manager can only determine market performance, being told to conduct it, say, by playing at the ¯rst occasion and being a quantity setter. Given the symmetry of the game, it su±ces to investigate the two submatrices where both ¯rms move either at the same time or sequentially. These are, respectively, matrix 2 and matrix 3, where ¯rm i is the row player and ¯rm j is the column player.

j

F

		C; D	C; ND	B; D	B; ND
	C; D	¼$^{CN}_{mm}$; ¼$^{CN}_{mm}$	¼$^{CN}_{me}$; ¼$^{CN}_{em}$	¼$^{QN}_{mm}$; ¼$^{PN}_{mm}$	¼$^{QN}_{me}$; ¼$^{PN}_{em}$
i F	C; ND	¼$^{CN}_{em}$; ¼$^{CN}_{me}$	¼$^{CN}_{ee}$; ¼$^{CN}_{ee}$	¼$^{QN}_{em}$; ¼$^{PN}_{me}$	¼$^{QN}_{ee}$; ¼$^{PN}_{ee}$
	B; D	¼$^{PN}_{mm}$; ¼$^{QN}_{mm}$	¼$^{PN}_{me}$; ¼$^{QN}_{em}$	¼$^{BN}_{mm}$; ¼$^{BN}_{mm}$	¼$^{BN}_{me}$; ¼$^{BN}_{em}$
	B; ND	¼$^{PN}_{em}$; ¼$^{QN}_{me}$	¼$^{PN}_{ee}$; ¼$^{QN}_{ee}$	¼$^{BN}_{em}$; ¼$^{BN}_{me}$	¼$^{BN}_{ee}$; ¼$^{BN}_{ee}$

Matrix 2

This subgame can be quickly solved by reducing the matrix through the deletion of a dominated strategy, namely FBND, which is at least weakly if not strictly dominated by the remaining three. It is quickly shown that the resulting 3 £ 3 matrix has (FCD, FCD) as its unique equilibrium in pure strategies. This also implies that (SCD, SCD) is the unique equilibrium of the subgame where both ¯rms move late.

As to the mixed setting where ¯rms play sequentially, matrix 3 shows that ¯rm i is indi®erent between the pro¯les FCD and FCND, while ¯rm j is indi®erent between SCD and SBD. This entails that any combination of the four pro¯les just mentioned can be an equilibrium of such a subgame, as well as that where ¯rm i plays late and ¯rm j plays early.

j

S

		C; D	C; ND	B; D	B; ND
	C; D	¼$^{CI}_{mm}$; ¼$^{Cf}_{mm}$	¼$^{CI}_{me}$; ¼$^{Cf}_{em}$	¼$^{QI}_{mm}$; ¼$^{Pf}_{mm}$	¼$^{QI}_{me}$; ¼$^{Pf}_{em}$
i F	C; ND	¼$^{CI}_{em}$; ¼$^{Cf}_{me}$	¼$^{CI}_{ee}$; ¼$^{Cf}_{ee}$	¼$^{QI}_{em}$; ¼$^{Pf}_{me}$	¼$^{QI}_{ee}$; ¼$^{Pf}_{ee}$
	B; D	¼$^{PI}_{mm}$; ¼$^{Qf}_{mm}$	¼$^{PI}_{me}$; ¼$^{Qf}_{em}$	¼$^{BI}_{mm}$; ¼$^{Bf}_{mm}$	¼$^{BI}_{me}$; ¼$^{Bf}_{em}$
	B; ND	¼$^{PI}_{em}$; ¼$^{Qf}_{me}$	¼$^{PI}_{ee}$; ¼$^{Qf}_{ee}$	¼$^{BI}_{em}$; ¼$^{Bf}_{me}$	¼$^{BI}_{ee}$; ¼$^{Bf}_{ee}$

Matrix 3

As a result, the reduced form of the whole game is that depicted in matrix 4. Observe that the payo®s may thought of as describing a situation where both ¯rms are managerial Cournot players and have to decide whether to play sequentially (strategy combinations x-y and y-x) or simultaneously (x-x and y-y); since strategy z is strictly dominant for both players, the game has a unique equilibrium identi¯ed by (x, x), i.e., (SCD, SCD): both ¯rms decide to delay as long as possible.

			j	
			w	z
i	w		$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{Cl}_{mm}; ¼^{Cf}_{mm}$
	z		$¼^{Cf}_{mm}; ¼^{Cl}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$

Matrix 4

Hence, I can formulate

Proposition 1 In the game where ¯rms ¯rst determine the timing, then choose the strategic variable and ¯nally their organizational structure, the unique equilibrium existing involves both ¯rms deciding to move at the latest occasion, to be quantity setters and to delegate the output decision to managers.

As to the remaining twenty games, they can be solved in the same way as the above one. It turns out that, observationally, only four equilibrium outcomes are possible: $(¼^{CN}_{mm}; ¼^{CN}_{mm})$; $(¼^{Cf}_{mm}; ¼^{Cl}_{mm})$; $(¼^{Cl}_{mm}; ¼^{Cf}_{mm})$; and ¯nally $(\bar{¼}; \bar{¼})$, i.e., the payo®s associated with the correlated equilibrium where the pro¯ts accruing to the ¯rms amount to $(¼^{Cf}_{mm}; ¼^{Cl}_{mm})$ and $(¼^{Cl}_{mm}; ¼^{Cf}_{mm})$, alternatively.[8]

I am thus in a position to summarize the whole range of epiphanies of the game in matrix 5.

					j			
			fs		cb		dnd	
			dndcb	cbdnd	dndfs	fsdnd	cbfs	fscb
	fs	dndcb	$\bar{¼}; \bar{¼}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{Cf}_{mm}; ¼^{Cl}_{mm}$
		cbdnd	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{Pf}_{mm}; ¼^{Ql}_{mm}$	$¼^{PN}_{me}; ¼^{QN}_{em}$	$\bar{¼}; \bar{¼}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$
i	cb	dndfs	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{Ql}_{mm}; ¼^{Pf}_{mm}$	$\bar{¼}; \bar{¼}$	$\bar{¼}; \bar{¼}$	$¼^{Pf}_{mm}; ¼^{Ql}_{mm}$	$¼^{Pf}_{mm}; ¼^{Ql}_{mm}$
		fsdnd	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{QN}_{em}; ¼^{PN}_{me}$	$\bar{¼}; \bar{¼}$	$\bar{¼}; \bar{¼}$	$¼^{Pf}_{mm}; ¼^{Ql}_{mm}$	$¼^{Cf}_{mm}; ¼^{Cl}_{mm}$
	dnd	cbfs	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$\bar{¼}; \bar{¼}$	$¼^{Ql}_{mm}; ¼^{Pf}_{mm}$	$¼^{Ql}_{mm}; ¼^{Pf}_{mm}$	$\bar{¼}; \bar{¼}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$
		fscb	$¼^{Cl}_{mm}; ¼^{Cf}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{Ql}_{mm}; ¼^{Pf}_{mm}$	$¼^{Cl}_{mm}; ¼^{Cf}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$	$¼^{CN}_{mm}; ¼^{CN}_{mm}$

Matrix 5

Legenda: $¼^{Cl}_{mm} = ¼^{Ql}_{mm} = ¼^{QN}_{em}$; $¼^{Pf}_{mm} = ¼^{Cf}_{mm} = ¼^{PN}_{me}$:
$\bar{¼} = (¼^{Cl}_{mm} + ¼^{Cf}_{mm})=2$; or the average of any other pair of pro¯ts observationally equivalent to the Cournot-Stackelberg outcome under two-sided delegation.

[8] Some of the games yielded by particular permutations are characterized by equilibria where pro¯ts are $(¼^{Ql}_{mm}; ¼^{Pf}_{mm})$ or $(¼^{QN}_{em}; ¼^{PN}_{me})$; which are observationally equivalent to $(¼^{Cl}_{mm}; ¼^{Cf}_{mm})$:

By subdividing it in nine quadrants, the matrix can be quickly reduced. For instance, consider the four north-east cells describing the subgame arising when both ¯rms locate the decision concerning the timing of moves at the ¯rst stage. In such a setting, the strategy pro¯le FSCBDND is weakly dominant for both ¯rms, so that the equilibrium outcome of this subgame is (¼$^{CN}_{mm}$; ¼$^{CN}_{mm}$), i.e., exactly that associated to the particular game described by matrices 2-4, (SCD, SCD).

Proceeding likewise for the rest of the subgames depicted in matrix 5, one obtains its reduced form, matrix 5.1, whose unique equilibrium is (g, g), i.e., the equilibrium of that particular game where the timing decision is taken ¯rst, followed by the choice of the variable and ¯nally by the decision concerning the structure of the ¯rm.

		j: g	h	k
i	g	¼$^{CN}_{mm}$; ¼$^{CN}_{mm}$	¼$^{Pf}_{mm}$; ¼$^{QI}_{mm}$	¼$^{CN}_{mm}$; ¼$^{CN}_{mm}$
	h	¼$^{QI}_{mm}$; ¼$^{Pf}_{mm}$	$\bar{¼}$; $\bar{¼}$	¼$^{Pf}_{mm}$; ¼$^{QI}_{mm}$
	k	¼$^{CN}_{mm}$; ¼$^{CN}_{mm}$	¼$^{QI}_{mm}$; ¼$^{Pf}_{mm}$	$\bar{¼}$; $\bar{¼}$

Matrix 5.1

We already know from Proposition 1 that the equilibrium of such a game is (SCD, SCD). Any other permutation of rows (or columns) in matrices 5 and 5.1 leads to the same conclusion. Hence, I can claim

Proposition 2 When stockholders are faced with the need of determining how to conduct the ensuing market competition, they ¯rst decide that the move at the market stage shall be taken as late as possible; then, decide to behave as Cournot agents; ¯nally, they delegate the output choice to managers. No other sequence of decisions is subgame perfect.

Obviously, this applies in the case of substitute goods; when goods are complements, Bertrand behaviour is selected and ¯rms move early, their optimal strategy being selected by managers. Proposition 2 can be given the following twofold explanation. First, the allocation of the decision concerning the timing of moves at the ¯rst stage leaves open the possibility of being a Bertrand follower. As a consequence, owners can say that they prefer to move late in that they can always delegate as a remedy, should they happen to play a quantity strategy. Second, and more relevant, the decision to move late is a sound one in the light of the rational anticipation of being managerial Cournot ¯rms thereafter. Which is precisely what happens at the second stage: stockholders prefer to be Cournot players in that this is a dominant strategy. Then, in the following stage where the internal organization of the firm must be designed, they must delegate the control over the output decision to agents interested in expanding the scale of production, in order to try and fully exploit the decision taken at the first stage. As a consequence, the equilibrium outcome of the whole decision tree is observationally equivalent to Vickers' (1985) result, but for the absence of timing in his paper. In other words, Vickers' equilibrium must be indeed expected to emerge as the subgame perfect equilibrium of a game where firms can completely shape the nature of competition, provided that they must not take into account capacity constraints.

The above discussion produces the following two relevant corollaries:

Corollary 1 If the decision problem faced by firms at the outset of an oligopoly game is fully fledged, neither the simultaneous Cournot equilibrium, nor any sequential play will obtain.

This amounts to saying that the claims contained in Lemmata 2 and 3 above are not robust to the extension of the decision problem faced by firm to include the possibility of separation between ownership and control. Moreover,

Corollary 2 The possibility of delegation cancels the dominance of the strategy space over the distribution of roles.

From the optimal strategy profile, it appears that it is no longer true that the choice of the strategy space is more relevant than the choice of roles (see Lemma 1). Indeed, firms chose first the timing, and decide to move late, which they would clearly avoid in the absence of any possibility of delegation.

5 Concluding remarks

In this paper, I have tackled the issue how firms can be expected to endogenously shape market competition, if they are to decide upon the strategy space, the timing of moves, their own internal organization as well as the sequence according to which such decisions are to be taken.

The equilibrium of the whole game turns out to be unique, such that in the case of substitutability between products, the decisions are taken as follows: first, firms' owners decide to play as late as possible, then choose to set quantities rather than prices (the opposite holds when goods are complements), and finally delegate control to managers who are thus exclusively entitled to decide upon the output level at the market stage. This equilibrium observationally reproduces the one derived by Vickers (1985), and appears thus to stress the relevance of the internal structure of firms in determining how market competition should look like. Conversely, this result seems to cast a shadow on a variety of outcomes which have received a large deal of attention throughout the years. In particular, it seemingly rules out any possibility of observing sequential play, i.e., Stackelberg equilibria, as well as simultaneous equilibria where ¯rms act as strict pro¯t-maximizers.

The above conclusions hold in a setting where ¯rms' choices between price and output strategies are assumed not to be a®ected by technology, i.e., either capacity constraints or increasing marginal cost. A relevant extension of the foregoing analysis would consist in taking into account the role played by the slope of cost curves.

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