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Should civil servants be restricted in wage bargaining ?

A mixed-duopoly approach

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Should civil servants be restricted in wage bargaining? A mixed-duopoly approach

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Abstract

Should civil servants (employees at public institutions) be allowed to bargain collectively? To answer this question, we construct a model of unionized mixed duopoly and examine the optimal regulatory framework of public institutions, especially focusing on a wage regulation imposed on the public firm. The wage regulation turns out to yield critical welfare implications as it gives rise to two opposing strategic effects: the wage regulation intensifies downstream-market competition while it loosens upstream-market competition. The overall welfare effect is ambiguous, depending crucially on the degree of product differentiation between the firms. We also show that, in contrast to the popular belief, granting the right to bargain collectively to civil servants would not necessarily help them because they tend to demand excessively high wages when they are allowed to bargain collectively. Finally, we briefly discuss a new perspective on the role of profit motives in public institutions when the wages are determined endogenously.

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1 Introduction

Mixed markets, where state-owned public firms compete against private firms, are fairly common in developed, developing, and former communist transitional economies. In many countries, public firms exist and compete with private firms in a range of industries such as the airline, rail, telecommunications, natural gas, electricity, steel, and overnight-delivery industries, as well as services such as banking, home loans, health care, life insurance, hospitals, broadcasting, and education.[1] Accordingly, the study of mixed markets have become increasingly popular in recent years.[2]

In standard mixed-market models, public firms are typically assumed to maximize social welfare while private firms are to maximize profit.[3] Under this setup, it is often supposed that the role of public firms is to maximize social welfare by correcting inefficiencies arising from market failures. There is no convincing reason to believe, however, that civil servants (employees in the public sector) share the same goals; it rather seems more natural to assume that they aim at maximizing their own utility just like employees in the private sector.[4] If the goals of civil servants are not to maximize social welfare, their behavior may need to be regulated in some ways. What becomes crucial along this line is how wages in the public sector should be regulated because the wage level virtually determines the firm's productive efficiency, ultimately leading to serious welfare implications.[5] If wages in the public sector are

[1] Among developed countries, mixed markets are certainly more prevalent in Europe, Canada, and Japan. Although they are less significant in the United States, there are examples of mixed oligopolies such as the packaging and overnight-delivery industries.

[2] Merrill and Schneider (1966) and Harris and Wiens (1980) are the pioneering works in this field. See also Bös (1986, 1991), De Fraja and Delbono (1990), and Nett (1993) for excellent surveys.

[3] See, for instance, De Fraja and Delbono (1989), Cremer *et al.* (1991), Fjell and Pal (1996), Anderson *et al.* (1997), Pal (1998), Pal and White (1998), and Matsushima and Matsumura (2003).

[4] Of course, one can argue that mission-oriented public institutions tend to attract more 'motivated agents.' For instance, Besley and Ghatak (2005) emphasize the importance of motivation and preference matching in a mission-oriented, rather than profit-oriented, sector. Still, there is no convincing reason to believe that even the goals of those 'motivated agents' coincide precisely with the goals of pubic institutions.

[5] The productive efficiency of public and/or private firms in mixed markets is examined by many researchers in other contexts. See Nett (1994), Nishimori and Ogawa (2002), Corneo and Rob (2003), Ma (2004), and Matsumura and Matsushima (2004) for theoretical discussions on this issue. Using the data on Japanese parcel

set in an inappropriate way, any subsequent effort to increase efficiency might totally be wiped out. It is this aspect of public firms that we focus on in this paper.

In reality, the way civil servants are regulated is surprisingly diverse across countries. In many countries today, civil service salaries are determined largely through collective bargaining between the union and the government, although there are often some job- and title-specific restrictions. In contrast, there are still some countries such as the US and Japan where civil servants are tightly regulated. In those countries, civil service salaries are more or less tied to the average wages in the respective industries (the 'equal pay for equal work' principle) or those in the private sector as a whole. In Japan, for instance, civil servants are strictly deprived of the right to bargain collectively, and their wages are instead determined based on the advise of the National Personnel Authority, called *Jinji-In-Kankoku*, with its particular emphasis on the equalization between the private and public sectors.

Although different countries have their own regulations, a recent trend is clearly shifting towards the former, i.e., granting civil servants the right to organize and bargain collectively, mostly from the viewpoint of protecting workers' rights. For instance, a report by the Committee on Freedom of Association, one of the six Governing Body committees of International Labour Organization (ILO), points out that the current Japanese system is not consistent with international labor standards, and urges the Japanese government to engage in full consultations with the trade unions with the view to amend the current legislation that denies civil servants the right to bargain collectively (Cases 2177 and 2183, November 2002). The stance taken by ILO reflects an emerging global consensus that the right to organize and bargain collectively constitutes an important part of workers' rights that should be respected even for civil servants.

Despite this recent trend, however, welfare consequences of allowing civil servants to bargain collectively are not necessarily straightforward, especially in a mixed market. This paper thus examines the optimal regulatory framework of public institutions with a particular focus

companies, Mizutani and Uranishi (2003) empirically examine the efficiency of public firms. Meggison and Netter (2001) provide an excellent survey.

on the optimal wage regulation imposed on civil servants. To this end, we consider two distinct regulatory frameworks in a mixed duopoly. In the first, civil servants are allowed to form a union to represent themselves and, more importantly, to bargain collectively just as workers in the private sector. In the second, civil servants are prohibited to bargain collectively, and their wages are tightly regulated by some wage-setting rule, which more or less abides by the 'equal pay for equal work' principle. We compare these two regimes and explore welfare implications of the wage regulation imposed on civil servants.

The analysis reveals that the way civil service salaries are determined indeed has substantial welfare consequences. As is normally the case in this type of setup, the welfare effect of the wage regulation hinges critically on its impact on the equilibrium wages: roughly speaking, the wage regulation is welfare-enhancing if it lowers the wages. First, the wage regulation, which totally deprives civil servants of the right to bargain collectively, can have a direct effect as it places an exogenous cap on the public firm's wage. In a situation where the firms and their respective unions interact strategically, however, there are two additional indirect effects, one positive and one negative, which work through strategic market interactions. The first effect, a positive one, is that the wage regulation by design gives a cost advantage to the public firm, which forces the private firm's union to lower its wage in order to compete in the downstream market. The second effect, a negative one, is that it also releases the private firm's union from stiff wage competition as it can now set its wage unilaterally, knowing that the public firm's wage is automatically set according to the rule. We can thus summarize these observations as follows: the wage regulation intensifies downstream-market competition (the downstream-market effect) while it loosens upstream-market competition (the upstream-market effect). The overall welfare impact is indeed ambiguous due to this tradeoff and can be either positive or negative, depending on the degree of product differentiation between the two firms.

While the main purpose of the paper is to provide some insight on the optimal regulatory framework of public institutions, it also raises two additional implications of some interest. First, the model shows somewhat paradoxically that although the private firm's union always loses with the wage regulation, the public firm's union may sometimes benefit from it. To

see this, it is important to recognize that the public firm's union can be more aggressive in wage bargaining as it can take advantage of the public firm's inherent tendency to expand output. This result indicates, however, that this incentive can be excessively strong even from the union's viewpoint: the union tends to demand excessively high wages, which lead to inefficiently low employment, when it is allowed to bargain collectively. The wage regulation then effectively keeps the union from becoming overly aggressive and demanding excessively high wages. The result thus implies that there are situations where the union would be made better off by strategically giving up the right to bargain collectively in wage bargaining.

Second, the model also provides a new perspective on the role of budget constraints on public institutions. The public firm must reduce output in pursuit of more profit when a tighter budget constraint is imposed, and a reduction in output normally entails a welfare loss. In the present setup, however, this can actually be welfare-enhancing because the tighter constraint is instrumental in inhibiting the union to be overly aggressive in wage bargaining and thus controlling its behavior. We argue that this aspect provides a new perspective on the role of profit motives in public institutions when the wages are set endogenously.

As stated, there are increasingly many works on mixed oligopoly where a welfare-maximizing public firm competes with profit-maximizing private firms. At the same time, the literature on unionized (successive) oligopoly have also flourished almost independently.[6] There are, however, surprisingly few works that integrate these two strands and examine unionized mixed oligopoly.[7] Moreover, we also believe that the optimal regulatory framework of civil servants is an important agenda with immense policy implications. The main task of this paper is hence to shed light on this aspect of mixed markets which, in our opinion, has not been examined enough in a rigorous context. To this end, the paper proceeds as follows. The basic setup is briefly outline in the next section. The market equilibrium under each regime is characterized

[6] See, for instance, Horn and Wolinsky (1988), Naylor (2002), Lommerud *et al.* (2003), and López and Naylor (2004).

[7] An exception, to the best of our knowledge, is De Fraja (1993) who explicitly incorporates wage bargaining in mixed oligopoly in an attempt to examine the effect of privatization on the wages. Besides several differences in the setup (which we will mention later), the present paper crucially differs from De Fraja (1993) as our focus is primarily on welfare consequences of the wage regulation.

in sections 3 and 4, and the welfare analysis follows in section 5. The model is then extended to examine the role of the budget constraint in section 6. Finally, some concluding remarks are made in section 7.

2 The Model

2.1 Environment

We formulate a mixed-duopoly model, in which a welfare-maximizing public firm competes against a profit-maximizing domestic private firm. For expositional purposes, we sometimes refer to the public (private) firm as firm 0 (firm 1) and its union as union 0 (union 1).[8]

The basic structure of the model follows a standard product differentiation model.[9] Each firm produces a differentiated good. A representative consumer's utility is given by

$$U = x_0 + x_1 - \frac{x_0^2 + 2\gamma x_0 x_1 + x_1^2}{2}, \tag{1}$$

where $\gamma \in (0, 1)$ represents the degree of product differentiation.[10] This specification implies the following inverse demand functions: for positive demands and $i = 0, 1$,

$$p_i = 1 - x_i - \gamma x_j, \quad j \neq i. \tag{2}$$

The firms are homogeneous with respect to the productivity. Each firm adopts a constant-returns-to-scale technology where one unit of labor is turned into one unit of the final good. The price of labor, i.e., the wage, that firm i has to pay is denoted by w_i.

[8] In this paper, the government is not permitted to nationalize more than one firm. As pointed out by Merrill and Schneider (1966), the most efficient outcome is achieved by the nationalization of all firms, if nationalization does not change the costs of firms (that is, there is no X-inefficiency in the public firm). The need to analyze a mixed oligopoly arises because it is impossible or undesirable, for political or economic reasons, to nationalize an entire sector. For example, without competitors, public firms may increase their costs, which reduces social welfare. Thus, we do not consider the possibility of nationalizing all firms.

[9] See, for instance, Singh and Vives (1984).

[10] This is a departure from De Fraja (1993) where the public and private firms produce a homogeneous good (perfect substitutes). Needless to say, the case of perfect substitutes is a special case of our specification ($\gamma = 1$).

2.2 Wage setting

The private firm is unionized, and its wage is determined as a consequence of (Nash) bargaining between the firm and its union. Let $\bar{w}$ denote the competitive wage. Taking this as the reservation wage, the union sets the wage w_1 to maximize the following utility function:

$$u_1 = (w_1 - \bar{w})x_1. \tag{3}$$

This setup implies that the union possesses full bargaining power.[11] We also set $\bar{w} = 0$, as its level is inconsequential in a qualitative sense.

While the private firm's wage is determined by collective bargaining, we consider two distinct wage-setting regimes for the public firm. In one regime, no regulation is imposed on the public firm so that the public firm's union (union 0) is allowed to bargain collectively. Since the public firm is unionized just as the private firm, the union sets the wage w_0 to maximize

$$u_0 = (w_0 - \bar{w})x_0, \tag{4}$$

where $\bar{w} = 0$ as above.

In the other regime, on the other hand, the public firm's union is prohibited to bargain collectively. In the absence of collective bargaining, the wage w_0 is determined according to some wage-setting rule along the line of the 'equal work, equal pay' principle. More specifically, the public firm's wage is given by

$$w_0 = kw_1 + (1 - k)w^{\mathrm{pr}} = kw_1, \tag{5}$$

where w^{pr} is the average wage for the entire private sector. An important point in this specification is the fact that w^{pr} is exogenous. Since its level is inconsequential in a qualitative sense, we again set $w^{\mathrm{pr}} = 0$ for analytical simplicity in what follows.[12]

[11] This specification allows us to focus on a case where the union possesses sufficiently strong bargaining power. As the union's bargaining power becomes smaller, the model naturally converges to the standard mixed-oligopoly case where strategic interactions in the input market cannot be discussed. For the sake of the analysis, therefore, we consider the other end of the spectrum to emphasize the impact of wage regulations.

[12] Setting $w^{\mathrm{pr}} = 0$ directly implies $w^{\mathrm{pr}} < w_1$ in equilibrium. Although the level of w^{pr} is not consequential, this fact (that $w^{\mathrm{pr}} < w_1$) is qualitatively important. We focus on this case since the average wage for unionized workers is normally higher than that for the entire private sector which necessarily includes non-unionized workers.

In this setup, $k \in (0, 1]$ is an exogenously given variable which determines how closely w_0 should follow w_1.[13] The 'equal work, equal pay' principle is tightly implemented when k is close to one. In this paper, we take this variable k as exogenous, reflecting various technological as well as institutional factors. When the two firms are technologically identical and workers are fully mobile, for instance, k would have to be fairly close to one in order to attract any worker. We in general consider a case where k is sufficiently large.

2.3 Timing

We consider a two-stage game, and the timing of the game is as follows:

1. [the upstream market] If the public firm's union is allowed to bargain collectively, each union chooses its wage w_i simultaneously. If not, union 1 unilaterally sets the wage w_1 while w_0 is determined by the wage-setting rule (5).
2. [the downstream market] Each firm chooses its quantity x_i simultaneously to maximize profit.

3 The output market

We first consider the problem faced by the public firm. The public firm aims at maximizing the social welfare,[14] which is defined as

$$W = (U - p_0 x_0 - p_1 x_1) + (\pi_0 + \pi_1) + (u_0 + u_1). \tag{6}$$

With some simple algebra, this can simply be reduced to $W = U$. Taking w_0 as given, the public firm's problem is defined as

$$\max_{x_0} \quad U, \quad s.t.\ (p_0 - w_0)x_0 \geq 0.$$

[13] Of course, k can in principle take any positive number. We restrict attention to the case where $k \leq 1$ because it is unrealistic and perhaps politically infeasible to institute a rule that sets civil service salaries above the market average.

[14] In De Fraja (1993), the public firm is assumed to maximize the weighted sum of consumer surplus, profit and the union's utility where the weight attached to the union's utility is exogenously given. The assumption is necessary to obtain an equilibrium as, without it, the union would be able to unlimitedly raise its wage. See footnote 15 for more on this point.

The constraint implies that there is some lowerbound for the public firm's profit, i.e., the public firm faces a budget constraint.[15] This simply means that even the public firm is not allowed to incur an unlimited amount of loss. For now, we assume that the lowerbound is zero so that the public firm must yield nonnegative profits.

Similarly, consider the problem faced by the profit-maximizing private firm. Taking w_1 as given, the private firm's problem is defined as

$$\max_{x_1} \quad (p_1 - w_1)x_1 = (1 - x_1 - \gamma x_0 - w_1)x_1. \tag{7}$$

Solving these two problems yields the following result.

Lemma 1 *In the output market equilibrium, the budget constraint for the public firm is always binding. The output levels are given by*

$$x_0 = \frac{2 - \gamma - 2w_0 + \gamma w_1}{2 - \gamma^2}, \quad x_1 = \frac{1 - \gamma - w_1 + \gamma w_0}{2 - \gamma^2}.$$

PROOF: See Appendix.

The lemma states that the budget constraint for the public firm is always binding. The public firm thus sets the quantity at a level that yields zero profit in equilibrium. As we will see later, this indicates an important role played by the budget constraint imposed on the public firm.

4 The market equilibrium

4.1 The unregulated public firm

We first consider a case where no regulation is imposed on the public firm, and its wage is determined as a result of collective bargaining between the firm and the union. Because of

[15] Without this restriction, the public firm's union can unlimitedly raise its wage because the optimal output level of the public firm is independent of the wage, which only affects the distribution of wealth between the firm and the union. Since no firms, including public entities, possess an unlimited amount of resources, it is natural to assume that the public firm faces a restriction of this kind. In Japan, for instance, the Postal Law (Article 3) stipulates that postal fees must be set at an appropriate level that is sufficient to cover all necessary expenses.

this, we need to consider two independent maximization problems simultaneously. First, the problem for union 0 is defined as

$$\max_{w_0} \quad w_0 x_0 = \frac{w_0(2-\gamma-2w_0+\gamma w_1)}{2-\gamma^2}.$$

Similarly, the problem for union 1 is defined as

$$\max_{w_1} \quad w_1 x_1 = \frac{w_1(1-\gamma-w_1+\gamma w_0)}{2-\gamma^2}.$$

Lemma 2 *Suppose that no regulation is imposed on the public firm, and its union is allowed to bargain collectively. Then, the equilibrium wage and output levels, denoted as w_i^N and x_i^N, are given by*

$$w_0^N = \frac{4-\gamma-\gamma^2}{8-\gamma^2}, \quad w_1^N = \frac{4-2\gamma-\gamma^2}{8-\gamma^2},$$
$$x_0^N = \frac{2(4-\gamma-\gamma^2)}{(8-\gamma^2)(2-\gamma^2)}, \quad x_1^N = \frac{4-2\gamma-\gamma^2}{(8-\gamma^2)(2-\gamma^2)}.$$

PROOF: The first-order conditions are given by

$$w_0 = \frac{2-\gamma+\gamma w_1}{4}, \tag{8}$$
$$w_1 = \frac{1-\gamma+\gamma w_0}{2}. \tag{9}$$

Solving and substituting them into the output levels derived in lemma 1 then yields the results.

Q.E.D.

4.2 The regulated public firm

We now shift our attention to the case where the public firm is tightly regulated in order to see how the wage regulation affects the equilibrium outcome. In this case, the public firm's wage is determined automatically by the wage-setting rule (5). Taking the equilibrium outcome in the output market as given, union 1 maximizes

$$u_1 = w_1 x_1 = \frac{w_1(1-\gamma-w_1+\gamma w_0)}{2-\gamma^2}. \tag{10}$$

Knowing that the public firm simply follows the wage-setting rule, union 1 solves

$$\max_{w_1} \quad \frac{w_1(1-\gamma-w_1+\gamma k w_1)}{2-\gamma^2}.$$

Lemma 3 *Suppose that the wage regulation is imposed on the public firm, and its union is prohibited to bargain collectively. Then, the equilibrium wage and output levels, denoted as* w_i^R *and* x_i^R*, are given by*

$$w_0^R = \frac{k(1-\gamma)}{2(1-\gamma k)}, \quad w_1^R = \frac{1-\gamma}{2(1-\gamma k)},$$
$$x_0^R = \frac{4-\gamma-\gamma^2-2(1+\gamma-\gamma^2)k}{2(1-\gamma k)(2-\gamma^2)}, \quad x_1^R = \frac{1-\gamma}{2(2-\gamma^2)}.$$

PROOF: Solving the problem for union 1, we obtain the equilibrium wages. Substituting them into the output levels derived in lemma 1 then yields the equilibrium output levels.

Q.E.D.

5 The optimal regulatory framework of public institutions

The underlying theme of this paper is whether and how civil servants, especially their wages, should be regulated. With the equilibrium wages and output levels, we are now ready to assess the impact of different wage-setting regimes on social welfare.

The economy consists of three components: the unions, the firms and consumers. To see the welfare impact of the wage regulation, however, we first need to pay close attention to how the wage regulation affects the equilibrium wages as the welfare impact on each component hinges critically on it. We then examine each component in turn in order to identify who gains and who loses with the wage regulation.

5.1 The equilibrium wages

The equilibrium wage levels have critical welfare implications as they exert direct influences on the output levels. We first establish that the wage regulation can either increase or decrease the wages, especially depending on γ.

Proposition 1 *The wage regulation raises union 0's wage, i.e.,* $w_0^R > w_0^N$*, if*

$$k > \frac{2(4-\gamma-\gamma^2)}{8-3\gamma^2-\gamma^3} \equiv f_u(\gamma).$$

Similarly, it raises union 1's wage, i.e., $w_1^R > w_1^N$, if

$$k > \frac{4-\gamma-\gamma^2}{2(4-2\gamma-\gamma^2)} \equiv h_u(\gamma).$$

PROOF: It directly follows from lemmas 2 and 3.

Q.E.D.

Figure 1 illustrates $f_u(\gamma)$ and $h_u(\gamma)$. To see the impact of the wage regulation, it is important to notice that since the public firm has an inherent tendency to expand output due to its mission, its union can take advantage of this and become more aggressive in wage bargaining than the private firm's union. The wage regulation then tends to lower the public firm's wage by placing an exogenous cap on it. This is a direct effect of the wage regulation because its effect is present without any market interactions, i.e., the effect is independent of γ. Since the direct effect dominates, the wage regulation tends to lower the public firm's wage when γ is sufficiently close to zero.

Beside this direct effect, the wage regulation also gives rise to two additional indirect effects which work through strategic market interactions. The first indirect effect arises from the fact that the public firm by design ends up with a cost advantage under the wage regulation (when $k < 1$). Since the public firm is able to procure its labor input at a lower price, this virtually forces the private firm's union to lower its wage in order to compete in the downstream market. This aspect of the regulation is welfare-enhancing because a lower wage generally leads to more output, which illustrates a virtue of the wage regulation: by placing an exogenous cap on the public firm's wage, the regulation intensifies downstream market competition and realizes more output and lower market prices.

This does not necessarily mean, however, that the wage regulation invariably lowers the equilibrium wages. Although the wage regulation certainly has a bright side, there is also a cost associated with it because the private firm's union can now set its wage unilaterally without any strategic concerns. Knowing that the public firm's wage is set according to the wage-setting rule, this releases the union from stiff wage competition and hence loosens upstream

market competition. This aspect of the regulation is welfare-reducing as it tends to raise the equilibrium wages, leading to less output.

The overall welfare effect is determined largely as a result of this tradeoff. The proposition indicates that the downstream-market effect becomes more dominant and pushes the wage down to zero as γ goes to one, i.e., as the degree of market competition becomes severer. As γ decreases, on the other hand, the upstream-market effect becomes more dominant, allowing the private firm's union to demand a higher wage. As we will see later, the wage regulation tends to be welfare-reducing when γ is in some intermediate range where the upstream-market effect dominates.

5.2 The unions

Notice that a higher wage does not always make the union better off, nor does a lower wage always make it worse off. We now examine under what conditions each union is made better off under the wage regulation.

Proposition 2 *The wage regulation makes union 0 better off if*

$$k > \frac{(4-\gamma-\gamma^2)(64-32\gamma^2+\gamma^4-\gamma^5-\gamma(1-\gamma)(8-\gamma^2)\sqrt{16+\gamma^2})}{4(64-80\gamma^2+32\gamma^3+5\gamma^4-8\gamma^5+2\gamma^6+\gamma^7)} \equiv g_u(\gamma),$$

while it never makes union 1 better off.

PROOF: See Appendix.

Figure 2 illustrates $g_u(\gamma)$. The proposition shows two results that are somewhat counter-intuitive. First, the wage regulation never makes the private firm's union better off although it tends to raise its wage for a wide range of γ. This is mostly due to the fact that the private firm would lose the cost advantage under the regulation and is hence forced to cut down its output or, equivalently, employment. Although the wage regulation allows the private firm's union to set its wage unilaterally, and this will often be reflected in a higher wage, it never benefits the union as it loses a competitive edge in the market.

Second, the wage regulation often makes the public firm's union better off although it tends to decrease its wage. This is certainly paradoxical, given the fact that the right to bargain

collectively is granted to civil servants in many countries in order to protect their human rights. As stated, when no regulation is imposed and the public firm's union can bargain collectively, the union can take advantage of the public firm's mission of maximizing welfare and demand a higher wage. As it turns out, though, this does not necessarily work to the union's advantage as this incentive can sometimes be excessively strong: under plausible circumstances, the wage regulation is desirable for the public firm's union, not the private firm's, because it tends to demand excessively higher wages when it is allowed to bargain. In this sense, there is a situation where the public firm's union would be made better by strategically giving up the right to bargain collectively.

5.3 The firms

We now focus on how the wage regulation imposed on the public firm affects the profit made by each firm. This turns out to be a simple exercise since the public firm always makes zero profit in equilibrium (see Lemma 1), which allows us to restrict attention to the private firm.

Proposition 3 *The wage regulation always lowers firm 1's profit.*

Proof: See Appendix.

The proposition states that the wage regulation imposed on the public firm always lowers the private firm's profit. The result is fairly intuitive. Even without the wage regulation, the public firm tends to operate on a larger scale because of the difference in the objectives, which generally crowds out the private firm. This factor is somewhat alleviated when the wage regulation is not imposed, because the cost advantage then belongs to the private firm with the public firm's union becoming excessively aggressive. When the wage regulation is imposed, on the other hand, the situation is totally turned around where the cost advantage now shifts to the public firm. On top of the difference in the objectives, this forces the private firm to lower its output towards zero as γ increases. Along with proposition 2, this implies that the private firm and its union are the unambiguous loser of the wage regulation.

5.4 Consumers

Another important component of social welfare is consumer surplus. In general, the more the firms produce, the more consumers benefit since more production results in lower market prices. A critical factor here is again the wage levels which determine the cost of production. Since the public firm occupies a larger market share, the public firm's wage is especially important.

Proposition 4 *The wage regulation enhances consumer surplus if*

$$\begin{aligned} k \;<\; & \frac{512+256\gamma-832\gamma^2-336\gamma^3+472\gamma^4+133\gamma^5-90\gamma^6-24\gamma^7+4\gamma^8+\gamma^9}{256+512\gamma-320\gamma^2-832\gamma^3+116\gamma^4+472\gamma^5-19\gamma^6-90\gamma^7-3\gamma^8+4\gamma^9} \\ & + \frac{(1-\gamma)(8-\gamma^2)(2-\gamma^2)}{256+512\gamma-320\gamma^2-832\gamma^3+116\gamma^4+472\gamma^5-19\gamma^6-90\gamma^7-3\gamma^8+4\gamma^9} \\ & \times \sqrt{256+192\gamma-304\gamma^2-208\gamma^3+131\gamma^4+50\gamma^5-16\gamma^6-2\gamma^7+\gamma^8}. \end{aligned}$$

PROOF: See Appendix.

Figure 3 illustrates the right-hand side of the inequality. As we have already seen, since the upstream-market effect dominates, the wage regulation tends to raise the public firm's wage when γ is in some intermediate range. This implies that the wage regulation is more likely to benefit consumers when γ is at either end of the spectrum.

5.5 Social welfare

The public firm aims at maximizing social welfare. Likewise, the government's ultimate concern is supposedly to maximize social welfare. We say that the wage regulation is efficient if it enhances social welfare.

Proposition 5 *The wage regulation is efficient (enhances social welfare) if*

$$k < \frac{\gamma K-(1-\gamma)(8-\gamma^2)(2-\gamma^2)\sqrt{K}}{256-512\gamma-320\gamma^2+960\gamma^3-76\gamma^4-504\gamma^5-101\gamma^6+102\gamma^7-15\gamma^8-8\gamma^9},$$

where

$$K \equiv (4-\gamma-\gamma^2)(64-64\gamma-28\gamma^2+37\gamma^3+5\gamma^4-5\gamma^5-\gamma^6).$$

PROOF: See Appendix.

Figure 4 illustrates the right-hand side of the inequality. As stated, unambiguous losers of the wage regulation are the private firm and its union because the regulation by design gives the public firm a cost advantage, which would otherwise belong to the private firm. If the wage regulation is to be efficient, any positive effect arising from it must overcome the cost incurred by the private firm. Again, the primary factor in this is the public firm's wage. When γ is in the intermediate range, the regulation tends to raise the public firm's wage and benefit the public firm's union. This is, however, due to an increase in the wages, which subsequently leads to a decrease in the total output.

Figure 5 depicts how social welfare, consumer surplus and the utility of the public firm's union are related to each other. The figure indicates several logical relationships among them. For instance, it follows from the figure that any inefficient wage regulation, the one that reduces social welfare, always benefits the public firm's union. This result points out an inherent tension between welfare-maximizing public firms and utility-maximizing civil servants. This observation ultimately amounts to the following statement.

Proposition 6 *There exists no regulatory framework that is Pareto-improving by itself under any circumstances.*

PROOF: To show this, we need to show that the wage regulation is neither Pareto-improving nor Pareto-worsening (if the regulation is Pareto-worsening, then everyone can be made better off by removing the regulation). First, since the private firm and its union inevitably lose on the wage regulation, it can never be Pareto-improving. The wage regulation can never be Pareto-worsening either because an inefficient regulation always benefits the public firm's union (see figure 5). This proves that there exists no regulatory framework that is Pareto-improving under any circumstances.

Q.E.D.

6 An extension

In mixed-market models with wage bargaining, some restrictions must be placed on the public firm since otherwise its union could demand unlimitedly higher wages. In order to circumvent this problem, we have thus far assumed that the public firm must earn nonnegative profits. As we argue, it is certainly natural to assume that even public firms face a budget constraint of some kind since no entities possess an unlimited amount of resources. At the same time, though, how much budget to grant to each public firm is a matter of political concern, and there is no convincing reason to believe that all public firms must break even. In this section, therefore, we relax this assumption and examine the role of the budget constraint imposed on the public firm. We in particular show that it sometimes pays to let the public firm pursue more profit (a tighter budget constraint) as it inhibits its union from being excessively aggressive in wage bargaining.

Since the model becomes fairly complicated with this modification, we use numerical examples to illustrate the impact of a tighter budget constraint. For the computation, we set $k = 0.9$ and $\gamma = 0.75$.

Regulated			Unionized		
	$\bar{\pi} = 0$	$\bar{\pi} = 0.01$		$\bar{\pi} = 0$	$\bar{\pi} = 0.01$
w_0^R	0.34615	0.37701	w_0	0.36135	0.34140
w_1^R	0.38462	0.41890	w_1	0.26050	0.25799
x_0^R	0.58863	0.53771	x_0	0.50274	0.50309
x_1^R	0.08696	0.08891	x_1	0.18122	0.18235
W^R	0.46017	0.44224	W	0.47284	0.47304
π_1^R	0.00756	0.00790	π_1	0.03284	0.03325
u_0^R	0.20376	0.20272	u_0	0.18166	0.17175
u_1^R	0.03344	0.03724	u_1	0.04721	0.04704
CS^R	0.21541	0.19438	CS	0.21112	0.21198

($\gamma = 3/4$, $\pi_0 \geq \bar{\pi} = 1/100$, $k = 9/10$)

As we have noted, a virtue of a tighter budget constraint is to control the public firm's union. This aspect is evidently absent when the wage regulation is imposed on the public firm, and a tighter budget is generally welfare-reducing. The reason why a tighter budget is welfare-reducing is fairly straightforward. A primary effect is on the public firm's output.

Under a tighter budget, the public firm needs to reduce its output in order to raise the market price. Moreover, this change in the output level gives rise to a secondary effect. While a tighter budget reduces the public firm's output, it provides a room for the private firm to increase its output. This allows the private firm's union to demand a higher wage, which consequently raises the public firm's wage as well: w_1 increases from 0.385 to 0.419 while w_0 also increases from 0.346 to 0.377. An increase in the wages reduces the total output, which inevitably reduces consumer surplus and social welfare.

One important role of public firms is to correct inefficiencies that arise in oligopolistic markets because firms have some control over the market prices, which leads them to reduce output to an inefficient level. In this sense, intuition certainly suggests that it is not desirable to force the public firm to pursue more profit by imposing a tighter budget constraint. This conclusion does not hold, however, when the public firm's union is allowed to bargain collectively. A tighter budget constraint forces the public firm's union to be less aggressive in wage bargaining and hence lower its wage. Due to the strategic complementarity between the unions, this also lowers the private firm's wage as well. A decrease in the wages all works to improve welfare by increasing the total output, lowering the market price and hence enhancing consumer surplus. The analysis thus points out a channel through which imposing a tighter budget constraint would actually enhance welfare when the public firm's union is allowed to bargain collectively, thereby shedding light on a new perspective on the role of profit motives in public institutions.

7 Conclusion

The paper presents a model of unionized mixed duopoly and examine the optimal regulatory framework of public institutions in order to gain some policy implications. In particular, perhaps not surprisingly, we show that the way civil service salaries are determined has critical welfare implications. The analysis reveals, however, that welfare effects of the wage regulation are subtle and certainly not straightforward as the regulation gives rise to two opposing indirect effects that operate through strategic market interactions. The overall welfare impact is indeed

ambiguous, depending crucially on the degree of product differentiation between the firms.

Besides this, the paper also raises several interesting issues. First, in contract to the popular belief, the wage regulation imposed on the public firm may actually benefit its workers because they tend to demand excessively higher wages when they are allowed to bargain collectively. In this sense, the wage regulation functions virtually as a commitment device to keep them away from stiff wage competition, which ultimately leads to more employment. Conversely speaking, we can argue that granting the right to bargain collectively to civil servants would not necessarily help them, despite its original intention. It is also pointed out that the wage regulation is unambiguously detrimental to the private firm and its workers because it gives the public firm a competitive edge in the market.

Second, the paper also raises a new perspective on the role of budget constraints on the public firm. A tighter budget constraint implies that the public firm must shift attention from welfare maximization to profit maximization. In ordinary circumstances, this is not desirable as the public firm must decrease its output, resulting in higher market prices. When civil servants are allowed to bargain collectively, however, imposing a tighter budget constraint can actually be welfare-enhancing because it is instrumental in regulating their behavior. The logic also implies another virtue of partial privatization, much in the spirit of Matsumura (1998).

As a final note, since the model is highly stylized to deliver the main message in a relatively clear way, there are admittedly several potential avenues to extend the current analysis. For instance, we take the wage-setting rule as exogenous, assuming that it is supposedly subject to many political and institutional restrictions. Since the wage-setting rule yields quite a critical welfare impact, however, an attempt may be made to endogenize it. This extension adds an extra dimension to the model because one needs to explicitly consider interactions in the labor market to thoroughly characterize the optimal wage-setting rule.[16] This implies that there are now three markets – the upstream, downstream and labor markets – to be considered. We sidestep this process because our main focus is on the tradeoff between the upstream-market

[16] A possible way to model this is to assume that the marginal cost of the public firm is a decreasing function of k since a smaller k implies a larger wage disparity between the firms, and the public firm consequently faces a difficulty attracting high-quality workers.

and downstream-market effects, which would not be affected in a qualitative sense by the extension. It is nonetheless of some interest to pursue this issue in future by examining a situation where the public and private firms compete for workers in the labor market in order to endogenize the wage-setting rule.

[2006.3.8, 747 (2006-7)]

Appendix

Proof of Lemma 1: The Lagrangian for the public firm's problem is formulated as

$$\mathcal{L} = x_0 + x_1 - \frac{x_0^2 + 2\gamma x_0 x_1 + x_1^2}{2} + \lambda(1 - x_0 - \gamma x_1 - w_0)x_0.$$

Taking w_0 as given, the first-order condition is given by

$$\frac{\partial \mathcal{L}}{\partial x_0} = 0 \Leftrightarrow 1 - x_0 - \gamma x_1 + \lambda(1 - 2x_0 - \gamma x_1 - w_0) = 0.$$

If the constraint is slack, and there exists an interior solution, the optimal quantity for firm 0 is

$$x_0 = 1 - \gamma x_1. \tag{A.1}$$

If the constraint is binding, on the other hand, the public firm sets the quantity so that the resulting profit is zero. The constraint and the optimal quantity in this case are

$$1 - x_0 - \gamma x_1 - w_0 = 0, \quad x_0 = \frac{(1+\lambda)(1-\gamma x_1) - \lambda w_0}{1 + 2\lambda}. \tag{A.2}$$

The problem for the private firm is, on the other hand, much simpler. The optimal quantity for the private firm is then given by

$$x_1 = \frac{1 - \gamma x_0 - w_1}{2}. \tag{A.3}$$

Given these results, we now obtain the output level for each firm. Solving the first-order conditions (A.2) and (A.3), we obtain

$$x_0 = \frac{2 - \gamma - 2w_0 + \gamma w_1}{2 - \gamma^2}, \tag{A.4}$$

$$x_1 = \frac{1 - \gamma - w_1 + \gamma w_0}{2 - \gamma^2}, \tag{A.5}$$

$$\lambda = \frac{(2 - \gamma^2)w_0}{2\gamma - 2w_0 + \gamma w_1}. \tag{A.6}$$

Notice that the constraint is always binding if $w_0 > 0$, which is always the case as long as $k > 0$.

Q.E.D.

Proof of Proposition 2: Using the results obtained thus far (see Lemma 3), we can compute the utility of each union under the regulation:

$$u_0^R = w_0^R x_0^R = \frac{k(1-\gamma)(4 - \gamma - \gamma^2 - 2(1 + \gamma - \gamma^2)k)}{4(1 - k\gamma)^2(2 - \gamma^2)}, \; u_1^R = w_1^R x_1^R = \frac{(1-\gamma)^2}{4(1 - k\gamma)(2 - \gamma^2)}. \tag{A.7}$$

Similarly, we can also compute the utility under no regulation (see Lemma 2):

$$u_0^N = w_0^N x_0^N = \frac{2(4-\gamma-\gamma^2)^2}{(8-\gamma^2)^2(2-\gamma^2)},\ u_1^N = w_1^N x_1^N = \frac{(4-2\gamma-\gamma^2)^2}{(8-\gamma^2)^2(2-\gamma^2)}. \tag{A.8}$$

Comparing u_i^R and u_i^N for $i = 0, 1$, we can obtain the results in the proposition.

Q.E.D.

Proof of Proposition 3: Using the results obtained thus far (see eq(7), Lemmas 1, 2, and 3), we can compute firm 1's profit under each regime:

$$\pi_1^R = \frac{(1-\gamma)^2}{4(2-\gamma^2)^2}, \tag{A.9}$$

$$\pi_1^N = \frac{(4-2\gamma-\gamma^2)^2}{(8-\gamma^2)^2(2-\gamma^2)^2}. \tag{A.10}$$

With some algebra, we can show that $\pi_1^N > \pi_1^R$ for any k and γ.

Q.E.D.

Proof of Proposition 4: Let CS denote the consumer surplus. The following relationship then holds:

$$CS = U - p_0 x_0 - p_1 x_1 = U - \pi_1 - u_0 - u_1. \tag{A.11}$$

Given this, we can compute the consumer surplus under each regime as follows:

$$\begin{aligned} CS^R &= \frac{17-2\gamma-16\gamma^2+2\gamma^3+3\gamma^4}{8(1-\gamma k)^2(2-\gamma^2)^2} \\ &\quad - \frac{(1+\gamma)(2(8+\gamma-11\gamma^2+3\gamma^3+\gamma^4)k-(4+4\gamma-3\gamma^2-7\gamma^3+4\gamma^4)k^2)}{8(1-\gamma k)^2(2-\gamma^2)^2}, \end{aligned} \tag{A.12}$$

$$CS^N = \frac{80+16\gamma-80\gamma^2-12\gamma^3+17\gamma^4+4\gamma^5}{2(8-\gamma^2)^2(2-\gamma^2)^2}. \tag{A.13}$$

Comparing these two and solving for k yields the result.

Q.E.D.

Proof of Proposition 5: Noting that $W = U$ by design, we can compute the social welfare under each regime:

$$\begin{aligned} W^R &= \frac{23-4k^2-2(7+23k-4k^2)\gamma-(12-28k-23k^2)\gamma^2}{8(1-\gamma k)^2(2-\gamma^2)^2} \\ &\quad + \frac{2(3+12k-11k^2)\gamma^3+(1-12k-9k^2)\gamma^4-2k(1-4k)\gamma^5}{8(1-\gamma k)^2(2-\gamma^2)^2}, \end{aligned} \tag{A.14}$$

$$W^N = \frac{304-144\gamma-256\gamma^2+92\gamma^3+67\gamma^4-12\gamma^5-6\gamma^6}{2(8-\gamma^2)^2(2-\gamma^2)^2}. \tag{A.15}$$

Comparing these two and solving for k yields the result.

Q.E.D.

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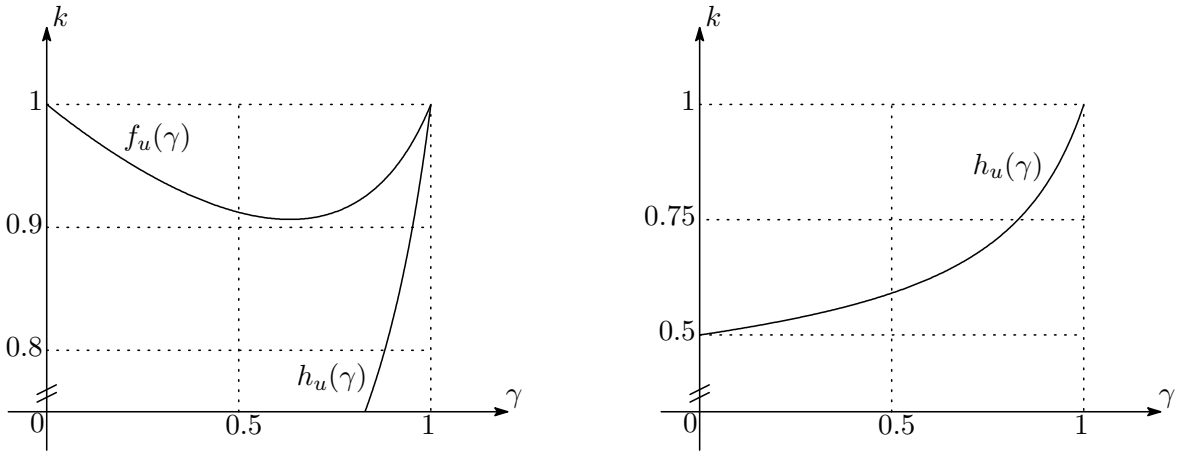

Figure 1: Wages

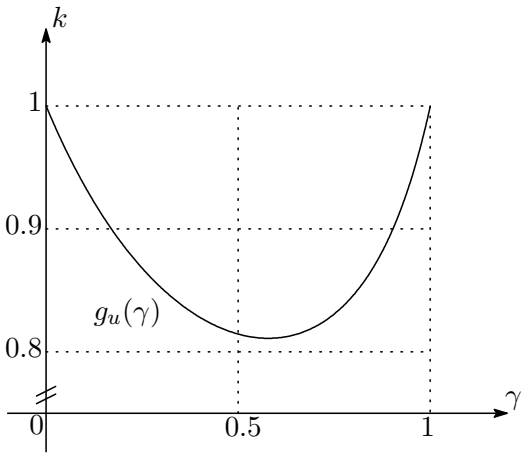

Figure 2: The public firm's union

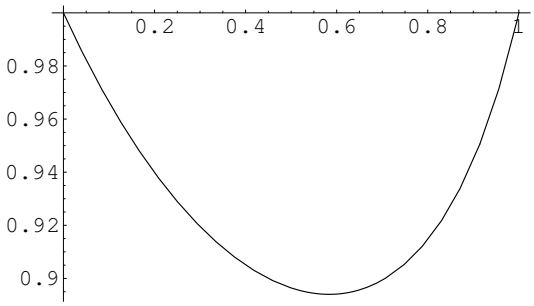

Figure 3: Consumer surplus

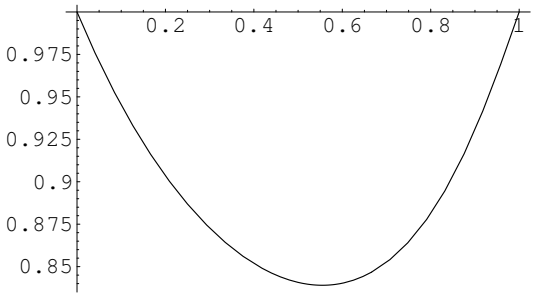

Figure 4: Social welfare

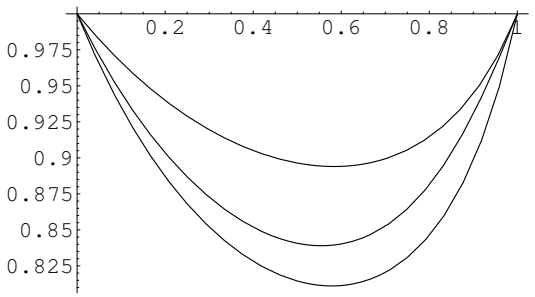

Figure 5: Comparison: consumer surplus (top), social welfare (middle) and the utility of the public firm's union (bottom)