Firms' Ownership, Employees' Altruism, and Product Market Competition*

Alessandro De Chiara† and Ester Manna ‡

January 10, 2022

Abstract

The paper considers profit-maximizing (or private) firms and socially-concerned (or public) firms that compete against each other on both prices and quality. In this setting, we study how product market competition affects firms' decision to hire altruistic or selfish employees. We show that public firms will always hire altruistic employees, whereas private firms will hire selfish employees only if (i) products are sufficiently differentiated and (ii) they compete against public firms. Lastly, we determine which market configuration is associated with the highest quality and the overall customers' utility. We find that mixed duopoly is more likely to be preferred when product market competition is tougher.

Keywords: Employees' motivation, Firms' ownership, Hiring Decision, Nationalization, Privatization, Vertical and Horizontal Differentiation.

JEL classifications: D03, D21, L13.

*We would like to thank the editor Angus Chu and two anonymous referees for their thoughtful and constructive comments. Both authors acknowledge the financial support of the Spanish Ministry through grant PID2020-114040RB-I00, the Ministerio de Economia y Competitividad and Fondo Europeo de Desarrollo Regional through grant ECO2016-78991-R, the Ministerio de Ciencia, Innovación y Universidades trough grant RTI2018-096155-B-I00, and the Government of Catalonia through grant 2014SGR493.

†Universitat de Barcelona, Department of Economics and Barcelona Economic Analysis Team (BEAT), Avinguda Diagonal 696, 08034, Barcelona, Spain. E-mail: aledechiara@ub.edu.

‡Professora Lectora Serra Húnter, Universitat de Barcelona and Barcelona Economic Analysis Team (BEAT), Avinguda Diagonal 696, 08034, Barcelona, Spain. E-mail: estermanna@ub.edu.

1 Introduction

Abundant experimental and empirical evidence shows 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". 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 they work for 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 fits the case of non-profits organizations or firms providing public good services, such as health care and education.[1] By using the German Socio-Economic Panel (GSOEP), Dur and Zoutenbier (2015) find that employees who work in the caring industries are significantly more altruistic than employees working in other sectors.[2] 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 firms that are heterogenous since they maximize different objective functions.[3] As an example, consider residential care services for the elderly that, in Europe, are provided by both the public and the private sector.[4]

In this paper, we consider a setting where private firms maximize profits, whereas public (i.e., state-owned) firms care about both profits and their customers' well-being. In doing so, we follow the extensive literature on socially concerned firms (see, among others, Kopel and Brand, 2012, Kopel et al., 2014, and Kopel and Putz, 2021). In this environment, we show how product market competition affects the firms' hiring decision between an altruistic and a selfish employee, and its ensuing effect on market outcomes. Ultimately, we are interested in determining the firms' optimal ownership structure (between nationalization, privatization, and mixed duopoly) as function of product market competition. We build a model in which firms compete against each other on prices and the quality of the service provided. 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

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

[2] The German Socio-Economic Panel data (GSOEP) is a representative panel study of the resident population in Germany. Dur and Zoutenbier (2015) classify as caring industries: Education and Sport, Health Service, Service Industries, Voluntary Church, and Private Household.

[3] In the 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 respect, our 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).

[4] Eurofound (2017) documents a great deal of heterogeneity in the provision of elderly care across European countries: private, for-profit provision is especially common in countries such as Germany and the UK, whereas public-sector provision is prevalent in Nordic countries.

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 customers' choice. For instance, the educational services provided by public and private schools may differ with respect to, among other things, their religious connotation, the offering of sports activities, and/or the primary language of instruction. To incorporate this aspect and model competition, we use a Hotelling framework where a public and a private firm compete to attract customers. In the model, each firm initially decides whether to hire an altruistic or a self-interested employee.

We find that the public firm always hires an altruistic employee, whereas the private firm will hire a selfish employee when services are sufficiently differentiated. To understand why, consider that altruistic employees limit the price that firms can charge to their customers. This is more detrimental to the private than to the public firm because the latter also cares about the customers' well-being. When 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 a self-interested employee. In contrast, when firms offer similar services, non-captive customers have alternative options and the private firm must hire an altruistic employee to attract these customers.

When both firms maximize profits or both firms are public, they always hire altruistic employees irrespective of the degree of competition in the market. Indeed, 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 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 critically impact on quality and customers' well-being. In the second part of the manuscript, we study under which market configuration (between full public or private provision, and mixed-duopoly) consumers are better off and aggregate quality is maximized. Consider first the case in which the public firm is more efficient than the private one. We find that consumers benefit from having a mixed duopoly environment. This is particularly the case when competition in the market is mild. In that case, only the public firm hires an altruistic employee and the increase in its quality offsets the reduction in the quality provided by the private firm. This result is obtained regardless of whether the social planner takes into account the aggregate quality in the market or the consumers' overall utility. Suppose that the public firm is instead less efficient than the private one. If so, our results differ depending of what the main objective of the social planner is. More specifically, if the social planner mostly cares about quality, our model suggests that consumers always benefit from the privatization of the public firm. In contrast, if the social planner maximizes the overall consumers' utility, privatization is desirable only if the public firm is particularly inefficient. When the difference in efficiency between the private and the public firm is not too high and competition among them is severe, consumers find it beneficial to have a mixed duopoly environment in which both firms hire altruistic employees. Interestingly, if competition is mild instead, consumers might prefer to have only public firms in the market. This is because the reduction in prices outweighs that in quality.

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 one key 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. Recently, Xu and Lee (2019) study the desirability of privatizing the public firm in a mixed duopoly model that allows for bilateral trade and assumes that the private firm is socially concerned. Differently from these papers, we 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.

Literature review. This paper is related to the strand of the economic literature on *psychological incentives* that considers the 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, employers can extract labor donations from motivated employees (see Francois and Vlassopoulos, 2008, for a survey).[5] 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, and Barigozzi and Burani, 2016). Differently from our paper, previous papers in the literature do not focus on the role played by competition between firms in affecting their 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). However, in both papers firms are homogenous in their objective functions even if they are perceived differently from the employees. Instead, in our model firms differ in their objective functions and this will be crucial in influencing their hiring decisions. Our paper is also related to those by Kosfeld and von Siemens (2009, 2011), and von Siemens and Kosfeld (2014) in which the authors study the self-selection of workers differing in their motivation to cooperate, considering team production and adverse selection. They find that workers sort into firms that either involve high bonus and no cooperation or no bonus and cooperation.[6]

[5] In a recent paper, Barigozzi and Manna (2020) show that the presence of envious employees in mission-oriented organizations limits the employer's ability to extract labor donation from motivated employees.

[6] Cerrone and Manna (2018) study how heterogeneity in intrinsic motivation affects the optimal contract offered to employees in teams.

Closely related to the current paper is Manna (2017). By using a Salop model, Manna (2017) shows that profit-maximizing firms always hire altruistic employees even when they would have been better off hiring selfish employees. In the current manuscript, we show that, in an environment where firms are heterogenous in their objective functions, different equilibria emerge depending on the degree of competition in the market. Considering competition between a profit-maximizing and a socially-concerned firm, our paper is related to Kopel and Brand (2012), Kopel et al. (2014), and particularly close to Kopel and Putz (2021). In this recent paper, Kopel and Putz (2021) study a duopoly market where a socially concerned firm hires an intrinsically motivated manager to compete against a profit-maximizing firm that is simply interested in maximizing compensation. They show that the socially concerned firm might prefer a flat wage for compensating its motivated manager rather than a variable bonus. Differently from this paper, the focus of our analysis is on the firms' hiring decision and optimal ownership structure.

Within the literature on the *effects of competition on managerial incentives*, our 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 unambiguously 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 agency costs. Similar to their paper, we 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 employees receive.

The paper is also related to the literature on *strategic delegation* (see among others Schelling, 1960, Vickers, 1985, Fershtman and Judd, 1987, and Sklivas, 1987). This literature shows that delegating authority over a strategic decision (e.g., price or quantity) to a manager can enable the firm to commit to a more or less aggressive competitive stance. Similarly, in our manuscript employers can hire altruistic employees to convince the rivals that they will pursue a more aggressive behavior: as such employees also care about the customers' utility, the employers will find it profitable to decrease the price and/or increase the quality. Thus, the choice of hiring altruistic or selfish employees serves as a commitment device. However, differently from this literature, the employees do not directly choose price or quality, but only carry out a productive task.

Outline. The remainder of the paper proceeds as follows. In Section 2 we present the set-up and in Section 3 we characterize the equilibrium of the model; in Section 4 we illustrate the conditions under which the privatization of the public firm increases quality and customers' well-being; in Section 5 we provide concluding remarks.

2 The model

There are three types of actors 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 two extremes of the Hotelling line. Each firm's owner hires an employee 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, we describe in detail the utility functions of each actor 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. $\overline{v} > 0$.[7] 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 product market competition is tough.

Firms. Without loss of generality, we assume that firm A is private and maximizes its profits, whereas firm B is public and does not only care about its profits, but also about the customers' utilities:

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

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

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 is commonly used in the large literature on socially concerned firms mentioned in the introduction and in the related literature.[8] The parameter $\alpha \in [0, 1]$ represents the weight that the public firm puts on

[7] The model is solved under the assumption that the market is covered. In particular, we assume that the parameter v is sufficiently high so that customers always obtain a non-negative utility from buying the service.

[8] Brekke et al. (2008, 2012) also adopt a similar objective function for hospitals as they have altruistic preferences towards their patients. Unlike our model, Brekke et al. (2012) also suppose that the public firm can keep only a fraction of its profits. In particular, they introduce a parameter δ that measures the degree to which the public firm is profit-constrained. A similar formalization is also used by Glaeser and

the consumers' well-being. If $\alpha = 0$ both firms are profit-maximizers, while if $\alpha > 0$ the public firm also cares about the well-being of the average customer buying the product from firm A and firm B denoted by $\overline{U}_A$ and $\overline{U}_B$:[9]

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

where $\tilde{x}$ is the location of the marginal consumer who is indifferent between firm A and firm B.

Employees. The employees are wealth constrained with zero initial wealth and have a reservation wage of zero. They have quadratic effort costs, which are observable to the employer. The exerted effort determines the quality of the services. Thus, the products are also *vertically differentiated*. Similarly to Delfgaauw and Dur (2008) and Manna (2017), quality q is normalized in such a way that it linearly depends on the employees' effort, that is assumed to be observable by the employer.

The key assumption of the model is that employees may have *altruistic* preferences towards their customers. The parameter θ measures the employees' altruism. There are two types of employees: self-interested employees with $\underline{\theta} = 0$ and altruistic (or motivated) employees with $\overline{\theta} > 0$, and their type is observable.[10] The employees' utility function consists of their own *egoistic payoff*, given by the difference between wage and effort costs, and their *altruistic payoff*. Therefore, the utility of an employee who works in firm A or in firm B is given, respectively, by the following:

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

where β_i represents the employees' cost of exerting effort by working in firm i. We can normalize $\beta_A = 1$ and set $\beta_B = \beta \in (0, 2)$. More details on this parameter, as well as the discussion of the key assumptions of the model, are provided in the next subsection.

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

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. Our main results would not qualitatively change if the public firm maximized a weighted function of its profits and customers' well-being. The weight the public firm attaches to consumers' well-being is exogenously given, whereas other authors endogenize this parameter and study its strategic choice by the firms' owners (e.g., see Planer-Friedrich and Sahm, 2020, and Bárcena-Ruiz and Sagasta, 2021).

[9]The employees' utilities are not included in the public firm's maximization problem. As there is complete information about the employees' types, the employers need not offer an information rent to the employees and the participation constraints bind. Therefore, employees' utilities are equal to 0.

[10]Throughout the paper, we will use the terms altruistic and motivated interchangeably.

The equilibrium concept we employ is that of subgame perfection. All the mathematical computations and proofs of the results are provided in the appendix.

2.1 Discussion of the assumptions of the model

Some assumptions of the model deserve a detailed discussion.

Altruistic employees. We assume that employees might care about their customers' well-being. 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 feel elated if they discover 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, workers in the leisure industry (e.g., recreation, entertainment, sports, tourism) who may find their job fulfilling if they succeed in improving the customers' experience.

It is also important to note that, in the current manuscript, 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. 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. In these papers non-profit organizations have a comparative advantage in hiring motivated workers.

Is the public firm more inefficient than the private? Some empirical papers provide evidence showing that the public firm is less efficient than the private one (see, for a survey, Megginson and Netter, 2001, and Kikeri and Nellis, 2002). In our model, this inefficiency would be reflected by the parameter $\beta \in [1, 2)$: in this case, the employees' cost of exerting effort is weakly higher in the public firm. This parameter could 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. However, we can also think of markets that can be served more efficiently by a public firm (e.g. natural monopolies). For this reason, our analysis also considers the case in which $\beta \in (0, 1)$. However, to guarantee that all the prices and quality levels provided by each firm are positive, the parameter β cannot be too low. All the assumptions on the parameters with their respective justifications are reported in the Appendix.

Public firm's objective function. In our model, a public firm maximizes its own profits and the utilities of all customers in the market. Therefore, what we define as a public firm is in fact a *socially-concerned firm* (in addition to the papers already cited in the introduction and

in the related literature, see, among others, Planer-Friedrich and Sahm, 2018, and Arya et al., 2019). Unlike a benevolent government, which may be interested in maximizing social welfare, we have in mind a local public agency that is in charge of providing educational or health-care services in a given area, or a non-profit organization. In these cases, the fact that this public firm does not internalize the rival's profits may be plausible. By caring about the surplus of all consumers, and not just about its own customers, our public firm is not customer-oriented in the sense of Planer-Friedrich and Sahm (2018). A justification for considering all consumers, and not only its own, is provided by Planer-Friedrich and Sahm (2018), which shows that when firms can endogenously choose their corporate culture (i.e., whether to care for all consumers or only for its own), they would prefer to care for all consumers. It is important to stress that the gist of our analysis would not be affected if only the utility of its own customers entered the public firm's objective function.

Firms compete on quality. After the hiring decision, firms compete against each other on prices and quality of the service provided. In the literature on health-care provision, the idea that hospitals compete on quality to attract patients is well-established. Indeed, one of the main objectives 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. Similarly, profit and non-profit organizations compete on both dimensions in the residential care market, where services can be highly differentiated and prices vary widely (e.g., for the UK see Forder and Allan, 2011).

Perfect competition in the labor market. The number of employees of each type is assumed to be at least equal to 2, so that there is perfect competition in the labor market. In this way, we abstract from potential problems concerning the firms' selection of employees with different degrees of altruism when they are in limited supply. This assumption allows us 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.

3 Firms' hiring decision and equilibrium outcome

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 choose price and quality to maximize equations (1) and (2), respectively, subject to the employees' participation constraint:

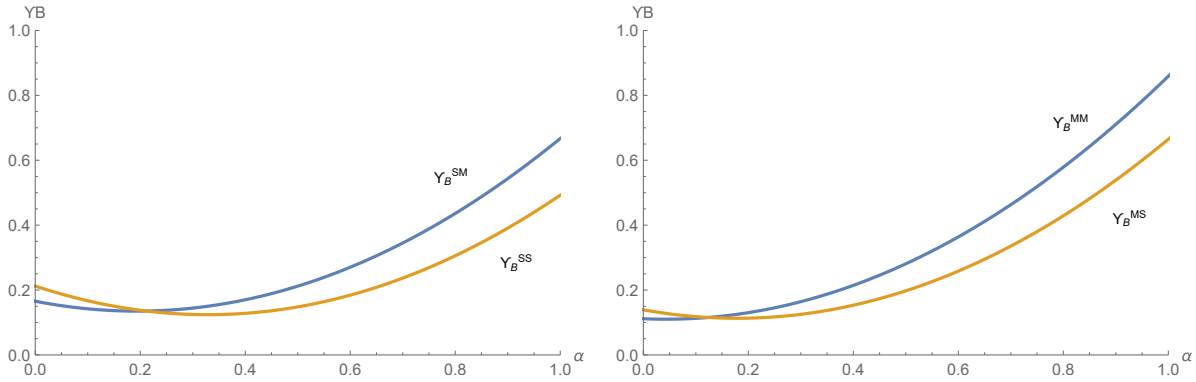
$$\begin{aligned} \omega_A - \frac{1}{2}q_A^2 + \theta_A \overline{U}_A(q_A, q_B, p_A, p_B) \geq 0; \\ \omega_B - \frac{\beta}{2}q_B^2 + \theta_B \overline{U}_B(q_A, q_B, p_A, p_B) \geq 0. \end{aligned} \tag{6}$$

Each firm's payoff when it employs an altruistic or a selfish employee is analyzed for any possible combination of types hired by the rival firm. This allows us to compare the firms' benefits and to analyze their hiring decision in Stage 1. To understand the intuition behind the firms' hiring decisions, it is useful to highlight the distinction and the similarities between private and public firms as well as between selfish and altruistic employees. Despite their different objectives, in stage 2 both the public and the private firm will offer a contract that leaves no rent to their chosen employee, that is, the participation constraints (6) will always bind in equilibrium. Being uninterested in the customer's wellbeing, a selfish employee can only be paid through the wage. Conversely, an altruistic employee can be compensated through a combination of wage and customers' surplus. Then, due to their shared interest in the customers' wellbeing, the public firm always finds it less costly to hire the altruistic employee as s/he can be compensated by increasing customers' surplus. More notably, whether the private firm also hires the altruistic employee hinges on the degree of competition in the market, which is captured in the model by the parameter t. Consider that, unlike the public firm, the private firm is willing to extract as much customers' surplus as it can. When competition is stiff (i.e., t is low), customers are not loyal to the closer firm, but will choose the one which offers more surplus via the pair (q, p), independently of their degree of inertia. Then, to avoid losing excessive business to the public firm, the private firm must compete in customers' surplus. If so, hiring altruistic employees becomes particularly attractive: the private firm must necessarily increase customers' surplus and, by doing so, it already compensates its altruistic employee for the effort provided. By contrast, when competition is mild (i.e., t is high), customers' decisions are mostly driven by their proximity to the firms. Thus, because of customers' inertia, the private firm prefers to hire the selfish employee: since the firm leaves little surplus to customers, the altruistic employee would be paid mostly with the wage. Although the altruistic employee would request a lower salary than the self-interested employee to deliver the same quality-price pair (q, p), the public firm would react to the private firm's choice of hiring an altruistic employee by raising customers' surplus. Consequently, the private firm must raise quality and lower the price whenever it hires an altruistic employee. Lemma 1 shows that the public firm will hire an altruistic employee whenever it is sufficiently socially concerned.

Lemma 1. *There exists a threshold level of $\alpha < 1$ above which hiring an altruistic employee is always a dominant strategy for a public firm.*

Irrespective of the private firm's hiring decision, the public firm always prefers to hire an altruistic employee, unless α is very low. Both the public firm and the altruistic employee care about the customers' well-being. As α increases, their preferences are more aligned and the public firm always benefits from hiring him. This result is illustrated in the next figures in which we compare public firm's benefits as functions of α when: (i) only the public firm hires the altruistic employee (blue curve) with respect to the case in which both firms hire selfish employees (orange curve), see the first graph in Figure 1; (ii) both firms hire the altruistic employee (blue curve) with respect to the case in which only the private firm does (orange curve), see the second graph in Figure 1. It is worth observing that public firm's benefits are increasing in α. Moreover, the blue curves are steeper than the orange ones, meaning that an increase in α has a stronger positive impact on public firm's benefits in the case in which it hires the altruistic employee. In both figures, the parameters take the following values: $t = 0.7$, $\overline{\theta} = 0.2$, $\overline{v} = 0.2$, and $\beta = 1.2$. Note that, for these values of the parameters, the blue curves are above the orange curves when $\alpha > 0.212$ (first graph) and when $\alpha > 0.124$ (second graph).

Figure 1: Comparison public firm's benefits as functions of α. The superscripts SM, SS, MS, MM refer to the four possible scenarios. More specifically, the first (resp. second) letter indicates the private (resp. public) firm's hiring decision between a selfish and a motivated employee. The parameters take the following values: $t = 0.7$, $\overline{\theta} = 0.2$, $\overline{v} = 0.2$, and $\beta = 1.2$.



The private firm makes its hiring decision, knowing that the public firm will always hire the altruistic employee as it is socially concerned. We find that 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. These results are summarized in Proposition 1 which illustrates the solution of the subgame perfect equilibrium

of the game.[11]

Proposition 1. *There exists a threshold value of t, denoted $\tilde{t}$, which is lower than 1 and 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.*

In the next subsection, we study how the different exogenous parameters affect the optimal levels of quality, demand, and price set by both firms in these possible scenarios.

3.1 Impact on market outcomes

We first consider the case in which market competition is fierce ($t \leq \tilde{t}$) and both firms hire altruistic (or motivated) employees. The superscript MM describes this equilibrium. In this case, we find that firms choose the following quality levels:

$$q_A^{MM} = \frac{3\beta t - 1 - 2\alpha\beta t}{6\beta t - 1 - \beta}; \quad q_B^{MM} = \frac{3t - 1 + 2\alpha t}{6\beta t - 1 - \beta}; \tag{7}$$

and they set the following prices:

$$p_A^{MM} = 2t\left(\frac{3\beta t - 1 - 2\alpha\beta t}{6\beta t - 1 - \beta}\right) - \frac{3}{2}\overline{\theta}t; \quad p_B^{MM} = 2t\left(\frac{\beta(3t-1) - \alpha(4\beta t - 1 - \beta)}{6\beta t - 1 - \beta}\right) - \frac{3}{2}\overline{\theta}t. \tag{8}$$

We also find that the private firm's demand coincides with its quality, whereas the public firm's demand is equal to its quality multiplied by the parameter β.

It is interesting to highlight that an increase in the employees' degree of altruism $\overline{\theta}$ does not affect quality and demand levels. Since (i) both firms follow the same hiring strategy at the equilibrium and (ii) demand is constant, firms cannot win additional customers by hiring altruistic employees. For this reason, 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.[12] 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.

[11] Somewhat in line with our results, Leong and Yang (2020) empirically find that a higher degree of product market competition improves firms' social performance.

[12] As in all settings prices decrease in $\overline{\theta}$, this parameter cannot be to large to guarantee that prices do not take negative values (see Assumption 1 in the appendix).

When both firms maximize profits ($\alpha = 0$) 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. However, as α increases so that the public firm becomes more socially concerned, the quality provided by the public (private) firm increases (decreases), and so does its demand. This is because the public firm's concern about the customer's well-being leads to an increase in its quality and, consequently, in its demand. In contrast, even if the private firm hires an altruistic employee, an increase in α negatively affects its quality and demand. Moreover, an increase in α has a negative impact on the prices charged by both the public and the private firms. The public firm reduces the price for its service as it partially internalizes its negative effect on its own customers' well-being. But then the private firm is also forced to reduce its price to attract customers.

If the public firm becomes more inefficient (a higher β), its quality decreases, while the quality of its competitor increases. It is also interesting to show that the quality provided by the private firm is higher than the one provided by the public firm if $\beta > \frac{3+2\alpha}{3-2\alpha}$. This inequality is more difficult to satisfy as α increases. A higher quality for the private firm leads to a higher demand and allows the private firm to set a higher price. Conversely, both the demand and the price set by the public firm decrease in β.

Lastly, an increase in t reduces the competition between firms leading to an increase in both prices. It also affects positively the quality provided by the private firm, while it decreases the one provided by the public firm.

We now analyze the case in which market competition is mild ($t > \tilde{t}$) and the public firm hires the altruistic (or motivated) employee. The superscript SM describes this equilibrium. In this case, we find that firms choose the following quality levels:

$$q_A^{SM} = q_A^{MM} - \frac{3\beta\overline{\theta}t}{2(6\beta t - 1 - \beta)}; \quad q_B^{SM} = q_B^{MM} + \frac{3\overline{\theta}t}{2(6\beta t - 1 - \beta)}; \tag{9}$$

and they set the following prices:

$$p_A^{SM} = p_A^{MM} + \frac{3\overline{\theta}t(4\beta t - 1 - \beta)}{2(6\beta t - 1 - \beta)}; \quad p_B^{SM} = p_B^{MM} + \frac{3\beta\overline{\theta}t^2}{6\beta t - 1 - \beta}. \tag{10}$$

We again find that the private firm's demand coincides with its quality, whereas the public firm's demand is equal to its quality multiplied by the parameter β.

Quality levels and demands now also depend 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 firm pays a lower wage to its employee reducing the costs. At the same time, a higher $\overline{\theta}$ reduces both the price charged by the private and the public firm, leading to a reduction in total revenues. 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 a selfish employee when t is sufficiently high.

3.2 Other market configurations

In this subsection, we study the firms' hiring decisions and we characterize the equilibrium of the model under two alternative market configurations: when both firms are private and when they are both public, respectively. We highlight how firms will always end up hiring altruistic employees under these different scenarios, in one occurrence to their common detriment.

3.2.1 Both firms are profit-maximizers

We begin by studying the firms' hiring decision when both firms are profit-maximizers. We find that regardless of whether the rival firm hires an altruistic or a selfish employee, each firm always prefers to hire an altruistic employee. The intuition is the following. Suppose that both firms were employing self-interested employees. 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 employee. Intuitively, an employer could pay a lower salary to an altruistic 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. We denote by the superscript Pr this scenario in which both firms are private.

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 realized profits are:

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

As the above remark shows, the employees' altruism affects neither quality nor demand, whilst 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. The effect on profits of the price reduction outweighs that of the wage reduction when t is sufficiently high. In that case, firms are trapped in a prisoners' dilemma as they end up hiring the altruistic employees even if they would have been better off by hiring the selfish

ones.

3.2.2 Both firms are public

We now characterize the equilibrium of the model when both firms are public. The result is illustrated in Remark 2, where the superscript Pu refers to this scenario.

Remark 2. *When both firms are public, there is a unique and symmetric subgame perfect equilibrium in which each firm hires an altruistic employee, sets:*

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

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 realized benefits are:

$$\Upsilon_i^{Pu} = \frac{t}{2} - \frac{1}{8\beta} + \overline{\theta}\left[\overline{v} + \frac{1}{2}\beta - 2t(1-\alpha) + \frac{3}{2}t\overline{\theta}\right] + \alpha\left[2\overline{v} + \frac{1}{\beta} - t\left(\frac{7}{2} - 4\alpha - 3\overline{\theta}\right)\right].$$

Similarly to the previous case where both firms maximize profits, Remark 2 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.[13] 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 employee must exert, and indirectly, as it impacts on the customers' utility about which the altruistic employee cares. In contrast, price only affects the employee'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, instead of increasing quality keeping the price constant, because providing more quality is more expensive as it requires more effort.

4 Privatization, nationalization, or mixed duopoly?

The objective of this section is to study whether and under which circumstances customers may benefit from the privatization of the public firm or the nationalization of the private firm. The debate over the public and private provision of goods and services in sectors such as healthcare and education is always very heated. For instance, in the wake of the Covid-19 crisis and the alleged mismanagement of patients in residential care homes in the UK there are renewed calls for nationalizing the service, which is currently primarily run by private providers.[14] We determine which market configuration is associated with the highest product quality provided in the market (Subsection 4.1), and with the highest total customers' utility (Subsection 4.2).

[13] When both firms are public, the price also depends negatively on the parameter α. Notice that the degree of altruism must be below a certain threshold so that prices are non-negative, i.e. $\overline{\theta} < \frac{2(1-2\alpha)}{3}$. In the case in which $\overline{\theta}$ is higher than this ratio, the price is set equal to 0.

[14] E.g., see "*The lesson of the Covid-19 care homes tragedy: renationalising is no longer taboo*" in The Guardian on July 6, 2020.

4.1 Quality, competition, and market configuration

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.[15] Differently from their paper, in our model the quality provided by each firm depends on the effort exerted by the employees which is affected by their type. Whether the private firm decides to hire altruistic or selfish employees crucially depends on the degree of competition in the market. If competition is tough, both firms hire altruistic 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:

$$\begin{aligned} Q^{MM} =& \frac{3t(1+\beta) - 2[1+(\beta-1)\alpha t]}{\alpha(6t\beta - 1 - \beta)}; \\ Q^{SM} =& Q^{MM} - \frac{3\bar{\theta}t(\beta-1)}{2(6\beta t - 1 - \beta)}. \end{aligned} \tag{11}$$

If both firms are public (respectively, private), aggregate quality is $Q^{Pu} = \frac{1}{\beta}$ ($Q^{Pr} = 1$). First of all, it is possible to observe that if $\beta = 1$ aggregate levels are equal to 1, regardless of the market configuration. Now, consider the case in which the public firm is more inefficient than the private one, i.e., $\beta > 1$. In that case, both aggregate levels are lower than 1 and $Q^{MM} > Q^{SM}$. Conversely, if the public firm is more efficient than the private, both aggregate levels are higher than 1 and $Q^{SM} > Q^{MM}$. This is because when $\beta < 1$ the increase in the quality provided by the public firm from hiring the altruistic employee outweighs the reduction in the quality provided by the private firm.

We also compare these aggregate levels with the one obtained when both firms are public (denoted Q^{Pu}) and we summarize our results in Lemma 2.

Lemma 2. *We can rank aggregate quality levels as follows:*

(i) *If* $\beta = 1$, $Q^{SM} = Q^{MM} = Q^{Pu} = Q^{Pr}$.

(ii) *If* $\beta < 1$, $Q^{SM} > Q^{MM} > Q^{Pu} > Q^{Pr}$.

(iii) *If* $\beta > 1$, $Q^{Pr} > Q^{MM} > Q^{SM} \geq Q^{Pu}$.

In a nutshell, if a social planner mostly care about the quality of the service provided in the market, her policy prescription should be to: (i) allow private and public firms to compete in the market when the public firm is more efficient than the private. Consumers will benefit from having mixed duopoly particularly when product market competition is mild. In that case, only

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

the public firm hires the altruistic employee and the increase in its quality offsets the reduction in the quality provided by the private firm; (ii) privatize the public sector when the public firm is less efficient than the private one, as by doing so consumers are never worse off. In this case, if the social planner wants to have both types of firms in the market, consumers would be better off when competition in the market is severe so that both firms hire altruistic employees.

Figure 2 illustrates the aggregate quality levels in the different settings as functions of β, whereas Proposition 2 summarizes the key results of the analysis.

Proposition 2. *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 $\beta > 1$, it is socially desirable to privatize the public firm, particularly when $\overline{\theta}$ is high.

(iii) If $\beta < 1$, it is socially desirable to have both the public and the private firms competing in the market. Consumers are better off when competition between firms is mild.

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 when at least one firm is public 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 when $\beta > 1$ an increase in $\overline{\theta}$ only negatively affects Q^{SM}, that is the aggregate quality under mixed duopoly when market competition is mild. When the public firm is more efficient than the private firm, i.e., $\beta < 1$, aggregate quality is very high under mixed duopoly. Interestingly, consumers are better off in an environment in which both types of firms are active, competition among them is mild, as in this case $Q^{SM} > Q^{MM}$, and the public firm is not too socially concerned. The result that competition between the public and private sector may improve service quality has some empirical support: Bergman et al. (2016) find that allowing private firms to provide nursing-home care for the elderly lowered mortality rate (an indicator of non-contractible quality commonly used as performance indicator in the healthcare literature) in Sweden, thanks to the associated increase in competition.

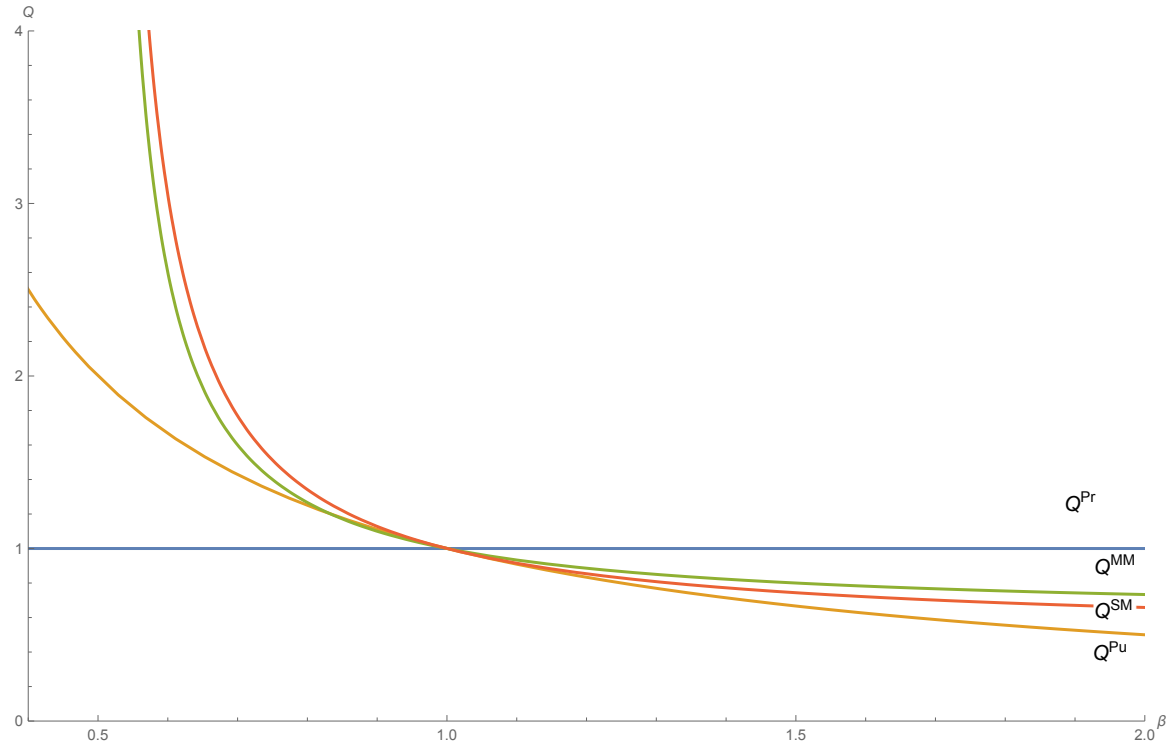
4.2 Customers' well-being, competition, and market configuration

In this section, we briefly analyze how the results of the previous subsection would change if the social planner considered the overall customers' utility:

$$\int_0^{d_A} (\overline{v} + q_A - p_A - td_A)dx + \int_0^{d_B} (\overline{v} + q_B - p_B - td_B)dx. \tag{12}$$

In addition to quality, the social planner now also cares about the price charged by each firm in the market. As the price is very low when both firms are public, we can expect that consumers can benefit from the nationalization of the private firm. Indeed, we find that, whenever $\beta \leq 1$,

Figure 2: Ranking of aggregate quality levels with $\alpha = 0.3$, $t = 0.6$, and $\overline{\theta} = 0.3$.



consumers' utility is always higher under full public provision than under full private provision. To see this result, note that:

$$\begin{aligned} U^{Pr} =& \overline{v} + \frac{1}{2} - \frac{3}{2}t(1-\overline{\theta}); \\ U^{Pu} =& \overline{v} + \frac{1}{2\beta} - \frac{3}{2}t(1-\overline{\theta}) + 2\alpha t. \end{aligned} \tag{13}$$

It is simple to observe that $U^{Pu} > U^{Pr}$ if $\beta \leq \frac{1}{1-4t\alpha}$ and this is always the case whenever $\beta \leq 1$. However, even if the price set in the market when both firms are public is lower than the one set by the private firms, when the private firm is sufficiently more efficient than the public firm, the positive effect on quality provided by the private firms can offset this negative impact on prices. By comparing the two previous equations, it is also worth highlighting that full public provision is preferable if t and/or α are sufficiently high. Henceforth, we denote by t' the value of t such that $U^{Pu} = U^{Pr}$.

We now compare the customers' utilities in equation (13) with those obtained under mixed duopoly, which can be written in the following way:

$$\begin{aligned} U^{MM} =& \overline{v} + q_A^{MM}\left[q_A^{MM}\left(\frac{2-t}{2}\right) - p_A^{MM}\right] + \beta q_B^{MM}\left[q_B^{MM}\left(\frac{2-t\beta}{2}\right) - p_B^{MM}\theta\right]; \\ U^{SM} =& \overline{v} + q_A^{SM}\left[q_A^{SM}\left(\frac{2-t}{2}\right) - p_A^{SM}\right] + \beta q_B^{SM}\left[q_B^{SM}\left(\frac{2-t\beta}{2}\right) - p_B^{SM}\theta\right]. \end{aligned} \tag{14}$$

Firstly, note that when we compare U^{MM} with U^{SM} our results are very similar to those obtained when we compare aggregate quality levels in these two settings. More specifically, we

find that there exists a threshold value of β above which $U^{MM} > U^{SM}$, but this threshold is now always lower than 1. This is because, in addition to the effect on quality described in the previous subsection, it holds that $p_A^{MM} < p_A^{SM}$ and $p_B^{MM} < p_B^{SM}$ (these results can be simply shown from comparing equations (8) and (10)). This implies that the setting in which both firms hire altruistic employees is more likely to be preferred by consumers now that we also take into account the prices set by the firms. Secondly, whether the consumers' utility under full public provision is higher than those obtained under these two alternative settings of mixed duopoly depends on the degree of market competition t. In particular, we find that full public provision is preferred by consumers when t is high enough. In the next remark we summarize the main result of the analysis when $\beta \leq 1$.

Remark 3. *Suppose $\beta \leq 1$. There exists a threshold value of t, denoted by $\hat{t}$, such that the market configuration that most benefits consumers is:*

(i) a mixed duopoly if $t \leq \hat{t}$;

(ii) full public provision if $t > \hat{t}$.

Irrespective of whether the threshold value $\hat{t}$ is lower or higher than the threshold value $\tilde{t}$, found in Proposition 1, when $t \leq \hat{t}$ customers benefits from having both private and public firms in the market. We can distinguish between two cases, though: (i) If $\hat{t} \leq \tilde{t}$, then when $t \leq \hat{t}$ there is a mixed duopoly in which both firms hire altruistic employees; (ii) If $\hat{t} > \tilde{t}$, then when $t \leq \tilde{t}$ there is a mixed duopoly in which both firms hire altruistic employees, whereas when $t \in (\tilde{t}, \hat{t}]$ there is a mixed duopoly in which only the public firm hires the altruistic employee. Conversely, when competition in the market is mild, *i.e.*, $t > \hat{t}$, consumers benefit from the nationalization of the private firm and this is particularly the case as α takes higher values.

We now turn to the case in which the private firm is relatively more efficient than the public firm, i.e., $\beta > 1$. An increase in β has two effects: (i) it has a positive impact on both $\hat{t}$ and t' shrinking the region in which full public provision is preferred; (ii) it makes that privatization might be beneficial for customers, as shown in the following remark.

Remark 4. *Suppose $\beta > 1$. The market configuration that most benefits consumers is:*

(i) a mixed duopoly or full private provision if $t \leq \max\{\hat{t}, t'\}$;

(ii) full public provision if $t > \max\{\hat{t}, t'\}$.

If the products are sufficiently differentiated so that t is above the two thresholds $\hat{t}$ and t', full public provision is again the one that most benefits customers. Now, consider the case in which $t \leq \max\{\hat{t}, t'\}$. We find that U^{MM} is always greater than the customers' utility under full private provision, whereas U^{SM} can be lower than U^{Pr} when β is sufficiently high. Therefore, we can distinguish between two cases: (i) If $\max\{\hat{t}, t'\} \leq \tilde{t}$, then when $t \leq \max\{\hat{t}, t'\}$ there is a mixed duopoly in which both firms hire altruistic employees; (ii) If $\max\{\hat{t}, t'\} > \tilde{t}$, then when $t \leq \tilde{t}$ there is a mixed duopoly in which both firms hire altruistic employees, whereas when $t \in \left(\tilde{t}, \max\{\hat{t}, t'\}\right]$ there is either a mixed duopoly in which only the public firm hires the altruistic employee or full private provision depending on β. In general, we can conclude that as β increases customers benefit from privatizing at least one of the public firms.

5 Conclusions

This paper investigates how product market competition impacts on firms' hiring decision in a mixed duopoly environment, and how their interaction impacts on market outcomes. We have shown 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 for the product or service, 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. It is important to stress that the private firm will always hire an altruistic employee if it competes with another private firm. By doing so, quality in the market increases and, as a result, it might be socially desirable to privatize the public firm. This is always the case when the public firm is more inefficient than the private and the social planner cares about the aggregate quality provided in the market. If instead the social planner cares about the overall customers' utility, this is indeed the case only if the public firm is much more inefficient than the private firm. If the difference in efficiency between the two firms is not too large and competition among them is severe, consumers benefit from having a mixed duopoly environment in which both firms hire altruistic employees. Interestingly, if competition is mild instead, consumers might prefer to have only public firms in the market. This is because the reduction in prices outweighs that in quality. Finally, if the public firm is more efficient than the private firm, it is always socially desirable to have both the public and the private firms active in the market. This is particularly the case when competition in the market is mild. This result is obtained regardless of what is the objective function of the social planner.

One last remark is in order: In the model, we have assumed away information frictions, namely, the employer can perfectly observe the employees' degree of altruism and the amount of effort he puts in. As a result, it is only because of competitive pressure that the private firm may prefer not to hire the altruistic employee, although he requests a lower wage to carry out a productive task. In a sense, there is a link with a strand of the literature in behavioral economics highlighting counterintuitive results in contexts of complete information. A prominent example is Dur and Glazer (2008) who demonstrate that an envious risk-averse agent may optimally bear some risk, although the risk-neutral principal can observe his type and verify his level of effort.

References

Arrow, K. J., 1963. Uncertainty and the welfare economics of medical care. American Economic Review 53, 941–969.

Arya, A., Mittendorf, B., Ramanan, R. N., 2019. Beyond profits: The rise of dual-purpose organizations and its consequences for disclosure. The Accounting Review 94 (1), 25–43.

Baggs, J., De Bettignies, J.-E., 2007. Product market competition and agency costs. The Journal of Industrial Economics 55 (2), 289–323.

Bárcena-Ruiz, J. C., Sagasta, A., 2021. Environmental policies with consumer-friendly firms and cross-ownership. Economic Modelling 103, 105612.

Barigozzi, F., Burani, N., 2016. Screening workers for ability and motivation. Oxford Economic Papers 68 (2), 627–650.

Barigozzi, F., Burani, N., 2019. Competition for talent when firms' mission matters. Games and Economic Behavior 116 (1), 128–151.

Barigozzi, F., Ma, C.-t. A., 2018. Product differentiation with multiple qualities. International Journal of Industrial Organization 61, 380–412.

Barigozzi, F., Manna, E., 2020. Envy in mission-oriented organisations. Journal of Economic Behavior & Organization 179, 395–424.

Barros, P., Siciliani, L., 2012. Public and private sector interface. Handbook of Health Economics 2, 927–1002.

Bénabou, R., Tirole, J., 2016. Bonus culture: Competitive pay, screening, and multitasking. Journal of Political Economy 124 (2), 305–370.

Bergman, M. A., Johansson, P., Lundberg, S., Spagnolo, G., 2016. Privatization and quality: Evidence from elderly care in sweden. Journal of Health Economics 49, 109–119.

Besley, T., Ghatak, M., 2005. Competition and incentives with motivated agents. The American economic review 95 (3), 616–636.

Biglaiser, G., Ma, A. C.-t., 2007. Moonlighting: public service and private practice. The RAND Journal of Economics 38 (4), 1113–1133.

Bond, P., Glode, V., 2014. The labor market for bankers and regulators. The Review of Financial Studies 27 (9), 2539–2579.

Brekke, K. A., Nyborg, K., 2008. Attracting responsible employees: Green production as labor market screening. Resource and Energy Economics 30 (4), 509–526.

Brekke, K. A., Nyborg, K., 2010. Selfish bakers, caring nurses? a model of work motivation. Journal of Economic Behavior & Organization 75 (3), 377–394.

Brekke, K. R., Siciliani, L., Straume, O. R., 2008. Competition and waiting times in hospital markets. Journal of Public Economics 92 (7), 1607–1628.

Brekke, K. R., Siciliani, L., Straume, O. R., 2012. Quality competition with profit constraints. Journal of Economic Behavior & Organization 84 (2), 642–659.

Buurman, M., Delfgaauw, J., Dur, R., Van den Bossche, S., 2012. Public sector employees: Risk averse and altruistic? Journal of Economic Behavior & Organization 83 (3), 279–291.

Cerrone, C., Manna, E., 2018. Pay for performance with motivated employees. The BE Journal of Economic Analysis & Policy 18 (1), 1–8.

Charness, G., Cobo-Reyes, R., Sánchez, Á., 2016. The effect of charitable giving on workers' performance: Experimental evidence. Journal of Economic Behavior & Organization 131, 61–74.

Delfgaauw, J., Dur, R., 2008. Incentives and workers' motivation in the public sector. The Economic Journal 118 (525), 171–191.

Delfgaauw, J., Dur, R., 2010. Managerial talent, motivation, and self-selection into public management. Journal of Public Economics 94 (9-10), 654–660.

Dur, R., Glazer, A., 2008. Optimal contracts when a worker envies his boss. The Journal of Law, Economics, & Organization 24 (1), 120–137.

Dur, R., van Lent, M., 2018. Serving the public interest in several ways: Theory and empirics. Labour Economics 51, 13–24.

Dur, R., Zoutenbier, R., 2014. Working for a good cause. Public Administration Review 74 (2), 144–155.

Dur, R., Zoutenbier, R., 2015. Intrinsic motivations of public sector employees: Evidence for germany. German Economic Review 16 (3), 343–366.

Ellis, R. P., McGuire, T. G., 1986. Provider behavior under prospective reimbursement: Cost sharing and supply. Journal of health economics 5 (2), 129–151.

Eurofound, 2017. Care homes for older Europeans: Public, for-profit and non-profit providers. Publications Office of the European Union, , Luxembourg.

Fehr, E., Schmidt, K. M., 2006. The economics of fairness, reciprocity and altruism–experimental evidence and new theories. Handbook of the economics of giving, altruism and reciprocity 1, 615–691.

Fershtman, C., Judd, K. L., 1987. Equilibrium incentives in oligopoly. The American Economic Review, 927–940.

Forder, J. E., Allan, S., 2011. Competition in the care homes market. report for the OHE Commission on Competition in the NHS.

Fraja, G., Delbono, F., 1990. Game theoretic models of mixed oligopoly. Journal of Economic Surveys 4 (1), 1–17.

Francois, P., 2000. Public service motivation as an argument for government provision. Journal of Public Economics 78 (3), 275–299.

Francois, P., 2007. Making a difference. The RAND Journal of Economics 38 (3), 714–732.

Francois, P., Vlassopoulos, M., 2008. Pro-social motivation and the delivery of social services. CESifo Economic Studies 54 (1), 22–54.

Ghatak, M., Mueller, H., 2011. Thanks for nothing? not-for-profits and motivated agents. Journal of Public Economics 95 (1), 94–105.

Glaeser, E. L., Shleifer, A., 2001. Not-for-profit entrepreneurs. Journal of public economics 81 (1), 99–115.

Glazer, A., 2004. Motivating devoted workers. International Journal of Industrial Organization 22 (3), 427–440.

Heyes, A., 2005. The economics of vocation or 'why is a badly paid nurse a good nurse'? Journal of health economics 24 (3), 561–569.

Hotelling, H., 1929. Stability in competition. The Economic Journal 39 (153), 41–57.

Imas, A., 2014. Working for the "warm glow": On the benefits and limits of prosocial incentives. Journal of Public Economics 114, 14–18.

Ishibashi, K., Kaneko, T., 2008. Partial privatization in mixed duopoly with price and quality competition. Journal of Economics 95 (3), 213–231.

Jaimovich, E., Rud, J. P., 2014. Excessive public employment and rent-seeking traps. Journal of Development Economics 106, 144–155.

Kikeri, S., Nellis, J., 2002. Privatization in competitive sectors. World Bank Policy Research Working Paper.

Konow, J., 2010. Mixed feelings: Theories of and evidence on giving. Journal of Public Economics 94 (3), 279–297.

Kopel, M., Brand, B., 2012. Socially responsible firms and endogenous choice of strategic incentives. Economic Modelling 29 (3), 982–989.

Kopel, M., Lamantia, F., Szidarovszky, F., 2014. Evolutionary competition in a mixed market with socially concerned firms. Journal of Economic Dynamics and Control 48, 394–409.

Kopel, M., Putz, E. M., 2021. Why socially concerned firms use low-powered managerial incentives: A complementary explanation. Economic Modelling 94, 473–482.

Kosfeld, M., von Siemens, F. A., 2009. Worker self-selection and the profits from cooperation. Journal of the European Economic Association 7 (2-3), 573–582.

Kosfeld, M., von Siemens, F. A., 2011. Competition, cooperation, and corporate culture. The RAND Journal of Economics 42 (1), 23–43.

Laine, L. T., Ma, C.-t. A., 2017. Quality and competition between public and private firms. Journal of Economic Behavior & Organization 140, 336–353.

Leong, C. K., Yang, Y. C., 2020. Market competition and firms' social performance. Economic Modelling 91, 601–612.

Lilley, A., Slonim, R., 2014. The price of warm glow. Journal of Public Economics 114, 58–74.

Ma, C.-t. A., 2007. Altruism and incentives in public and private health care. In: Finance and Incentives of the Health Care System, Proceedings of the 50th Anniversary Symposium of the Yrj Jahnsson Foundation, edited by Antti Suvanto and Hannu Vartiainen, Government Institute for Economic Research, Helsinki. pp. 79–104.

Macchiavello, R., 2008. Public sector motivation and development failures. Journal of Development Economics 86 (1), 201–213.

Manna, E., 2017. Customer-oriented employees: Blessing or curse for firms? Journal of Economics & Management Strategy 26 (4), 842–875.

Matsumura, T., 1998. Partial privatization in mixed duopoly. Journal of Public Economics 70 (3), 473–483.

Megginson, W. L., Netter, J. M., 2001. From state to market: A survey of empirical studies on privatization. Journal of economic literature 39 (2), 321–389.

Nett, L., 1993. Mixed oligopoly with homogeneous goods. Annals of Public and Cooperative Economics 64 (3), 367–393.

Ottoni-Wilhelm, M., Vesterlund, L., Xie, H., 2014. Why do people give? testing pure and impure altruism. Tech. rep., National Bureau of Economic Research.

Planer-Friedrich, L., Sahm, M., 2018. Why firms should care for all consumers". Economics Bulletin 38 (3), 1603–1612.

Planer-Friedrich, L., Sahm, M., 2020. Strategic corporate social responsibility, imperfect competition, and market concentration. Journal of Economics 129 (1), 79–101.

Prendergast, C., 2007. The motivation and bias of bureaucrats. The American Economic Review 97 (1), 180–196.

Raith, M., 2003. Competition, risk and managerial incentives. American Economic Review 93 (4), 1425–1436.

Schelling, T. C., 1960. The Strategy of Conflict. Harvard university press.

Sklivas, S. D., 1987. The strategic choice of managerial incentives. The RAND Journal of Economics, 452–458.

Tonin, M., Vlassopoulos, M., 2010. Disentangling the sources of pro-socially motivated effort: A field experiment. Journal of Public Economics 94 (11), 1086–1092.

Tonin, M., Vlassopoulos, M., 2015. Corporate philanthropy and productivity: Evidence from an online real effort experiment. Management Science 61 (8), 1795–1811.

Urquiola, M., 2016. Competition among schools: Traditional public and private schools 5, 209–237.

Vickers, J., 1985. Delegation and the theory of the firm. The Economic Journal 95, 138–147.

von Siemens, F. A., Kosfeld, M., 2014. Team production in competitive labor markets with adverse selection. European Economic Review 68, 181–198.

Xu, L., Lee, S.-H., 2019. Tariffs and privatization policy in a bilateral trade with corporate social responsibility. Economic Modelling 80, 339–351.

A Computations and proofs of the results

We report here the computations and proofs of all the results present in the text.

Characterization of the equilibria. The equilibria of the game are found by backward induction. The last stage, in which customers choose from which firm to buy the good, is straightforward. 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's maximization problem can be rewritten as follows:

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

In the next subsections, we characterize the equilibrium and the optimal market outcomes in four different scenarios: (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, we analyze the best response of each firm to the choice made by its competitor.

A.1 Both firms hire selfish employees

We start by considering the case in which both firms hire self-interested employees, i.e. $\theta_A = \theta_B = 0$. Each firm maximizes equation (A2) subject to the employees' participation constraints:

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

Each employer 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), we get:

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

First-order conditions:

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

The first-order conditions depend on the quality and price chosen by the rival firm. Solving the system of equations, we find the optimal levels of quality and price (we denote them with the superscript SS):

$$q_A^{SS} = \frac{3\beta t - 1 - 2\alpha\beta t}{6\beta t - 1 - \beta}; \quad q_B^{SS} = \frac{3t - 1 + 2\alpha t}{6\beta t - 1 - \beta}; \tag{A5}$$

$$p_A^{SS} = 2t\left[\frac{3\beta t - 1 - 2\alpha\beta t}{6\beta t - 1 - \beta}\right]; \quad p_B^{SS} = \frac{2t(3t-1)\beta - 2\alpha t(4\beta t - 1 - \beta)}{6\beta t - 1 - \beta};. \tag{A6}$$

Substituting the optimal levels of quality and price into (A1), we obtain that 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:

$$\overline{U}_A^{SS} = \overline{v} + \left(\frac{3\beta t - 1 - 2\alpha\beta t}{6\beta t - 1 - \beta}\right)\left(1 - \frac{5t}{2}\right); \quad \overline{U}_B^{SS} = \overline{v} + \frac{(3t-1)(2-5\beta t)}{2(6\beta t - 1 - \beta)} + \frac{\alpha\beta t(7t-2)}{6\beta t - 1 - \beta}. \tag{A7}$$

The following wages are paid:

$$w_A^{SS} = \frac{1}{2}\left(\frac{3\beta t - 1 - 2\alpha\beta t}{6\beta t - 1 - \beta}\right)^2; \quad w_B^{SS} = \frac{\beta}{2}\left(\frac{3t - 1 + 2\alpha t}{6\beta t - 1 - \beta}\right)^2. \tag{A8}$$

Finally, firms' profits are obtained from substituting the optimal market outcomes into equation (A2).

A.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 employees' participation constraints, that now is:

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

The participation constraints bind and, as before, equation (A2) can be rewritten as functions of qualities and prices. First-order conditions:

$$\begin{aligned}
&\frac{\partial \pi_A}{\partial p_A} = 0 \quad \Leftrightarrow \quad \frac{1}{2} + \frac{(q_A - q_B) + (p_B - 2p_A)}{2t} - \frac{3}{4}\overline{\theta} = 0; \\
&\frac{\partial \Upsilon_B}{\partial p_B} = 0 \quad \Leftrightarrow \quad \frac{1-2\alpha}{2} + \frac{(q_B - q_A) + (p_A - 2p_B)}{2t} - \frac{3}{4}\overline{\theta} = 0; \\
&\frac{\partial \pi_A}{\partial q_A} = 0 \quad \Leftrightarrow \quad \frac{p_A}{2t} - q_A + \frac{3}{4}\overline{\theta} = 0; \\
&\frac{\partial \Upsilon_B}{\partial q_B} = 0 \quad \Leftrightarrow \quad \alpha + \frac{p_B}{2t} - \beta q_B + \frac{3}{4}\overline{\theta} = 0.
\end{aligned} \tag{A9}$$

Solving the system of equations, we find the optimal levels of quality and price. Interestingly, we find that:

$$q_A^{MM} = q_A^{SS}, \quad q_B^{MM} = q_B^{SS} \quad \text{and} \quad p_A^{MM} = p_A^{SS} - \frac{3}{2}t\overline{\theta}, \quad p_B^{MM} = p_B^{SS} - \frac{3}{2}t\overline{\theta}.$$

Substituting quality and price levels into (A1), we obtain the demand for each firm, finding that $d_A^{MM} = d_A^{SS}$ and $d_B^{MM} = d_B^{SS}$. The utility of the average customer buying the product from firm A and firm B is:

$$\overline{U}_A^{MM} = \overline{U}_A^{SS} + \frac{3}{2}t\overline{\theta}; \quad \overline{U}_B^{MM} = \overline{U}_B^{SS} + \frac{3}{2}t\overline{\theta};$$

and the following wages are paid:

$$w_A^{MM} = w_A^{SS} - \overline{\theta}\left(\overline{U}_A^{SS} + \frac{3}{2}t\overline{\theta}\right); \quad w_B^{MM} = w_B^{SS} - \overline{\theta}\left(\overline{U}_B^{SS} + \frac{3}{2}t\overline{\theta}\right).$$

Firms' profits are obtained from substituting the optimal market outcomes into equation (A2).

A.3 Only the private firm hires the altruist

We consider now the case in which only the employee in the private firm is altruistic, i.e. $\theta_A = \overline{\theta}$ and $\theta_B = 0$. Each firm maximizes its objective function, subject to the following 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 only as functions of qualities and prices. Computing the first-order conditions:

$$\begin{aligned}
&\frac{\partial \pi_A}{\partial p_A} = 0 \quad \Leftrightarrow \quad \frac{1}{2} + \frac{(q_A - q_B) + (p_B - 2p_A)}{2t} - \frac{3}{4}\overline{\theta} = 0; \\
&\frac{\partial \Upsilon_B}{\partial p_B} = 0 \quad \Leftrightarrow \quad \frac{1-2\alpha}{2} + \frac{(q_B - q_A) + (p_A - 2p_B)}{2t} = 0; \\
&\frac{\partial \pi_A}{\partial q_A} = 0 \quad \Leftrightarrow \quad \frac{p_A}{2t} - q_A + \frac{3}{4}\overline{\theta} = 0; \\
&\frac{\partial \Upsilon_B}{\partial q_B} = 0 \quad \Leftrightarrow \quad \alpha + \frac{p_B}{2t} - \beta q_B = 0.
\end{aligned} \tag{A10}$$

Solving the system of equations, we find the optimal levels of quality and price (we denote them with the superscript MS):

$$q_A^{MS} = q_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \quad q_B^{MS} = q_B^{SS} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \tag{A11}$$

$$p_A^{MS} = p_A^{SS} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta}; \quad p_B^{MS} = p_B^{SS} - \frac{3\beta t^2}{6\beta t - 1 - \beta}\overline{\theta}. \tag{A12}$$

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

$$d_A^{MS} = d_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \quad d_B^{MS} = d_B^{SS} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}. \tag{A13}$$

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

$$\begin{aligned} \overline{U}_A^{MS} =& \overline{v} + \left(q_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(1 - \frac{t}{2}\right) - \left(2t\, q_A^{SS} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta}\right); \\ \overline{U}_B^{MS} =& \overline{v} + \left(q_B^{SS} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(1 - \frac{\beta t}{2}\right) - \left(p_B^{SS} - \frac{3\beta t^2}{(6\beta t - 1 - \beta)}\overline{\theta}\right). \end{aligned} \tag{A14}$$

The following wages are paid:

$$w_A^{MS} = \frac{1}{2}\left(q_A^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)^2 - \overline{\theta}\,\overline{U}_A^{MS}; \quad w_B^{MS} = \frac{\beta}{2}\left(q_B^{SS} - \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)^2. \tag{A15}$$

Finally, firms' profits are obtained from substituting the optimal market outcomes into equation (A2).

A.4 Only the public firm hires the altruist

When only the public firm hires the altruistic employee, $\theta_A = 0$ and $\theta_B = \overline{\theta}$. Each firm maximizes equation (A2) subject to the following employees' participation constraints:

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

Participation constraints bind and equation (A2) can be rewritten as functions of qualities and prices. First-order conditions:

$$\begin{aligned} \frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{(q_A - q_B) + (p_B - 2p_A)}{2t} = 0; \\ \frac{\partial \Upsilon_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \frac{1 - 2\alpha}{2} + \frac{(q_B - q_A) + (p_A - 2p_B)}{2t} = 0; \\ \frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \frac{p_A}{2t} - q_A + \frac{3}{4}\overline{\theta} = 0; \\ \frac{\partial \Upsilon_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad \alpha + \frac{p_B}{2t} - \beta q_B + \frac{3}{4}\overline{\theta} = 0. \end{aligned} \tag{A16}$$

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

$$q_A^{SM} = q_A^{SS} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \quad q_B^{SM} = q_B^{SS} + \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \tag{A17}$$

$$p_A^{SM} = p_A^{SS} - \frac{3\beta t^2}{6\beta t - 1 - \beta}\overline{\theta}; \quad p_B^{SM} = p_B^{SS} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta}. \tag{A18}$$

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

$$d_A^{SM} = d_A^{SS} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}; \quad d_B^{SM} = d_B^{SS} + \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}. \tag{A19}$$

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

$$\begin{aligned} \overline{U}_A^{SM} =& \overline{v} + \left(q_A^{SS} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(1 - \frac{5}{2}t\right); \\ \overline{U}_B^{SM} =& \overline{v} + \left(q_B^{SS} + \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)\left(1 - \frac{\beta t}{2}\right) - \left[p_B^{SS} - \frac{3t}{2}\left(\frac{4\beta t - 1 - \beta}{6\beta t - 1 - \beta}\right)\overline{\theta}\right]. \end{aligned} \tag{A20}$$

The following wages are paid:

$$w_A^{SM} = \frac{1}{2}\left(q_A^{SS} - \frac{3\beta t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)^2; \quad w_B^{SM} = \frac{\beta}{2}\left(q_B^{SS} + \frac{3t}{2(6\beta t - 1 - \beta)}\overline{\theta}\right)^2 - \overline{\theta}\,\overline{U}_B^{SM}. \tag{A21}$$

Finally, firms' profits are obtained from substituting the optimal market outcomes into equation (A2).

A.5 Conditions on the parameters

We want to guarantee that market outcomes do not take negative values. By comparing quality levels provided by the private and public firms in all scenarios, we find that:

$$q_A^{MS} > q_A^{SS} = q_A^{MM} > q_A^{SM} \quad \text{and} \quad q_B^{SM} > q_B^{SS} = q_B^{MM} > q_B^{MS}.$$

As the demand for the private firm coincides with its quality (i.e., $d_A = q_A$) and the demand for the public firm is β times its quality (i.e., $d_B = \beta q_B$), the previous ranking is not affected when we compare demands. Therefore, if q_A^{SM} and q_B^{MS} are non-negative, all quality and demand levels are greater than 0. When we instead compare prices, we obtain the following two rankings:

$$p_A^{SS} > p_A^{SM} > p_A^{MS} > p_A^{MM} \quad \text{and} \quad p_B^{SS} > p_B^{MS} > p_B^{SM} > p_B^{MM}.$$

It is possible to observe that for both firms prices are the lowest when both employees are motivated.

We find all the market outcomes do not take negative values if t is sufficiently high. Moreover, to satisfy the second-order conditions, t has to be lower than 1 and this is indeed the case if β is sufficiently high. These conditions are summarized in Assumption 1.

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

(i) $t \in \left(\max\left\{\frac{2}{\beta(6-4\alpha-3\overline{\theta})}, \frac{1+\beta}{4\beta}\right\}, 1\right)$;

(ii) $\beta > \frac{2}{6-4\alpha-3\overline{\theta}}$.

Note that $\alpha < \frac{5-3\overline{\theta}}{4}$ to guarantee that β takes positive values, but it cannot be larger than 2. At the same time, $\overline{v}$ should be sufficiently high to guarantee that the market is covered and $\overline{\theta}$ sufficiently low to guarantee that wages are non-negative.

A.6 Proof of Lemma 1

In the initial stage of the game, both firms choose simultaneously which type of employee to hire. The type choice reduces to the game illustrated in the following table.

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

Table 1: The Type-Choice Game

We 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., $\Upsilon_B^{SM} > \Upsilon_B^{SS}$ and $\Upsilon_B^{MM} > \Upsilon_B^{MS}$, if it is sufficiently socially concerned.
To prove this result, first note that $\Upsilon_B^{SM} - \Upsilon_B^{SS} \geq 0$ if:

$$\alpha\left(U_A^{SM} + U_B^{SM} - U_A^{SS} - U_B^{SS}\right) + \omega_B^{SS} - \omega_B^{SM} \geq p_B^{SS}\, d_B^{SS} - p_B^{SM}\, d_B^{SM}. \tag{A22}$$

It is simple to show that the left-hand side of Inequality (A22) is always positive as both the terms $\alpha\left(U_A^{SM} + U_B^{SM} - U_A^{SS} - U_B^{SS}\right) = \alpha\left[\frac{3}{2}t\overline{\theta}\left(\frac{2-\beta}{6\beta t-1-\beta}\right)\right]$ and $\omega_B^{SS} - \omega_B^{SM}$ are positive. Conversely, the right-hand side of the inequality is either positive or negative as $p_B^{SM} < p_B^{SS}$, whereas $d_B^{SM} > d_B^{SS}$. Let us denote by $\hat{\alpha}$ the threshold value of α for which $\Upsilon_B^{SM} - \Upsilon_B^{SS} = 0$:

$$\hat{\alpha} \equiv \frac{-8(1+\beta)[1+\overline{v}(1+\beta)] - 3t^2\overline{\theta}\Big[68 - 11\overline{\theta} + 4\beta[4(5-9t+6\overline{v}-2\overline{\theta}) + 15t\overline{\theta}]\Big]}{8t\beta\Big[5-13t+\beta[5+8t(9t-5)]\Big]}$$
$$+\frac{4t\Big[6+\beta[23+8\beta+3(1+\beta)(8\upsilon-\overline{\theta})]\Big]}{8t\beta\Big[5-13t+\beta[5+8t(9t-5)]\Big]}.$$

The denominator is always positive given our assumption on the parameters. Moreover, the numerator of the first line is always negative, whereas the numerator of the second line is always positive. It is possible to show that $\hat{\alpha}$ is decreasing in $\overline{v}$ and $\overline{\theta}$, whereas it is increasing in β and t. Then, to see that this threshold is always lower than 1, take the following parameter values:

$\overline{\theta} = \upsilon = 0$, $\beta = 2$, and $t = 1$. Even by setting these extreme values of the parameters, $\hat{\alpha} = 0.63$. Now, note that the difference $\Upsilon_B^{SM} - \Upsilon_B^{SS}$ is continuous and strictly increasing in α as:

$$\frac{\partial(\Upsilon_B^{SM} - \Upsilon_B^{SS})}{\partial\alpha} = \frac{t\beta\overline{\theta}[5(1+\beta) + 2t(4\beta(9t-5)-5)]}{(6\beta t - 1 - \beta)^2} > 0,$$

for any values of the parameters. As a result, if $\Upsilon_B^{SM} - \Upsilon_B^{SS} = 0$ at $\hat{\alpha}$, $\Upsilon_B^{SM} - \Upsilon_B^{SS} > 0$ for any $\alpha > \hat{\alpha}$. Finally, it is possible to show that $\hat{\alpha}$ can take non-positive values. In that case, the public firm always find it beneficial to hire the motivated employee when the private firm hires the selfish.

Second, note that $\Upsilon_B^{MM} - \Upsilon_B^{MS} \geq 0$ if:

$$\alpha\Big(U_A^{MM} + U_B^{MM} + U_A^{MS} + U_B^{MS}\Big) + \omega_B^{MS} - \omega_B^{MM} \geq p_B^{MS}\, d_B^{MS} - p_B^{MM}\, d_B^{MM}. \tag{A23}$$

Similarly to the previous comparison, the left-hand side of Inequality (A23) is always positive, whereas the right-hand side can be either positive or negative. Let us denote α' the threshold value of α for which $\Upsilon_B^{MM} - \Upsilon_B^{MS} = 0$:

$$\alpha' \equiv \hat{\alpha} - \frac{3\overline{\theta}(4\beta t - 1)[\beta(9t-2)+2]}{4\beta\Big[5 - 13t + \beta[5 + 8t(9t-5)]\Big]} < \hat{\alpha} < 1.$$

We find that α' is also decreasing in $\overline{\upsilon}$ and $\overline{\theta}$, and increasing in β and t. Furthermore, the difference $\Upsilon_B^{MM} - \Upsilon_B^{MS}$ is continuous and increasing in α as:

$$\frac{\partial(\Upsilon_B^{MM} - \Upsilon_B^{MS})}{\partial\alpha} = \frac{t\beta\overline{\theta}[5(1+\beta) + t(8\beta(9t-5)-13)]}{(6\beta t - 1 - \beta)^2} > 0,$$

for any values of the parameters.

Hiring an altruistic employee is always a dominant strategy for a public firm if both conditions $\Upsilon_B^{SM} > \Upsilon_B^{SS}$ and $\Upsilon_B^{MM} > \Upsilon_B^{MS}$ hold. Therefore, we can conclude that this is indeed the case when $\alpha > \hat{\alpha}$, as $\hat{\alpha} > \alpha'$. □

A.7 Proof of Proposition 1

Consider the private firm's best response to the hiring choice of the public firm. 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}. We find that $\pi_A^{SM} > \pi_A^{MM}$ if:

$$\frac{3\overline{\theta}t\Big[4t^2\beta^2(6 - 4\alpha - 33\overline{\theta}) - t\beta[20 - 8\alpha - \overline{\theta}(48 + 45\beta)] + 4[1 - (1+\beta)^2\overline{\theta}]\Big]}{8(6\beta t - 1 - \beta)^2} > 0.$$

This is the case if:

$$t > \frac{\beta[20 - 8\alpha - \overline{\theta}(48 + 45\beta)] + \sqrt{\Omega}}{8\beta^2(6 - 4\alpha - 33\overline{\theta})} \equiv \tilde{t},$$

where $\Omega = 64\beta^3(6 - 4\alpha - 33\overline{\theta})[20 - 8\alpha - \overline{\theta}(48 + 45\beta)] + \beta^2[20 - 8\alpha - \overline{\theta}(48 + 45\beta)]^2 > 0$.

Now we make three observations. Firstly, the threshold $\tilde{t}$ is decreasing in β. Secondly, when β approaches its lower bound, *i.e.*, $\beta \downarrow \frac{2}{6-4\alpha-3\overline{\theta}}$, $\tilde{t}$ is lower than 1, for all admissible parameter values. Thirdly, the threshold $\tilde{t}$ could be lower than the lower bound of t. In that case, the private firm always hires the selfish employee. □

A.8 Proof of Remark 1

Each firm maximizes its profits and hires an altruistic employee:

$$\pi_A = p_A \left[\frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t}\right] - \omega_A, \quad \pi_B = p_B \left[\frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t}\right] - \omega_B, \tag{A24}$$

subject to the employees' 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:

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

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

$$w_i = \frac{1}{2}q_i^2 - \overline{\theta}\left(\overline{v} + q_i - p_i - \frac{t}{2}d_i\right) \quad \text{with} \quad i = A, B. \tag{A25}$$

Then, profits can be rewritten as:

$$\begin{aligned} \pi_A &= \left(p_A - \frac{t}{2}\overline{\theta}\right)\left[\frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t}\right] - \frac{1}{2}q_A^2 + \overline{\theta}\left(\overline{v} + q_A - p_A\right), \\ \pi_B &= \left(p_B - \frac{t}{2}\overline{\theta}\right)\left[\frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t}\right] - \frac{1}{2}q_B^2 + \overline{\theta}\left(\overline{v} + q_B - p_B\right). \end{aligned} \tag{A26}$$

First-order conditions:

$$\begin{aligned} \frac{\partial \pi_A}{\partial p_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t} - \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - \overline{\theta} = 0; \\ \frac{\partial \pi_B}{\partial p_B} = 0 \quad &\Leftrightarrow \quad \frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t} - \frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - \overline{\theta} = 0; \\ \frac{\partial \pi_A}{\partial q_A} = 0 \quad &\Leftrightarrow \quad \frac{1}{2t}\left(p_A - \frac{t}{2}\overline{\theta}\right) - q_A + \overline{\theta} = 0; \\ \frac{\partial \pi_B}{\partial q_B} = 0 \quad &\Leftrightarrow \quad \frac{1}{2t}\left(p_B - \frac{t}{2}\overline{\theta}\right) - q_B + \overline{\theta} = 0 \end{aligned} \tag{A27}$$

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

$$q_A^{Pr} = q_B^{Pr} = \frac{1}{2}; \quad p_A^{Pr} = p_B^{Pr} = t - \frac{3}{2}t\,\overline{\theta}. \tag{A28}$$

Firms share the demand in the market and the employees receive the following wage:

$$\omega_A^{Pr} = \omega_B^{Pr} = \frac{1}{8} - \overline{\theta}\left[\frac{1}{2}\left(2\overline{v} + 1 - 3t + 3t\overline{\theta}\right)\right]. \tag{A29}$$

Substituting the market outcomes into the firms' profits, we get the expression in the remark. □

A.9 Proof of Remark 2

Both public firms hire altruistic employees and maximize the following:

$$\begin{aligned}\Upsilon_A =& p_A\left(\frac{1}{2} + \frac{[q_A - q_B] + [p_B - p_A]}{2t}\right) - \omega_A + \alpha[\overline{U}_A + \overline{U}_B],\\ \Upsilon_B =& p_B\left(\frac{1}{2} + \frac{[q_B - q_A] + [p_A - p_B]}{2t}\right) - \omega_B + \alpha[\overline{U}_A + \overline{U}_B],\end{aligned} \tag{A30}$$

subject to the employees' 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:

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

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

$$w_i = \frac{\beta}{2}q_i^2 - \overline{\theta}\left(\overline{v} + q_i - p_i - \frac{t}{2}d_i\right) \quad \text{with} \quad i = A, B. \tag{A31}$$

We substitute the wages into the public firms' objective function and we compute the first-order conditions:

$$\begin{aligned}
&\frac{\partial \Upsilon_A}{\partial p_A} = 0 \quad \Leftrightarrow \quad \frac{1}{2} - \frac{p_A}{2t} + \frac{[q_A - q_B] + [p_B - p_A]}{2t} - \frac{3}{4}\overline{\theta} - \alpha = 0;\\
&\frac{\partial \Upsilon_B}{\partial p_B} = 0 \quad \Leftrightarrow \quad \frac{1}{2} - \frac{p_B}{2t} + \frac{[q_B - q_A] + [p_A - p_B]}{2t} - \frac{3}{4}\overline{\theta} - \alpha = 0;\\
&\frac{\partial \Upsilon_A}{\partial q_A} = 0 \quad \Leftrightarrow \quad \frac{p_A}{2t} - \beta q_A + \frac{3}{4}\overline{\theta} + \alpha = 0;\\
&\frac{\partial \Upsilon_B}{\partial q_B} = 0 \quad \Leftrightarrow \quad \frac{p_B}{2t} - \beta q_B + \frac{3}{4}\overline{\theta} + \alpha = 0
\end{aligned} \tag{A32}$$

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

$$q_A^{Pu} = q_B^{Pu} = \frac{1}{2\beta}; \quad p_A^{Pu} = p_B^{Pu} = t(1 - 2\alpha) - \frac{3}{2}t\,\overline{\theta}. \tag{A33}$$

Firms share the demand in the market and the employees receive the following wage:

$$\omega_A^{Pu} = \omega_B^{Pu} = \frac{1}{8\beta} - \overline{\theta}\left[\overline{v} + \frac{1}{2\beta} - \left(t(1 - 2\alpha) - \frac{3}{2}t\,\overline{\theta}\right) - \frac{t}{4}\right]. \tag{A34}$$

Substituting the market outcomes into the firms' objective function, we get the firms' utilities illustrated in the proposition. □

A.10 Proof of Lemma 2 and Proposition 2

The results in Lemma 2 are found by comparing the aggregate quality levels in equation (11) with those obtained when firms are both public, or both private. Proposition 2 summarizes the key results of the analysis, whereas the proof and intuitions are provided in the text. □

A.11 Proof of Remark 3

We report in the text the overall customers' utility in the four possible scenarios.

Full privatization can never be the consumer-preferred market configuration as $\beta \leq 1$. Thus, we can restrict attention to the comparison between full public provision and mixed duopoly. We find $\hat{t}$ as the threshold of t above which $U^{Pu} > U^{MM}$ or $U^{Pu} > U^{SM}$ depending of whether both firms hire altruistic employees or only the public one does. The threshold is not reported here due to its complexity, but it has been computed by using Mathematica Wolfram and is available under request. However, here we provide a numerical example to show that it is possible to find parameter values for which the threshold $\hat{t}$ takes values in the admissible interval of t. For instance, if we take the following values of the parameters: $\beta = 0.8$, $\overline{\theta} = 0.25$, $\alpha = 0.3$, and $\overline{v} = 0.5$, the threshold $\hat{t} \cong 0.625$ is positive and lower than 1. For these values of the parameters, $\tilde{t} \cong 0.485 < \hat{t}$, and t can take values between 0.58 and 1 given Assumption 1. This implies that if $t \in (0.58, 0.625]$ customers benefit from having mixed duopoly, even if only the public firm hires the altruistic employee, while if $t \in (0.625, 1)$ consumers benefit from the nationalization of the private firm. □

A.12 Proof of Remark 4

It follows directly from the argument in the text. Again, we provide a numerical example to show that it is possible to find parameter values for which the threshold $\hat{t}$ takes values in the admissible interval of t. For instance, if we take the same values of the parameters used in the proof of the previous remark: $\overline{\theta} = 0.25$, $\alpha = 0.3$, and $\overline{v} = 0.5$, with the exception of β that now converges to 2, we find that the threshold $\hat{t} \cong 0.417$. For these values of the parameters, $\tilde{t} \cong 0.36 < \hat{t}$ and t can take values between 0.375 and 1 given Assumption 1. This implies that if $t \in (0.375, 0.417]$ full private provision is beneficial for customers, while if $t \in (0.417, 1)$ consumers benefit from the nationalization of the private firm. □