WORKING PAPERS

Col.lecció d'Economia E19/392

Firms' ownership, employees' altruism, and competition

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UB Economics Working Papers 2019/392

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Abstract: The paper investigates how product market competition affects the firms' decision to hire altruistic or selfish employees in a mixed duopoly where a public and a private firm compete against each other on prices and quality. When firms offer similar services, so that product competition is fierce, both firms benefit from hiring altruistic employees even if it leads to lower prices. Conversely, when firms offer sufficiently differentiated services, the private firm prefers to hire selfish employees as starting a price war with the public firm is not profitable. However, the private firm would hire altruistic employees if it faced another private firm. Therefore, when firms offer differentiated products, customers may benefit from the privatization of the public firm, especially when the employees' degree of altruism is high.

JEL Codes: D03, D21, L13.

Keywords: Firms' ownership, Altruism, Hiring Decision, Quality Choice, Privatization, Vertical and Horizontal Differentiation.

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Acknowledgements: I wish to thank Alessandro De Chiara, Georg Kirchsteiger, Marcello D'Amato, Salvatore Piccolo for a number of insightful comments and useful observations. I also acknowledge the financial support of the Ministerio de Economia y Competitividad and Fondo Europeo de Desarrollo Regional through grant ECO2016-78991-R (MINECO/FEDER, UE) and the Government of Catalonia through grant 2014SGR493. The usual disclaimer applies..
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ISSN 1136-8365

1 Introduction

There is a large experimental and empirical evidence showing that individuals display altruistic preferences (see among others Buurman et al., 2012, Konow, 2010, Tonin and Vlassopoulos, 2010, 2015, Imas, 2014, Lilley and Slonim, 2014, Ottoni-Wilhelm et al., 2014, Charness et al., 2016, and Dur and van Lent, 2018). As defined by Fehr and Schmidt (2006) "A person is altruistic if her utility increases with the well-being of other people".[1] Altruistic employees are not only interested in their "egoistic" payoff but also in the customers' well-being. More specifically, they internalize in their own utility the effects that both prices and quality entail for customers' utility. When this is the case, employees also care about the price charged by the firms and the firms can extract a lower amount of surplus from their customers for any given level of quality (see Manna, 2017).

The assumption that employees care about the customers' utility is particularly plausible if we consider non-profits organizations or firms providing public good services, such as health care and education.[2] By using the German Socio-Economic Panel (GSOEP), I find that employees in health care, education, and public administration (including both public and private firms) are significantly more altruistic than employees working in other sectors.[3] Following Becker et al. (2012) and Dur and Zoutenbier (2015), I measure the employees' altruism by using the response to the following question asked in the 2004 wave of the survey: "How important is it for you to be there for others?" I use a Linear Probability Model to estimate the probability that a worker with given altruism is employed in these specific sectors, controlling for gender, age, and education.[4] The regression specification is:

$$Pr(Sector\ =\ Public\,Good\,Services) = c + \upsilon A + x'\delta + \epsilon,$$

where A represents the employees' altruism, and the vector x contains the control variables. Table 1 shows the estimation results of the linear probability model. The coefficient shows the

[1]Altruism, among other things, may account for charitable donations and the voluntary provision of public goods (see Andreoni, 1989, 1990, and Andreoni and Miller, 2002).

[2]In health care markets, for example, Arrow (1963) emphasizes the importance of a physician's altruism to provide high quality medical care.

[3]The German Socio-Economic Panel data (GSOEP) is a representative panel study of the resident population in Germany. By using the same data, Dur and Zoutenbier (2015) also find that public sector employees are more altruistic than private sector employees.

[4]I use a Linear Probability Model because the dependent variable is a dummy that takes value 1 if an employee works in the public good services (health care, education, and public administration), and 0 otherwise. See Table 2 in the appendix for more details on the independent variables.

change in the decimal probability of working in the public good services (health care, education, and public administration) instead of other sectors given a unit change in the employees' altruism. The estimation results show that the likelihood that a worker is employed in the public good services is increasing in his altruism. This effect is positive and statistically significant. A unit increase in altruism increases the likelihood of working in the public good services instead of the other sectors by 6.5 percentage points.

Table 1: The table reports the coefficients of the Probit model. While Column 1 only considers my measure of altruism, Column 2 also controls for gender, age, and education. The employees' altruism is measured by using the response to the question: "How important is it for you to be there for others?"

	Public Good Services (1)	Public Good Services (2)
Altruism	0.136***	0.065***
	(0.02)	(0.02)
Controls	No	Yes
Constant	-1.02	-0.86
	(0.07)	(0.09)
N	11,546	11,546
$Pseudo\ R^2$	0.0028	0.09

*** Denotes significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Standard errors are reported in parentheses.

When the analysis focuses on these sectors, it is important to take into account that in many countries these services are provided by both public and private institutions that are heterogenous since they maximize different objective functions.[5] In this paper, I consider a setting where private firms maximize profits, while public firms face profit constraints and also care about the customers' well-being, in so following the literature on non-profit firms (see Malani et al., 2003, for an overview of the literature).

The main objective of the paper is to investigate how product market competition affects the firms' hiring decision between an altruistic and a selfish employee, and ultimately its effect on market outcomes.

After the employment decision, firms compete against each other on prices and quality of the

[5]In education and health-care sectors, many European markets are dominated by public firms, but in the United States these sectors are mixed oligopolies. In this aspect, my paper contributes to the literature of mixed oligopolies (see for a survey Fraja and Delbono, 1990, and Nett, 1993). For recent surveys on education and health care, see also Barros and Siciliani (2012), and Urquiola (2016).

service provided.[6] A high level of quality may play a crucial role in the customers' decision between different firms. Quality depends on the effort exerted by employees. As employees may be given different incentives to provide effort there exists some degree of *vertical differentiation* between firms. However, quality and price are not the only variables that customers take into account when they decide which service to buy. Firms may also offer heterogeneous services and attract different types of consumers. Therefore, there also exists some degree of *horizontal differentiation* between firms which impacts on the customers' choice.[7] To incorporate this aspect and model competition, I use a Hotelling model where a public and a private firm compete to attract customers.

My model suggests that when firms offer sufficiently differentiated services, it may be socially desirable to privatize the public firm. While the public firm always hires an altruistic employee, since their preferences are more congruous, a private firm hires an altruistic employee only if it faces another private firm. The private organization hires a selfish employee when competing with a public firm because setting a high price does not lead to a drastic reduction in the demand. To see this, consider that altruistic employees limit the price that can be charged by the firms. This is more detrimental to the private than to the public firm because the latter also cares about the users' well-being. When the services are sufficiently differentiated, the private firm does not find it profitable to start a price war with the public firm and prefers to hire the self-interested employee. In contrast, when both firms maximize profits, they always hire altruistic employees irrespective of the degree of competition in the market. The reason is the following. If one firm hires an altruistic employee, its quality is higher than the quality provided by its competitor. With higher quality, this firm would obtain a comparative advantage in terms of demand and price. However, if one firm hires an altruistic employee, the best response of its

[6]In the literature on health-care provision, the idea that hospitals compete on quality to attract patients is consolidated. Indeed, the main objective of recent reforms in several countries is to stimulate competition in order to increase quality. In the US the Medicare and Medicaid programmes allow every hospital to receive a Diagnosis-Related Group (DRG) tariff for every patient admitted for treatment, which may induce them to increase the quality of the services provided. Every country has developed its own version of the DRG system. The UK, France, Canada and Australia have introduced Health-care Resource Group (HRGs), Groups Homogenes de Malades (GHMs), Case-Mix Groups (CMGs), and Australian National DRGs (AN-DRGs), respectively.

[7]Consider the case of schools. Schools offer different educational services and this is especially true if one considers the educational services provided by public and private schools. In several countries, most private schools have a strong religious connotation while public schools are typically secular. Furthermore, in many countries there are a number of foreign and international schools that are private, including American, French and British schools. Such international schools typically offer bi-lingual programs, as well as English as a Foreign Language (EFL) exams if the students' first language is not English. Then, private schools can cater to parents who want to give their children an education closer to international standards. Also hospitals can have different specializations. For instance, they may be specialized in care for cardiac or oncology patients.

rival is to follow suit.

Since the quality provided in the market depends on the effort exerted by the employees, whether firms hire selfish or altruistic employees importantly impact on quality and customers' well-being. Determining under which conditions the privatization of the public firm improves quality and the overall customers' utility is a relevant question particularly in sectors where quality is a major concern as firms strive to provide better services to attract customers. A suitable example is the health-care sector where the main objective of recent reforms, like the Medicare and Medicaid programmes in the US, was to increase quality. For this reason, privatization has been a policy topic in mixed oligopolies. Matsumura (1998) and Ishibashi and Kaneko (2008) show that a partial privatization of the public firm, whose objective is a weighted sum of profit and social welfare, is a valuable policy for the government. Differently from these papers, I show that whether customers benefit from the privatization of the public firm crucially depends on the degree of competition in the market and the employees' degree of altruism. More specifically, I find that privatization increases quality and customers' well-being when firms offer sufficiently differentiated services, as under mixed duopoly only the public firm hires an altruistic employee, and when the employees' degree of altruism is high.

Literature review. This paper is related to the strand of the economic literature on *psychological incentives* that considers the existing interaction between employees' altruism and monetary incentives. In this literature, the idea is that employees derive non-monetary benefits from providing some types of services (see Biglaiser and Ma, 2007, Buurman et al., 2012, and Dur and Zoutenbier, 2014). This idea has mainly been referred to public service employees (see among others Bond and Glode, 2014, and Jaimovich and Rud, 2014). In particular, most studies have argued that public service employees are eager to serve the others and satisfy the customers' needs (see Francois, 2000, 2007, Glazer, 2004, Prendergast, 2007, and Macchiavello, 2008). As a result, this literature has emphasized how, especially in the public service or non-profit sectors, the employers can extract labor donations from motivated employees (see Francois and Vlassopoulos, 2008, for a survey). Other relevant papers in this literature consider the self-selection and workplace behavior of intrinsically motivated workers (see among others Besley and Ghatak, 2005, Brekke and Nyborg, 2008, 2010, Dur and Zoutenbier, 2015, Barigozzi and Burani, 2016, and Cassar, 2016). However, this literature does not focus on the role played by competition in affecting the firms' hiring decision and in shaping the monetary incentives paid to the employees. Notable exceptions are the papers by Bénabou and Tirole (2016) and

Barigozzi and Burani (2019) that consider a competitive environment. However, in both papers firms are homogenous in their objective functions but they are perceived differently from the employees. Furthermore, the scope of these papers is pretty different.

Manna (2017) is more related to the current paper. By using a Salop model, Manna (2017) shows that profit-maximizers firms always hire altruistic employees even when they would have been better off hiring selfish employees. In contrast, in this paper I show that in a environment where firms are heterogenous in their objective functions, different equilibria emerge depending on the degree of competition in the market.

Within the literature on the *effects of competition on managerial incentives*, my paper is related to Raith (2003), wherein the author examines how the degree of competition among firms in an industry with free entry and exit impacts on the wages paid to their employees. The effect of competition on wages and effort takes place through a change in the equilibrium number of firms in the industry. The results suggest an unambiguous positive relationship between competition and wages. Baggs and De Bettignies (2007) also study how product market competition affects employee effort and firm efficiency. They show that the impact of competition differs depending on whether or not they are subject to agency costs. Similar to their paper, I use a spatial competition model in which firms offer both horizontally and vertically differentiated products. However, differently from their analysis the main objective of this paper is to determine how competition affects the firms' hiring decision and through this channel the monetary incentives they receive.

The remainder of the paper proceeds as follows. In Section 2 the model is presented and in Section 3 the equilibrium of the model is characterized; in Section 4 the conditions under which the privatization of the public firm increases quality and customers' well-being are illustrated; concluding remarks and discussion of the results are given in Section 5.

2 The model

There are three players in the model: customers, firms, and employees. A continuum of customers of mass 1 is distributed uniformly on a Hotelling line (Hotelling, 1929), whose distance is normalized to 1. There are two firms A and B that operate in the market and that are positioned at the extreme of the Hotelling line. The owner of the firm hires an employee (the agent) offering him a contract specifying the quality of the product q and wage ω. After the employment decision, the firms offer imperfectly substitutable services, competing against each other on quality q and prices p. In what follows, I describe in detail the utilities of each player of the model.

Customers. Each customer buys exactly one unit of the good. A customer k who is located between firm A and firm B enjoys a utility of

$$\begin{aligned} U_{Ak} = &\ v(q_A) - p_A - t\, x_{Ak}, \quad \text{if he buys the service from firm } A, \\ U_{Bk} = &\ v(q_B) - p_B - t\,(1 - x_{Ak}), \quad \text{if he buys the service from firm } B, \end{aligned}$$

where $v(q_i) = \overline{v} + q_i$ represents the customer's gross benefit from the good offered by firm i with $i = A, B$. Customers derive a non-negative utility $\overline{v}$ from the good irrespective of its quality, i.e. $\overline{v} > 0$.[8] The distance between firm A and customer k is denoted by x_{Ak}, and customer k incurs a transportation cost of $t\ x_{Ak}$ to travel to firm A. Similarly, the distance between firm B and customer k is denoted by $(1 - x_{Ak})$, and customer k incurs a transportation cost of $t(1 - x_{Ak})$ to firm B. The products offered by the firms are *horizontally differentiated* and the exogenous parameter t represents the degree of horizontal differentiation of the services offered by the firms. When t is low, firms offer similar services and competition is tough.

Firms. Firm A is private and maximizes its profits, whereas firm B is public and maximizes a weighted function of its profits and the customers' utilities:

$$\pi_A = p_A\, d_A - \omega_A, \tag{1}$$

$$\pi_B = \alpha(p_B\, d_B - \omega_B) + (1 - \alpha)(\overline{U}_A + \overline{U}_B), \tag{2}$$

where p_i and d_i are the price and the demand of firm i, respectively, and ω_i the wage paid to its employee with $i = A, B$. The specification of the public firm's objective function follows Brekke et al. (2008, 2012), where α measures the degree to which the public firm is profit-constrained. This formalization is also used by Glaeser and Shleifer (2001) and Ghatak and Mueller (2011) to distinguish between non-profit and for-profit firms and is relevant for any market where a regulator places a constraint on the public firms' ability to distribute profits. If $\alpha = 1$ both the private and the public firms are profit-maximizers, while if $\alpha < 1$ the public firm also cares about

[8] The model is solved under the assumption that the market is covered. In particular, the parameter v is sufficiently high so that customers always obtain a non-negative utility from buying the service (see Assumption 1 in the appendix).

the well-being of the average customer buying the product from firm A and firm B denoted by $\overline{U}_A$ and $\overline{U}_B$:

$$\overline{U}_A = \overline{v} + q_A - p_A - \frac{t}{2}\tilde{x}; \qquad \overline{U}_B = \overline{v} + q_B - p_B - \frac{t}{2}(1 - \tilde{x}), \tag{3}$$

where $\tilde{x}$ is the location of the marginal consumer who is indifferent between firm A and firm B. To simplify computations, I assume that the public firm and an altruistic employee care about the utility of the average customer who buys the product from the firm. However, this is not the only way to model their preferences. In particular, the public firm and an altruistic employee could care about the overall surplus of the customers who buy the product from the firm. Manna (2017) also considers this alternative specification of the employees' motivation in the case in which firms are profit-maximizers and shows that the results continue to hold.

Employees. The agents are wealth constrained with zero initial wealth and have a reservation wage of zero. They have quadratic effort costs, which are observable to the principal. The exerted effort determines the quality of the services. Thus, the products are also *vertically differentiated*. I normalize the quality q in such a way that it linearly depends on the employees' effort. There is no asymmetric information between the principal and the agent.

The key assumption of the model is that employees may have *altruistic* preferences towards their customers.[9] The parameter θ measures the employees' altruism. There are two types of agents, the self-interested agents with $\underline{\theta} = 0$ and the altruistic agents with $\overline{\theta} > 0$, and their type is observable. It is important to note that employees might care about their customers irrespective of whether the firm is public or private. This is because both types of firms offer services that the employees might value.[10] The employees' utility function consists of their own *egoistic payoff*, given by the difference between wage and effort costs, and their *altruistic payoff*.

[9] Several articles in the economics literature argue that doctors and nurses may benefit from taking care of their patients and therefore they may display altruistic preferences (see Ma, 2007, and Biglaiser and Ma, 2007). Interestingly, Ellis and McGuire (1986) define doctors as "perfect" if they give the same weight to their monetary compensation and to the patients' utility. Other suitable examples of altruistic employees are scientists who may benefit from finding a cure for a disease, teachers and professors who may be glad to teach to young students and develop methods to improve their learning process.

[10] In Heyes (2005), Delfgaauw and Dur (2010), and Barigozzi and Burani (2019), motivated workers obtain a non-monetary benefit only when employed by non-profit organizations. Therefore, these firms have a comparative advantage in hiring motivated workers.

Therefore, the utility of an agent who works in firm A or in firm B is given by:

$$\begin{aligned} V_A = &\quad \omega_A - \frac{1}{2}q_A^2 + \theta_A \overline{U}_A(q_A, q_B, p_A, p_B); \\ V_B = &\quad \omega_B - \frac{\beta}{2}q_B^2 + \theta_B \overline{U}_B(q_A, q_B, p_A, p_B). \end{aligned} \tag{4}$$

It is often argued that the public firm is less efficient than the private one. Supporting this view, the empirical literature argues that the privatization of the public firm increases efficiency (see for a survey Megginson and Netter, 2001, and Kikeri and Nellis, 2002). In my model, this inefficiency is reflected by the parameter $\beta \in [1, 2)$ that captures that the employees' cost of exerting effort is weakly higher in the public firm. This parameter can be interpreted as some additional bureaucratic costs that the employees might incur by working in the public firm instead of working in the private one. An alternative interpretation of this parameter is provided by Delfgaauw and Dur (2008) who show that the public firms attract lazier employees with a high cost of exerting effort.

The number of agents of each type is assumed to be larger than 2, so that there is perfect competition in the labour market. In this way, I abstract from potential problems concerning the firms' selection of employees with different degrees of altruism when they are in limited supply. This assumption allows me to focus on the impact of the presence of altruistic employees on firms' performance and on the customers' well-being in a setting where the public firm is profit-constrained, which is the main purpose of the article.

Timing of the model. *In stage 1*, each principal decides whether to hire an altruistic or a self-interested agent; *In stage 2*, each principal offers a contract in terms of the wage and the effort to his agent. Each agent accepts any contract which yields an expected utility of at least his reservation utility of 0; *In stage 3*, agents produce the good exerting the effort determined by the contract; finally, *in stage 4*, the customers choose from which firm to buy the good.

All the mathematical computations and proofs of the results are in the appendix.

3 Competition and altruistic employees

The equilibrium is determined by backward induction. In the last stage of the game, customers choose from which firm to buy the good. Customer l, who is located between the two firms, is indifferent between firm A and B if his utility from buying the product from firm A, U_{Al}, is equal to his utility from buying the product from firm B, U_{Bl}. This implies that the demands for firms A and B are:

$$d_A = \frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t}; \quad d_B = \frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t}. \tag{5}$$

Knowing the demand functions, firms A and B maximize equations (1) and (2), respectively, subject to the employees' participation constraint:

$$\begin{aligned} &\omega_A - \frac{1}{2}q_A^2 + \theta_A \overline{U}_A(q_A, q_B, p_A, p_B) \geq 0; \\ &\omega_B - \frac{\beta}{2}q_B^2 + \theta_B \overline{U}_B(q_A, q_B, p_A, p_B) \geq 0. \end{aligned} \tag{6}$$

The firm's payoff when it employs an altruistic or a selfish agent is analyzed for any possible combination of types hired by the rival firm. This allows me to compare the firms' profits and to analyze their hiring decision in Stage 1. Proposition 1 illustrates the solution of the subgame perfect equilibrium of the game.

Proposition 1. *There exists a positive value of t denoted by $\tilde{t}$ such that*

- *when $t \leq \tilde{t}$, there is a unique subgame perfect equilibrium in which both the public and the private firm hire altruistic employees;*
- *when $t > \tilde{t}$, there is a unique subgame perfect equilibrium in which the public firm hires an altruistic employee, while the private firm hires a selfish employee.*

Hiring an altruistic employee is always a dominant strategy for the public firm. Since both the public firm and the motivated employee care about the customers' well-being, their preferences are aligned and the public firm always benefits from hiring him. In contrast, the private firm's hiring decision crucially depends on the degree of competition in the market. In particular, there exists a threshold value of t below which the private firm also benefits from hiring an altruistic employee. If competition in the market is severe as firms offer similar services, non-captive customers who are around 1/2 have alternative options and the private firm must hire an altruistic employee to attract these customers. The employees' altruism plays a main role in satisfying the customers' needs and it is a key determinant of firms' performance. In contrast, when firms offer sufficiently differentiated products so that competition in the market is mild, hiring a selfish employee becomes a dominant strategy for the private firm. By hiring a selfish employee, the private firm does not lose all its customers and can charge a higher price for its service. As a result, when t is sufficiently high, there exists an equilibrium in which only the public firm hires an altruistic employee.

The result that motivated employees are eager to work in the public sector or in non-profit organizations is supported by a large empirical evidence (see Gregg et al., 2011, Salamon et al., 2012, and Dur and Zoutenbier, 2014). Gregg et al. (2011) and Salamon et al. (2012) use unpaid overtime as a proxy for employees' motivation in the workplace. Using data from the British Household Panel Survey (BHPS), Gregg et al. (2011) show that individuals in the non-profit sector are significantly more likely to do unpaid overtime than those in the for-profit sector. Moreover, Salamon et al. (2012) show that volunteer time accounts for about a quarter of not-for-profit contribution to GDP on average in the seven countries studied. By using data from a representative survey among more than 30.000 employees from 50 countries, Dur and Zoutenbier (2014) find that public sector employees are significantly more altruistic than private sector employees.

Impact on market outcomes. Proposition 2 illustrates the optimal levels of quality, demands, and prices when there is fierce competition between firms as they offer similar services.

Proposition 2. *When $t \leq \tilde{t}$, both the public and the private firms hire altruistic employees, setting the following optimal quality and price levels:*

$$q_A^{MM} = \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)}; \quad q_B^{MM} = \frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)};$$
$$p_A^{MM} = \frac{2t[\alpha(5\beta t - 1) - 2\beta t]}{\alpha(6\beta t - 1 - \beta)} - \frac{3}{2}t\overline{\theta}; \quad p_B^{MM} = \frac{2t[\alpha(7\beta t - 1 - \beta) - (4\beta t - 1 - \beta)]}{\alpha(6\beta t - 1 - \beta)} - \frac{3}{2}t\overline{\theta}.$$

The demand for each firm is $d_A^{MM} = q_A^{MM}$ and $d_B^{MM} = \beta q_B^{MM}$.

It is worth noting that quality and demand levels are not affected by the employees' altruism $\overline{\theta}$. Since both firms follow the same hiring strategy at the equilibrium where competition is fierce and since demand is constant, firms cannot win additional customers by hiring motivated employees. As firms cannot attract additional customers, they do not offer a higher quality product. In contrast, prices are negatively affected by $\overline{\theta}$ and its impact is the same in the public and in the private firm. Firms must charge a lower price to increase the customers' surplus and pay their altruistic employees a lower wage. Because both firms do exactly the same, this price reduction negatively impacts on revenues. However, if a firm deviated by not reducing the price, its profits would decrease since part of its demand would be stolen by its rival. At the equilibrium the firms prefer to reduce price maintaining quality constant, instead of increasing quality keeping the price constant, because providing more quality is more expensive as it requires more effort, and subsequently a higher wage.

If both firms maximize profits ($\alpha = 1$) and they are equally efficient ($\beta = 1$), quality levels are the same. In that case, firms charge the same price that depends on t and $\overline{\theta}$, and equally share the market, i.e. $d_A^{MM} = d_B^{MM} = \frac{1}{2}$. However, as the public firm's ability to distribute profits decreases (α is lower), the quality provided by the public (private) firm increases (decreases), and so does its demand. This is because the public firm particularly cares about the customer's well-being and this leads to an increase in its quality and, consequently, in its demand. In contrast, even if the private firm hires a motivated employee, a reduction in α negatively affects its quality and demand. Moreover, a reduction in α has a negative impact on the prices charged by both the public and the private firms. The public firm cares about the customers' well-being and, consequently, about the price they pay for the service. As a result, the price charged by the public firm is reduced. But then the private firm is also forced to reduce its price to attract customers.

If β and/or t increase, the quality provided by the public (private) firm decreases (increases), and so does its demand. Obviously, if the public firm becomes more inefficient, its quality decreases, while the quality of its competitor increases. It is also interesting to show that

$$q_A^{MM} > q_B^{MM} \quad \text{if} \quad \beta > \frac{2+\alpha}{5\alpha - 2}.$$

The above inequality is easier to satisfy as α and β increase.

An increase in the degree of inefficiency of the public firm β impacts positively on p_A^{MM} and negatively on p_B^{MM}. This effect is stronger when t is high. An increase in t reduces the competition between firms leading to an increase in both prices.

Proposition 3 illustrates the optimal levels of quality, demands, and prices when competition in the market is mild as firms offer sufficiently differentiated services.

Proposition 3. *When $t > \tilde{t}$ only the public firm hires the altruistic employee. Firms set:*

$$\begin{aligned}
q_A^{SM} =& \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \quad q_B^{MS} = \frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)} + \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta};\\
p_A^{SM} =& \frac{2t[\alpha(5\beta t - 1) - 2\beta t]}{\alpha(6\beta t - 1 - \beta)} - \frac{3\beta t^2}{2(6\beta t - 1 - \beta)}\overline{\theta};\\
p_B^{MS} =& \frac{2t[\alpha(7\beta t - 1 - \beta) - (4\beta t - 1 - \beta)]}{\alpha(6\beta t - 1 - \beta)} + \frac{3t(4\beta t - 1 - \beta)}{2(6\beta t - 1 - \beta)}\overline{\theta}.
\end{aligned}$$

The demand for each firm is $d_A^{SM} = q_A^{SM}$ and $d_B^{SM} = \beta q_B^{SM}$.

Quality levels and demands are similar to those in Proposition 2, but now there is an additional term that depends on $\overline{\theta}$. In particular, the employees' degree of altruism negatively impacts on the quality provided by the private firm and on its demand, while it positively impacts on that of the public firm. A lower quality implies that the private organization pays a lower wage to its employee reducing the costs. At the same time, a higher $\overline{\theta}$ reduces the price charged by the private firm and increases the one charged by the public one. This leads to a reduction in total revenues. However, this reduction in the private firm's price is lower than in the case in which both firms hire altruistic employees and this is why the private firm ends up hiring the selfish employee when t is sufficiently high.

3.1 Both firms are profit-maximizers

In this subsection, I study the firms' hiring decision when both firms are profit-maximizers. I find that regardless of whether the rival firm hires an altruistic or a selfish employee, each firm is always better-off by hiring an altruistic agent. The intuition is the following. Suppose that both firms were employing self-interested agents. One firm would be willing to deviate by hiring an altruistic employee. By doing so, its quality would be higher than the quality provided by the rival firm. With higher quality, this firm would obtain a comparative advantage in terms of demand and price. As a result, its profits would increase. But then, when one firm hires an altruistic employee, its competitor's best response is to follow suit. Therefore, there is a unique Nash Equilibrium in which both firms hire an altruistic agent. Intuitively, an employer could pay a lower salary to a motivated employee to implement the same quality-price pair requested from a selfish employee. By using a Salop model, Manna (2017) also finds when firms maximize profits, it is a dominant strategy for them to hire altruistic employees. Remark 1 shows the solution of the subgame perfect equilibrium of the game under Hotelling when both firms are profit-maximizers.

Remark 1. *When both firms maximize profits, there is a unique and symmetric subgame perfect equilibrium in which each firm hires an altruistic employee, sets:*

$$q_i^{Pr} = \frac{1}{2}, \quad p_i^{Pr} = t\left(1 - \frac{3}{2}\overline{\theta}\right),$$

and offers a wage which makes the employees' participation constraint bind. Firms share the *demand in the market* $d_i^{Pr} = \frac{1}{2}$*, and profits are realized:*

$$\pi_i^{Pr} = \left(\frac{1}{2}\right)\left(t - \frac{3}{2}t\overline{\theta}\right) - \frac{1}{4}\left[\frac{1}{2} - \overline{\theta}\Big(2\overline{v} + 1 - 3t + 3t\overline{\theta}\Big)\right].$$

As the above remark shows, the employees' altruism affects neither quality nor demand, while it has a negative impact on the price charged by the firms. Since firms follow the same strategy at the equilibrium, they share the demand in the market that is constant and equal to $\frac{1}{2}$. As firms cannot win additional customers, they do not offer a higher quality product, but they charge a lower price to increase the customers' surplus and pay their altruistic employees a lower wage.

3.2 Both firms are public

In this subsection, I characterize the equilibrium of the model when both firms are public. The result is illustrated in Proposition 4.

Proposition 4. *When both firms are public, there is a unique and symmetric subgame perfect equilibrium in which each firm hires an altruistic employee, sets:*

$$q_i^{Pu} = \frac{1}{2\beta}, \qquad p_i^{Pu} = \frac{(3\alpha - 2)t}{\alpha} - \frac{3}{2}t\overline{\theta},$$

and offers a wage which makes the employees' participation constraint bind. Firms share the demand in the market $d_i^{Pu} = \frac{1}{2}$*, and profits are realized:*

$$\pi_i^{Pu} = \alpha\left[\frac{(3\alpha - 2)t}{2\alpha} - \frac{3}{4}t\overline{\theta} - \frac{1}{8\beta}\right] + \frac{1}{2}\left[4\overline{v} + \frac{2}{\beta} - t\left(13 - \frac{8}{\alpha} - 6\overline{\theta}\right)\right]\left[1 - \frac{\alpha(2 - \overline{\theta}}{2}\right].$$

Similarly to the previous case where both firms maximize profits, Proposition 4 shows that the employees' altruism $\overline{\theta}$ affects neither quality nor demand, whereas it has a negative impact on the price charged by the firms and its impact is the same in both settings.[11] Both quality and price enter the altruistic employee's utility function. The quality enters the utility function both directly, as it affects the amount of effort the agent must exert, and indirectly, as it impacts on the customers' utility about which the altruistic agent cares. In contrast, price only affects the agent's utility function indirectly through its impact on the customers' well-being. At the equilibrium, when firms are symmetric, they prefer to reduce price maintaining quality constant,

[11] When both firms are public, the price also depends positively on α. Notice that the degree of altruism must be below a certain threshold so that prices are non-negative, i.e. $\overline{\theta} < \frac{2(3\alpha-2)}{3\alpha}$.

instead of increasing quality keeping the price constant, because providing more quality is more expensive as it requires more effort.

4 Can customers benefit from privatization?

The objective of this section is to study whether and under which circumstances customers may benefit from the privatization of the public firm. In Subsection 4.1 I analyze whether the privatization of the public firm may increase the overall quality provided in the market, whereas in Subsection 4.2 I consider the impact of privatization on the total customers' utility.

4.1 Impact of privatization on quality

It is worth analyzing whether the privatization of the public firm may improve the quality provided by the firms. This is a relevant problem particularly in sectors where firms compete on quality to attract customers. A suitable example is represented by the health-care sector where the main objective of recent reforms in several countries is to stimulate competition in order to increase quality (think of the Medicare and Medicaid programmes in the US).

In a recent paper by Laine and Ma (2017), the authors highlight the importance of analyzing the firms' choice of quality in markets where public and private firms compete.[12] Differently from their paper, in my model the quality provided by each firm depends on the effort exerted by the employees which is affected by their motivation. When the public firm is profit-constrained, whether firms decide to hire motivated or selfish employees crucially depends on the degree of competition in the market. If competition is tough, both firms hire motivated employees. In contrast, if competition is mild, only the public firm hires an altruistic employee, while the private firm hires a selfish one. Aggregate qualities in these cases are equal to the following, respectively:

$$Q^{MM} = \frac{t + 5t\beta - 2}{6t\beta - 1 - \beta} - \frac{2t(\beta - 1)}{\alpha(6t\beta - 1 - \beta)}; \tag{7}$$

$$Q^{SM} = \frac{t + 5t\beta - 2}{6t\beta - 1 - \beta} - \frac{2t(\beta - 1)}{\alpha(6t\beta - 1 - \beta)} - \frac{3t\overline{\theta}(\beta - 1)}{2(6t\beta - 1 - \beta)}. \tag{8}$$

Note that the first two terms in equations (7) and (8) coincide. The first term only depends on t and β, while the second term also depends on α. If there is no inefficiency in the public firm, i.e. $\beta = 1$, the first term is equal to 1, while the second term is equal to 0. However, for any values

[12] Barigozzi and Ma (2018) instead study the firms' decision of quality when they maximize profits.

of $\beta > 1$ the sum of these two terms is lower than 1. Moreover, in equation (8), there is an additional term that is negative for any values of $\beta > 1$. The reason is the following. When only the public firm hires an altruistic employee, the employee's motivation has a positive impact on the quality provided by the public firm, but a negative impact on the quality provided by the private firm. Overall, as $\beta > 1$ the negative impact of $\overline{\theta}$ on the private firm's quality is larger than the positive impact on the public firm's quality. In other words, the employee's altruism has a negative impact on the aggregate quality provided in the market. It is also worth noting that an increase in α has a positive impact on aggregate quality in both cases. This implies that aggregate quality increases as the public firm cares more about its own profits.

When firms are symmetric (both are public or private), their hiring decision does not depend on the degree of competition in the market. More specifically, firms always end up hiring motivated employees. When both firms are private aggregate quality is equal to 1, whereas when both firms are public it is equal to $\frac{1}{\beta}$. Therefore, for any $\beta > 1$ aggregate quality when both firms are public is always lower than the one obtained when both firms are profit-maximizers. I can finally rank the aggregate quality levels and provide a graphical representation in Figure 1.

$$Q^{Pr} > Q^{Pu} \quad and \quad Q^{Pr} > Q^{MM} > Q^{SM} \quad \text{if} \quad \beta > 1.$$

Whether Q^{MM} and Q^{SM} are higher or lower than Q^{Pu} depends on the values of the different parameters. More specifically, $Q^{MM} > Q^{SM} > Q^{Pu}$ if α, t, and β are sufficiently high and/or $\overline{\theta}$ is sufficiently low.

It is possible to conclude that consumers are never worse off by privatizing the public firm. This result is illustrated in Proposition 5.

Proposition 5. *By comparing the aggregate quality levels, we find that:*

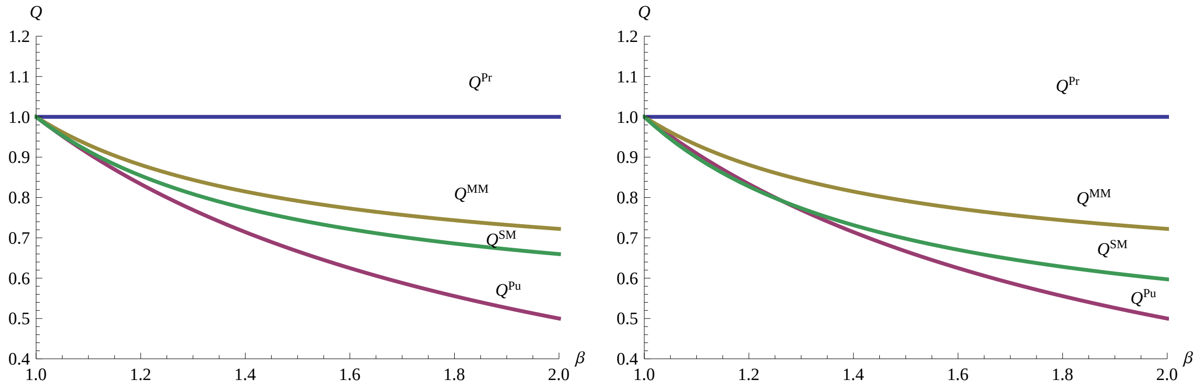
(i) If $\beta = 1$, the aggregate quality does not depend on the hiring decision and market structure.

(ii) If $\beta > 1$, the aggregate quality is the highest one when both firms are profit-maximizers. It is socially desirable to privatize the public firm. This is particularly the case when $\overline{\theta}$ is high.

If the employees' cost of exerting effort is the same irrespective of whether they work in the private or in the public firm, i.e. $\beta = 1$, the aggregate quality is equal to 1 is all scenarios. In contrast, when $\beta > 1$ the aggregate quality with profit constraints is always lower than 1.

When this is the case, customers benefit from the privatization of the public firm. This result is obtained irrespective of the degree of horizontal differentiation in the market. However, the benefits of privatization are larger when firms offer sufficiently differentiated products so that competition is mild and when the employees' degree of altruism $\overline{\theta}$ is particularly relevant. To understand why, note that $\overline{\theta}$ only negatively affects Q^{SM}, that is the aggregate quality under mixed duopoly when market competition is mild. This result is illustrated in Figure 1 where an increase in $\overline{\theta}$ from 0.25 to 0.5 downward distorts the green line.

Figure 1: Ranking of aggregate quality levels with $\alpha = 0.75$, $t = 0.5$, and $\overline{\theta} = 0.25$ on the left side and $\overline{\theta} = 0.5$ on the right.



4.2 Impact of privatization on customers' well-being

In the previous subsection, I have shown that if $\beta > 1$, the aggregate quality in the market is the highest when both firms maximize profits. As a result, the privatization of the public firm increases quality and is beneficial to customers. This is particularly the case when t and $\overline{\theta}$ are particularly high. However, the customers' utility does not only depend on quality, but also on the price charged by the firms. Therefore, it is important to analyze the overall customers' utility in these different environments. Lemma 1 illustrates the total customers' utility buying the service from firm A and firm B in the different scenarios.

Lemma 1. *The total customers' utility obtained by buying the service from both firms is:*

(a) $U^{Pr} = \frac{1}{2}(1 - 3t + 2\overline{v}) + \frac{3t\overline{\theta}}{2}$;

(b) $U^{MM} = \frac{2\beta t(3t-1)}{\alpha(6t\beta-1-\beta)} + \frac{(3t-1)(1-5\beta t)-\overline{v}(1-6\beta t)}{(6t\beta-1-\beta)} + \frac{3t\overline{\theta}}{2}$;

(c) $U^{SM} = \frac{2\beta t(3t-1)}{\alpha(6t\beta-1-\beta)} + \frac{(3t-1)(1-5\beta t)-\overline{v}(1-6\beta t)}{(6t\beta-1-\beta)} + \frac{3t\overline{\theta}}{2}\left[\frac{(3t-1)\beta}{(6t\beta-1-\beta)}\right]$;

(d) $U^{Pu} = \overline{v} + \frac{1}{2\beta} - \frac{(3\alpha-2)t}{\alpha} - \frac{t}{2} + \frac{3t\overline{\theta}}{2}$.

Considering Cases a and b, it is possible to note that $\overline{\theta}$ enters in the same way in both expressions. In particular, its impact is positive and equal to $\frac{3}{2}t$. Furthermore, by comparing these two expressions, it is simple to notice that the customers' utility is always higher with profit constraints than when both firms are profit-maximizers. However, this may no longer be the case when I compare Case a with Case c. More specifically, customers' utility when both firms maximize profits is higher than the one obtained with profit constraints when $\overline{\theta}$ is high enough. To understand this result, it is important to study the impact of $\overline{\theta}$ on the customers' well-being in Case c. In this case, the employees' altruism has a positive impact on the customers' utility, but its impact is lower than when both firms maximize profits. The intuition is the following. When both firms are profit-maximizers, their best strategy is always to hire altruistic employees irrespective of the agent's type employed by its competitor. The employees' motivation forces firms to compete fiercely reducing their prices and this effect leads to an increase in the customers' well-being. In contrast, in Case c only the public firm hires the altruistic employee and the positive effect on the total customers' well-being due to a reduction in the prices is milder.

Proposition 6. *By comparing the customers' utilities illustrated in Lemma 1, we find that*

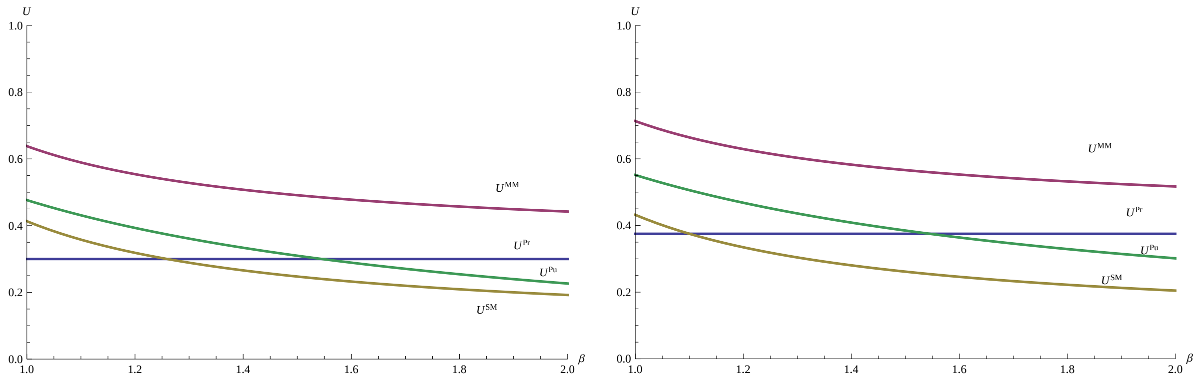
(i) When competition is fierce, the customers' utility is always higher with profit constraints than when both firms maximize profits.

(ii) When competition is mild, the customers' utility is higher with profit-maximizing firms if

$$\overline{\theta} > \frac{8t\beta(1-3t) + 2\alpha[1-\beta+12t^2\beta - 2\overline{v}\beta - t(3+\beta)]}{3\alpha t[2-(1-9t)\beta]}.$$

We can conclude that if competition is tough, customers obtain the highest utility when firms maximize different objective functions. Instead, when competition in the market is mild, as firms offer sufficiently differentiated products, privatization improves customers' utility if the employees' degree of altruism is high enough. The threshold value of $\overline{\theta}$ above which privatization is beneficial to customers is decreasing in β. For values of $\overline{\theta}$ and β sufficiently high, the ranking of overall customers' utility is the following: $U^{MM} > U^{Pr} > U^{Pu} > U^{SM}$ and a graphical representation is provided in Figure 2.

Figure 2: Ranking of customers' utilities with $\alpha = 0.85$, $t = 0.5$, $\overline{v} = 0.25$, and $\overline{\theta} = 0.4$ on the left side and $\overline{\theta} = 0.5$ on the right.



5 Conclusions

This paper investigates how market competition impacts on the firms' hiring decision in a mixed duopoly environment, and how their interaction impacts on the market outcome. I show that the firms' hiring decision crucially depends on the degree of competition in the market. More specifically, if competition in the market is fierce, as firms offer similar services, both the public and the private firm benefit from hiring altruistic employees. However, this is no longer the case when firms offer sufficiently differentiated services. In this case, only the public firm hires an altruistic employee. As altruistic employees also care about the price charged, the firms can extract a lower amount of surplus from their customers. This is more detrimental to the private than to the public firm because the latter is also interested in the customers' well-being. As the services are sufficiently differentiated, the private firm does not find it profitable to start a price war with the public firm and prefers to hire the self-interested employee. Conversely, the private organization hires an altruistic employee if it competes with another private firm. By doing so, quality in the market increases and, as a result, it is socially desirable to privatize the public firm.

This theoretical analysis calls for empirical studies to investigate how market competition affects altruism or, more in general, moral behavior. The result that market competition interacts with moral behavior has been borne out by the laboratory experiment of Falk and Szech (2013). The authors find that participants are more likely to accept the killing of a mice in a competitive double-auction market compared to an individual decision situation. They conclude that markets erode moral values. In another laboratory experiment, Bartling et al. (2014) study whether product market competition affects socially responsible behavior. They find that individuals incur additional production costs to mitigate a potential negative externality imposed on a third party, and that competition does not erode this concern. In a related paper, Bartling and Özdemir (2017) analyze whether a conscientious agent decides to forgo a profitable business opportunity for ethical reasons when there is the possibility that a competitor will rush in and conclude the deal. The authors find that individuals hardly take the selfish action: They do so only if it does not exist a social norm that classifies the selfish action as immoral. For future research, it would be interesting to investigate how individuals' degree of altruism relates to the individuals' responsiveness to changes in the competition intensity in a market.

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A The data

Public good services consider employees in health care, education, and public administration. In these sectors, most firms are public (the 72.6% of the firms). Public good services contain a total of 3,234 individuals representing the 28% of the entire sample. Most part of employees are women, 64.78% against the 35.22% of men. While the 48.7% of men holds a university degree, only the 35.7% of the women does. The average age is 43 years. Table 2 shows the variables of the analysis provided in the introduction.

Table 2: Description of the variables.

Altruism	1= Unimportant, 2= Less important, 3= Important, 4= Very important.
Public Good Services	Dummy: 1= Education, Health Care, Public Adminstration and Defence.
Male	Dummy: 1=male.
Age	
Education	Dummy: 1= degree.

B The theoretical analysis

I report the computations and proofs of the results when the public firm is profit-constrained. First, I characterize the equilibrium and so the optimal levels of quality, price, demand, wage, and profits in four different cases: (i) when both firms hire selfish employees; (ii) when both firms hire altruistic employees; (iii) when only the private firm hires the altruistic employee; (iv) when only the public firm hires the altruistic employee. Then, I analyze the best response of each firm to the choice made by its competitor. To guarantee an interior solution the following assumption is made.

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

- $t \in (0.4, 1)$*;*
- $\alpha \in \left[\frac{8\beta t}{4(5\beta t-1)+\overline{\theta}[18\beta t-3(1+\beta)]}, 1\right]$*;*
- $\overline{\theta} \in \left(0, \min\left\{\frac{4[\beta t(5\alpha-2)-\alpha]}{3\alpha(6\beta t-1-\beta)}, \frac{4[\beta t(7\alpha-4)-\alpha(1+2\beta)+(1+\beta)]}{3\alpha(6\beta t-1-\beta)}\right\}\right]$*, where both ratio values are strictly positive.*

B.1 Both firms hire selfish employees

I start by considering the case in which both firms hire self-interested employees, i.e. $\theta_A = \theta_B = 0$. In the last stage, customers choose from which firm to buy the good. The demand functions are given by:

$$d_A = \frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t}; \qquad d_B = \frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t}. \tag{A1}$$

Each firm maximizes the following:

$$\begin{aligned} \pi_A =& p_A \left(\frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t} \right) - \omega_A; \\ \pi_B =& \alpha \left[p_B \left(\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t} \right) - \omega_B \right] + (1-\alpha) \left[\overline{U}_A + \overline{U}_B \right] \end{aligned} \tag{A2}$$

subject to the agents' participation constraints:

$$\omega_A - \frac{1}{2} q_A^2 \geq 0; \qquad \omega_B - \frac{\beta}{2} q_B^2 \geq 0.$$

Each principal will set the lowest ω_i which satisfies the participation constraint with $i = A, B$. This implies that the employees' wage is equal to the cost of exerting effort. Moreover, the sum of the utilities of the average customer buying the product from firm A and firm B is:

$$\overline{U} = \overline{U}_A + \overline{U}_B = 2\overline{v} + q_A + q_B - p_A - p_B - \frac{t}{2}.$$

Substituting the wage functions and $\overline{U}$ into equation (A2), I get:

$$\begin{aligned} \pi_A =& p_A \left(\frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t} \right) - \frac{1}{2} q_A^2; \\ \pi_B =& \alpha \left[p_B \left(\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t} \right) - \frac{\beta}{2} q_B^2 \right] + (1-\alpha) \left[2\overline{v} + q_A + q_B - p_A - p_B - \frac{t}{2} \right]. \end{aligned} \tag{A3}$$

First order conditions:

$$\begin{aligned}
\frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{(q_A - q_B) + (p_B - 2p_A)}{2t} = 0; \\
\frac{\partial \pi_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \frac{3}{2}\alpha - 1 + \alpha \left[\frac{(q_B - q_A) + (p_A - 2p_B)}{2t}\right] = 0; \\
\frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \frac{p_A}{2t} - q_A = 0; \\
\frac{\partial \pi_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad 1 - \alpha + \alpha \left(\frac{p_B}{2t}\right) - \alpha\beta q_B = 0.
\end{aligned} \tag{A4}$$

The first order conditions depend also on the quality and price chosen by the rival firm. Solving the system of equations, I find the optimal levels of quality and price:

$$q_A^{SS} = \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)}; \quad q_B^{SS} = \frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)}; \tag{A5}$$

$$p_A^{SS} = \frac{2t[\alpha(5\beta t - 1) - 2\beta t]}{\alpha(6\beta t - 1 - \beta)}; \quad p_B^{SS} = \frac{2t[\alpha(7\beta t - 1 - \beta) - (4\beta t - 1 - \beta)]}{\alpha(6\beta t - 1 - \beta)}. \tag{A6}$$

Substituting the optimal levels of quality and price into (A1), I obtain the demand for each firm:

$$d_A^{SS} = \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)}; \quad d_B^{SS} = \beta \left[\frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)}\right]. \tag{A7}$$

The demand for firm A coincides with its quality, i.e. $d_A^{SS} = q_A^{SS}$, while the demand for firm B coincides with the product between its quality and β, i.e. $d_B^{SS} = \beta q_B^{SS}$.

The utility of the average customer buying the product from firm A and firm B is:

$$\overline{U}_A^{SS} = \overline{v} + q_A^{SS}\left(1 - \frac{t}{2}\right) - p_A^{SS}; \quad \overline{U}_B^{SS} = \overline{v} + q_B^{SS}\left(1 - \frac{\beta t}{2}\right) - p_B^{SS}. \tag{A8}$$

The following wages are paid:

$$w_A^{SS} = \frac{1}{2}\left(\frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)}\right)^2; \quad w_B^{SS} = \frac{\beta}{2}\left(\frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)}\right)^2. \tag{A9}$$

And finally firms obtain:

$$\pi_A^{SS} = \left(d_A^{SS}\right)\left(p_A^{SS}\right) - \frac{1}{2}\left(q_A^{SS}\right)^2; \tag{A10}$$

$$\begin{aligned}
\pi_B^{SS} =& \alpha \left[\left(d_B^{SS}\right)\left(p_B^{SS}\right) - \frac{\beta}{2}\left(q_B^{SS}\right)^2\right] + (1-\alpha)\left[U_A^{SS} + U_B^{SS}\right] \\
=& \alpha \left[\left(d_B^{SS}\right)\left(p_B^{SS}\right) - \frac{\beta}{2}\left(q_B^{SS}\right)^2\right] + (1-\alpha)\left[2\overline{v} + q_A^{SS} + q_B^{SS} - p_A^{SS} - p_B^{SS} - \frac{t}{2}\right].
\end{aligned} \tag{A11}$$

B.2 Both firms hire altruistic employees

Suppose now that both firms hire altruistic employees, i.e. $\theta_A = \theta_B = \overline{\theta} > 0$. Each firm maximizes equation (A2) subject to the agents' participation constraints:

$$\omega_A - \frac{1}{2}q_A^2 + \overline{\theta}\,\overline{U}_A \geq 0; \qquad \omega_B - \frac{\beta}{2}q_B^2 + \overline{\theta}\,\overline{U}_B \geq 0.$$

The participation constraints bind and equation (A2) can be rewritten as:

$$\begin{aligned}\pi_A =& \left(p_A - \frac{t}{2}\overline{\theta}\right)\left(\frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t}\right) - \frac{1}{2}q_A^2 + \overline{\theta}\left(\overline{v} + q_A - p_A\right);\\ \pi_B =& \alpha\left[\left(p_B - \frac{t}{2}\overline{\theta}\right)\left(\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t}\right) - \frac{\beta}{2}q_B^2 + \overline{\theta}\left(\overline{v} + q_B - p_B\right)\right] + \\ &+(1-\alpha)\left[2\overline{v} + q_A + q_B - p_A - p_B - \frac{t}{2}\right].\end{aligned} \tag{A12}$$

First order conditions:

$$\begin{aligned}\frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t} - \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - \overline{\theta} = 0;\\ \frac{\partial \pi_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \alpha\left[\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t} - \frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - \overline{\theta}\right] - (1-\alpha) = 0;\\ \frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - q_A + \overline{\theta} = 0;\\ \frac{\partial \pi_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad \frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - q_B + \overline{\theta} = 0.\end{aligned} \tag{A13}$$

Solving the system of equations, I find the optimal levels of quality and price:

$$q_A^{MM} = \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)} = q_A^{SS}; \quad q_B^{MM} = \frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)} = q_B^{SS}; \tag{A14}$$

$$\begin{aligned}p_A^{MM} =& \frac{2t[\alpha(5\beta t - 1) - 2\beta t]}{\alpha(6\beta t - 1 - \beta)} - \frac{3}{2}t\overline{\theta} = p_A^{SS} - \frac{3}{2}t\overline{\theta};\\ p_B^{MM} =& \frac{2t[\alpha(7\beta t - 1 - \beta) - (4\beta t - 1 - \beta)]}{\alpha(6\beta t - 1 - \beta)} - \frac{3}{2}t\overline{\theta} = p_B^{SS} - \frac{3}{2}t\overline{\theta}.\end{aligned} \tag{A15}$$

Substituting quality and price levels into (A1), I obtain the demand for each firm:

$$d_A^{MM} = \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)} = d_A^{SS}; \quad d_B^{MM} = \beta\left[\frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)}\right] = d_B^{SS}. \tag{A16}$$

The utility of the average customer buying the product from firm A and firm B is:

$$\begin{aligned}\overline{U}_A^{MM} =& \overline{v} + q_A^{SS}\left(1-\frac{t}{2}\right) - \left(p_A^{SS} - \frac{3}{2}t\overline{\theta}\right);\\ \overline{U}_B^{MM} =& \overline{v} + q_B^{SS}\left(1-\frac{\beta t}{2}\right) - \left(p_B^{SS} - \frac{3}{2}t\overline{\theta}\right).\end{aligned} \tag{A17}$$

The following wages are paid:

$$\begin{aligned}w_A^{MM} =& \frac{1}{2}\left(q_A^{SS}\right)^2 - \overline{\theta}\,\overline{U}_A^{MM} = w_A^{SS} - \overline{\theta}\,\overline{U}_A^{MM};\\ w_B^{MM} =& \frac{\beta}{2}\left(q_B^{SS}\right)^2 - \overline{\theta}\,\overline{U}_B^{MM} = w_B^{SS} - \overline{\theta}\,\overline{U}_B^{MM}.\end{aligned} \tag{A18}$$

And finally firms obtain:

$$\begin{aligned}\pi_A^{MM} =& \left(d_A^{MM}\right)\left(p_A^{MM}\right) - \frac{1}{2}\left(q_A^{MM}\right)^2 + \overline{\theta}\,\overline{U}_A^{MM}\\ =& \left(d_A^{SS}\right)\left(p_A^{SS} - \frac{3t}{2}\overline{\theta}\right) - \frac{1}{2}\left(q_A^{SS}\right)^2 + \overline{\theta}\left[\overline{v} + q_A^{SS}\left(1-\frac{t}{2}\right) - p_A^{SS} + \frac{3t}{2}\overline{\theta}\right];\end{aligned} \tag{A19}$$

$$\begin{aligned}\pi_B^{MM} =& \alpha\left[\left(d_B^{MM}\right)\left(p_B^{MM}\right) - \frac{\beta}{2}\left(q_B^{MM}\right)^2 + \overline{\theta}\,\overline{U}_B^{MM}\right] + \left(1-\alpha\right)\left(\overline{U}_A^{MM} + \overline{U}_B^{MM}\right)\\ =& \alpha\left[\left(d_B^{SS}\right)\left(p_B^{SS} - \frac{3t}{2}\overline{\theta}\right) - \frac{\beta}{2}\left(q_B^{SS}\right)^2 + \overline{\theta}\left(\overline{v} + q_B^{SS}\left(1-\frac{t}{2}\beta\right) - p_B^{SS} + \frac{3t}{2}\overline{\theta}\right)\right] +\\ &+\left(1-\alpha\right)\left[2\overline{v} + q_A^{SS} + q_B^{SS} - p_A^{SS} - p_B^{SS} + 3t\overline{\theta} - \frac{t}{2}\right].\end{aligned} \tag{A20}$$

B.3 Only the private firm hires the altruist

I consider now the case in which only the employee in the private firm is motivated, i.e. $\theta_A = \overline{\theta}$ and $\theta_B = 0$. Each firm maximizes its objective function subject to the employees' participation constraints:

$$\omega_A - \frac{1}{2}q_A^2 + \overline{\theta}\,\overline{U}_A \geq 0; \qquad \omega_B - \frac{\beta}{2}q_B^2 \geq 0.$$

The participation constraints bind and equation (A2) can be rewritten as:

$$\begin{aligned}\pi_A =& \left(p_A - \frac{t}{2}\overline{\theta}\right)\left(\frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t}\right) - \frac{1}{2}q_A^2 + \overline{\theta}\left(\overline{v} + q_A - p_A\right);\\ \pi_B =& \alpha\left[p_B\left(\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t}\right) - \frac{\beta}{2}q_B^2\right] + (1-\alpha)\left[2\overline{v} + q_A + q_B - p_A - p_B - \frac{t}{2}\right].\end{aligned} \tag{A21}$$

First order conditions:

$$
\begin{aligned}
\frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t} - \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - \overline{\theta} = 0; \\
\frac{\partial \pi_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \alpha\left[\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t} - \frac{1}{2t}p_B\right] - (1-\alpha) = 0; \\
\frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - q_A + \overline{\theta} = 0; \\
\frac{\partial \pi_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad \alpha\left[\frac{1}{2t}p_B - \beta q_B\right] + (1-\alpha) = 0.
\end{aligned}
\tag{A22}
$$

Solving the system of equations, I find the optimal levels of quality and price:

$$
\begin{aligned}
q_A^{MS} =& \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta} = q_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \\
q_B^{SM} =& \frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta} = q_B^{SS} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta};
\end{aligned}
\tag{A23}
$$

$$
\begin{aligned}
p_A^{MS} =& \frac{2t[\alpha(5\beta t - 1) - 2\beta t]}{\alpha(6\beta t - 1 - \beta)} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta} = p_A^{SS} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta}; \\
p_B^{SM} =& \frac{2t[\alpha(7\beta t - 1 - \beta) - (4\beta t - 1 - \beta)]}{\alpha(6\beta t - 1 - \beta)} - \frac{3\beta t^2}{(6\beta t - 1 - \beta)}\overline{\theta} = p_B^{SS} - \frac{3\beta t^2}{(6\beta t - 1 - \beta)}\overline{\theta}.
\end{aligned}
\tag{A24}
$$

Substituting the optimal levels of quality and price into (A1), I obtain the demand for each firm:

$$
\begin{aligned}
d_A^{MS} =& \frac{\alpha(5\beta t - 1) - 2\beta t}{\alpha(6\beta t - 1 - \beta)} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta} = d_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \\
d_B^{SM} =& \beta\left[\frac{\alpha(t-1) + 2t}{\alpha(6\beta t - 1 - \beta)}\right] - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta} = d_B^{SS} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}.
\end{aligned}
\tag{A25}
$$

The utility of the average customer buying the product from firm A and firm B is:

$$
\begin{aligned}
\overline{U}_A^{MS} =& \overline{v} + \left(q_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(1 - \frac{t}{2}\right) - \left(p_A^{SS} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta}\right); \\
\overline{U}_B^{SM} =& \overline{v} + \left(q_B^{SS} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(1 - \frac{\beta t}{2}\right) - \left(p_B^{SS} - \frac{3\beta t^2}{(6\beta t - 1 - \beta)}\overline{\theta}\right).
\end{aligned}
\tag{A26}
$$

The following wages are paid:

$$
w_A^{MS} = \frac{1}{2}\left(q_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)^2 - \overline{\theta}\,\overline{U}_A^{MS}; \quad w_B^{SM} = \frac{\beta}{2}\left(q_B^{SS} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)^2.
\tag{A27}
$$

And firms obtain:

$$\begin{aligned}
\pi_A^{MS} =&\left(d_A^{MS}\right)\left(p_A^{MS}\right) - \frac{1}{2}\left(q_A^{MS}\right)^2 + \overline{\theta}\,\overline{U}_A^{MS};\\
=&\left(d_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(p_A^{SS} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta}\right) - \frac{1}{2}\left[q_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right]^2 + \overline{\theta}\,\overline{U}_A^{MS};
\end{aligned} \tag{A28}$$

$$\begin{aligned}
\pi_B^{SM} =&\alpha\left[\left(d_B^{SM}\right)\left(p_B^{SM}\right) - \frac{\beta}{2}\left(q_B^{SM}\right)^2\right] + \left(1-\alpha\right)\left(\overline{U}_A^{MS} + \overline{U}_B^{SM}\right)\\
=&\alpha\left[\left(d_B^{SS} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(p_B^{SS} - \frac{3\beta t^2}{(6\beta t - 1 - \beta)}\overline{\theta}\right) - \frac{\beta}{2}\left(q_B^{SS} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)^2\right] +\\
&+\left(1-\alpha\right)\left(\overline{U}_A^{MS} + \overline{U}_B^{SM}\right).
\end{aligned} \tag{A29}$$

B.4 Only the public firm hires the altruist

Finally, I analyze the case in which only the public firm hires the altruistic employee, i.e. $\theta_A = 0$ and $\theta_B = \overline{\theta}$. Each firm maximizes equation (A2) subject to the agents' participation constraints:

$$\omega_A - \frac{1}{2}q_A^2 \geq 0; \qquad \omega_B - \frac{\beta}{2}q_B^2 + \overline{\theta}\overline{U}_B \geq 0.$$

Participation constraints bind and equation (A2) can be rewritten as:

$$\begin{aligned}
\pi_A =&p_A\left(\frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{2t}\right) - \frac{1}{2}q_A^2;\\
\pi_B =&\alpha\left[\left(p_B - \frac{t}{2}\overline{\theta}\right)\left(\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t}\right) - \frac{\beta}{2}q_B^2 + \overline{\theta}\left(\overline{v} + q_B - p_B\right)\right] +\\
&+(1-\alpha)\left[2\overline{v} + q_A + q_B - p_A - p_B - \frac{t}{2}\right].
\end{aligned} \tag{A30}$$

First order conditions:

$$\begin{aligned}
\frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{(q_A - q_B) + (p_B - p_A)}{t} - \frac{1}{2t}p_A = 0;\\
\frac{\partial \pi_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \alpha\left[\frac{1}{2} + \frac{(q_B - q_A) + (p_A - p_B)}{2t} - \frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - \overline{\theta}\right] - (1-\alpha) = 0;\\
\frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \frac{p_A}{2t} - q_A = 0;\\
\frac{\partial \pi_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad \alpha\left[\frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - \beta q_B + \overline{\theta}\right] + (1-\alpha) = 0.
\end{aligned} \tag{A31}$$

Solving the system of equations, I find the optimal levels of quality and price:

$$\begin{aligned} q_A^{SM} =& \frac{\alpha(5\beta t-1)-2\beta t}{\alpha(6\beta t-1-\beta)} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta} = q_{AS}^{SS} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}; \\ q_B^{MS} =& \frac{\alpha(t-1)+2t}{\alpha(6\beta t-1-\beta)} + \frac{3t}{2(6\beta t-1-\beta)}\overline{\theta} = q_B^{SS} + \frac{3t}{2(6\beta t-1-\beta)}\overline{\theta}; \end{aligned} \tag{A32}$$

$$\begin{aligned} p_A^{SM} =& \frac{2t[\alpha(5\beta t-1)-2\beta t]}{\alpha(6\beta t-1-\beta)} - \frac{3\beta t^2}{2(6\beta t-1-\beta)}\overline{\theta} = p_A^{SS} - \frac{3\beta t^2}{2(6\beta t-1-\beta)}\overline{\theta}; \\ p_B^{MS} =& \frac{2t[\alpha(7\beta t-1-\beta)-(4\beta t-1-\beta)]}{\alpha(6\beta t-1-\beta)} - \frac{3t}{2}\left(\frac{4\beta t-1-\beta}{6\beta t-1-\beta}\right)\overline{\theta} = p_B^{SS} - \frac{3t}{2}\left(\frac{4\beta t-1-\beta}{6\beta t-1-\beta}\right)\overline{\theta}. \end{aligned} \tag{A33}$$

Substituting the optimal levels of quality and price into (A1), I obtain the demand for each firm:

$$\begin{aligned} d_A^{SM} =& \frac{\alpha(5\beta t-1)-2\beta t}{\alpha(6\beta t-1-\beta)} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta} = d_A^{SS} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}; \\ d_B^{MS} =& \beta\left[\frac{\alpha(t-1)+2t}{\alpha(6\beta t-1-\beta)} + \frac{3t}{2(6\beta t-1-\beta)}\overline{\theta}\right] = d_B^{SS} + \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}. \end{aligned} \tag{A34}$$

The utility of the average customer buying the product from firm A and firm B is:

$$\begin{aligned} \overline{U}_A^{SM} =& \overline{v} + \left(q_A^{SS} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}\right)\left(1-\frac{t}{2}\right) - \left(p_A^{SS} - \frac{3\beta t^2}{2(6\beta t-1-\beta)}\overline{\theta}\right); \\ \overline{U}_B^{MS} =& \overline{v} + \left(q_B^{SS} + \frac{3t}{2(6\beta t-1-\beta)}\overline{\theta}\right)\left(1-\frac{\beta t}{2}\right) - \left(p_B^{SS} - \frac{3t}{2}\left(\frac{4\beta t-1-\beta}{6\beta t-1-\beta}\right)\overline{\theta}\right). \end{aligned} \tag{A35}$$

The following wages are paid:

$$\begin{aligned} w_A^{SM} =& \frac{1}{2}\left(q_A^{SS} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}\right)^2; \\ w_B^{MS} =& \frac{\beta}{2}\left(q_B^{SS} + \frac{3t}{2(6\beta t-1-\beta)}\overline{\theta}\right)^2 - \overline{\theta}\,\overline{U}_B^{MS}. \end{aligned} \tag{A36}$$

And firms obtain:

$$\begin{aligned} \pi_A^{SM} =& \left(d_A^{SM}\right)\left(p_A^{SM}\right) - \frac{1}{2}\left(q_A^{SM}\right)^2 \\ =& \left(d_A^{SS} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}\right)\left(p_A^{SS} - \frac{3\beta t^2}{2(6\beta t-1-\beta)}\overline{\theta}\right) - \frac{1}{2}\left(q_A^{SS} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}\right)^2; \end{aligned} \tag{A37}$$

$$
\begin{aligned}
\pi_B^{MS} =& \alpha \left[\left(d_B^{MS} \right) \left(p_B^{MS} \right) - \frac{1}{2} \left(q_B^{MS} \right)^2 \right] + \left(1-\alpha \right) \left(\overline{U}_A^{SM} + \overline{U}_B^{MS} \right) \\
=& \alpha \left[\left(d_B^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)} \overline{\theta} \right) \left(p_B^{SS} - \frac{3t}{2} \left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta} \right) \overline{\theta} \right) \right] + \\
& -\alpha \left[\frac{\beta}{2} \left(q_B^{SS} + \frac{3t}{2(6\beta t - 1 - \beta)} \overline{\theta} \right)^2 - \overline{\theta}\, \overline{U}_B^{MS} \right] + \left(1-\alpha \right) \left(\overline{U}_A^{SM} + \overline{U}_B^{MS} \right).
\end{aligned}
\tag{A38}
$$

B.5 Proof of Proposition 1

In the initial stage of the game, both firms choose simultaneously which type of agent to hire. Given prices, qualities and wages, the type choice reduces to the following game:

		Firm B	
		$\underline{\theta}$	$\overline{\theta}$
Firm A	$\underline{\theta}$	(π_A^{SS}, π_B^{SS})	(π_A^{SM}, π_B^{MS})
	$\overline{\theta}$	(π_A^{MS}, π_B^{SM})	(π_A^{MM}, π_B^{MM})

Table 3: The Type-Choice Game

I start by considering the public firm (firm B) and its best response to the choice of firm A. I want to show that, irrespective of the decision made by the private firm, the public firm is always better off by hiring an altruistic employee, i.e. $\pi_B^{MS} > \pi_B^{SS}$ and $\pi_B^{MM} > \pi_B^{SM}$. First, the difference between equation (A38) and equation (A11) is:

$$
\begin{aligned}
\pi_B^{MS} - \pi_B^{SS} = \alpha & \left[\beta \left(p_B^{SS} - \frac{3t(4\beta t - 1 - \beta)\overline{\theta}}{2(6\beta t - 1 - \beta)} \right) - \left(\frac{3t(4\beta t - 1 - \beta)\overline{\theta}}{2(6\beta t - 1 - \beta)} \right) d_B^{SS} + w_B^{SS} - w_B^{MS} \right] + \\
& + (1-\alpha) \left[\overline{U}_A^{SM} + \overline{U}_B^{MS} + \overline{U}_A^{SS} + \overline{U}_B^{SS} \right] > 0.
\end{aligned}
$$

The term multiplied by $(1-\alpha)$ is always positive and sufficiently high to outweigh the term multiplied by α that conversely can be negative when t is high enough.[13] Obviously, when the public firm is more profit-constrained (low α), it finds it more profitable to hire an altruistic employee.

[13]The term multiplied by α can be negative because by hiring an altruistic employee, the price charged by the public firm is reduced and this has a negative impact on revenues. However, an altruistic employee also receives a lower wage for a given level of effort and this leads to an increase in revenues. The negative impact outweighs the positive when t is sufficiently high. Note that when t is high also the term multiplied by $(1-\alpha)$ increases and becomes more positive.

Second, the difference between equation (A20) and equation (A29) is:

$$\pi_B^{MM} - \pi_B^{SM} = \alpha\left[\overline{\theta} d_B^{SS}\left(\frac{3\beta t^2}{2(6\beta t-1-\beta)} - \frac{3}{2}t\right) + \beta p_B^{SS}\left(1 - \frac{3\overline{\theta} t^2}{2(6\beta t-1-\beta)}\right)\left(\frac{3\overline{\theta} t}{2(6\beta t-1-\beta)}\right)\right] + \\ +\alpha\left(w_B^{SM} - w_B^{MM}\right) + (1-\alpha)\left[\overline{U}_A^{MM} + \overline{U}_B^{MM} + \overline{U}_A^{MS} + \overline{U}_B^{SM}\right] > 0.$$

Again, the term multiplied by $(1-\alpha)$ is always positive and sufficiently high to outweigh the term multiplied by α that conversely can be negative when t is high enough.

Consider now the private firm and its best response to the choice of firm B. Anticipating that the public firm is always better off by hiring an altruistic employee, the private firm has only to compare π_A^{SM} with π_A^{MM}. In particular, $\pi_A^{SM} > \pi_A^{MM}$ if

$$\left(p_A^{SS} - \frac{3\beta t^2}{2(6\beta t-1-\beta)}\overline{\theta}\right)\left(d_A^{SS} - \frac{3\beta t}{2(6\beta t-1-\beta)}\overline{\theta}\right) > \left(p_A^{SS} - \frac{3t}{2}\overline{\theta}\right) d_A^{SS} + \overline{\theta} U_A^{MM}.$$

By deriving both sides with respect to t, I find that the left-hand side is increasing in t, whereas the right-hand side is decreasing in t. Therefore, there exists a threshold value of t (denoted by $\tilde{t}$) above which $\pi_A^{SM} > \pi_A^{MM}$. □

B.6 Proof of Proposition 2

If $t \leq \tilde{t}$, both firms hire the altruistic employees. Then, the proof of Lemma 2 directly comes from the results in Subsection B.2. □

B.7 Proof of Proposition 3

If $t > \tilde{t}$, only the public firm hires an altruistic employee. Then, the proof of Lemma 3 directly comes from the results in Subsection B.4. □

B.8 Proof of Remark 1

Each firm hires an altruistic employee and maximizes its profits:

$$\begin{aligned} \pi_A &= p_A\left[\frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t}\right] - \omega_A, \\ \pi_B &= p_B\left[\frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t}\right] - \omega_B, \end{aligned} \tag{A39}$$

subject to the agents' participation constraints:

$$\omega_A - \frac{1}{2}q_A^2 + \overline{\theta}\,\overline{U}_A \geq 0; \quad \omega_B - \frac{1}{2}q_B^2 + \overline{\theta}\,\overline{U}_B \geq 0.$$

The altruistic employee also cares about the well-being of the average customer buying the product from his firm:

$$\overline{U}_A = \overline{v} + q_A - p_A - \frac{t}{2}d_A; \quad \overline{U}_B = \overline{v} + q_B - p_B - \frac{t}{2}d_B$$

Principal i will set the lowest wage which satisfies the participation constraint:

$$w_i = \frac{1}{2}q_i^2 - \overline{\theta}\left(\overline{v} + q_i - p_i - \frac{t}{2}d_i\right) \quad \text{with} \quad i = A, B. \tag{A40}$$

Then, profits can be rewritten as:

$$\begin{aligned}
\pi_A &= \left(p_A - \frac{t}{2}\overline{\theta}\right)\left[\frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t}\right] - \frac{1}{2}q_A^2 + \overline{\theta}\left(\overline{v} + q_A - p_A\right), \\
\pi_B &= \left(p_B - \frac{t}{2}\overline{\theta}\right)\left[\frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t}\right] - \frac{1}{2}q_B^2 + \overline{\theta}\left(\overline{v} + q_B - p_B\right).
\end{aligned} \tag{A41}$$

First order conditions:

$$\begin{aligned}
\frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t} - \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - \overline{\theta} = 0; \\
\frac{\partial \pi_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t} - \frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - \overline{\theta} = 0; \\
\frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - q_A + \overline{\theta} = 0; \\
\frac{\partial \pi_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad \frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - q_B + \overline{\theta} = 0
\end{aligned} \tag{A42}$$

Solving the system of equations, I obtain the optimal quality and price levels:

$$q_A^{Pr} = q_B^{Pr} = \frac{1}{2}; \quad p_A^{Pr} = p_B^{Pr} = t - \frac{3}{2}t\,\overline{\theta}. \tag{A43}$$

The employees receive the following wage:

$$\omega_A^{Pr} = \omega_B^{Pr} = \frac{1}{8} - \overline{\theta}\left[\frac{1}{2}\left(2\overline{v} + 1 - 3t + 3t\overline{\theta}\right)\right]. \tag{A44}$$

Firms share the demand in the market: $d_A^{Pr} = d_B^{Pr} = \frac{1}{2}$, and each principal obtains the following profits by hiring an altruistic employee:

$$\pi_A^{Pr} = \pi_B^{Pr} = \frac{1}{2}\left(t - \frac{3}{2}t\,\overline{\theta}\right) - \frac{1}{8} + \overline{\theta}\left[\frac{1}{2}\left(2\overline{v} + 1 - 3t + 3t\overline{\theta}\right)\right]. \tag{A45}$$

$\square$

B.9 Proof of Proposition 4

Both public firms hire altruistic employees and maximize the following:

$$\begin{aligned}\pi_A =&\alpha\left[p_A\left(\frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t}\right) - \omega_A\right] + (1-\alpha)[\overline{U}_A + \overline{U}_B],\\ \pi_B =&\alpha\left[p_B\left(\frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t}\right) - \omega_B\right] + (1-\alpha)[\overline{U}_A + \overline{U}_B],\end{aligned} \tag{A46}$$

subject to the agents' participation constraints:

$$\omega_A - \frac{\beta}{2}q_A^2 + \overline{\theta}\,\overline{U}_A \geq 0; \quad \omega_B - \frac{\beta}{2}q_B^2 + \overline{\theta}\,\overline{U}_B \geq 0.$$

Both firms and employees care about the well-being of the average customer:

$$\overline{U}_A = \overline{v} + q_A - p_A - \frac{t}{2}d_A; \quad \overline{U}_B = \overline{v} + q_B - p_B - \frac{t}{2}d_B$$

Principal i will set the lowest wage which satisfies the participation constrain:

$$w_i = \frac{\beta}{2}q_i^2 - \overline{\theta}\left(\overline{v} + q_i - p_i - \frac{t}{2}d_i\right) \quad \text{with} \quad i = A, B. \tag{A47}$$

Then, firms' objective functions can be rewritten as:

$$\begin{aligned}\pi_A =&\alpha\left[\left(p_A - \frac{t}{2}\overline{\theta}\right)\left(\frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t}\right) - \frac{\beta}{2}q_A^2 + \overline{\theta}\left(\overline{v} + q_A - p_A\right)\right]\\ &+(1-\alpha)\left[2\overline{v} + q_A + q_B - p_A - p_B - \frac{t}{2}\right],\\ \pi_B =&\alpha\left[\left(p_B - \frac{t}{2}\overline{\theta}\right)\left(\frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t}\right) - \frac{\beta}{2}q_B^2 + \overline{\theta}\left(\overline{v} + q_B - p_B\right)\right]\\ &+(1-\alpha)\left[2\overline{v} + q_A + q_B - p_A - p_B - \frac{t}{2}\right].\end{aligned} \tag{A48}$$

First order conditions:

$$\begin{aligned}
\frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \alpha\left(\frac{1}{2} - \frac{p_A}{2t} + \frac{[q_A - q_B] + [p_B - p_A]}{2t} - \frac{3}{4}\overline{\theta}\right) + (1-\alpha) = 0;\\
\frac{\partial \pi_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \alpha\left(\frac{1}{2} - \frac{p_B}{2t} + \frac{[q_B - q_A] + [p_A - p_B]}{2t} - \frac{3}{4}\overline{\theta}\right) + (1-\alpha) = 0;\\
\frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \alpha\left(\frac{p_A}{2t} - \beta q_A + \frac{3}{4}\overline{\theta}\right) + (1-\alpha) = 0;\\
\frac{\partial \pi_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad \alpha\left(\frac{p_B}{2t} - \beta q_B + \frac{3}{4}\overline{\theta}\right) + (1-\alpha) = 0
\end{aligned} \tag{A49}$$

Solving the system of equations, I obtain the optimal quality and price levels:

$$q_A^{Pu} = q_B^{Pu} = \frac{1}{2\beta}; \qquad p_A^{Pu} = p_B^{Pu} = \frac{(3\alpha - 2)t}{\alpha} - \frac{3}{2}t\,\overline{\theta}. \tag{A50}$$

The employees receive the following wage:

$$\omega_A^{Pu} = \omega_B^{Pu} = \frac{1}{8\beta} - \overline{\theta}\left[\overline{v} + \frac{1}{2\beta} - \left(\frac{(3\alpha - 2)t}{\alpha} - \frac{3}{2}t\,\overline{\theta}\right) - \frac{t}{4}\right]. \tag{A51}$$

Firms share the demand in the market: $d_A^{Pu} = d_B^{Pu} = \frac{1}{2}$, and each firm obtains the following:

$$\begin{aligned}
\pi_i^{Pu} =& \alpha\left[\frac{(3\alpha - 2)t}{2\alpha} - \frac{3}{4}t\,\overline{\theta} - \frac{1}{8\beta} + \overline{\theta}\left(\overline{v} + \frac{1}{2\beta} - \left(\frac{(3\alpha - 2)t}{\alpha} - \frac{3}{2}t\,\overline{\theta}\right) - \frac{t}{4}\right)\right]\\
&+ (1-\alpha)\left[2\overline{v} + \frac{1}{\beta} - \frac{t}{2} - \frac{t(6\alpha - 4)}{\alpha} + 3t\,\overline{\theta}\right].
\end{aligned} \tag{A52}$$

□

B.10 Proof of Proposition 5

The proof of this proposition is already provided in the text.

□

B.11 Proof of Lemma 1 and Proposition 6

The customers' utility does not only depend on quality, but also on the price charged by the firm. The customers' utilities in firm A and firm B are respectively given by:

$$U_A = \int_0^{d_A} (\overline{v} + q_A - p_A - t d_A) d(x); \qquad U_B = \int_0^{1-d_A} (\overline{v} + q_B - p_B - t d_B) d(x).$$

When both firms maximize profits, they always hire altruistic employees and the customers' utilities in firm A and firm B are:

$$U_A^{Pr} = \frac{1}{4}(1 - 3t + 2\overline{v} + 3t\overline{\theta}); \quad U_B^{Pr} = \frac{1}{4}(1 - 3t + 2\overline{v} + 3t\overline{\theta}).$$

Then, the total customers' utility buying the service from firm A and firm B is given by the sum of U_A and U_B, and it is equal to:

$$U^{Pr} = \frac{1}{2}(1 - 3t + 2\overline{v}) + \frac{3t\overline{\theta}}{2}.$$

With profit constraints, the hiring decision and, consequently, the customers' utility depend on the degree of competition in the market. If competition is severe, firms hire altruistic employees. In this case, the customers' utilities in firm A and firm B are:

$$U_A^{MM} = [t\beta(5\alpha - 2) - \alpha]\varphi, \quad U_B^{MM} = [t(2 + \alpha) - \alpha]\beta\varphi,$$

where

$$\varphi = \left(\frac{1}{\alpha(6\beta t - 1 - \beta)}\right)\left(\frac{(2\beta t + \alpha - 5\alpha\beta t)(3t - 1) - \alpha(\overline{v} - 6\beta t\overline{v})}{\alpha(6\beta t - 1 - \beta)} + \frac{3}{2}t\overline{\theta}\right).$$

Then, the total customers' utility is equal to:

$$\begin{aligned}
U^{MM} =& [\alpha(6\beta t - 1 - \beta)]\varphi \\
=& \frac{(2\beta t + \alpha - 5\alpha\beta t)(3t - 1) - \alpha(\overline{v} - 6\beta t\overline{v})}{\alpha(6\beta t - 1 - \beta)} + \frac{3t\overline{\theta}}{2} \\
=& \frac{2\beta t(3t - 1)}{\alpha(6t\beta - 1 - \beta)} + \frac{(3t - 1)(1 - 5\beta t) - \overline{v}(1 - 6\beta t)}{(6t\beta - 1 - \beta)} + \frac{3t\overline{\theta}}{2}.
\end{aligned}$$

Denote by ΔU^{MM} the difference between U^{MM} and U^{Pr}, that is:

$$\Delta U^{MM} = \frac{(3t - 1)[4\beta t - \alpha(4\beta t - 1 + \beta)]}{2\alpha(6\beta t - 1 - \beta)}. \tag{A53}$$

This difference only depends on β, t, and α. More specifically, it is increasing in β and t, while it is decreasing in α, and for any values of the parameters is always non-negative. As a result, the customers' utility is always higher under mixed duopoly than when both firms maximize profits.

If competition is mild, only the public firm hires the motivated employee. In this case, the customers' utilities in firm A and firm B are:

$$U_A^{SM} = \Big[2[t\beta(5\alpha - 2) - \alpha] - 3\alpha\beta\overline{\theta}\Big]\phi, \quad U_B^{MS} = \Big[2\beta[(\alpha t + 2) - \alpha] + 3\alpha\beta t\overline{\theta}\Big]\phi,$$

where

$$\phi = \frac{(4\beta t + 2\alpha - 10\alpha\beta t^2 + 3\alpha\beta t\overline{\theta})(3t-1) - 2\alpha\overline{v}(1 + t\beta - 6\beta t)}{4\alpha^2(6\beta t - 1 - \beta)^2}$$

Then, the total customers' utility is equal to:

$$U^{SM} = \frac{2\beta t(3t-1)}{\alpha(6t\beta - 1 - \beta)} + \frac{(3t-1)(1-5\beta t) - \overline{v}(1-6\beta t)}{(6t\beta - 1 - \beta)} + \frac{3t(3t-1)\beta\overline{\theta}}{2(6t\beta - 1 - \beta)}.$$

Denote by ΔU^{SM} the difference between U^{SM} and U^{Pr}, that is:

$$\Delta U^{SM} = \frac{(3t-1)[4\beta t - \alpha(4\beta t - 1 + \beta)]}{2\alpha(6\beta t - 1 - \beta)} - \frac{3t(3\beta t - 1)\overline{\theta}}{2(6\beta t - 1 - \beta)}. \quad \text{(A54)}$$

The first term is the same as in equation (A53). Now, there is an additional term that negatively depends on $\overline{\theta}$. I find that customers' utility when both firms maximize profits is higher than the one obtained with profit-constraints if $\overline{\theta}$ is sufficiently high. □