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Intrinsically Motivated Agents: Blessing or Curse for Firms?

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Abstract

I investigate whether the presence of intrinsically motivated agents benefits firms in a competitive environment. I find that firms may obtain higher profits by hiring self-interested agents than by hiring motivated agents. This is because the agents' intrinsic motivation has counteracting effects on the profits obtained by the firms. On the one hand, motivation has a positive impact on the profits due to a reduction of wages. Motivated employees provide a given level of quality for a lower wage. On the other hand, motivation has a negative impact on each firm's profits. The agents' intrinsic motivation has a positive impact on the quality offered by the firms. With higher quality, the degree of differentiation of the products is relatively less important, increasing competition and reducing prices. Firms find themselves trapped in a prisoner's dilemma in which the strategy of hiring self-interested agents is strictly dominated by that of hiring motivated agents. Hence, the very presence of motivated agents may hurt firms.

Keywords: Spatial Competition, Intrinsically Motivated Agents, Prisoner's Dilemma.

JEL classifications: D03, D21, L13.

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1 Introduction

Intrinsically motivated employees are interested not only in their wage, but also in how their work affects the well-being of the others. It is natural to think of motivated agents in public service provision (such as health care and education), or non-profits organizations.[1] However, also profit maximizing firms can attract intrinsically motivated employees, offering jobs which have a socially valuable impact. Firms operating in the internet industry, such as Google, Yahoo, Facebook, strive (or at least claim) to create brand-new products or services that enhance the well-being of their users.

Furthermore, lots of firms have shifted their strategy towards customized services and a more personal relationship with customers, seeking to strengthen their loyalty. To this end, these companies engage in more intense costumer-employee interaction delivered with a sense of warmth, friendliness, individual pride, and company spirit. Some of the companies that best express this new business paradigm can be found in the airline industry.[2]

In addition, other firms can also be appealing to motivated employees because they offer jobs that have a socially oriented mission. Consider, for example, those engineers working in developing countries or for firms offering environmental services (see for example Parsons, 1996).

The aim of this article is to investigate whether the presence of intrinsically motivated agents benefits firms in a competitive environment. In the model I consider n profit-maximizing firms which offer horizontally and vertically differentiated products. Firms decide whether to hire motivated or non motivated agents.

A large part of the literature takes for granted that firms benefit from hiring motivated agents. This is indeed true in a monopolistic environment. When there is only one firm in the market, it has a clear advantage in hiring motivated agents. By doing so, the quality of its products will be higher relative to the case in which it employs selfish agents. As it offers a higher level of quality, the monopolistic firm can charge higher prices and attain higher profits as compared to the case in which agents are selfish. But this conclusion may not hold in a competitive environment.

My results show that in a competitive environment, the agents' intrinsic motivation has counteracting effects on the profits obtained by the firms. On the one hand, motivation has a positive impact on the profits due to a reduction of wages: motivated employees provide a given level of quality for a lower wage. This result is in line with the existing literature where motivation is effective in stimulating work effort even in the absence of monetary rewards (see for example Gneezy and Rustichini, 2000a,b and Bénabou and Tirole, 2003, 2006).[3] On the

[1] See, for instance, Francois (2000), Dixit (2002) and Dewatripont, Jewitt and Tirole (1999).

[2] See for insights two articles on Forbes: America's best airlines and Putting people before profits.

[3] This literature shows that monetary incentives can negatively influence the individuals' behavior in terms of their levels of contribution. The reason is that monetary incentives give the agent a selfish motive to operate. Explicit incentives from principals may change how tasks are perceived by agents (Bénabou and Tirole, 2003) and they may also reduce the value of generous or civic minded acts as a signal of one's moral character (Gneezy and Rustichini, 2000a, and Bénabou and Tirole, 2006). If extrinsic incentives are not large enough, this change in perception can even lead to undesired effects on behavior (Gneezy and Rustichini, 2000b).

other hand, motivation has a negative impact on each firm's profits due to a reduction of the price of the products offered by the firms. The economic intuition behind this result is the following: the agents' motivation leads to an increase in the quality offered by the firms. This reduces the role played by product differentiation between firms, thereby increasing competition and reducing prices. This latter effect occurs only in the presence of competition between two or more firms, and it can be large enough to outweigh the gain generated by lower wages.

What effect dominates depends on the degree of differentiation of the goods and on the degree of intrinsic motivation. When the negative effect on the profits due to the reduction of the price dominates the positive effect due to the reduction of the wage, firms would obtain higher profits by hiring selfish agents than by hiring motivated agents. But firms find themselves trapped in a prisoner's dilemma. The strategy of hiring self-interested agents is strictly dominated by the strategy of hiring motivated agents. Hence, the presence of motivated agents may hurt firms.

In contrast, the agents' intrinsic motivation has a positive impact on the customers' utility. This is because a higher motivation of the agents increases the quality of the products and reduces the price charged by firms. Concerning the degree of differentiation of the goods, this has a negative impact on the customer's utility irrespective of whether agents are self-interested or not. As the goods are less substitutable, equilibrium prices increase leading to a reduction in the customers' utility. This negative impact is higher when the agents are self-interested. This is due to the fact that the prices paid by customers when agents are motivated are lower than the ones paid when they are selfish.

In the last part of the article, I consider the case in which the market structure is endogenous. I find that the number of firms that operate in the market may be higher when the agents are selfish. This occurs when the parameters are such that firms' profits are higher in the absence of motivated agents (i.e. when firms face a prisoner's dilemma because they have access to motivated agents). In this case, the agent's intrinsic motivation may also have a counteracting effect on the customers' utility. On the one hand, it has a positive impact due to an increase in the quality of the service offered by the firms. On the other hand, it has a negative impact due to a reduction in the number of firms. Because of horizontal differentiation a wider variety of goods is beneficial to costumers. Even though the overall effect of the agents' intrinsic motivation on the customers' utility is positive. Its impact turns out to be mitigated when the number of firms is endogenous.

This article is related to two strands of the literature: the literature on the effects of competition on managerial incentives and that on psychological incentives in organizations. The former focuses on the impact of competition on the incentives offered to the managers (see for example Hart, 1983, Scharfstein, 1988, Hermalin, 1992, Schmidt, 1997, Raith, 2003, and Baggs and De Bettignies, 2007)[4] without considering potential differences in agents' preferences. The

[4]Hart (1983) is the first to model the effect of competition on the agency problems between a firm's owner and a manager. Scharfstein (1988) reconsiders Hart's model relaxing the assumption of infinitely risk-adverse managers. Hermalin (1992) considers additional effects of competition on the agency problem, all of which are of potentially ambigous sign. Schmidt (1997) explains that greater competition may lead to stronger incentives for agents because greater effort is required to avert the threat of bankruptcy. Raith (2003) examines how the degree

latter focuses on the impact of monetary incentives on the level of effort exerted by motivated agents (see for instance Bénabou and Tirole, 2003, 2006; Gneezy and Rustichini, 2000a, 2000b). However, these works do not investigate the role of competition in shaping the optimal incentive structure.[5] My objective is to bridge these two strands of the literature considering the interaction between intrinsic motivation and monetary incentives in a competitive environment.

The remainder of the paper is as follows: in section 2 the set-up of the model is presented and a monopolistic environment is analyzed; in section 3 the equilibrium of the model is characterized when the number of firms is exogenous; in section 4 the condition under which the prisoner's dilemma arises is illustrated and the impact of competition on wages is studied; in section 5 the model is analyzed considering the case in which the market structure is endogenous; and concluding remarks are given in section 6.

2 The Set-Up of the Model

A continuum of costumers of mass 1 is distributed uniformly on a Salop circle (its perimeter is normalized to 1). Each costumer buys exactly one unit of the good. There are n profit-maximizing firms that operate on the market and are positioned around the circle.[6] The products offered by the firms are horizontally differentiated. Each firm consists of a principal and an agent, both risk neutral. The principal-agent relationship can be interpreted as the relationship between the owner of the firm who offers a contract in terms of quality of the product q and wage ω to an employee (the agent).

The agents are wealth constrained with zero initial wealth and have a reservation wage of zero. The agents have quadratic effort costs, which are observable to the principal. The exerted effort ϵ determines the quality of the services. Thus, the products can also be vertically differentiated. For the sake of simplicity, I assume that quality q depends linearly on workers' effort: $q = \epsilon$ in each firm. There is no asymmetric information between the principal and the agent. Since quality is verifiable, the principals need not offer an incentive to the agents because they have all the necessary information to implement the efficient levels of quality.
I depart from the traditional Salop model by assuming that agents' utilities might positively depend on the benefits of the customers. The parameter θ measures the intrinsic motivation of the agent. There are two types of agents: the self-interested agents with $\underline{\theta} = 0$ and the motivated agents with $\overline{\theta} > 0$. There is an infinite number of agents of both types and the type of each worker is observable.

of competition among firms in an industry with free entry and exit affects the incentives for their managers. Then, the effect of competition on incentives and effort takes place through a change in the equilibrium number of firms in the industry. His results suggest an unambiguous positive relationship between competition and incentives. Baggs and De Bettignies (2007) also conclude that competition increases managerial incentives.

[5] In this literature, some articles also study the matching of motivated employees between public and private sector (see for example Besley and Ghatak, 2005, Delfgaauw and Dur, 2007, 2008, and Prendergast, 2007). This is beyond the purpose of this work.

[6] The number of firms is initially assumed to be exogenous. This assumption is relaxed in section 5.

After the employment decision, the firms offer imperfectly substitutable services, competing against each other on quality q and prices p.

The timing of the model is as follows. *At stage 1*, each principal decides whether to hire a motivated or a self-interested agent; *At stage 2*, each principal offers a contract (ω, q) to his agent. The agents accept any contract which yields an expected utility of at least their reservation utility of 0; *At stage 3*, after agents have exerted effort determined by the contract, the principals simultaneously choose prices; *At stage 4*, the customers choose from which firm to buy the good.

2.1 The Objective Functions

Take a generic firm i. If a customer l purchases one unit of the good from the generic firm i, his utility is:

$$U_i = v(q_i) - p_i - t\, x_{il}, \tag{1}$$

where $v(q_i) = \overline{v} + q_i$ represents the customer's benefit from the good offered by the firm i. Customers derive some non-negative utility $\overline{v}$ from the good irrespective of its quality, i.e. $\overline{v} \geq 0$. The distance between firm i and customer l is represented by x_{il}. A customer l incurs a transport cost $t\, x_{il}$ for traveling to firm i and a cost $t\left(\frac{1}{n} - x_{il}\right)$ to firm $i+1$. The exogenous parameter t represents the degree of horizontal differentiation of the goods offered by the firms. When t is low, firms offer similar goods and competition is, subsequently, tougher.

To keep the analysis tractable, every firm in effect competes only with the immediate neighbors. Each firm has only two competitors, those located to the right and left of it.
Profits are given by the difference between revenues and the wage paid to the agent. Firm i maximizes the following profit function:

$$\pi_i = p_i\, d_i - \omega_i \tag{2}$$

The key assumption of this model is that agents can be intrinsically motivated. The agents' utility function consists of their own "egoistic" payoff, given by the difference between wage and effort costs, and their intrinsic motivation.
The agents' utility function from working in firm i can be written as:

$$V_i = \omega_i - \frac{1}{2}q_i^2 + \theta_i \overline{U}_i \tag{3}$$

where $\overline{U}_i$ represents the weighted average utility of the customer buying a product from firm i. This utility is equal to: $\overline{U}_i = v(q_i) - p_i - \frac{t}{2}\left[\frac{\alpha_1 x_{il} + \alpha_2 x_{il'}}{(\alpha_1+\alpha_2)}\right]$, with $\alpha_1 + \alpha_2 = 1$; α_1 and α_2 are the normalized weights attached to the customers to the right and left of firm i, respectively, and coincide with their relative masses; while l (respectively l') is the customer located to the right (left) of firm i who is indifferent between firm i and firm $i+1$ (firm $i-1$).

To guarantee an interior solution the following assumption is made.

Assumption 1. *The parameters fulfill the following conditions:*

- $t \in \left(\frac{2}{9}, \frac{4}{15}(2+3\overline{v}n)\right]$;
- $\overline{v} \in \left[0, \frac{8-16n\overline{\theta}+45nt\overline{\theta}-10n^2\overline{\theta}^2-27tn^2\overline{\theta}^2}{36n^2\overline{\theta}}\right]$;
- *and* $\overline{\theta} \in \left(0, \overline{\theta}_{max}\right]$ *with* $\overline{\theta}_{max} = \frac{(45t-16)+3\sqrt{64-64t+225\,t^2}}{2n\,(10+27t)}$.

The reasons why the above conditions must be met are as follows. Regarding the degree of differentiation of the products t, the inferior and the superior limits are set for the principals to attain non-negative profits and for the customers to derive a non-negative utility, respectively. Customers' valuation $\overline{v}$ must lie in the above specified interval for otherwise the motivated agents would earn negative wages. Finally, for $\overline{v}$ to be non-negative, the agents' intrinsic motivation $\overline{\theta}$ can not be higher than $\overline{\theta}_{max}$.

2.2 A Monopolistic firm

As a benchmark case, the equilibrium of a monopolistic firm is considered.

Proposition 1. *In equilibrium, a monopolistic firm always hires a motivated agent.*

Proof. See Appendix *A*. □

If a monopolistic firm hires a motivated agent, the quality of its product is higher relative to the case in which the agent is selfish. The higher quality leads to a higher wage but also allows the firm to charge a higher price. The latter effect on the firm's profits always dominates the former and this explains why the firm is better off hiring a motivated agent.

In the next section, I characterize the equilibrium in a competitive environment.

3 Competition and Agents' Motivation

The equilibrium is determined by backward induction. All the mathematical computations are in Appendix *B*.[7]

At stage 4, the customers choose which good to buy. A customer l is indifferent between firm i and $i+1$ if $U_i = U_{i+1}$, or equivalently $\overline{v} + q_i - p_i - t\,x_{il} = \overline{v} + q_{i+1} - p_{i+1} - t\,\left(\frac{1}{n} - x_{il}\right)$.[8] The demand for firm i is given by $x_{il} + x_{il'}$, that is:

$$d_i = \frac{1}{n} + \frac{[2q_i - q_{i+1} - q_{i-1}] + [p_{i+1} + p_{i-1} - 2p_i]}{2t}. \tag{4}$$

[7]The characterization of the equilibrium when agents are self-interested is in Appendix B.1, while the one when agents are motivated in Appendix *B*.2.

[8]It is simple to check that $x_{il} = \frac{1}{2n} + \frac{(q_i - q_{i+1}) + (p_{i+1} - p_i)}{2t}$.

At stage 3, the principal i chooses the price to maximize his objective function, taking qualities and wages as given.
The principal i maximizes his profits:

$$\max_{p_i} \pi_i = p_i \left[\frac{1}{n} + \frac{[2q_i - q_{i+1} - q_{i-1}] + [p_{i+1} + p_{i-1} - 2p_i]}{2t} \right] - \omega_i. \tag{5}$$

The equilibrium prices as functions of the levels of quality is obtained by taking the first order condition with respect to prices for each profit function π_i with $i = 1, ..., n$.

At stage 2, each firm i maximizes its profits with respect to ω_i and q_i under the following participation constraint:

$$\omega_i - \frac{1}{2} q_i^2 + \theta_i \overline{U}_i \geq 0. \tag{6}$$

The participation constraint guarantees that agent i does not choose his outside option.
In this stage, the firm's payoff when it employs a motivated or a non motivated agent is analyzed for any possible combination of types hired by the rival firms. This enables me to compare the firms' profits and analyze the optimal choice of the agent at stage 1.
Let π_{kl}^j denote the profit that the generic firm i obtains when it employs the agent j, while its direct rivals employ agents k and l, with j, k, l can be either motivated (M) or selfish (S) individuals.

Proposition 2. *The best response of each firm is to hire a motivated agent, i.e.* $\pi_{kl}^M > \pi_{kl}^S$ *for* $k, l \in \{S, M\}$.

Proof. See Appendix $B.3$. □

Regardless of whether the rival firms hire a motivated agent or not, principal i is always better-off by hiring a motivated agent.

4 A Prisoner's Dilemma

The previous section shows that hiring a motivated agent is a dominant strategy for each firm. But do firms benefit from hiring a motivated agent? The answer is provided by the next proposition.

Proposition 3. *Firms would obtain higher profits by hiring self-interested agents than by hiring motivated agents, i.e.* $\pi_{SS}^{*S} > \pi_{MM}^{*M}$, *whenever* $t > \hat{t} = \frac{2\,(8 + 18\,n\,\overline{v} + 5\,n\,\overline{\theta})}{9\,(8 - 3\,n\,\overline{\theta})}$.

Proof. See Appendix C. □

This condition fulfills assumption 1. Consider, for example, the case in which $n = 3$ and $\overline{v} = \frac{1}{6}$. The degree of differentiation of the product t is in the interval $\left(\frac{2}{9}, \frac{28}{30}\right]$, and $\overline{\theta}$ can be at most equal to 0.328. If $\overline{\theta} = 0.2$, the prisoner's dilemma occurs whenever $t > 0.72$ which is allowed for.

For t sufficiently high, the firms would be better off hiring self-interested agents. They would like to coordinate themselves and hire selfish individuals but they can not. As I have

shown in the previous section, the strategy of hiring self-interested agents is strictly dominated by that of hiring motivated agents. Hence, the very presence of motivated agents can hurt firms.[9]

To better understand the reason why a prisoner's dilemma may arise, it is useful to study more in detail the effect of the different parameters on the firms' profits.[10]
The profits obtained by hiring self-interested agents are:

$$\pi_{SS}^{*S} = \frac{t}{n^2} - \frac{2}{9\,n^2}; \tag{7}$$

while the profits obtained by hiring motivated agents are:

$$\pi_{MM}^{*M} = \frac{1}{n}\left[\frac{4t - 3nt\overline{\theta}}{4n}\right] - \frac{1}{2}\left[\frac{2 + n\overline{\theta}}{3n}\right]^2 + \overline{\theta}\left[\frac{8 - 15t + 12n\overline{v} + 4n\overline{\theta} + 9nt\overline{\theta}}{12n}\right]. \tag{8}$$

Impact of Agents' Intrinsic Motivation. In order to analyze the effect of agents' intrinsic motivation $\overline{\theta}$ on profits, I take the derivative of equation (8) with respect to $\overline{\theta}$:[11]

$$\frac{\partial \pi_{MM}^{*M}}{\partial \overline{\theta}} = \frac{\partial p_{MM}^{M}}{\partial \overline{\theta}}\, d_{MM}^{*M} - \frac{\partial \omega_{MM}^{*M}}{\partial \overline{\theta}} = -\frac{3t}{4}\,\frac{1}{n} + \frac{16 - 45t + 36n\overline{v} + 20n\overline{\theta} + 54nt\overline{\theta}}{36n}.$$

A higher motivation affects profits in different ways. First, it has a negative impact on the prices charged by firms, i.e. $\frac{\partial \overline{p}}{\partial \overline{\theta}} = -\frac{3}{4}t < 0$. Motivation has a positive impact on the quality offered by firms, i.e. $\frac{\partial \overline{q}}{\partial \overline{\theta}} = \frac{1}{3} > 0$. With higher qualities, product differentiation becomes relatively less important, leading to an increase in competition and a reduction of the price. This reduction of the price has a negative impact on firms' profits. Second, the agents' intrinsic motivation has a negative impact on the wages. Motivated employees provide a given level of quality for a lower wage with respect to self-interested agents. A lower wage impacts positively on profits. What effect dominates depends on the degree of substitutability of the products t, on the degree of intrinsic motivation $\overline{\theta}$, on the number of firms n and on the customer's interest $\overline{v}$. When the negative effect on profits due to the reduction of the price dominates the positive effect due to the reduction of the wage, firms would obtain higher profits by hiring selfish rather than motivated agents. The relationship between the agents' intrinsic motivation and the profits is illustrated in Figure 1. The first graph (a) shows firms' profits when individuals are selfish (straight line) and when they are motivated for different values of $\overline{\theta}$ (dashed lines). If $t > \hat{t}$, firms are worse-off when they hire motivated rather than selfish agents. However, the higher the agents' intrinsic motivation, the higher the degree of differentiation t for which the prisoner's dilemma arises.

[9] One might wonder if repeated interaction among firms could sustain an equilibrium in which each firm hires a selfish agent. However, this would require playing the entire stage game in every period. As a result, the hiring decision should be taken every time. This in in stark contrast with real-world employment contracts whose duration is typically long.

[10] Computations concerning the levels of quality, price, demand and wage are provided in Appendix B.

[11] Note that the impact of agents' intrinsic motivation on the demand is null since firms share the demand in the market: $d_{MM}^{*M} = \frac{1}{n}$.

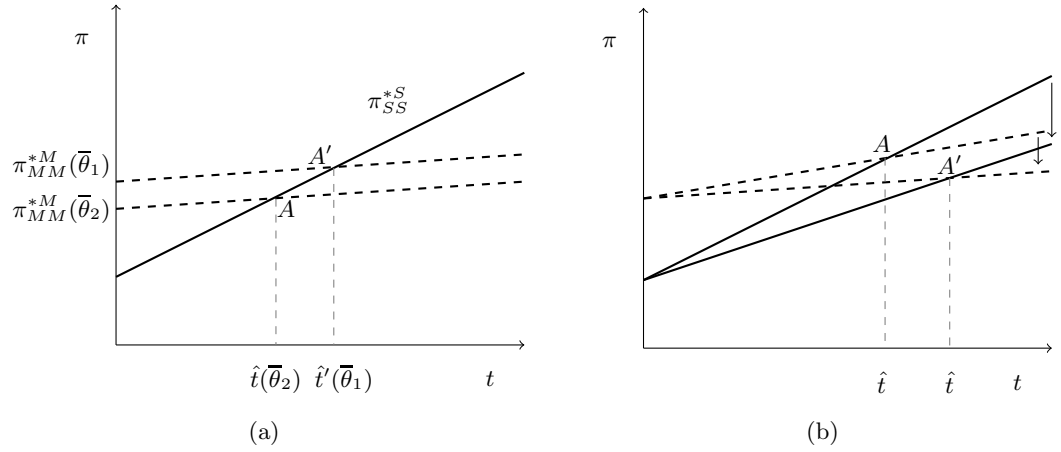

Figure 1: Comparison between Profits

In other words, the threshold value of $\hat{t}$ above which the prisoner's dilemma arises is increasing in $\overline{\theta}$, i.e. $\hat{t}(\overline{\theta}_1) > \hat{t}(\overline{\theta}_2)$ with $\overline{\theta}_1 > \overline{\theta}_2$.[12] Therefore, as the firms in equilibrium are induced to hire motivated agents, they must hope that these agents have a high degree of intrinsic motivation so that their loss is reduced. Put differently, firms are more severely hurt when they need to hire motivated agents who actually do not care very much about customers' satisfaction.

Impact of the Number of Firms. In the second graph (b), firms' profits obtained by hiring selfish individuals (straight lines) and by hiring motivated agents (dashed lines) are compared for different numbers of firms in the market. A higher number of firms in the market reduces firms' profits irrespective of whether the agents are motivated or not: both the straight and the dashed lines tilt down. However, the negative impact of the number of firms on the profits is higher when the agents are selfish. This can be seen from the derivative of the differential profits between π^{*S}_{SS} and π^{*M}_{MM} with respect to n:

$$\frac{\partial(\pi^{*S}_{SS} - \pi^{*M}_{MM})}{\partial n} = -\frac{2\overline{\theta}(9t-2)}{9n^2} < 0.$$

When the number of firms in the market increases, the prisoner's dilemma occurs for a higher value of t.

Impact of Customers' Interest. An increase of $\overline{v}$ has a positive impact on firms' profits when agents are motivated. This is because an increase in $\overline{v}$ reduces the wage paid to motivated agents leading to an increase in profits. In contrast, the customer's interest $\overline{v}$ has no impact on the firms' profits if agents are self-interested. As $\overline{v}$ increases, the loss obtained by hiring motivated agents is reduced.

Impact of Horizontal Differentiation. It is also possible to note from Figure 1 that the profits obtained by hiring motivated agents (dashed lines) are flatter than the profits obtained by hiring

[12] Take again the example provided previously. When $\overline{\theta} = 0.2$ the threshold value of t above which the prisoner's dilemma arises is 0.72. For a higher value of $\overline{\theta} = 0.3$, the threshold value of t becomes $t > 0.9$.

selfish individuals (straight lines). To better understand why this occurs, consider the derivative of the differential profits with respect to t:

$$\frac{\partial(\pi_{SS}^{*S} - \pi_{MM}^{*M})}{\partial t} = \frac{\overline{\theta}(8 - 3n\overline{\theta})}{4n} > 0.$$

The degree of differentiation of the products t positively impacts on the profits irrespective of whether the agents are motivated or not. However, the positive impact of t on the profits is higher when agents are self-interested. This effect is due to the impact of t on the wages paid to agents. More specifically, when all agents are self-interested, their wage is given by the following equation:

$$\omega_{SS}^{*S} = \frac{2}{9n^2}, \tag{9}$$

while when all agents are motivated, they receive the following wage:

$$\omega_{MM}^{*M} = \frac{1}{2}\left[\frac{2 + n\overline{\theta}}{3n}\right]^2 - \overline{\theta}\left[\frac{8 - 15t + 12n\overline{v} + 4n\overline{\theta} + 9nt\overline{\theta}}{12n}\right]. \tag{10}$$

While the wages paid to selfish agents (equation 9) are not affected by t but only by n,[13] the wages paid to intrinsically motivated agents (equation 10) are also affected by the degree of differentiation t. The impact of t on the wages paid to motivated agents is positive. This result can be shown deriving equation (10) with respect to t: $\frac{\partial \omega_{MM}^{*M}}{\partial t} = \frac{\overline{\theta}(5 - 3n\overline{\theta})}{4n} > 0$. As t takes a higher value, there is less competition because the products are less substitutable. If the products are less substitutable, prices are higher, the customers' utility is reduced and principals have to pay higher wages to motivated agents to keep the level of quality constant. This result explains the different slope of the profits lines in Figure 1.

In conclusion, the prisoner's dilemma is more likely to arise, the higher the degree of differentiation of the products t, the lower the agents' intrinsic motivation $\overline{\theta}$, the lower the number of firms n, and the lower the customer's interest $\overline{v}$.

Impact of Parameters on Customers' Interest. It also interesting to study the impact of these parameters on the customers' utility. The average customer's utility deriving from buying a product from firm i when all agents are selfish and when all agents are motivated are equal to the following, respectively:

$$\overline{U}_S^* = \frac{8 - 15t + 12n\overline{v}}{12n}; \quad \overline{U}_M^* = \frac{8 - 15t + 12n\overline{v} + 4n\overline{\theta} + 9nt\overline{\theta}}{12n}.$$

Obviously, a higher valuation of the product by customers $\overline{v}$ has a positive impact on their utility. Furthermore, the impact of the agents' intrinsic motivation $\overline{\theta}$ is also positive. This is because a higher motivation of the agents increases the quality of the product and reduces the price offered by the firms. Concerning the degree of differentiation of the products t, this has a

[13] An increase in n reduces the levels of quality offered by firms leading to a reduction of the wage paid to agents.

negative impact on the customer's utility irrespective of whether the agents are self-interested or not. However, this negative impact of t is higher when agents are self-interested. As t is high, firms offer different products. This reduces the competition in the market and increases equilibrium prices. However, the prices paid by the customers when the agents are motivated are lower than the ones paid when they are selfish. Finally, the number of firms n has a positive impact on the customer's utility if $t > \frac{8}{15}$. As the products are less substitutable, customers are less interested in the quality and choose a product closer to their location. An increase in the number of firms reduces the distance between customers and firms leading to an increase in their utility.

5 Endogenous Market Structure

In this section, the assumption of an exogenous number of firms is relaxed. There is an additional stage, stage 0, in which each firm must decide whether to enter the market and incur an entry cost $F \geq 0$ or stay out. The entry cost F affects the degree of competition among firms and through this channel the customer's utility. The equilibrium number of firms competing in the market is determined by the zero-profit condition. Markets with lower entry costs F are more competitive because the number of firms which enter the market is larger and therefore prices lower.

The intrinsic motivation of the agents has an impact on the profits obtained by firms, and then on the number of firms present in the market. I analyze how the number of firms varies with different degree of motivation. More specifically, the equilibrium number of firms when all agents are self-interested is compared with the one in which they are all motivated.[14]

When agents are self-interested, the number of firms is equal to:

$$\begin{gathered} n_S^* = \lfloor \hat{n}_S \rfloor ; \\ \text{where } \hat{n}_S = \frac{\sqrt{(9t-2)}}{3\sqrt{F}}. \end{gathered} \tag{11}$$

In the above equation, n_S^* is the greatest integer less than or equal to $\hat{n}_S$.

Lemma 1. *The number of the firms when agents are self-interested increases with the degree of differentiation of the products t and decreases with the cost of entry F.*

Proof. See Appendix D.1. □

A lower t means that products are more substitutable leading to lower equilibrium prices and profits. Similarly, it is straightforward that a reduction of the fix cost F increases the number of the firms leading to a reduction in profits.

[14]Note that due to the integer problem, the profits firms can attain may be slightly higher than 0.

When agents are motivated, the number of the firms is equal to:

$$n_M^* = \lfloor \widehat{n}_M \rfloor ;$$

$$\text{where} \quad \widehat{n}_M = \frac{2\left(-2\overline{\theta}(9t-2) + 3\sqrt{(9t-2)(4F - 4\overline{v}\overline{\theta} - 2\overline{\theta}^2 + t\overline{\theta}^2}\right)}{36F - 36\overline{v}\overline{\theta} - 10\overline{\theta}^2 - 27t\overline{\theta}^2}. \tag{12}$$

In the above equation, n_M^* is the greatest integer less than or equal to $\widehat{n}_M$.

Lemma 2. *The number of the firms when agents are motivated decreases with product substitutability, with the cost of entry F, but it increases with $\overline{v}$. The impact of agents' intrinsic motivation is ambiguous.*

Proof. See Appendix *D*.2. □

Akin to the previous case, when products are more substitutable (lower t) the equilibrium prices decrease leading to a reduction in gross profits. A reduction in the fix cost F increases the number of firms leading to a reduction in gross profits. In addition, a high valuation of the good $\overline{v}$ has a positive impact on the profits (due to a reduction in the wage) and then on the number of firms. The effect of the agents' intrinsic motivation on the number of firms is ambiguous. If the negative impact on the revenues (reduction in the price) is greater than the positive impact due to the reduction in the costs (reduction in the wage), the agents' intrinsic motivation has a negative impact on the number firms. Otherwise, it impacts positively on the number of firms.

Comparing the number of firms obtained in the two different cases, I find that

Proposition 4. *If $t > \widehat{t}$, the number of firms in the market is higher when agents are self-interested than when they are motivated: $n_S^* \geq n_M^*$.*[15]

Proof. See Appendix *D*.3. □

Proposition 4 says that when the prisoner's dilemma occurs, the gross profits obtained by hiring self-interested agents are higher than those obtained by hiring motivated agents, and so is the number of firms. In this case, motivation has a countervailing effect on the customers' utility due to a reduction in the number of firms and to an increase in the quality of the service. On the one hand, motivation has a positive impact on the quality of the products offered by firms increasing the customers' utility. On the other hand, motivation has a negative impact on the number of firms leading to a reduction in the customers' utility. Because of horizontal differentiation a wider variety of goods is beneficial to customers. The overall effect is positive.[16] This means that the effect on the quality (vertical differentiation) is higher than the effect on the number of firms (horizontal differentiation). Therefore we can conclude that the positive impact of the agents' intrinsic motivation on the customers' utility is mitigated.

[15] Where $\widehat{t}$ is equal to the following: $\widehat{t} = \frac{2\left(48F - 18\overline{v}\overline{\theta} - 5\overline{\theta}^2 - 8\sqrt{3}\sqrt{12F^2 - 9\overline{v}\overline{\theta} - 4F\overline{\theta}^2}\right)}{27\overline{\theta}^2}$. The inequality $t > \widehat{t}$ is equivalent to the one present in Proposition 3 substituting the optimal number of firms in the market.

[16] This result is shown in Appendix *D*.4.

5.1 The Impact of Horizontal Differentiation with Endogenous Market Structure

In the previous section, I have shown that the degree of horizontal differentiation t has no direct effect on the wages offered to self-interested agents. However, t impacts on the number of firms present in the market and, then, indirectly on the wages paid to selfish agents.
When n is endogenous, wages are obtained by substituting the value of n found in equation (11) into condition (9):

$$\omega_{SS}^{*S} = \frac{2F}{9t-2}. \tag{13}$$

Proposition 5. *With endogenous n, the wages are higher in markets with more substitutable products, but lower in markets with lower entry costs.*

Proof. See Appendix $D.5$. □

When products are more substitutable, prices and profits are lower for any given number of firms. This induces some firms to exit. Each surviving firm produces a higher level of quality and provides a higher wage to its agent. Moreover, a decrease in the entry cost F leads to the entry of new firms. In equilibrium, each firm produces a smaller level of quality, and therefore provides a lower wage to its own agent.[17]

Concerning the interaction between t and the wages offered to motivated agents when n is endogenous, the result is ambiguous. On the one hand, a higher t has a positive impact on the wages. If the products are less substitutable, the customers are worse off and principals have to pay higher wages to motivated agents to keep the level of quality constant. On the other hand, a high t has a negative impact on the wages. If the products are less substitutable, prices and profits raise leading to the entry of new firms. Each firm produces a lower level of quality and each motivated agent receives a lower wage by his own principal. What effect dominates depends on the value of the parameters. Note that a reduction of the entry cost F gives raise only to the latter effect on the wages above described. Hence, we can conclude on the existence of a positive relation between the entry cost F and the wage ω.

5.2 The Social Optimum

In this subsection, I compare the quality and the number of firms in the market equilibrium $\overline{q}_{MM}^{*M}, n_M^*$ with those which maximize social welfare q^*, n^*. A social planner chooses q^* and n^* in order to maximize the sum of principals' profits, agents' and customers' utilities. The following lemma characterizes the solution to the social planner's problem.

Lemma 3. *The socially optimal level of quality and number of firms are given by:*

$$q^* = (1+\overline{\theta}) \quad \textit{and} \quad n^* = \frac{1}{2}\sqrt{\frac{t}{F+(1+\overline{\theta})\left(\frac{1}{2}-\overline{\theta}\right)-\overline{\theta}\overline{v}}}\,.$$

[17] This result is in line with the one of Raith (1993).

Proof. See Appendix $D.6$. □

Being identical, each firm produces the same level of quality. The left-hand side of the socially optimal level of quality is the marginal cost of exerting effort[18] and the right-hand side is the marginal benefit of an increase in quality. An increase in quality directly benefits customers and indirectly affects agents' utility through their intrinsic motivation. Hence, the social optimum level of quality is positively correlated with the agents' intrinsic motivation $\overline{\theta}$. Moreover, it is always higher than the one obtained in the market equilibrium:

$$q^* = (1 + \overline{\theta}) > \frac{2}{3n_M^*} + \frac{1}{3}\overline{\theta} = \overline{q}_{MM}^{*M}.$$

When firms choose q to maximize their profit functions, they do not fully internalize the positive effect of quality on the agents' and the customers' utility.

As for the social optimum number of firms, this decreases with the degree of substitutability and the entry cost F, but increases with the customers' interest $\overline{v}$. The effect of agents' intrinsic motivation $\overline{\theta}$ is instead ambiguous. The first two effects are common to the standard Salop model in which there is no vertical differentiation nor there are intrinsically motivated agents.[19] The social planner chooses the social optimum number n^* that minimizes the sum of fixed costs and customers' transportation costs.
With motivated agents and vertically differentiated goods, some additional elements arise. Each time a firm enters the market a new agent is hired. This agent benefits from positively affecting the customers' utility: $\overline{\theta}[q^* + \overline{v}] = \overline{\theta}[(1 + \overline{\theta}) + \overline{v}]$. However, this agent exerts costly effort to deliver quality. Given that each agent bears this cost, it would be desirable to have only one good and one agent: $\frac{1}{2}q^* = \frac{1}{2}(1 + \overline{\theta})$. There are two conflicting forces. On the one hand, horizontal differentiation calls for increasing the number of goods. On the other hand, vertical differentiation calls for a unique firm producing one good.

6 Future Research and Conclusions

In this article, I have shown that firms do not always benefit by hiring motivated agents. This is because agents' intrinsic motivation has a countervailing effect on firms' profits. A higher motivation has a negative effect on the price of the product offered by the firms. The economic intuition behind this result is the following: agents' motivation has a positive impact on the quality offered by firms, and this reduces the relative importance of product differentiation between firms, leading to stiffened competition and reduced prices. This effect has a negative impact on profits. In contrast, the effect of the intrinsic motivation on the wages is negative and this impacts positively on profits. What effect dominates depends on the degree of differentiation of the products offered by the firms and on the degree of intrinsic motivation. When the negative

[18] Recall that the cost function is quadratic.

[19] In the standard Salop model, the socially optimal number of firms is equal to: $n^* = \frac{1}{2}\sqrt{\frac{t}{F}}$ (see Salop, 1979).

effect on profits due to the reduction in the price dominates the positive effect due to the reduction in the wage, firms would obtain higher profits by hiring selfish agents than by hiring motivated agents. However, there is a prisoners' dilemma in which the strategy of hiring self-interested agents is dominated by the strategy of hiring motivated agents. Hence, the presence of motivated agents may hurt firms.

Providing high-quality services and caring about customers do not always guarantee profitability as can be observed in the US airline industry (see the case of Virgin America as reported in the article of The New York Times: "At Virgin America, a Fine Line Between Pizazz and Profit", September 7, 2013)[20].

I have also considered the case in which the equilibrium number of firms is endogenous. I have found that the number of the firms when the agents are selfish can be higher than the number of the firms when the agents are motivated. In this case, the intrinsic motivation has a countervailing effect on the customers' utility due to a reduction in the number of firms and to an increase in the quality of the service offered by firms. The overall effect is positive. However, the positive impact of the agents' intrinsic motivation on the customers' utility is reduced.

[20]The article raises the question: "can an airline make money and still be beloved?"

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A A Monopolistic Firm: Proof of Proposition 1

I start considering the case in which there is only one firm in the market. In this case, the degree of differentiation of the products $t \in \left[\frac{1}{2}, 1\right]$. The equilibrium is determined by backward induction. A customer located at x obtains a utility from the monopolistic firm equal to: $\overline{v} + q - p - tx$. Costumers have a common and positive $\overline{v}$ that is common knowledge. Customers derive some positive utility from the good irrespective of its quality. At stage 3, the demand of the firm is the following:

$$d = x = \frac{\overline{v} + q - p}{t} \tag{14}$$

At stage 2, the principal maximizes his profits with respect to the price, taking quality and wage as given:

$$\max_{p} \Pi = p \left[\frac{\overline{v} + q - p}{t} \right] - \omega - F \tag{15}$$

Taking the first order condition, I obtain the equilibrium price as function of the levels of quality offered by the firm:

$$p = \frac{\overline{v} + q}{2} - \frac{1}{4} t \, \theta \tag{16}$$

Substituting equilibrium price into equation (15), I obtain an expression for profits as a function of the level of quality and wage offered by the monopolistic firm:

$$\pi = \left[\frac{\overline{v} + q}{2} - \frac{1}{4} t \, \theta \right] \left[\frac{\overline{v} + q}{2t} + \frac{1}{4} t \, \theta \right] - \omega - F \tag{17}$$

At stage 1, these functions are maximized with respect to ω, q under the following participation constraint:

$$\omega - \frac{1}{2} q^2 + \theta \, \overline{U} \geq 0 \tag{18}$$

where $\overline{U}$ represents the utility of the average customer buying from the monopolistic firm. The participation constraint guarantees that the agent does not choose his outside option.

The firm can decide to hire a motivated agent with $\theta = \overline{\theta} > 0$ or a selfish agent with $\theta = 0$. If the firm hires a motivated or a non-motivated agent, the optimal levels of quality are respectively equal to:

$$\overline{q}^* = \frac{2\overline{v} + t\overline{\theta}}{2(2t-1)} > \frac{2\overline{v}}{2(2t-1)} = q^* \tag{19}$$

with wages

$$\overline{\omega}^* = \frac{1}{2} \left[\frac{2\overline{v} + t\overline{\theta}}{2(2t-1)} \right]^2 - \overline{\theta} \left[\frac{t(2\overline{v} + t\overline{\theta})}{4(2t-1)} \right] > \frac{1}{2} \left[\frac{2\overline{v}}{2(2t-1)} \right]^2 = \omega^* \tag{20}$$

The chosen price at stage 2 is:

$$\overline{p}^* = \frac{2t\overline{v} + t\overline{\theta}(1-t)}{2(2t-1)} > \frac{2t\overline{v}}{2(2t-1)} = p^* \tag{21}$$

And at stage 3, the demand is realized

$$\overline{d}^* = \frac{2\overline{v} + t\overline{\theta}}{2(2t-1)} > \frac{2\overline{v}}{2(2t-1)} = d^* \tag{22}$$

and the principal obtains the following profits:

$$\overline{\Pi}^* = \left[\frac{2t\overline{v} + t\overline{\theta}(1-t)}{2(2t-1)}\right]\left[\frac{2\overline{v} + t\overline{\theta}}{2(2t-1)}\right] - \frac{1}{2}\left[\frac{2\overline{v} + t\overline{\theta}}{2(2t-1)}\right]^2 + \overline{\theta}\left[\frac{t(2\overline{v} + t\overline{\theta})}{4(2t-1)}\right] - F > \tag{23}$$

$$\left[\frac{2t\overline{v}}{2(2t-1)}\right]\left[\frac{2\overline{v}}{2(2t-1)}\right] - \frac{1}{2}\left[\frac{2\overline{v}}{2(2t-1)}\right]^2 - F = \Pi^*$$

If a monopolistic firm hires a motivated agent, the quality of its product is higher relative to the case in which the agent is selfish. The higher quality leads to a higher wage but also allows the firm to charge a higher price. The latter effect on the firm's profits always dominates the former and a monopolistic firm always hires a motivated agent.

B Competition and Agents' Motivation

B.1 The Characterization of the Equilibrium when Agents are Self-Interested

I begin by characterizing the equilibrium when agents are self-interested, i.e. $\theta_i = \underline{\theta} = 0$.

At stage 3, the customers choose which good to buy. A customer l is indifferent between firm i and $i+1$ if $U_i = U_{i+1}$. Then, the demand for firm i is equal to:

$$d_i = \frac{1}{n} + \frac{[q_i - q] + [p - p_i]}{t}. \tag{24}$$

At stage 2, the principal i chooses the price to maximize his objective functions, taking qualities and wages as given.
The principal i maximizes his profits:

$$\max_{p_i} \pi_i = p_i\left[\frac{1}{n} + \frac{[q_i - q] + [p - p_i]}{t}\right] - \frac{1}{2}q_i^2. \tag{25}$$

Taking the first order condition with respect to the price, I obtain the equilibrium price as function of the levels of quality offered by the firms.

$$p_i = \frac{t}{n} + \frac{(q_i - q)}{3}. \tag{26}$$

Then, substituting equilibrium price into equation (25), I obtain an expression for profits as a function of the levels of quality and wages offered by the firms.

$$\pi_i = \left[\frac{t}{n} + \frac{(q_i - q)}{3}\right]\left[\frac{1}{n} + \frac{(q_i - q)}{3t}\right] - \frac{1}{2}q_i^2. \tag{27}$$

At stage 1 the optimal levels of quality and wages are determined. The unique solution is the symmetric first-best equilibrium in which the principals elicit quality's levels

$$q_{SS}^{*S} = \frac{2}{3n} \tag{28}$$

with wages

$$\omega_{SS}^{*S} = \frac{2}{9n^2}. \tag{29}$$

The chosen prices at stage 2 are:

$$p_{SS}^{*S} = \frac{t}{n}. \tag{30}$$

A reduction of t leads to a reduction of the prices of both firms. As t goes to 0 the firms offer always more similar products. The firms are more competitive and the prices go down.

And at stage 3, the demands are realized with

$$d_{SS}^{*S} = \frac{1}{n} \tag{31}$$

and the principals obtain the following profits:

$$\pi_{SS}^{*S} = \frac{9t-2}{9n^2}. \tag{32}$$

The profits obtained by the firms are increasing in t and decreasing in n.

B.2 Characterization of the Equilibrium when Agents are Motivated

In this subsection, I determine the equilibrium when all agents are intrinsically motivated, i.e. $\theta_i = \overline{\theta} > 0$.

At stage 3, the customers choose which good to buy. The firms are symmetric in the agents' intrinsic motivation and the demand for firm i is equal to:

$$d_i = \frac{1}{n} + \frac{[q_i - q] + [p - p_i]}{t}. \tag{33}$$

At stage 2, the principal i chooses the price to maximize his objective functions, taking qualities and wages as given.
The principal i maximizes his profits:

$$\max_{\overline{p}_i} \overline{\pi}_i = \overline{p}_i \left[\frac{1}{n} + \frac{(\overline{q}_i - \overline{q}) + (\overline{p} - \overline{p}_i)}{t}\right] - \frac{1}{2}\overline{q}_i^2 + \tag{34}$$

$$+\overline{\theta}\left[\overline{v} + \overline{q}_i - \overline{p}_i - \frac{t}{4}\left(\frac{1}{n} + \frac{(\overline{q}_i - \overline{q}) + (\overline{p} - \overline{p}_i)}{t}\right)\right].$$

Taking the first order condition with respect to the prices, I obtain the equilibrium prices as function of the levels of quality offered by the firms. The price of the firm i will be equal to:

$$\overline{p}_i = \frac{t}{n} - \frac{3}{4}t\overline{\theta} + \frac{(\overline{q}_i - \overline{q})}{3}. \tag{35}$$

Substituting equilibrium prices into the equation (34), I obtain an expression for profits as a function of the levels of quality and wages offered by the two firms:

$$\overline{\pi}_i = \left[\frac{t}{n} - \frac{3}{4}t\overline{\theta} + \frac{(\overline{q}_i - \overline{q})}{3}\right]\left[\frac{1}{n} + \frac{(\overline{q}_i - \overline{q})}{3t}\right] - \frac{1}{2}\overline{q}_i^2 + \tag{36}$$

$$+\overline{\theta}\left[\overline{v} + \overline{q}_i - \frac{t}{n} + \frac{3}{4}t\overline{\theta} - \frac{(\overline{q}_i - \overline{q})}{3} - \frac{t}{4}\left(\frac{1}{n} + \frac{\overline{q}_i - \overline{q}}{3t}\right)\right].$$

At stage 1, I obtain the optimal levels of quality that are equal to:

$$q_{MM}^{*M} = \frac{2 + n\overline{\theta}}{3n}. \tag{37}$$

The quality of the services offered in the firms will be higher or equal to the case in which agents are selfish, studied in the previous subsection, i.e. $q_{MM}^{*M} > q_{SS}^{*S}$.
The wages are given by:

$$\omega_{MM}^{*M} = \frac{1}{2}\left(\frac{2 + n\overline{\theta}}{3n}\right)^2 - \overline{\theta}\left[\frac{8 - 15t + 12n\overline{v} + 4n\overline{\theta} + 9nt\overline{\theta}}{12n}\right]. \tag{38}$$

The agents' intrinsic motivation has a negative impact on wages. This is because motivated employees provide a given level of quality for a lower wage.[21]
Furthermore, competition has a negative impact on the wages given to motivated agents: $\frac{\partial \omega_{MM}^{*M}}{\partial t} = \frac{\overline{\theta}(5 - 3n\overline{\theta})}{4n} > 0$.

At stage 2, the prices are given by:

$$p_{MM}^{*M} = t\left(\frac{1}{n} - \frac{3}{4}\overline{\theta}\right). \tag{39}$$

When agents are intrinsically motivated, the price of the products offered by firms is lower than the previous case, $p_{MM}^{*M} < p_{SS}^{*S}$. The effect of $\overline{\theta}$ on the price is negative. Motivation has a positive impact on the quality offered by the firms. It implicitly reduces the product differentiation between firms stiffening competition and reducing price. With higher qualities, the location becomes relatively less important, leading to fiercer competition. This fall in price has a positive impact on the customer's utility.

At stage 1, the firms share the demand in the market:

$$d_{MM}^{*M} = \frac{1}{n} \tag{40}$$

and the profits are realized:

$$\pi_{MM}^{*M} = \frac{1}{n}\left[\frac{4t - 3nt\overline{\theta}}{4n}\right] - \frac{1}{2}\left[\frac{2 + n\overline{\theta}}{3n}\right]^2 + \overline{\theta}\left[\frac{8 - 15t + 12n\overline{v} + 4n\overline{\theta} + 9nt\overline{\theta}}{12n}\right]. \tag{41}$$

The agents' intrinsic motivation has a countervailing effect on the marginal profits obtained by the firms. On the one hand, motivation has a positive impact on the marginal profits. This is due to a reduction of the wage. Motivated employees provide a given level of quality for a lower wage. This result supports the previous literature in which motivation is effective in stimulating work effort even in the absence of monetary rewards (see for example Gneezy and Rustichini, 2000a,b and Bénabou and Tirole, 2003, 2006). On the other hand, motivation has a negative impact on each firm's marginal profits due to a reduction of the price of the product offered

[21] The agents' intrinsic motivation has a countervailing effect on the wages. On the one hand, the principals have to pay higher wages to motivated agents in order to compensate them for an increasing in the levels of the quality. On the other hand, motivated agents provide a given level of effort even in the absence of a monetary compensation for that. The overall effect is negative.

by the firms. The economic intuition behind this result is the following: the agents' motivation has a positive impact on the quality offered by firms. This reduces the product differentiation between firms thereby increasing competition and reducing prices. With higher qualities, the product differentiation becomes relatively less important leading to fiercer competition.

B.3 Proof of Proposition 2

Assume to the contrary that $\pi_{kl}^S \geq \pi_{kl}^M$ for some $k, l \in \{S, M\}$. This would imply that there exist $k, l \in \{S, M\}$ such that

$$d_{kl}^S \; p_{kl}^S - \frac{1}{2}(q_{kl}^S)^2 \geq d_{kl}^M \; p_{kl}^M - \frac{1}{2}(q_{kl}^M)^2 + \overline{\theta} \; \overline{U}_{kl}^M .$$

If it were the case, principal i would decide to implement the same schedule (q_{kl}^S, p_{kl}^S) by hiring motivated agents, but paying them a lower wage. Since $\pi_{kl}^S < \pi_{kl}^S + \overline{\theta} \; \overline{U}_{kl}^S$, this leads to a contradiction.

C A Prisoner's Dilemma: Proof of Proposition 3

The profits obtained by hiring self-interested agents are higher than the profits obtained by hiring motivated agents if the following condition is met:

$$\pi_{SS}^{*S} - \pi_{MM}^{*M} = \frac{-16\overline{\theta} + 72t\overline{\theta} - 36n\overline{v}\overline{\theta} - 10n\overline{\theta}^2 - 27nt\overline{\theta}^2}{36n} > 0,$$

which is the case whenever the following holds:

$$t > \frac{2(8 + 18n\overline{v} + 5n\overline{\theta})}{9(8 - 3n \; \overline{\theta})}.$$

D Endogenous Market Structure

D.1 Proof of Lemma 1

The profits obtained by the firms when all agents are selfish are equal to:

$$\pi_{SS}^{*S} = \frac{(9t - 2)}{9n^2} - F. \tag{42}$$

The derivative of equation (42) with respect to n can be written as:

$$-\frac{2(9t - 2)}{9n^3} < 0,$$

where the term is negative because of Assumption 1. Hence profits are decreasing in n. Moreover, the profits by hiring selfish individuals are decreasing in F and increasing in t. Hence, n must be decreasing in F and increasing in t.

D.2 Proof of Lemma 2

The profits obtained by the firms when all agents are motivated are equal to:

$$\pi_{MM}^{*M} = \frac{1}{n}\left[\frac{4t - 3nt\overline{\theta}}{4n}\right] - \frac{1}{2}\left[\frac{2 + n\overline{\theta}}{3n}\right]^2 + \overline{\theta}\left[\frac{8 - 15t + 12n\overline{v} + 4n\overline{\theta} + 9nt\overline{\theta}}{12n}\right] - F. \qquad (43)$$

The derivative of equation (43) with respect to n can be written as:

$$-\frac{2[(1 - n\,\overline{\theta})(9t - 2)]}{(9n^3)} < 0$$

where the overall effect is negative due to Assumption 1.[22] Hence profits are decreasing in n. Moreover, the profits attained by hiring motivated individuals are decreasing in F and increasing in t and $\overline{v}$. Hence n must be decreasing in F and increasing in t and $\overline{v}$.

The agent's intrinsic motivation has a countervailing effect on the number of firms. On the one hand, a high intrinsic motivation increases the quality of the products offered by the firms. This effect reduces the relative importance of t increasing competition and reducing prices. The reduction of the price has a negative impact on the profits and then on the number of firms. On the other hand, high intrinsic motivation reduces the wage. This effect has a positive impact on the profits and then on the number of firms.

D.3 Proof of Proposition 4

When $t > \hat{t}$ the profits obtained by hiring selfish individuals are higher than the profits obtained by hiring motivated individuals, i.e. $\pi_{SS}^{*S} > \pi_{MM}^{*M}$. Then, the number of firms in the market is higher or equal to the number of firms when agents are motivated.

D.4 The impact of agents' intrinsic motivation on customers' utility

When the prisoner's dilemma occurs, the gross profits obtained by hiring self-interested agents are higher than those obtained by hiring motivated agents, and so is the number of firms. In this case, motivation has a countervailing effect on the customers' utility due to a reduction of the number of firms and to an increase in the quality of the service. However, the overall effect is positive. It not immediate to see that the overall effect is positive. Remember that the average customer's utility deriving from buying a product from firm i when all agents are selfish and when all agents are motivated are equal to the following, respectively:

$$\overline{U}_S^* = \frac{8 - 15t + 12n_S^*\overline{v}}{12n_S^*}; \quad \overline{U}_M^* = \frac{8 - 15t + 12n_M^*\overline{v} + 4n_M^*\overline{\theta} + 9n_M^*t\overline{\theta}}{12n_M^*}.$$

Substituting the values of n_S^* and n_M^* into the average customers' utilities and comparing the two equations, the following result is obtained:

$$\overline{U}_M^* > \overline{U}_S^* \text{ if } \frac{(8 - 15t)(36F - 36v\overline{\theta} - 10\overline{\theta}^2 - 27t\overline{\theta}^2)}{24\left[-2(9t - 2)\overline{\theta} + 3\sqrt{(9t - 2)(4F - 4v\overline{\theta} - 2\overline{\theta}^2 + t\overline{\theta}^2)}\right]} - \frac{\sqrt{F}(8 - 15t)}{36\sqrt{(9t - 2)}} + \overline{\theta}\left(\frac{1}{3} + \frac{3}{4}t\right) > 0.$$

[22] If the number of the firms increases, the upper limit for $\overline{\theta}$ to obtain an interior solution decreases. The product $n\overline{\theta}$ must be always lower than 1.

The last term is positive. After some computations, I find that the difference between the first and the second element is positive if:

$$v \geq \underbrace{\frac{(-5148F + 288\sqrt{F(9t-2)}\,\overline{\theta} - 10\overline{\theta}^2 - 27t\overline{\theta}^2)}{36\overline{\theta}}}_{<0}.$$

Since the valuation of the good by customers $\overline{v}$ is non-negative, this inequality always holds.

D.5 Proof of Proposition 5

The following are the derivatives of equation (29) with respect to t and F, respectively:

$$\frac{\partial \omega_{SS}^{*S}}{\partial t} = -\frac{18F}{(9t-2)^2} < 0; \qquad \frac{\partial \omega_{SS}^{*S}}{\partial F} = \frac{2}{(9t-2)} > 0.$$

Then, the wages are higher in markets with more substitutable products, but lower in markets with lower entry costs.

D.6 Proof of Lemma 3

A social planner chooses q^* and n^* in order to maximize the sum of the principals' profits, the agents' and the customers' utilities.

$$\max_{q^*,n^*} \Omega = \sum_{i=1}^{n} (p_i d_i - \omega_i - F) + \sum_{i=1}^{n} \left(\omega_i - \frac{1}{2}q_i^2 + \overline{\theta U}_i\right) + \left(\overline{v} + q_i - p_i - \frac{t}{4n}\right).$$

Setting the levels of price equal to 0 and doing some simple computations, it is possible to rewrite the previous equation in the following way:

$$\max_{q^*,n^*} \Omega = -nF - \frac{1}{2}\sum_{i=1}^{n} q_i^2 + \overline{\theta}\sum_{i=1}^{n}\left(\overline{v} + q_i - \frac{t}{4n}\right) + \overline{v} + q_i - \frac{t}{4n}. \tag{44}$$

The socially optimal level of quality for each firm is obtained by deriving equation (44) with respect to q_i:

$$q_i = (1 + \overline{\theta}) = q^* \tag{45}$$

Then, substituting the social optimum level of quality into equation (44), I obtain an expression for the social welfare as function of the number of firms:

$$\max_{q^*,n^*} \Omega = -nF - \frac{1}{2}n(1+\overline{\theta})^2 + n\overline{\theta}\left(\overline{v} + (1+\overline{\theta}) - \frac{t}{4n}\right) + \overline{v} + (1+\overline{\theta}) - \frac{t}{4n}. \tag{46}$$

Deriving equation (46) with respect to n, the social optimum number of firms is obtained:

$$n^* = \frac{1}{2}\sqrt{\frac{t}{F + (1+\overline{\theta})\left(\frac{1}{2} - \overline{\theta}\right) - \overline{\theta}\overline{v}}}. \tag{47}$$