When Does Competition Foster Commitment? Online Supplement

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This version: July 14, 2015

Abstract

We here provide examples that demonstrate how the model in "When Does Competition Foster Commitment" can be extended to cases in which 1) strategy-specific investments improve profitability by increasing demand rather than by reducing costs or 2) commitment also serves as a coordination device.

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1. Introduction

There are some directions in which the model in Ferreira and Kittsteiner (2015) can be extended. First, the analysis similarly applies to cases in which strategy-specific investments improve profitability by increasing demand rather than by reducing costs (Section 2 of this supplement). Second, it is possible to generalize the model to situations in which commitment also serves as a coordination device (Section 3 of this supplement). In such an extension, to induce strategy-specific investments, competitive pressure must be stronger than that in the case of no coordination frictions. Throughout this supplement we use the notation and terminology introduced in Ferreira and Kittsteiner (2015); in particular as we abstract from demand shocks (as in Section 6 of Ferreira and Kittsteiner, 2015) we drop refernces to d for notational simplicity.

2. Demand-shifting Investments: An Example on the Hotelling Line

We here provide a brief example in which the worker's investment $y = 1$ is necessary for the firm to reposition itself in the product space. That is, in this example c_F will act as a demand shifter. More specifically, we assume that in market A the firm always maintains a monopoly position, i.e. $\Pi_A^{l_A}(c_F) = \Pi_A^{h_A}(c_F)$. In market B, F competes with another firm. Products in market B are imperfect substitutes. We model product differentiation by assuming that each market is represented by a Hotelling line $[0, 1]$. The competitor is always located at position 1 in market B. Without the worker's specific investment or if the firm chooses $s = AB$, F is at position 0 in both markets (denoted by $c_F = \bar{c} = \bar{\bar{c}}$). If the worker invests and the firm chooses $s = A$, the firm assumes a new position in market A at $\frac{1}{2}$ (the optimal position for a monopolist), denoted by $c_F = \underline{c}$). We normalize all costs of production to zero (independently of c_F). Customers are uniformly distributed on the Hotelling line in both markets, with a mass of one in each market. A customer's valuation of a product in market $x \in \{A, B\}$, is given by v_x (net of transportation costs). A customer in x has quadratic transportation costs given by $t_x z^2$, with parameter $t_x > 0$ if his distance from the chosen supplier is z. The degree of competition in market B is given by the parameter t_B, which is a measure of the degree of substitutability between the products of firm F and those of its competitor.

We define $C_B = l_B$ if $t_B = \bar{t}$ and $C_B = h_B$ if $t_B = \underline{t}$ and assume that v_B is sufficiently large to assure that all customers prefer to buy.[1] For simplicity we ignore demand shocks. Firms simultaneously set prices p_i^x, where $i = 1$ denotes firm F and $i = 2$ denotes its competitor in B. Given prices p_1^B and p_2^B, the indifferent customer's position $\bar{z}$ in market B is given by

$$t_B \bar{z}^2 + p_1^B = t_B (1 - \bar{z})^2 + p_2^B \Rightarrow \bar{z} = \frac{p_2^B - p_1^B}{2t_B} + \frac{1}{2}.$$

Thus F's profit in market B in the symmetric equilibrium is $\Pi_B^{l_B}(\bar{c}) = \frac{\bar{t}}{2}$ and $\Pi_B^{h_B}(\bar{c}) = \frac{\underline{t}}{2}$.

In market A demand only depends on firm F's location (which is at zero if $c_F = \bar{c}$). We use the normalization $t_A = 1$ and assume that $v_A \in \left(\frac{3}{4}, 3\right)$.[2] The firm F, if located at position $\frac{1}{2}$ and setting a price $p_1^A \le v_A$, faces a demand of $z = \min(2\sqrt{v_A - p_1^A}, 1)$. Optimal price and profit are given by $p_1^A = v_A - \frac{1}{4}$ and $\Pi_A^{l_A}(\underline{c}) = v_A - \frac{1}{4}$. Similarly, if the firm is located at zero (in market A) it faces a demand of $z = \min(\sqrt{v_A - p_1^A}, 1)$. Optimal price and profit are then given by $p_1^A = \frac{2}{3} v_A$ and $\Pi_A^{l_A}(\bar{c}) = \frac{2v_A}{3}\sqrt{\frac{v_A}{3}}$.

Because we have $\Pi_A^{l_A}(\underline{c}) > \Pi_A^{l_A}(\bar{c})$, Assumption 1 in Ferreira and Kittsteiner (2015) holds (parts 1a and 1b hold trivially), which illustrates that the analysis in Ferreira and Kittsteiner (2015) also applies here.

Condition 1 in Ferreira and Kittsteiner (2015) holds because

$$\Pi_B^{h_B}(\bar{c}) - \Pi_B^{l_B}(\bar{c}) = \frac{\underline{t} - \bar{t}}{2} < 0,$$

[1] This assumption facilitates the exposition, for the equilibrium below we require $v_B \ge \frac{5}{4}\bar{t}$.

[2] This assumption guarantees that at position $\frac{1}{2}$ the firm optimally covers the entire market whereas at position 0 it does not.

and thus the contestability effect holds in this market and the credibility of commitment is enhanced by competition in market B.[3]

3. Multiple Workers: Commitment and Coordination

In Ferreira and Kittsteiner (2015) we restrict attention to the CEO's inability to commit to a focused strategy and its consequences for workers' incentives to undertake strategy-specific investments. In this subsection we consider the case in which the CEO and the workers face both an incentive and a coordination problem.[4] We now assume that the firm employs two workers, indexed by $i = 1, 2$. To generate efficiency gains, both workers need to invest at the same time.[5] More precisely, we modify period 0 as follows. Both workers simultaneously decide whether to invest ($y_i = 1$) or not ($y_i = 0$). As before, the cost of investment is e and its benefit is 1 for each player, but now only if both players play $y_i = 1$ and the CEO chooses $s = A$. Otherwise, the benefit for each worker is zero. That is, efficiency improvements happen if and only if both workers invest and the CEO chooses the focused strategy $s = A$. Consequently, the expected payoff of worker i is zero if she does not invest ($y_i = 0$), it is equal to $-e$ if she invests but the other worker chooses not to invest, whereas it is equal to $b - e$ (as defined earlier) if both workers invest (i.e., $y_1 = y_2 = 1$).

If $b > e$ workers play a standard coordination game in which there are two pure-strategy equilibria $(y_1^*, y_2^*) = (0, 0)$ and $(y_1^*, y_2^*) = (1, 1)$. The first equilibrium yields a payoff of zero for each worker and the second equilibrium (the efficient equilibrium) yields an expected payoff of $b - e$ for each worker. To make the coordination problem interesting, as a selection criterion we assume that workers play the risk-dominant equilibrium.[6] The risk-dominant

[3] By assumption, there is no competition in market A, thus the efficiency effect is not defined in this example.

[4] Similarly, Bolton, Brunnermeier, and Veldkamp (2013) study the effects of commitment on worker coordination, but their work focuses on leadership styles.

[5] A generalization to many workers is possible. An earlier version of the paper assumes that the firm employs a continuum of workers and that cost reduction requires a certain proportion of workers to invest.

[6] It is known from the literature on global games (see e.g. Carlsson and van Damme, 1993) that if one

equilibrium is $(1,1)$ if and only if $b \geq 2e$, i.e., in the risk-dominant equilibrium a player only invests if coordination yields a benefit that is sufficiently larger than the cost of investing. In this case, each worker's net expected benefit from investing is strictly positive (i.e. $b > e$). To be sufficiently incentivized to invest, a worker has to receive a *coordination rent* of $b - e \geq 2e - e = e$. Although whether coordination is achieved is common knowledge in a pure-strategy Nash equilibrium, in the risk-dominant equilibrium each player selects her strategy as if she was uncertain about the other player's action and believes that coordination may fail with probability $\frac{1}{2}$ if she invests. If the credibility of commitment (b) is not strong enough to compensate workers for bearing strategic uncertainty, workers would not coordinate on the efficient equilibrium.

Denote the outcome of the workers decision by $y = y_1 y_2$, i.e. $y = 1$ if both invest and $y = 0$ otherwise. Thus in equilibrium we now have that

$$y^* = \begin{cases} 1 & \text{if } b^* \geq 2e, \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

Equivalently to the definition in Section 3.4. in Ferreira and Kittsteiner (2015) an equilibrium is given by (b^*, y^*) where (1) and (2) in Ferreira and Kittsteiner (2015), and (1) are fulfilled. Propositions 1, 3 and 4 in Ferreira and Kittsteiner (2015) easily generalize to this model.

The main conclusion from this reinterpretation of the model is that commitment needs to be stronger (i.e. b^* needs to be larger) if coordination frictions exist. That is, coordination frictions amplify the incentive problem. This implies that, under Conditions 1 and 2 (in Ferreira and Kittsteiner, 2015), with coordination frictions competition has to be more

introduces uncertainty about payoffs, under certain conditions, as private uncertainty about payoffs becomes small, only one of the two strategy profiles (0,0) and (1,1) will be played in equilibrium. Furthermore, as private uncertainty becomes small, workers will choose the strategy profile that constitutes the risk-dominant equilibrium of the game with complete information. If instead of selecting the risk-dominant equilibrium workers played the efficient equilibrium, coordination would not cause frictions and the results of the one-worker case derived in the previous sections would continue to hold.

intense (i.e., τ_A and τ_B have to be larger) to incentivize coordinated investment. Our model thus suggests that firms will stick to the (inefficient) status quo organization until a large competitive shock pushes them over the threshold.

In addition, in this version of the model a worker's payoff now jumps upwards by the coordination rent of $e > 0$ at $b^* = 2e$. Thus, total production efficiency, as given by the sum of workers' and the firm's payoffs, strictly increases at the threshold b^* because both profits and workers' payoffs increase.[7] In sum, in firms for which worker coordination is an issue, there will be resistance to change even though change may be strictly Pareto improving; a large competitive shock might be necessary to break this resistance.[8]

References

[1] Bolton, P., Brunnermeier, M. K. and Veldkamp, L., 2013, "Leadership, Coordination, and Corporate Culture." *Review of Economic Studies* 80, 512-537.

[2] Carlsson, H. and van Damme, E., 1993, "Global Games and Equilibrium Selection." *Econometrica* 61, 989-1018.

[3] Dow, J. and Perotti, E. C., 2013, "Resistance to Change." Working paper, London Business School and University of Amsterdam.

[4] Ferreira and Kittsteiner, 2015, "When does Competition Foster Commitment?" *Management Science*

[7] In a previous version, we presented a more general version of this extension, in which the increase in total efficiency at the minimal value b^* that achieves investment is continuously increasing in the degree of coordination frictions.

[8] A recent paper by Dow and Perotti (2013) develops an alternative model of organizational inertia. In that model, employees resist to (potentially Pareto improving) changes because the process of change creates winners and losers, and contractual incompleteness prevents the full compensation of losses. Our model in this subsection has a similar flavor, but it focuses instead on coordination issues.