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Why High-level Executives Earn Less in the Governmental Than in the Private Sector

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Abstract

Governmental officials often have far greater responsibilities and make far more consequential decisions than do CEOs of private firms. Nevertheless, governmental officials often earn far less and face low-powered incentives. We offer explanations for the differences, considering Nash bargaining with the head of a governmental agency or with the CEO of a for-profit firm. If regulations restrict the price a governmental agency can charge, or if at a governmental agency one official sets price and a different official negotiates pay, then the head of a governmental agency may earn less than the head of a for-profit firm. We also show that a governmental official paid less than a private CEO faces weaker incentives. That in turn can make costs, other than CEO pay, higher at a governmental agency. We also consider elections, with voters choosing an official to set the price of the good, and voters choosing an official to negotiate with the CEO over his pay. A governmental official will be paid less than a CEO at a private firm if the income distribution in the population is sufficiently unequal.

Keywords: CEO pay, governmental officials, Nash bargaining, tax distortions, structure-induced equilibrium, low-powered incentives

JEL classification numbers: D23, H11, J31, J45

1 Introduction

Governmental agencies often pay senior officials less than do for-profit firms, and often offer lower-powered incentives than for-profit firms. That is surprising in two ways. First, senior governmental officials can have immense and important responsibilities, far more than in the private sector. Second, though senior officials do not earn high pay, lower-level workers commonly earn more than in the private sector, and governmental agencies may pay high prices in procurement.

Data show that workers in the U.S. federal government with a professional degree or doctorate earned 18 percent less than similar private-sector employees.[1] (The earnings are for total compensation, including fringe benefits.) But that is not because the government always pays less. Federal government workers with a BA degree or less education earned 15 percent more than similar workers in the private sector. Federal government workers with a high school diploma or less education earned 36 percent more than similar workers in the private sector. A similar pattern holds when comparing state government workers with private sector workers. Workers with only a high school diploma earn a 19% premium in the public sector over the private sector. But workers with M.A., professional, or PhD degrees earn less than in the private sector; for professionals the gap is 17%.[2]

Perhaps the low pay arises because, for many important positions, an official's pay is set by statute, and is not subject to negotiation. The President of the United States earns $400,000 a year; it would be strange indeed to have the winner of the election say he would take the position only if paid more. Similarly, the Secretary of Defense is a Level I position of the Executive Schedule, and thus earns a salary of $235,600 per year.

But the compensation of many other public officials is negotiated. That is true, for example, for the president of the University of California, or for the CEOs of public hospitals. The Los Angeles school district had negotiated with its superintendent to offer a pay package of $439,998.[3]

The low-pay and low-powered incentives are examined belowwith a model of bargaining. Consider a CEO with firm-specific skills, so that he is difficult to replace. The CEO engages in Nash bargaining with his employer about his compensation. A for-profit firm bargains over the division of profits. The CEO of a state-owned firm or the head of a governmental agency bargains over the share of consumer surplus and profits he gets.

We would expect bargaining to be more common for high-level positions, associated

[1] Congressional Budget Office 2012.

[2] See Biggs and Richwine (2014).

[3] `http://www.dailynews.com/social-affairs/20150320/former-lausd-superintendent-deasys-pay-nearly-440000-last-year`

with higher levels of education. And it is those positions which more closely resemble the position of a CEO at a private firm.

The following analysis of Nash bargaining at a for-profit firm is standard. The analysis for governmental firms is novel by considering four differences between governmental organizations and private firms. First, government values both profits *and* consumer welfare when evaluating the surplus generated by an agency's head, instead of valuing only profits. Second, a governmental organization may be unable to charge prices as high as a for-profit firm can, because of regulation or non-excludability of the product. Third, government may have to impose distortionary taxes to pay a CEO. Fourth, instead of a sole negotiator, one official may set the good's price, and a different official may negotiate over the pay of the agency's head.

The pay differences between CEOs in government and in for-profit firms can appear for several reasons unrelated to our explanation. CEOs in the government may have lower ability (though it is reasonably common for former partners at Goldman Sachs to take large pay cuts when entering government). The compensation for government service can come not during the period of service, but afterwards with lobbying contracts or book royalties (though rarely does a former U.S. president earn as much as a CEO of a large private firm). The compensation may include non-pecuniary benefits, be it in the accouterments of power, or in the ability to determine important policies. Bureaucratic rules, the separation of powers, and rulings by courts may so limit the choices faced by a governmental official that it little matters who is that official, so that the marginal product of even a highly able official may be small. Government limits competition and job hopping within the government, and so a governmental official may find few competing governmental organizations that try to attract him with high compensation. We deny none of these, but instead focus on one aspect—bargaining outcomes, with the difference between for-profit and governmental organizations arising from differences in objectives, negotiating procedures, and costs of paying a CEO.

Though we shall speak of negotiations with a CEO, a similar analysis can apply when government negotiates with a supplier of an input to the government, for example, in negotiations with a military contractor. And a byproduct of our analysis is results relating to the price that a governmental agency will charge for services it provides. For example, we show that voters subject to a high tax will favor a high price for governmental services.

2 Literature

The literature examining pay at governmental agencies, and comparing that with pay at private firms, is sparse. Hadley (2016) looks not at for-profit and governmentally-controlled firms, but at the degree to which for-profit firms are the most politically sensitive (that is, federal contractors with government contracts that are most visible and that constitute much of their revenue), finding that CEO pay declines with political sensitivity. In comparing CEO pay at a for-profit firm with pay at a governmentally controlled firm, some empirical work has considered the effects of privatization. The general pattern is that CEO pay increases following privatization. Wolfram (1998) finds that on average CEOs at Britain's twelve regional electricity distribution companies had nearly a threefold salary increase in the two years following the industry privatization in 1990. The increased pay did not arise from increases in managerial talent, because privatization little changed personnel at the top ranks. Salary increases are highly correlated with firms' potential profits (as measured by the administratively assigned price cap). That is consistent with our assumption that Nash bargaining with a for-profit firm concerns the allocation of profits between the owners and the CEO. Similarly, in a study of British building societies that converted from a mutual to a proprietary form, Shiwakoti, Ashton, and Keasey (2004) find that after the conversions the pay of the CEOs and directors increased.

The differences in pay may arise from the lower profits, or even losses, earned by state-owned enterprises. That may reflect deliberate governmental policy, as Boycko, Shleifer, and Vishny (1994) claim that politicians use state-owned enterprises to favor their political supporters through excessive employment, regionally targeted investments, and deliberate under-pricing of products or overpricing of purchased inputs (from politically-connected suppliers). In empirical work, Boardman and Vining (1989) examine the economic performance of the 500 largest non-U.S. industrial firms in 1983. Using four profitability ratios and two measures of X-efficiency they document that state-owned and mixed (state and private ownership) enterprises are significantly less profitable than privately-owned firms.

Perhaps government pays less to attract managers with intrinsic motivation. Were that so, then increased pay would reduce performance. But several studies find the opposite. A study of local legislators in Brazil finds that increased pay increases both the quality and performance of elected officials (Ferraz and Finan 2009). Gagliarducci and Nannicini (2013) find the same for mayors in Italy. In Finland, increased pay for members of Parliament increases their quality as proxied by their education (Kotakorpi and Poutvaara 2011); in Spain increased pay for mayors increases municipal efficiency (Benito, Martinez-Cordoba, and Guillamon 2021). Evidence relating to members of the European Parliament is mixed: salary increases increased absenteeism, but did not affect work effort (Mocan and Altindag 2013). Braendle (2015) finds that increased salary increased effort (for example as measured by the number of speeches), but also increased absenteeism. Looking at how pay varies with performance, rather than at how performance varies with pay, a study of top civil servants in Norwegian local governments finds a positive relation, with, however, weak incentives (Geys, Heggedal, and Sorensen 2017). Our model can explain this pattern.

3 Assumptions

We shall consider a for-profit firm and a governmental organization that provide a private good. The governmental organization could be a state-owned enterprise, such as the Amtrak railroad or the U.S. Postal Service in the United States. Or it could be an agency providing a service that a private firm could also provide, such as education at a zero price. Alternatively, the agency could engage in an activity in which private firms could not, say environmental protection. The analysis below is sufficiently general to apply to all these cases. But, for brevity, we shall speak of a governmental agency, calling the head of that agency its CEO.

Let a monopolistic firm or agency face the demand function $Q(p)$ and the cost function $C(Q)$, where $p \geq 0$ is the price and $Q \geq 0$ is the quantity. The functions satisfy $Q' < 0$, $C' > 0$, and $C'' \geq 0$. At price p the firm's profit is

$$\Pi(p) = pQ(p) - C(Q(p)),$$

and consumer surplus is

$$S(p) = \int_p^\infty Q(x)dx.$$

The CEO under consideration has organization-specific skills that make him more productive than anyone else could be at the organization. For simplicity, we mostly suppose that the CEO is uniquely skilled. If he does not lead the organization, it must shut down, producing nothing. That assumption is not at all necessary. Similar results hold if negotiations are held with a CEO who has a higher marginal product than his replacement would. That is, negotiations are held with the person who would generate the greatest profits or the greatest surplus.

We shall speak of the negotiator and of a CEO. For a private, for-profit, firm, the negotiator is the owner of the firm who pays the CEO and gets all profits. For a governmental agency, the interpretation should be that the negotiator is the decisive voter, an elected mayor, a cabinet secretary, or the like. The CEO could be a school superintendent, the chief of police, the head of a state hospital, the manager of a public corporation, and so on.

The CEO and the negotiator engage in Nash bargaining to set the CEO's compensation, w, which is paid as a lump sum, and to set the product's price, p. The CEO's reservation utility is zero; the negotiator's reservation utility is also zero. Nash bargaining results in a lump-sum payment to the CEO and in the good's price, with the values maximizing the product of the CEO's income and the negotiator's utility.

4 Pay set with Nash bargaining

To analyze price and wage determination in private and state-owned organizations in a unified model, we consider Nash bargaining between a negotiator and a CEO over the salary and the good's price. The negotiator represents the preferences of the decisive voter, who may be the median voter. Changing the parameters, however, allows us to deal with a negotiator who owns a profit-maximizing firm, and with a politician who maximizes the welfare of voters when providing a good at a price of zero.

When the population is large, any one voter's surplus is small—he gets only a small share of aggregate profits, and any one voter's consumer surplus may be small. That may suggest that the CEO of a governmental agency could bargain for only a small salary. Not so. Though the per capita profits and consumer surplus are small, the cost to any one voter of paying a large salary is also small.

We shall also allow for a distortionary tax. The distortion suggests that a governmental CEO will earn less than a CEO at a for-profit firm, because any increased pay to the CEO requires an increase in taxes, which reduces a voter's utility by more than the amount of the tax. But, as we shall see, that intuition is misleading.

4.1 Outcomes from Nash bargaining

Let citizen-voters have the same quasi-linear utility function but differ in incomes. A voter with income $y > 0$ is called voter y. For notational simplicity, normalize average income to 1.

The voter's consumer surplus from the good the governmental agency provides is $s(p)$. He pays a tax, $t(y)$. A tax imposes an excess burden, so that the cost to a person of paying the tax $t(y)$ is $(1+\lambda)t(y)$, with $\lambda \geq 0$, which parameterizes the marginal cost of taxation; as λ increases, the marginal tax distortions are greater. Then, voter y's indirect utility is

$$u(p, y) = s(p) - (1+\lambda)t(y). \tag{1}$$

The demand function for the good is the same for all consumers, so that the individual consumer surplus relates to aggregate consumer surplus, $S(p)$, as follows:

$$s(p) = S(p)/N, \tag{2}$$

where N is the total population (or measure) of citizen-voters.

The gap between the payment to the CEO and the agency's profit, $T = w - \Pi(p)$, is financed by additional taxes when T is positive, and used to reduce existing taxes when it is negative.[4]

Voters pay taxes or receive tax reductions in proportion to income. Normalizing average income equal to 1 implies that voter y's tax or subsidy is $t(y) = yT/N$. Making this substitution into the utility function (1) and noting (2), we rewrite voter y's indirect utility function as[5]

$$v(p, w, y) = \frac{S(p) + y(1+\lambda)(\Pi(p) - w)}{N}. \tag{3}$$

Suppose now that voter y is the negotiator in the Nash bargaining with the governmental CEO. Denote the CEO's wage by w_G; the price is p_G. The negotiation maximizes the product of w and $v(p, w, y)$. Define $\theta \equiv 1/[(1+\lambda)y] > 0$. Then the Nash bargaining outcome maximizes $w[\theta S(p) + \Pi(p) - w]$, so that the price is

$$p_G = \arg\max \ \theta S(p) + \Pi(p), \tag{4}$$

and the pay is

$$w_G = \frac{\theta S(p_G) + \Pi(p_G)}{2}. \tag{5}$$

To characterize the bargaining outcomes concisely, define the inverse demand function, $p(Q)$ such that $Q(p(Q)) \equiv 1$. Denote the resulting output by $Q_G = Q(p_G)$. Then, the first-order condition for (4) reveals that Q_G satisfies

$$\theta p(Q) + (1-\theta)\{p(Q) + p'(Q)Q\} = C'(Q). \tag{6}$$

This condition facilitates the understanding of how the bargaining outcomes differ between the two organizational modes. Because the term in the braces on the left-hand side of (6) is the marginal revenue under monopoly, Q_G is the output that equalizes the weighted average of the price and the monopolistic marginal revenue to the marginal cost. Recalling that $\theta = 1/[(1+\lambda)y]$ shows that the weight tilts to the latter as either the voter is richer or the marginal tax distortion is greater.

We should be also careful about the second-order condition for (4) because the weight, θ, is not necessarily less than one. As in the standard analysis of monopoly, we shall assume

[4]We need to assume that if $T < 0$, voters incur tax distortions; otherwise, the choice set of the Nash bargaining is non-convex, and our simple solution fails to hold.

[5]Rewriting the indirect utility function as

$$v(p, w, y) = \frac{y}{N}\left\{\frac{S(p)}{y} - (1+\lambda)(\Pi(p) - w)\right\},$$

allows the model to have voters heterogeneous not in income but in preferences for the good. That is, voter y is an individual whose demand for the good is $1/(yN)$ of the market demand. This interpretation does not alter the results.

throughout the analysis that the marginal revenue under monopoly is decreasing in the output, i.e., $2p'(Q) + p''(Q)Q < 0$, and assume a decreasing demand function, $p'(Q) < 0$. Then the second-order condition for (4) holds if $\theta \le 1$, but not otherwise. For example, if the price elasticity of demand is constant at $\varepsilon > 1$ and the marginal cost of production is also constant at c, we have $p_G = \varepsilon c/(\varepsilon - 1 + \theta)$ with the second-order condition satisfied irrespective of θ. If the demand curve is linear, on the other hand, $\theta < 2$ is necessary for an internal solution. We hereafter assume the second-order condition holding at the bargaining outcome.[6]

The first-order condition, (6), captures the bargaining outcome in a for-profit organization, too, in which the profit, $\Pi(p)$, is shared between the negotiator and the CEO. The Nash bargaining maximizes $w(\Pi(p) - w)$. Denote the solution by a pair of p_F and w_F and the resulting output by $Q_F = Q(p_F)$ Then setting $\theta = 0$ in (6) yields the first-order condition:

$$p(Q_F) + p'(Q_F)Q_F = C'(Q_F), \tag{7}$$

and the pay satisfies

$$w_F = \frac{\Pi(p_F)}{2}. \tag{8}$$

Clearly, the bargaining chooses the monopoly output and the CEO earns half the profits.

4.2 Governmental agency not regulated

Compare now the Nash bargaining outcomes between the alternative organizational modes, assuming that the governmental agency is not restricted in pricing. Recalling our unified characterization of the bargaining outcomes shown in (4) and (5), only the difference in θ matters: $\theta > 0$ in the governmental agency and $\theta = 0$ in the for-profit firm. From (4) and (5), p_G decreases with θ and w_G increases with θ, so that

Proposition 1 *If a decisive voter chooses the price and pay without any regulation, the governmental organization sets a lower price and a higher pay to the CEO than a for-profit firm, i.e., $p_G < p_F$ and $w_G > w_F$, independently of the voter's income, or of the marginal cost of taxation. As either of them increases, the price becomes higher and the CEO pay becomes lower.*

Appendix A contains the proofs of this proposition and of all the others. Appendix B shows the case with a linear demand curve.

[6]More generally, if $p(Q_G) + p'(Q_G)Q_G > 0$, then the second-order condition holds for any $\theta \ge 0$; otherwisie it holds if and only if $\theta < 1 + (p'(Q_G) - C''(Q_G))/(p'(Q_G) + p''(Q_G)Q_G)$.

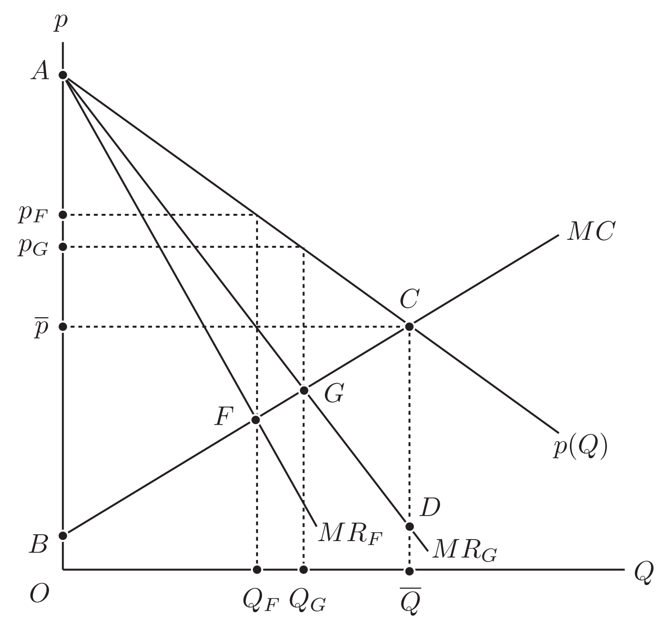

Figure 1: Governmental agency versus for-profit agency

Figure 1 illustrates the Nash bargaining outcomes under the two organizational modes. $p(Q)$ is the demand curve and MR_F is the marginal revenue under monopoly. MR_G represents their weighted average corresponding to the left-hand side of (6) and MC is the marginal cost.[7] Q_G and Q_F are determined at the respective intersections of MR_G and MR_F with MC, i.e., points G and F, and the prices, p_G and p_F, are set according to the demand curve. We then obviously observe $p_G > p_F$. Making use of the marginal revenue curves, the CEO's pay is half the area of AGB in the governmental agency, and is the area of AFB in the for-profit organization.[8] This demonstrates that $w_G > w_F$. Finally, recalling $\theta = 1/[(1+\lambda)y]$, we observe that either a higher y or a higher λ increases p_G and decreases w_G as it tilts MR_G closer to MR_F.

A lower price and a higher pay in the governmental organization arises because the Nash bargaining divides both profits and consumer surplus between the decisive voter and the CEO. Indeed, if there is no tax distortion (i.e., $\lambda = 0$) and the negotiator unconcerned about redistribution (i.e., $y = 1$), the governmental organization sets the price to the marginal cost to maximize the pie. As the tax distortion increases, the governmental negotiator favors paying the CEO more out of profits and charges a higher price to reduce

[7]This figure assumes $0 < \theta < 1$, but it does not matter as far as the second order condition for (4) holds. If $\theta > 1$, all we have is that MR_θ lies above the demand curve, yielding $p_G < \overline{p}$ and $Q_G > \overline{Q}$.

[8]The diagrammatic exposition assumes away the fixed costs of production, which does not matter at all. The CEO pay in either organization decreases by half the fixed costs if they exist. The same qualification applies to the diagrammatic explanations we will employ hereafter, too.

tax distortions. Nonetheless, a reduction in the pie harms the CEO, lowering the pay, though he is still paid more than he would be at a for-profit firm.

5 Pay with price regulation

We see that if a governmental agency faces the same profit opportunities as a for-profit firm, and a single negotiator determines both the price and pay, a governmental CEO would earn more than he would at a for-profit firm, and this result holds irrespective of how small are profits at the governmental agency, irrespective of the size of tax distortions, and irrespective of how much the negotiator cares about redistribution.

Matters can differ, however, if a governmental agency's price is restricted. The examples are ubiquitous. They include companies in public-utility industries, such as power, gas, and water, which can raise prices only with the government's permission. Fairness consideration may render the providers of some services price-regulated, like organizations in the education and healthcare industries.

Suppose, for example, that a governmental agency is regulated to provide a private good at a price, $\overline{p} < p_F$. From (5), the CEO earns

$$w_G = \frac{\theta S(\overline{p}) + \Pi(\overline{p})}{2}. \tag{9}$$

The following proposition demonstrates conditions for which the governmental CEO is paid less than he would be at a for-profit organization.

Proposition 2 *Suppose a governmental agency is regulated to charge a price lower than the monopoly price. Then, given the price, the pay to a governmental CEO decreases as either the marginal cost of taxation or the decisive voter's income increases. If either of them is sufficiently large, the governmental CEO earns less than he would at a for-profit organization, i.e., $w_G < w_F$. Alternatively, given both of them, w_G is less than w_F if the regulated price is sufficiently low.*

Figure 1 illustrates the case when w_G is less than w_F with the governmental agency's price regulated at the marginal cost. In this case, w_G is equal to half of the area subtracting CDG from ABG, and $w_G < w_F$ if the area AFG is smaller than CDG. Then, an increase in θ, owing to an increase in either the decisive voter's income or the marginal cost of taxation, makes the area AGF smaller and CDG greater by shifting MR_G to the right, so that it makes $w_G < w_F$ for a wider range of parameters.

A higher marginal cost of taxation makes the finance of the CEO's pay more costly, harming the decisive voter. The richer he is, the greater tax burdens he wants to avoid related to the finance. In Proposition 1, he can do so owing to larger profits produced by a higher price, but in Proposition 2 he cannot due to price regulation.

Figure 1 also illustrates that w_G is less than w_F for a wider range of paramters as $\overline{p}$ is set lower. With a lower $\overline{p}$, the increased demand causes $\overline{Q}$ to moves the right, locating point C upward along MC and point D downward along MR_G. As a result, the area CDG increases, making w_G smaller.

Notice that, with the appropriate definition of consumer surplus, this argument carries over to a governmental agency providing a public good. Nonetheless, it has at least three limitations. First, typical estimates of the marginal cost of public funds, $1 + \lambda$, are less than 2, which restricts the realistic range of θ considered in Proposition 2.[9] Second, the Nash bargaining at a governmental agency does not necessarily consider the utility of a voter with income high enough to achieve $w_G < w_F$. Third, the argument requires that a governmental agency cannot earn as high profits as does a for-profit firm. The difference may arise because governments often provide merit goods (such as schooling) and non-excludable public goods at a low or even zero price. But the next section shows that when one official sets price, and a different official negotiates over pay, then even in the absence of such a difference in profit opportunities the head of a governmental agency may earn less.

6 One official sets price and another sets compensation

This section examines outcomes when one official sets the good's price, and a different official negotiates with the CEO about pay. Or one can think that the state government sets the fees at schools, while local school boards set pay.[10] We will also extend the model to consider elected officials.

Let the distribution of income among voters lie in a compact interval $[y_L,\ y_H]$, with $0 < y_L < y_H$. The poorest voter has income y_L; the richest has income y_H. The median income is y_M, for which we assume $y_L < y_M < y_H$.

[9] Estimates are in Barrios, Pycroft, and Saveyn (2013) and the papers cited there.

[10] For example, the state government in California sets the price for schooling, but each local school board sets the compensation of the school district superintendent. Thus, regarding the price, Article IX, Sec. 5 of California's Constitution states that "The Legislature shall provide for a system of common schools by which a free school shall be kept up and supported in each district," and legislation enacted in 2012 (AB 1575) forbids schools from charging any fee that students and their families must pay "as a condition for registering for school or classes, or as a condition for participation in a class or an extracurricular activity, regardless of whether the class or activity is elective or compulsory, or is for credit."

Consider a model with two sequential stages; the selection stage and the price-pay stage. In the selection stage, the official who sets the price (who we call the price setter) and the negotiator over CEO pay (who we call the wage negotiator) are selected.[11] The price setter's income is y_p; the wage negotiator's is y_w.

In the price-pay stage, given the outcome in the selection stage, the bargaining between the wage negotiator and the CEO determines the pay w and the price setter chooses the price p. Each official chooses a policy taking the other as given. The pair of the price and pay forms a structure-induced equilibrium at this stage. We will solve this two-stage game by backward induction, making use of the notion of subgame perfection.

6.1 Equilibrium price and pay

Consider first bargaining over w. Define $\theta_w = 1/[(1+\lambda)y_w]$. Given p, the Nash product is $w \cdot v(p, w, y_w) = w\{\theta_w S(p) + \Pi(p) - w\}/N$. Then, for a given price p_G, the bargaining results in CEO pay of

$$w_G = \frac{\theta_w S(p_G) + \Pi(p_G)}{2}. \tag{10}$$

Consider next the good's price, p_G. An official with income y_p who takes w as given chooses the price

$$p_G = \arg\max \ \theta_p S(p) + \Pi(p), \tag{11}$$

where $\theta_p = 1/[(1+\lambda)y_p]$. Similarly to (6), we express the first-order condition in terms of the quantity as follows:

$$\theta_p p(Q) + (1-\theta_p)\{p(Q) + p'(Q)Q\} = C'(Q). \tag{12}$$

The solution, denoted by Q_G, then determines the price $p_G = p(Q_G)$, which decreases as θ_p increases, as we already observed in Proposition 1. The expression in (12) also shows that $p_G < p_F$, as observed in Proposition 1, owing to consideration of consumer surplus.

The equilibrium price and CEO pay satisfy both (10) and (12). They are functions of y_p, y_w, and λ. In what follows we assume that the parameter values of the model guarantee that $w_G > 0$ in equilibrium.[12]

[11] We will discuss sequential moves later.

[12] To find its sufficient condition, let $\theta_L \equiv 1/[(1+\lambda)y_L]$ and $\theta_H \equiv 1/[(1+\lambda)y_H]$, and denote by p_L the price preferred by an official with the lowest income, y_L, that is, $p_L = \arg\max \ \ \theta_L S(p) + \Pi(p)$. Then, w_G is necessarily positive if $\theta_H S(p_L) + \Pi(p_L) > 0$. Because the price p_L is the lowest possible price realized in equilibrium, this condition guarantees that the lowest possible equilibrium wage is strictly positive.

6.2 Comparative statics

Examining comparative statics is useful for both understanding the outcomes in the price-pay stage and determining the outcomes in the selection stage. We obtain the following.

Proposition 3 *At the equilibrium in the price-pay stage, having a richer price setter always increases the price, and also increases the CEO pay if and only if he is poorer than the wage negotiator. However, having a richer wage-negotiator reduces the CEO pay without affecting the choice of the price, regardless of whether or not he is richer than the price setter.*

We demonstrate the results diagrammatically, separating two cases of $y_p < y_w$ and $y_p > y_w$.

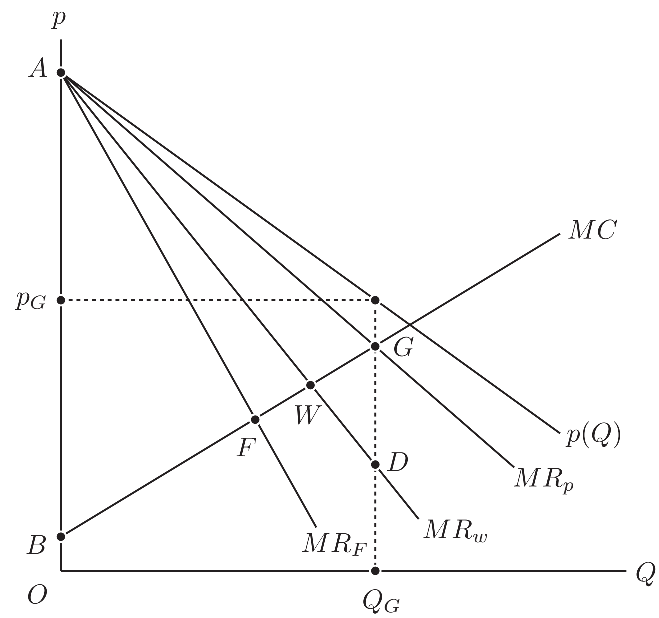

Figure 2: Different price setter and wage negotiator with $y_p < y_w$

Figure 2 illustrates the equilibrium and the comparative statics results when the price setter is poorer than the wage negotiator, i.e., $y_p < y_w$.[13] In this figure, MR_p is the marginal revenue with weight θ_p, which corresponds to the left-hand side of (12). MR_w is the counterpart with weight θ_w replacing θ_p. Because of $y_p < y_w$ and hence $\theta_p > \theta_w$, MR_p is located above MR_w. As we already know, given a pay to the CEO, the price setter chooses the price, p_G, to equalize his marginal revenue to the marginal cost. This occurs at point G. On the other hand, taking the choice of the price and hence the quantity,

[13] Figures 2 and 3 assume that both θ_p and θ_w are smaller than 1, but the explanations here carry over to other cases as far as the second-order condition is satisfied.

Q_G, as given, the wage negotiator sets the pay to divide half the total pie equal to the area ABW *minus* WGD. This pair of p_G and w_G is the outcome realized in the unique structure-induced equilibrium with given y_p and y_w.

Consider now the effects on equilibrium outcomes of having a richer price setter. As a higher y_p shifts MR_p to the left, a richer price setter charges a higher price; point G moves downward along MC, increasing p_G and decreasing Q_G. The area WGD decreases in response and hence increases w_G. Yielding larger profits and reducing tax burdens, a higher price benefits the wage negotiator more than the price setter when the former is richer than the latter.

The figure also shows that an increase in y_w reduces w_G by shifting MR_w to the left, while having no effect on p_G; as point W moves downward along MC, the area ABW becomes smaller and WGD bigger. This is because a richer wage negotiator wants to avoid paying more taxes.

Figure 3, on the other hand, addresses the case of $y_p > y_w$, where MR_p is located below MR_w in contrast to Figure 2. The pay to the CEO is half the area of the rectangle, $ADGB$. Having a higher y_p, which shifts MR_p to the left, results in a higher p_G and a lower w_G. The price set by a richer price setter is too high for a poorer wage negotiator. An increase in y_w, on the other hand, which shifts MR_w to the left, decreases w_G, not affecting p_G and Q_G, because the richer wage negotiator has to pay higher taxes.

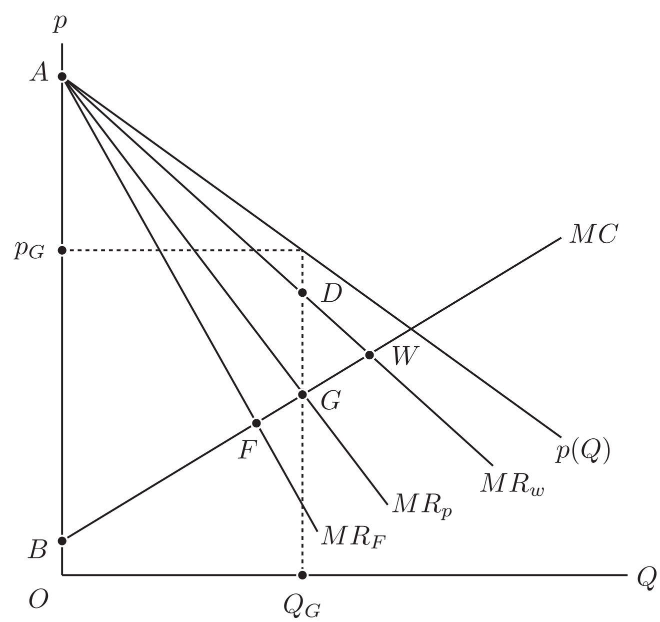

Figure 3: Different price setter and wage negotiator with $y_p > y_w$

In summary, appointing a richer wage negotiator decreases the CEO's pay because payment to the CEO imposes a larger burden on him through proportional income taxes.

However, it does not affect the price because the price setter is concerned only about maximizing the total pie he faces. Appointing a richer price setter increases the price because he prefers to generate extra revenues, with which the government can reduce tax burdens. Its impact on the CEO's pay depends on whether the total pie facing the wage negotiator increases in response to the higher price chosen by the price setter, and it is critical whether the wage negotiator is richer than the price setter. If the wage negotiator is richer, the total pie facing the wage setter increases because the wage negotiator can reduce tax burdens more than the price setter; hence the CEO's pay increases, and *vice versa.*

6.3 How CEO pay varies with negotiators' incomes

Consider now the condition for which the CEO earns less at a governmental agency than he would at a for-profit firm, using Figures 2 and 3.

Figure 3, which assumes that $y_p > y_w$ (i.e., $\theta_p < \theta_w$), shows that w_G always exceeds w_F , because w_G is equal to half the area $ABGD$ and w_F is to half the area ABF. Hence, for $w_G < w_F$, the price setter must be poorer than the wage setter, i.e., $y_p < y_w$. The intuition is that a higher-income official bears a larger tax burden that matters in the negotiation, and a lower-income official more sharply reduces the price and hence the profits that matter in the negotiation as well. But this is not sufficient. In Figure 2, which assumes that $y_p < y_w$ (i.e., $\theta_p > \theta_w$), w_G is equal to half of the area ABW minus WGD, and w_F is AFB. The necessary and sufficient condition for $w_G < w_F$ is then that the area WGD is greater than AFW. To ensure this, MR_p and MR_w must be located sufficiently apart, or in other words, y_w must be sufficiently greater than y_p. Formally,

Proposition 4 *A governmental CEO earns less than he would at a for-profit firm if and only if the wage negotiator is sufficiently wealthier relative to the price setter to satisfy the inequality*

$$\theta_w < \theta_p - \frac{1}{S(p^*(\theta_p))} \int_0^{\theta_p} S(p^*(\theta))d\theta, \tag{13}$$

where $p^*(\theta) = \arg\max \theta S(p) + \Pi(\theta)$, $\theta_w = 1/[(1+\lambda)y_w]$ *and* $\theta_p = 1/[(1+\lambda)y_p]$.

6.4 Sequential moves

We thus far assumed that the choices of price and pay are made simultaneously. Here we consider sequential decisions, assuming that the second-order conditions for payoff maximization still hold.

Consider first outcomes when pay is set before price. Because the price setter chooses p taking w as given, the equilibrium price follows (11), as with simultaneous moves. Accordingly, the equilibrium pay does not change either, because the price does not respond to the pay.

We verify this result with Figures 2. Without depending on the bargaining outcome on pay, the price setter chooses p_G at the point G, where MR_p and MC intersect. Because the wage negotiator's decision does not affect the choice of the price, the equilibrium outcome does not change even if he moves before the price setter. The logic is the same in the case of Figure 3.

Consider next the outcomes when the price is set before pay.

In Figure 2, with simultaneous moves, p_G is determined at the point G and w_G corresponds to half the area of ABW minus WGD. The price setter earns the payoff equal to the area ABG *minus* w_G, where ABG shows that p_G maximizes $[S(p)+y_p(1+\lambda)\Pi(p)]/N$, i.e., the total pie facing the price setter. Suppose now that the price is set in advance to the pay and the price setter reduces the price marginally below p_G in the figure. We then observe that the area WGD decreases due to an increase in Q_G so that w_G decreases, whereas the total pie facing the price setter decreases only negligibly, being almost equal to ABG. If y_p is less than y_w, the price setter has an incentive to choose a price lower than what he would choose with simultaneous moves. Accordingly, the price is set lower and the pay lower as well when the price setter moves first.

On the other hand, if $y_p > y_w$, as we see in Figure 3, lowering p_G increases w_G because the area $ABGW$ increases. The price setter thus has an incentive to increase the price from p_G in the figure, in contrast to the case of $y_p < y_w$, and as a result, the price is set higher and the pay lower when the price setter moves first.

Proposition 5 *When the pay is negotiated before the price is set, the equilibrium price and pay are the same as when they take place simultaneously. When the price is set before the pay is negotiated, both the price and the pay are lower than when they are set simultaneously, if the price setter is poorer than the wage negotiator, i.e., $y_p < y_w$. Otherwise, the price is higher and the pay is lower.*

With sequential moves, if and only if the price setter is poorer than the wage negotiator, can the price setter induce the wage negotiator to reduce the pay by committing to a price lower than what he would set with simultaneous moves. The reason is that a richer wage negotiator has to pay more tax burdens beyond the benefits from the price reduction. On the other hand, if the price setter is richer than the wage negotiator, a price slightly higher than what would be chosen with simultaneous moves harms the wage negotiator. His welfare loss from the price increase exceeds the gain from tax reduction, thereby inducing him to reduce the pay.

6.5 Selecting wage negotiator and price setter

The analysis thus far took as given the types of the two officials who set price and pay, yielding results that differ from those when only one official is in charge. Of course there is no assurance that such types of officials are elected. This issue is examined here, keeping the assumption of simultaneous moves in the choices of the price and pay.

The election stage has one person chosen to set p and the other chosen to negotiate over w. Plugging the outcomes at the price-pay stage into (3), voter y's utility at the election stage is

$$v(p_G, w_G, y) = \frac{S(p_G) + y(1+\lambda)(\Pi(p_G) - w_G)}{N}, \tag{14}$$

where p_G and w_G depend on y_p and y_w through (10) and (11). Following the literature on strategic delegation (see e.g. Persson and Tabellini (2000, Ch. 12)), assume sincere voting, with voters taking account of how their own choices affect the outcomes that will be realized in the price-pay stage. Assume further that each voter takes as given the type of citizen-voter who will be elected in the other election, and consider a subgame-perfect structure-induced equilibrium of this policy-making game.[14]

6.5.1 Structure-induced equilibrium

Consider first an election in which voters choose a wage negotiator.

To begin with, notice that given any price, every voter wants to minimize the pay. As we observed, in Figure 3, where $y_w < y_p$, the pay decreases as MR_w moves down closer to MR_p. In Figure 2, where $y_w > y_p$, the pay decreases as MR_w locates below MR_p and closer to MR_F. This observation demonstrates that the pay is minimized when the wage negotiator has the highest possible income, y_H, and hence every voter has a strategic incentive to delegate the wage-negotiation authority to the richest citizen in the population.

Consider next the choice of a price setter. Assuming that the wage negotiator is the richest citizen, look at Figure 2 again, where the price setter is poorer than the wage negotiator. As we observed in the game with sequential moves, the price setter becomes better off by setting a price strictly below p_G shown in the figure. This is because it reduces pay, w_G. In the game with simultaneous moves, of course, the price setter himself cannot exercise this advantage. Voters can do so, however, by appointing a price setter whose

[14] For this equilibrium concept, see Conde-Ruiz and Galasso (2005) and Shepsle (1979).

income is smaller than their own; a poorer price setter will choose a price strictly lower than what they themselves would choose in a simultaneous-move game. Thus, each voter has a strategic incentive to delegate the price-setting authority to a poorer citizen.

Consider majority voting outcomes. In the subgame-perfect structure-induced equilibrium, the richest citizen is appointed as the wage negotiator, and given this choice, the citizen who is poorer than the median voter is elected as the price setter, i.e., $y_w = y_H$ and $y_p < y_M$.[15] We can also show that the poorer is the median voter, the more likely is the poorest citizen to be appointed as the price setter.

The next proposition formally summarizes the results.

Proposition 6 *In the unique subgame-perfect structure-induced equilibrium with an income distribution satisfying $y_L < y_M < y_H$, the elected wage negotiator has income $y_w = y_H$. The elected price setter has income*

$$y_p = \max\left\{y_L,\ \frac{y_M}{2 - y_M/y_H}\right\}. \tag{15}$$

Proposition 6 also has an implication about how an unequal income distribution affects the types of elected officials: the less equal is the income distribution, the larger the income gap between the elected officials. More specifically, as y_H increases, y_p decreases and y_w increases. The reason is as follows. With a higher-income official negotiating the wage, less of an increase in consumer surplus will be passed on to CEO pay, as we can see in (10).[16] This attenuation induces voters to delegate a lower-income citizen as the price setter: he would set a lower price, generating a larger consumer surplus and a smaller profit.

Lastly, Proposition 6 shows that the tax distortion, λ, does not affect the election outcomes. Because only θ's matter to the differences in voters' preferences over p and a change in λ has the same effect on them, it does not affect each voter's optimal type.

6.6 Effect of income distribution

Combining Propositions 4 and 6, lets us compare CEO pay between a governmental agency and a for-profit firm, incorporating the choices of a price setter and a wage negotiator. In particular, we will examine the effect of income distribution by varying the median income within a given support of the distribution. From Proposition 6, every voter prefers the

[15] The only exception is a special case when the median voter is also the richest citizen, i.e., $y_M = y_H$. Given that the wage negotiator is the richest, he has no incentive to choose a poorer citizen than himself as the price setter, but appoints a citizen having exactly the same income with him. In this case, both the wage negotiator and price setter are the richest in the population, i.e., $y_w = y_p = y_H$.

[16] In other words, with a richer wage negotiator, more of a loss in profits will be shifted to the CEO pay because he will incur more tax burdens.

richest person to be the wage negotiator and the median voter prefers the poorer person to be the price setter, the poorer he is. A wage negotiator with high income wants to avoid a further reduction in profit and weighs consumer surplus less; a lower-income price setter wants to cut the price more, both of which lead to lower CEO pay. In contrast to Propositions 2 and 4, we show that in a society with unequal income distribution, the political economy of price regulation and wage negotiation *endogenously* leads a governmental agency to pay the CEO less than does a for-profit firm.

Proposition 7 *Consider an income distribution with* $y_L < y_M < y_H$*, whose support is wide enough to satisfy (13) when* $\theta_p = 1/[(1+\lambda)y_L]$ *and* $\theta_w = 1/[(1+\lambda)y_H]$*. There then exists a threshold for the median income,* $\overline{y}_M > y_L$*, such that a governmental CEO earns less than he would at a for-profit firm if and only if* $y_M < \overline{y}_M$*.*

6.7 CEO pay and the cost of public funds

Next consider the effect of a higher cost of public funds on the pay of a governmental CEO when one official sets price and another official negotiates pay. As seen in Proposition 6, in equilibrium neither y_w nor y_p depends on the tax distortion (λ), so that we can take the types of the two officials as given, satisfying $y_p < y_w$.

A higher marginal cost of taxation has two counteracting effects on the equilibrium pay of a governmental CEO, w_G. Look at Figure 2, where $y_p < y_w$ is assumed. First, a higher λ shifts MR_w to the left and decreases w_G, which corresponds to half the area of ABW *minus* WGD. This is because the wage negotiator takes account of a higher opportunity cost of the CEO's pay. Second, a higher λ shifts MR_p to the left as well, leading to a higher price. The price setter wants to avoid the tax burden by financing the pay with more profits. This increases the CEO's pay as we see a reduction in the area WGD in the figure.

Notice that if the price setter and the wage negotiator have the same income, the second effect on the equilibrium pay is negligibly small and dominated by the first. This is why we established in Proposition 1 (where a governmental agency and a for-profit firm face the same profit opportunities) that pay is higher at a governmental agency, irrespective of the size of the tax distortion. But the conclusions differ if the officials differ in incomes.

Because of these counteracting effects, the effect of a higher λ on w_G is generally ambiguous. To obtain definite results, we will specify the demand function to have a constant price elasticity, $\varepsilon > 1$, so that we express it as $Q(p) = Ap^{-\varepsilon}$, with A a positive constant. Let the marginal cost of production be constant at $c > 0$.

Under these assumptions, we obtain

Proposition 8 *Suppose that the demand function has a constant price elasticity and that the marginal cost of production is constant. There then exists a threshold for the marginal cost of taxation, $\overline{\lambda}$, such that a governmental CEO earns less than he would at a for-profit firm if and only if $\lambda < \overline{\lambda}$.* [17]

The intuition behind this result comes from Figure 2, which assumes $y_w > y_p$. As we discussed in relation to Proposition 4, MR_p must be located sufficiently above MR_w for w_G to be less than w_F. However, given y_p and y_w, an increase in the marginal cost of taxation, λ, makes these two curves located closer as the difference between θ_p and θ_w shrinks. That is, a higher marginal cost of taxation leads the policy preferences to be more similar between the price setter and the wage negotiator even though they have different incomes. This makes the situation closer to the one described in Figure 1.[18]

Proposition 8 has contrasting implications to the claims in the previous propositions. Proposition 1 shows that a higher λ decreases w_G while keeping the inequality $w_G > w_F$ intact. Proposition 2 demonstrated that w_G is less than w_F for sufficiently large values of λ under a regulated price, while w_G is decreasing in λ. Proposition 8, in contrast, shows that w_G is less than w_F for sufficiently small values of λ. In addition, w_G is increasing in λ at least in some range of $\lambda < \overline{\lambda}$, because $w_G < w_F$ when λ is smaller than $\overline{\lambda}$ and $w_G > w_F$ when it exceeds $\overline{\lambda}$.

7 Performance incentives

We so far compared pay at for-profit and governmental organizations. Large pay, however, is not necessarily the same as high-powered incentives—a CEO may be paid well regardless of his performance, and the CEO's base salary may be so small that even with high-powered incentives his total pay will be small. As mentioned in the Introduction, evidence shows that top echelons of bureaucrats face lower-powered performance incentives than CEOs in private firms. Higher production costs in state-owned enterprises have been referred to as X-inefficiency. This section explores the source of inefficient production in a governmental organization in a political-economy context and shows that the conditions that make a governmental official earn less than a CEO at a for-profit firm also make the governmental official face low-powered incentives—that is, his pay increases little with an increase in the surplus he generates.

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[17] This result carries over to the case of a linear demand function as long as we assume $\theta < 2$ for the second-order condition. See Appendix B.

[18] Note that the threshold, $\overline{\lambda}$, is not necessarily positive. It is guaranteed to be positive if $w_G < w_F$ in an equilibrium with $\lambda = 0$ (See Figure 5 in appendix A).

Previous papers do not explain from a positive perspective why a governmental agency gives its CEO performance incentives weaker than a private firm does.[19] We will examine this issue in the context of a CEO choosing an irreversible and non-contractable effort level before he starts wage negotiation.

Consider a governmental agency potentially as profitable as a for-profit firm, an official with income y_p setting the price of the good, and an official with income y_w (with $y_p < y_w$) bargaining over the wage. The CEO's irreversible effort is made before the price and the wage are set. Denote the effort level by z and consider how differently the wages respond to its marginal increase between a for-profit firm and a governmental agency, i.e, $dw_G/dz - dw_F/dz = d(w_G - w_F)/dz$.

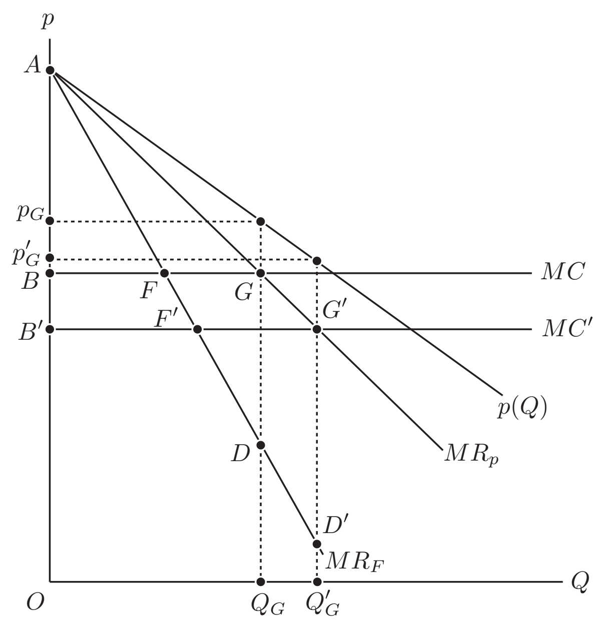

Figure 4: Governmental agency versus for-profit agency

Figure 4 illustrates when a governmental CEO has a weaker incentive for cost reduction. For simplicity, it assumes that the marginal cost is constant, initially given at MC, and a CEO can reduce it to MC' by undertaking a cost-reducing investment.

Consider a for-profit organization first. The CEO initially earns half the area ABF, and by conducting the investment it increases to $AB'F'$. Thus, the area $BFF'B$ represents how strong his incentive is to undertake the investment.

Consider next a governmental organization. For the purpose of illustration, assume

[19] The standard theoretical explanation on X-inefficiency is based on agency theory, focussing on inferior monitoring. See, e.g., Laffont and Tirole (1993). An exception is Haskel and Sanchis (1995), who considered a bargaining model between state-owned or private firms and workers, and examined how privatization affects works' effort.

an extreme case of $0 < \theta_p < 1$ and $\theta_w = 0$. In Figure 4, the price setter faces the marginal revenue labelled MR_p and the wage setter sets $MR_w = MR_F$. Then, at the initial equilibrium, the price is p_G and the CEO's pay, w_G, is half of the area ABF *minus* FGD, showing that $w_G < w_F$. After he undertakes the cost-reducing investment, the price is reduced to p'_G and his pay is half of the area $AB'F'$ *minus* $F'G'D'$.

Comparison of these results reveals that the investment rewards the CEO at the governmental agency less than at the for-profit firm; his pay increase at the former is smaller by half of the area $F'G'D'$ *minus* FGD, which we can verify is positive because MR_p is flatter than MR_F.

The governmental CEO is rewarded because the price reduction driven by the investment is less beneficial to the wage negotiator the richer he is than the price setter. If their income gap is so large as to make $w_G < w_F$, the total pie the wage negotiator splits with the CEO at a governmental organization does not increase as much as it does at a for-profit one.

Consider next another extreme case, in which the wage negotiator faces the same marginal revenue as the price setter, i.e., $\theta_w = \theta_p$ and hence $MR_p = MR_w$. At the equilibrium before investment, the price is p_G and the CEO's pay is half of ABG at a governmental agency, holding $w_G > w_F$. After he undertakes the investment, the price is p'_G and his pay is half the area $AB'G'$. The investment thus rewards the CEO more than it would at a for-profit firm by half of the area $FF'G'G$.

Under a subgame-perfect structure-induced equilibrium, the price setter sets the price lower than the level optimal to the wage negotiator because the price setter is poorer and bears smaller tax burdens to pay the CEO. A further price reduction driven by a cost-reducing investment, then, is no more profitable at a governmental organization than at a for-profit firm. In addition, the wage negotiator benefits less from the price reduction as he incurs larger tax burdens. With these two effects combined, a governmental organization induces a weaker incentive to the CEO than a for-profit one.

To formalize the argument, we will use the previous specification of demand with a constant price elasticity and constant marginal costs.

Proposition 9 *Suppose that the demand function has a constant price elasticity and the marginal cost of production is constant. Then, in the unique subgame-perfect structure-induced equilibrium, a governmental CEO faces weaker incentives to reduce marginal cost than does a CEO in a for-profit firm if and only if* $w_G < w_F$. [20]

The above diagrammatic illustration also shows that the same conclusion holds in the

[20] This result carries over to the case of a linear demand function as long as we assume $\theta < 2$ for the second-order condition. See Appendix B.

case where the investment does not reduce the marginal cost but instead improves the quality of the product, causing the demand curve to shift upward in a parallel fashion. In terms of an investment that reduces fixed costs, no changes occur in the equilibrium prices chosen by a governmental CEO and a for-profit one. Therefore, both face the same incentive to undertake the investment, as it rewards them with half of the cost reduction.

8 Wasteful governmental spending

If governmental CEOs are paid little, why, in contrast, does the government appear wasteful and overpay some workers and suppliers? Why, as the evidence presented in the Introduction suggests, do low-skilled workers earn high pay in governmental agencies?

One possible explanation, at least at the local level, is that lower-skilled workers constitute many of the voters, and so their political influence may generate high pay. Furthermore, with firm-specific human capital being less important for lower-level jobs and pay being determined more by market demand than by personal negotiations, voters may want the government to increase their pay or higher more workers, as such an increase will also increase pay in the private sector.

Another possible explanation, consistent with our model, is that the low pay and weak incentives of governmental CEOs give such officials insufficient motivation to reduce costs. Section 7 showed that a governmental CEO has weaker incentives to invest in increasing social benefits from his agency when such investments are non-contractible. Thus, a CEO who must negotiate long-term wage scales at his agency may incur a cost, including an opportunity cost and an emotional one, in avoiding high wages for agency workers. Low wages would increase the surplus generated by the agency in future periods. But in Nash bargaining in future periods, the increased surplus would only slightly increase the CEO's pay, giving them little incentive to reduce costs.

The problem may be exacerbated when low pay or weak incentives reduce the ability of a government to attract high-ability CEOs. For example, Decarolis, et al. (2018) find that low competence in bureaus, rather than just corruption, causes delays and high costs involved with procurement by federal bureaus in the United States. Suppose that the government is unsure about the abilities of potential CEOs, but that a CEO can engage in a costly activity that signals high ability. Suppose further that signaling is a discrete rather than a continuous activity, such that an individual is willing to incur the cost of signaling only if the expected pay gain is sufficiently high. In terms of our bargaining model, signaling high ability would be associated with a larger surplus, which in turn would result in higher negotiated pay. But if pay only slightly increases with the surplus, a potential CEO has little incentive to engage in such costly signaling, and therefore the government will find it difficult to appoint high-quality CEOs.

9 Conclusion

An essential assumption in our approach is that the owner of a private firm cares only about profits, whereas a negotiator with a governmental CEO cares about both profits and consumer surplus. The size of the pie to be divided in bargaining may, therefore, often be larger at a governmental agency, making for higher CEO pay. Nevertheless, we showed conditions which make a governmental CEO's pay smaller. Furthermore, voters who oppose high CEO pay may want the government to engage in those activities where CEO pay will not be large, or will favor low prices for a governmentally produced good because that will reduce CEO pay.

The performance of a governmental agency may improve if the CEO, or potential CEOs, expect to earn high pay: a potential CEO may incur the cost of signaling his quality, allowing the government to appoint higher quality CEOs, an incumbent CEO may be more willing to continue working at the agency rather than searching for a new position, MBA students may be more willing to learn the skills most valuable at governmental agencies, and so on. Because tax distortions reduce the bargained wage, they may have the secondary effect of reducing efficiency in the public sector. If, however, low CEO pay results from decentralized decisions about price and wage, reducing tax distortions may further reduce CEO pay and so may reduce efficiency in a governmental agency.

Attempting to unilaterally increase CEO pay above the level that would result from Nash bargaining is not time consistent. What the government can do is to increase the surplus generated at a governmental agency, and thereby generate an increase in CEO pay. Suppose, for example, that Congress could allocate funds to invest in Amtrak or the US postal service. Under Nash bargaining, that would increase the CEO's pay. That increased pay could in turn increase the quality of the CEO hired, or his effort, further increasing the surplus. So, on one hand, because CEO pay would increase the public does not get the full benefit of the investment. But, on the other hand, the credible increase in future pay could increase the quality of management and so further increase the surplus generated. Because a CEO may earn less at a governmental agency than at a for-profit firm, the benefits of an investment that increases the surplus and pay may be greater at a governmental agency.

Thus, low CEO pay at a governmental agency need not benefit voters or contribute to a government's austerity plans. It may instead cause profligate spending in the public sector. By giving a governmental CEO weak incentives to run the agency efficiently, it may result in higher wages for low-level government employees and higher procurement costs than in the private sector. It may also hinder hiring a high-quality CEO in the government.

Appendix A: Proofs of Propositions

Proof of Proposition 1: Define $p(\theta) = \arg\max \theta S(p) + \Pi(p)$. Then, $p = p(\theta)$ satisfies the first-order condition, $-\theta Q(p) + \Pi'(p) = 0$ with the second-order condition, $-\theta Q'(p) + \Pi''(p) < 0$, assumed. Accordingly, $p'(\theta) = Q(p)/[-\theta Q'(p) + \Pi''(p)] < 0$. Because $p_F = p(0)$ and $p_G = p(\theta)$ with $\theta > 0$, we have $p_G < p_F$. Next, defining $w(\theta) = [\theta S(p(\theta)) + \Pi(p(\theta))]/2$, we have $w'(\theta) = S(p(\theta)) > 0$. Because $w_F = w(0)$ and $w_G = w(\theta)$ with $\theta > 0$, $w_G > w_F$. Finally, because $\theta \equiv 1/[(1+\lambda)y]$, the properties about y, λ, and θ stated in the proposition also follow. ||

Proof of Proposition 2: Using (8), $w_F > w_G$ if and only if $\theta < [\Pi(p_F) - \Pi(\overline{p})]/S(\overline{p})$. Hence, given $\overline{p}$, w_G is less than w_F for a wider range of parameters as $\theta = 1/[(1+\lambda)y]$ is larger. On the other hand, given θ, define a price level, $\overline{p}(\theta) = \min\{\ \overline{p} \mid \theta S(\overline{p}) + \Pi(\overline{p}) = \Pi(p_F)\}$. Then, owing to the second-order condition for $\theta S(p) + \Pi(p)$, w_G is less than w_F if and only if $\overline{p} < \overline{p}(\theta)$. ||

Proof of Proposition 3: Differentiating (12) yields

$$\frac{\partial p_G}{\partial \theta_p} = p'(Q_G)\frac{\partial Q_G}{\partial \theta_p} = \frac{[p'(Q_G)]^2 Q_G}{\Delta} < 0,$$

where $\Delta = \theta_p(Q_G)p'(Q_G) + (1-\theta_p)(2p'(Q_G) + p''(Q_G)Q_G) < 0$ owing to the second-order condition. Because $\theta_p = 1/[(1+\lambda)y_p]$, we have $\partial p_G/\partial y_p > 0$. $\partial p_G/\partial \theta_w = 0$ follows from (12). Regarding the equilibrium pay, differentiating (10) yields

$$\frac{\partial w_G}{\partial \theta_w} = \frac{S(p_G)}{2} > 0.$$

Because $\theta_w = 1/[(1+\lambda)y_w]$, $\partial w_G/\partial y_w < 0$. Finally, differentiating (10) and making use of (12) yields

$$\frac{\partial w_G}{\partial \theta_p} = \frac{Q(p_G)}{2}\frac{\partial p_G}{\partial \theta_p}\left(\theta_p - \theta_w\right), \tag{16}$$

which is negative, and hence $\partial w_G/\partial y_p > 0$, if and only if $\theta_p > \theta_w$, i.e., $y_w > y_p$, because $\partial y_G/\partial \theta_p < 0$. ||

Proof of Proposition 4: Define

$$p^*(\theta) = \arg\max \theta S(p) + \Pi(p) \tag{17}$$

and

$$w^*(\theta, \theta') = \frac{\theta' S(p^*(\theta)) + \Pi(p^*(\theta))}{2}. \tag{18}$$

Notice that $p^*(0) = p_F$, $p^*(\theta_p) = p_G$, $w^*(0,0) = w_F$, and $w^*(\theta_p, \theta_w) = w_G$. Accordingly, the difference between w_G and w_F is

$$\begin{aligned} w_G - w_F &= w^*(\theta_p, \theta_w) - w^*(\theta_p, \theta_p) + w^*(\theta_p, \theta_p) - w^*(0,0) \\ &= \frac{1}{2}\left\{(\theta_w - \theta_p)S(p(\theta_p)) + \int_0^{\theta_p} S(p(\theta))d\theta\right\}, \end{aligned} \tag{19}$$

where we use the first-order condition for $p^*(\theta)$, $\theta S'(p^*(\theta)) + \Pi'(p^*(\theta)) = 0$, to obtain the second line. This yields (13) as the necessary and sufficient condition for $w_G < w_F$. ||

Proof of Proposition 5: The price setter chooses a price, p, to maximize $v(p, w, y_p) = [\theta_p S(p) + \Pi(p) - w]/N$, and hence he chooses the same price, p_G, whatever w is chosen in advance. On the other hand, if the price is chosen first, the wage negotiator chooses the pay

$$w_G = \frac{\theta_w S(p) + \Pi(p)}{2} \equiv w_G(p), \tag{20}$$

and the price setter anticipates this reaction in the pay. More specifically, the first-order condition for price setting is amended to

$$-\theta_p Q(p) + \Pi'(p) = w_G'(p),$$

where

$$w_G'(p_G) = \frac{(\theta_p - \theta_w)Q(p_G)}{2} \tag{21}$$

and we assume the second-order condition. Under simultaneous moves, the equilibrium price, p_G, satisfies $-\theta_p Q(p_G) + \Pi'(p_G) = 0$. Hence, in the subgame-perfect equilibrium with the price set first, the equilibrium price falls below p_G if and only if $w'(p_G) > 0$. This fact implies that the pay is always lower than what would be realized in the equilibrium with simultaneous moves. Further, owing to (21), $w'(p_G) > 0$ holds if and only if $\theta_p > \theta_w$, i.e., $y_w > y_p$. ||

Proof of Proposition 6: As discussed in the text, because p_G is independent of y_w and w_G decreases with y_w, (14) shows that every voter favors voter y_H as the wage setter. Regarding the choice of the price setter, consider voter y's most-preferred candidate. We can find it by differentiating (14) with respect to y_p, taking account of its effects on p_G and w_G through (10) and (11). Because $\partial w_G/\partial p_G = (\theta_p - \theta_w)Q(p_G)/2$ from (16), we have

$$\begin{aligned} \frac{dv(p_G, w_G, y)}{dy_p} &= \frac{1}{N}\left[-Q(p_G) + y(1+\lambda)\left(\Pi'(p_G) - \frac{\partial w_G}{\partial p_G}\right)\right]\frac{\partial p_G}{\partial y_p} \\ &= \frac{yQ(p_G)}{N}\frac{\partial p_G}{\partial y_p}\left[\frac{1}{2}\left(\frac{1}{y_p} + \frac{1}{y_w}\right) - \frac{1}{y}\right]. \end{aligned} \tag{22}$$

This expression shows that, owing to $\partial p_G/\partial y_p > 0$, every voter has a single-peaked preference with respect to y_p. Specifically, voter y's most-preferred candidate has income y_p satisfying

$$y_p = \max\left\{y_L,\ \frac{y}{2 - y/y_w}\right\}. \tag{23}$$

Because $y_w = y_H$, the median voter theorem demonstrates that a voter with income y_p in (15) is elected in the equilibrium. ||

Proof of Proposition 7: Assume a compact income distribution, $[y_L, y_H]$, that satisfies (13) when $\theta_p = 1/[(1+\lambda)y_L]$ and $\theta_w = 1/[(1+\lambda)y_H]$ and set $y_w = y_H$ because it occurs in the equilibrium owing to Proposition 6. Denote the right-hand side of (13) by $f(\theta_p)$ and differentiate it with respect to θ_p. We then obtain

$$f'(\theta_p) = -\frac{Q(p^*(\theta_p))p^{*\prime}(\theta_p)}{S(p^*(\theta_p))^2}\int_0^{\theta_p} S(p^*(\theta))d\theta > 0.$$

We notice that θ_p is decreasing in y_p and (13) does not hold, that is, $\theta_w > f(\theta_p)$, when $y_p = y_H$. Then, there is a unique threshold, $\overline{\theta}$, such that $\theta_w < f(\theta_p)$ if and only if $\theta_p > \overline{\theta}$. This threshold gives a unique income, $\overline{y}$, such that $\overline{\theta} = 1/[(1+\lambda)\overline{y}]$, and using this, (13) holds if and only if $y_p < \overline{y}$. Finally, using (15), we can rewrite the condition into $y_M < \overline{y}_M \equiv 2\overline{y}/(1 + \overline{y}/y_H)$. ||

Proof of proposition 8 With the demand and cost functions assumed, the prices chosen by a governmental agency and a for-profit firm are

$$p_G = \frac{\varepsilon c}{\varepsilon + \theta_p - 1}$$

and

$$p_F = \frac{\varepsilon c}{\varepsilon - 1}.$$

Substituting them into (13) reduces (19) to

$$w_G - w_F = \frac{A}{\varepsilon - 1}\left(\frac{\varepsilon + \theta_p - 1}{\varepsilon c}\right)^{\varepsilon - 1}\Omega, \tag{24}$$

where

$$\Omega = \theta_w - \frac{(\varepsilon - 1)^{\varepsilon}}{\varepsilon}(\theta_p - 1 + \varepsilon)^{1-\varepsilon} - \frac{\varepsilon - 1}{\varepsilon}(\theta_p - 1). \tag{25}$$

Hence $w_G < w_F$ if and only if $\Omega < 0$. Figure 5 depicts this condition with the upward-sloping curve showing the locus of (θ_p, θ_w) that holds $\Omega = 0$. More specifically, because $\varepsilon > 1$, the right-hand side of (25) is a convex function of θ_p, and its derivative at $\theta_p = 0$ is zero. We also observe that any pair of (θ_p, θ_w) yields $w_G > w_F$ if and only if it is located above the locus. Now assume that point B is a pair of (θ_p, θ_w) when $w_G < w_F$ is realized in the equilibrium with $\lambda = 0$. Then, as λ increases, point A approaches to O on the line OB, and we find a unique threshold for λ, denoted by $\overline{\lambda}$, such that $w_G > w_F$ if and only if $\lambda > \overline{\lambda}$. If B is on the segment OC, the threshold is negative. ||

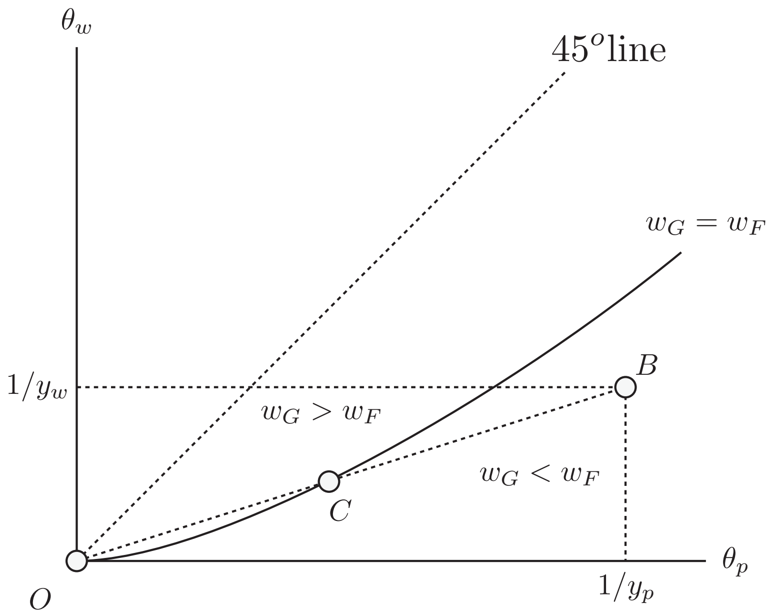

Figure 5: Effects of a higher λ

Proof of proposition 9 From (24), as Ω does not depend on c, a reduction in c reduces the difference in pay, $w_G - w_F$, if and only if $\Omega < 0$, which is equivalent to $w_G < w_F$. ||

Appendix B: the case of a linear demand function

This appendix shows that Propositions 7 and 9 carry over to the case when the demand function is linear. Without loss of generality, let it be $p(Q) = A - Q$ with $A > c$, where c is marginal cost. Then, given the price p, the consumer surplus and the profit are

$$S(p) = \frac{(A-p)^2}{2}$$

and

$$\Pi(p) = (A-p)(p-c).$$

Maximizing $\theta S(p) + \Pi(p)$ yields the optimal price

$$p^*(\theta) = \frac{(1-\theta)A + c}{2-\theta},$$

where we assume that $\theta < 2$ for the second-order condition. Note that $p^*(\theta) > c$ if and only if $\theta < 1$. Plugging these into (19) and rearranging terms yields

$$w_G - w_F = \frac{1}{2}\left(\frac{A-c}{2-\theta_p}\right)^2\left[\theta_w - \theta_p + \int_0^{\theta_p}\left(\frac{2-\theta_p}{2-\theta}\right)^2 d\theta\right] = \frac{1}{2}\left(\frac{A-c}{2-\theta_p}\right)^2\left(\theta_w - \frac{\theta_p^2}{2}\right). \quad (26)$$

Therefore, $w_G < w_F$ if and only if $\theta_w < \theta_p^2/2$. Using this condition, we can draw a graph similar to Figure 5 to prove the existence of a threshold for λ discussed in Proposition 7. From (26), we can also verify that a reduction in c increases w_G more than w_F if and only if $\theta_w > \theta_p^2/2$, i.e., $w_G > w_F$, the same conclusion that we obtained in Proposition 9.

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10 Notation

$c(q)$ Production cost

CS Consumer surplus

p_F Price at for-profit firm

p_G Price at governmental agency

q Output

w_F CEO pay at for-profit firm

w_G CEO pay at governmental organization

w_N CEO pay at non-profit firm

y_H Highest income in the population

y_L Lowest income in the population

y_M Median income

y_p Income of price setter

y_w Income of wage setter

π Profits

λ Tax distortion

θ Weight on valuation of good