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Labor Market Information Acquisition and Downsizing

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Abstract

We study the optimal mechanism for downsizing the public sector which takes into account different informational constraints (complete versus asymmetric information on each worker's efficiency) and political constraints (mandatory versus voluntary downsizing). Under complete information, the optimal structure of downsizing (who is laid-off and who is not) does not depend on the political constraint and is determined by the (marginal) cost of retaining a worker in the public sector. Since this cost includes his opportunity cost in the private sector, information acquisition on opportunity costs affects the structure of downsizing. Under asymmetric information, the political constraints determine which workers obtain information rents and therefore affect the structure of downsizing. An increase in the precision of the information on workers' opportunity costs may increase or decrease social welfare depending on its impacts on the information rents.

1. Introduction

Public sector downsizing is an increasingly important element in economic reforms of developing countries and transition economies.[1] Countries which followed state-led development strategies often exhibit bloated bureaucracy with overstaffed public enterprises. Severe labor redundancies in the public sector are common in transition economies, where the shift to a market economy requires a great number of workers to be relocated out of the public sector. In some other countries, the need for public sector downsizing comes from a fiscal crisis which requires a severe cutback in government expenditures.

While the gains from downsizing are potentially large, the chances of mishandling it are considerable as well. According to some recent cross-country studies of downsizing programs, adverse selection plagues downsizing programs so that many programs exhibit the "revolving door" syndrome, whereby separated workers are subsequently rehired,[2] and downsizing programs carried by governments before privatization tend to reduce instead of increasing privatization prices (Chong and López-de-Silanes, 2002). They also argue that a naive mechanism using severance pay to induce voluntary separation is likely to fail in this respect since, when more able workers have better job opportunities in the private sector, such a mechanism induces good workers to leave and hence creates the subsequent need to rehire them.

The previous findings suggest that to be successful, a downsizing mechanism must carefully deal with adverse selection problems. For this purpose, we adopt a

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mechanism design approach and study the optimal mechanism for public sector downsizing which accounts for different informational and political constraints. Concerning informational constraints, we distinguish two kinds of information: one is about each worker's productive efficiency in the public sector and the other is about each worker's outside opportunity (i.e., the utility that he is expected to obtain in the private sector). Both kinds of information are necessary to determine the desirable size of downsizing and to successfully implement it.

Even if the government designs a mechanism properly accounting for the relevant informational constraint, the mechanism cannot be implemented if it is politically unfeasible.[3] In this respect, we can distinguish two main forms of downsizing: mandatory and voluntary downsizing.[4] Under mandatory downsizing, the government has the right to lay off any worker in the public sector and hence the political constraint is minimal. In contrast, under voluntary downsizing, any worker has the right to stay in the public sector with his current status and cannot be laid off against his will, and therefore the political constraint is maximal. In this paper, we consider these two extreme modes of downsizing although our analysis can be extended to an intermediate political constraint in which the government needs the approval of a majority of workers.

In our analysis, we focus on how information acquisition in the labor market affects the optimal mechanism and social welfare. Actually, there exists a growing empirical literature estimating the losses that displaced workers experience after downsizing.[5] Despite an increasing number of such empirical studies, there has been, to the best of our knowledge, no attempt to formally incorporate the acquisition of labor market information into the design of downsizing mechanisms. In our model, we consider two sorts of information acquisition about workers' outside opportunities. First, the government can acquire information about how the outcome of a worker's private sector experience is correlated with his efficiency in the public sector. It can obtain this information from regressions explaining displaced workers' achievements in the private sector.[6] Second, the government can acquire information at the individual level about the factors which affect the likely outcome of private sector experience. For instance, consider the case in which a displaced worker pursues an investment project. Then, with tests that evaluate his skill or aptitude necessary for running the project, the government can update his belief about the success of the project. In our analysis, we assume that the first type of information has already been acquired and that the government can receive either a good or bad signal about the outcome of each worker's private sector experience. We study how an increase in the precision of the signal affects the optimal structure of downsizing and social welfare depending on the informational constraint (whether or not there is adverse selection) and the political constraint (whether downsizing is mandatory or voluntary).

We consider a two-type model in which a worker's type, i.e., his productive efficiency in the public sector, can be efficient or inefficient. Define the full marginal cost of retaining a worker in the public sector as the sum of his production cost in the public sector and his expected opportunity cost in the private sector. Then, it is optimal to start laying off the workers with the highest full cost. Whether or not an inefficient worker has a higher full cost than an efficient worker depends on the degree of (positive) correlation between his efficiency in the public sector and the outcome of his job search. For instance, if the human capital of the workers in the public sector is firm-specific and the private sector is poorly developed, the degree of correlation will be low. Then, an inefficient worker will have a higher full cost than an efficient worker. We focus below on this case.

When there is complete information about each worker's type, the optimal structure of downsizing is independent of the nature of the political constraint and has two regimes depending on the precision of the signal: for low (high) precision, the optimal order of downsizing is determined first by the type (the signal) and then by the signal (the type). For instance, for low precision, it is optimal to let go the inefficient workers having the bad signal (i.e., low opportunity cost) before the efficient workers having the good signal (i.e., high opportunity cost). However, as the precision increases, the opportunity cost of workers having the good signal (the bad signal) increases (decreases) so that for high precision, it may be optimal to let go the latter before the former.

The impact of asymmetric information about each worker's type on the optimal structure of downsizing differs depending on the political constraint in place. Under mandatory downsizing, as long as the probability of retaining inefficient workers is positive, an efficient worker can have an information rent by pretending to be inefficient since an inefficient one has a higher production cost. This makes retaining an additional inefficient worker more costly under asymmetric information than under complete information since it increases the information rent of efficient workers. Under voluntary downsizing, if a worker refuses the downsizing offer, he remains in the public sector and enjoys the status quo utility level. Therefore, to induce an efficient worker to quit, the government has to compensate him for the loss of the utility under the status quo. This, in turn, makes an inefficient worker obtain an information rent by pretending to be efficient as long as the probability of laying off efficient workers is positive. Therefore, laying off an efficient worker becomes more costly under asymmetric information than under complete information since it increases the information rent of inefficient workers.

The impact of an increase in the precision of the signal on social welfare is always positive if there is complete information on workers' types or if the probability of receiving the signal is independent of the type. In other words, Blackwell's theorem can be applied to these cases. However, if there is asymmetric information about workers' types and the efficient type has a higher probability of receiving the good signal than the inefficient type, Blackwell's theorem cannot be applied and an increase in the precision of the signal can even reduce social welfare. Since an efficient worker has a lower production cost but a higher opportunity cost, an increase in the precision increases the difference between an efficient worker's full cost and that of an inefficient worker having the same signal. Therefore, the government has to give up more information rents and this may decrease social welfare.

Our work is closely related to studies on downsizing under adverse selection. In this literature, we can distinguish three kinds of papers according to whether adverse selection is assumed about worker's productivity inside a firm or outside the firm or about both. First, Diwan (1994), Levy and McLean (1996), Rama (1997), and Jeon and Laffont (1999) study downsizing when adverse selection is about workers' productivity inside a public sector. While the first three papers study specific mechanisms (such as randomization, severance pay, etc.), the last paper analyzes the optimal mechanism under voluntary downsizing and its implementation through wage and severance pay. Second, Kahn (1985) analyzes optimal severance pay when there is asymmetric information about workers' outside opportunities and complete information about their on-the-job productivities. Last, Estache, Laffont, and Zhang (2004) study the optimal downsizing mechanism when each worker has private information about both his productivity in the public sector and his productivity in the private sector.[7] In relation to the mechanism design literature, our paper belongs to the literature on type-dependent reservation utility (Jullien, 2000; Laffont and Tirole, 1990; Lewis and Sappington, 1989; Maggi and Rodriguez-Clare, 1995). However, none of the previously mentioned papers studies how information acquisition about agents' reservation utilities (or workers' outside opportunities) affects the optimal mechanism.

Our paper is also related to the literature on reforms under political constraints in transition economies. For instance, Dewatripont and Roland (1992a, b, 1995) study in dynamic contexts the relative merits of gradualism versus big-bang strategy when there is either adverse selection or aggregate uncertainty. Since we do not consider aggregate uncertainty, our work is close to the first two papers. However, they assume that workers have the same outside option regardless of the type and therefore do not study the interaction between efficiency in the public sector and opportunity cost in the private sector, which is the focus of our paper. Although we take a static partial-equilibrium approach, our analysis generates useful insights about sequencing or speed of reforms in transition economies (see Section 6).[8]

2. Model

Public Sector

The economy is composed of the public sector and the private one. We consider downsizing of the public sector in which risk-neutral workers of mass 1 are employed before downsizing: the set of the workers is denoted by I. To focus on heterogeneity in terms of productive efficiency, we assume that the workers are homogeneous in all other aspects. Worker i's type, with i in I, is denoted by θ_i. θ_i represents worker i's marginal production cost in the public sector.[9] The θ_is are independently and identically distributed and take the value $\underline{\theta}$ ($\overline{\theta}$) with probability $\nu(\underline{\theta}) = \nu$ ($\nu(\overline{\theta}) = 1 - \nu$). Let $\Delta\theta \equiv \overline{\theta} - \underline{\theta} > 0$. We call type $\underline{\theta}$ the efficient type and type $\overline{\theta}$ the inefficient type. In terms of the informational constraint, we distinguish the case in which the government (or the managers of the public sector) knows the θ_is from the case in which θ_i is worker i's private information.

We represent the inefficiency of the public sector by assuming that all workers are asked to produce the same quantity normalized to one. This assumption holds both before and after downsizing since we do not envision any reform of incentive schemes in the public sector.[10] Also, in the absence of any downsizing program, the salaries in the public sector are assumed to be large enough so that each worker i derives a utility level from the public sector before downsizing $U^p(\theta_i)$[11] larger than his outside opportunity.

The government maximizes social welfare, denoted by W, defined as follows:

$$W \equiv S(q) - (1+\lambda)\sum_{i\in I} t_i + \alpha \sum_{i\in I} U_i \quad \text{with} \quad \lambda > 0 \quad \text{and} \quad 0 \le \alpha \le 1.$$

S(·) represents the social surplus generated by public production. S(·) is increasing and strictly concave with $S'(0) = \infty$. q represents the total quantity produced by the public sector and is equal to the mass of workers retained in the public sector. λ represents the shadow cost of public funds.[12] t_i is the monetary transfer from the government to worker i. U_i represents worker i's utility. α represents the degree to which the government internalizes the utilities of the workers in the public sector.[13] Since $\alpha < 1 + \lambda$, transfers to workers are socially costly and the government will try to extract the workers' rents (conditionally to the inefficiency of the public sector described above). Therefore, before downsizing, under asymmetric information about θ_is, the efficient type obtains an information rent equal to $\Delta\theta$ (i.e., $U^p(\underline{\theta}) - U^p(\overline{\theta}) = \Delta\theta$)[14] while under complete information about θ_is, no information rent is given (i.e., $U^p(\underline{\theta}) = U^p(\overline{\theta})$). We assume that $S'(1)$ is low enough so that it is optimal to lay off some workers.

Private Sector

A worker with type θ in $\{\underline{\theta}, \overline{\theta}\}$ has an expected utility $U^m(\theta)$ when he enters the private sector.[15] More precisely, the outcome of his private sector experience can be either a success or a failure. In the case of success, he obtains utility U^H while in the case of failure, he obtains utility $U^L(<U^H)$. For example, a displaced worker pursues an investment project and the project can either succeed or fail. Alternatively, U^H (U^L) may represent finding a good job (a bad job). A worker's job search outcome can depend on his efficiency in the public sector: a worker with type θ will succeed with probability $\mu(\theta)$. Therefore, we have:[16]

$$U^m(\theta) \equiv \mu(\theta)U^H + (1-\mu(\theta))U^L.$$

We assume that it is common knowledge that the efficient type is more likely to succeed in the private sector than the inefficient type ($\mu(\underline{\theta}) \geq \mu(\overline{\theta})$). Let $\mu \equiv \nu\mu(\underline{\theta}) + (1 - \nu)\mu(\overline{\theta})$. For simplicity, we introduce the following notation:

$$\underline{\mu} = \mu(\underline{\theta}), \overline{\mu} = \mu(\overline{\theta}), \quad \Delta\mu = \underline{\mu} - \overline{\mu} \geq 0.$$

In what follows, we make two assumptions.

Assumption 1. $\Delta\theta < U^H - U^L$.

Assumption 1 holds in general since wages are more responsive to workers' productivities in the private sector than in the public sector. Indeed, firms in the private sector can use more powerful incentive schemes and compete to attract workers. The assumption holds easily under the interpretation that U^L represents finding no job (in particular in Less Developed Countries with poor social safety nets).

Assumption 2. $\Delta\mu < \Delta\theta/(U^H - U^L)$.

Assumption 2 holds when public sector workers' human capital is firm-specific rather than general ($\Delta\mu$ small). Assumption 2 also holds in transition economies with poorly developed private sector: then most of laid-off state-firm employees will not be absorbed by the private sector and will remain unemployed ($\underline{\mu}$ and $\overline{\mu}$ very small so $\Delta\mu$ small). However, if the human capital is general enough or the private sector is well developed, Assumption 2 may not hold: we discuss this case in Section 5.

Information Acquisition

We formalize information acquisition on the labor market as follows. The government, after incurring some cost, receives a signal σ_i about worker i's probability of being successful in the labor market. The signal σ_i is assumed to be publicly observable and can take two values: either σ^G or σ^B. σ^G (σ^B) is a good (bad) signal in the following sense: given a type, the probability of being successful in the labor market is higher when $\sigma_i = \sigma^G$ than when $\sigma_i = \sigma^B$. In other words, the posterior probabilities are such that:

$$P(U^H|\sigma^G, \theta) \geq P(U^H|\sigma^B, \theta) \quad \text{for all } \theta \text{ in } \{\underline{\theta}, \overline{\theta}\}.$$

When there is complete information on workers' types, we define the relative improvement in the precision of the signal σ^G, denoted by $\xi(\theta)$, as follows:

$$\xi(\theta) \equiv \frac{P(U^H | \sigma^G, \theta) - \mu(\theta)}{1 - \mu(\theta)},$$

where $\xi(\theta)$ belongs to [0, 1]. We assume for simplicity that the technology of information acquisition is such that the improvement in the precision is the same regardless of the signal and the type:

$$\xi \equiv \frac{P(U^H | \sigma^G, \theta) - \mu(\theta)}{1 - \mu(\theta)} = \frac{P(U^L | \sigma^B, \theta) - (1 - \mu(\theta))}{1 - (1 - \mu(\theta))} \quad \text{for all } \theta \text{ in } \{\underline{\theta}, \bar{\theta}\}.$$

Therefore, given ξ, the posterior probabilities are given by:

$$P(U^H | \sigma^G, \theta) = \xi + (1 - \xi)\mu(\theta); \quad P(U^L | \sigma^B, \theta) = \xi + (1 - \xi)(1 - \mu(\theta)).$$

We assume that the σ_is are independently distributed for all i in I and, for workers of the same type, the σ_is are identically distributed. Since σ_i is an unbiased signal of the probability of success, $\Pr(\sigma_i = \sigma^G | \theta) = \mu(\theta)$ and $\Pr(\sigma_i = \sigma^B | \theta) = 1 - \mu(\theta)$. Since we have workers of mass 1, the mass of type θ workers receiving signal σ^G is given by $\nu(\theta)\mu(\theta)$.

Downsizing Mechanism

When θ_i is worker i's private information, according to the revelation principle, we can restrict our attention to the set of direct revelation mechanisms without loss of generality. A downsizing mechanism is then defined by:

$$\{p(\hat{\theta}_i, \sigma_i), t(\hat{\theta}_i, \sigma_i)\},$$

where $\hat{\theta}_i$ represents worker i's report on his type, p the probability to retain the worker in the public sector[17] and t the monetary transfer from the government to the worker. Since σ_i is publicly observable, worker i is not requested to make a report on σ_i. When θ_i is known to the government, we can just replace $\hat{\theta}_i$ with θ_i in the above mechanism. In terms of the political constraint, we distinguish mandatory from voluntary downsizing.

Let $U^m(\theta, \sigma)$ (respectively, $U(\theta, \sigma)$) represent the utility that a worker with type θ and signal σ expects to obtain by entering the labor market (by accepting the downsizing mechanism). We have:

$$U^m(\theta, \sigma) \equiv P(U^H | \theta, \sigma)U^H + P(U^L | \theta, \sigma)U^L;$$
$$U(\theta, \sigma) \equiv t(\theta, \sigma) - p(\theta, \sigma)\theta + (1 - p(\theta, \sigma))U^m(\theta, \sigma).$$

For simplicity, we introduce the following notation:

$$\underline{p}^G = p(\underline{\theta}, \sigma^G), \quad \underline{p}^B = p(\underline{\theta}, \sigma^B), \quad \bar{p}^G = p(\bar{\theta}, \sigma^G), \quad \bar{p}^B = p(\bar{\theta}, \sigma^B).$$

$(\underline{t}^G, \underline{t}^B, \bar{t}^G, \bar{t}^B)$, $(\underline{U}^{mG}, \underline{U}^{mB}, \overline{U}^{mG}, \overline{U}^{mB})$ and $(\underline{U}^G, \underline{U}^B, \overline{U}^G, \overline{U}^B)$ are similarly defined.

3. Mandatory Downsizing

Complete Information Case

We consider here the case of complete information on the θ_is. For example, superiors usually know their workers' abilities. Hence, if this information can be elicited for downsizing, complete information on the θ_is is a good approximation of reality.

The acquisition of labor market information on $\mu(\theta)$ and σ allows the government to discriminate workers at the participation stage. Under mandatory downsizing, in order to induce worker i's participation, it is enough to guarantee him a utility level larger than $U^m(\theta_i, \sigma_i)$ and therefore the participation constraints are written as follows:

$$(PC\colon \underline{\theta},\sigma^G)\quad \underline{U}^G \equiv \underline{t}^G - \underline{p}^G\underline{\theta} + \left(1-\underline{p}^G\right)\underline{U}^{mG} \geq \underline{U}^{mG}, \tag{1}$$

$$(PC\colon \underline{\theta},\sigma^B)\quad \underline{U}^B \equiv \underline{t}^B - \underline{p}^B\underline{\theta} + \left(1-\underline{p}^B\right)\underline{U}^{mB} \geq \underline{U}^{mB}, \tag{2}$$

$$(PC\colon \overline{\theta},\sigma^G)\quad \overline{U}^G \equiv \overline{t}^G - \overline{p}^G\overline{\theta} + \left(1-\overline{p}^G\right)\overline{U}^{mG} \geq \overline{U}^{mG}, \tag{3}$$

$$(PC\colon \overline{\theta},\sigma^B)\quad \overline{U}^B \equiv \overline{t}^B - \overline{p}^B\overline{\theta} + \left(1-\overline{p}^B\right)\overline{U}^{mB} \geq \overline{U}^{mB}. \tag{4}$$

The government maximizes social welfare given below subject to the participation constraints (1) to (4).

$$\begin{aligned}
&S\left[\nu\left(\underline{\mu}\underline{p}^G + (1-\underline{\mu})\underline{p}^B\right) + (1-\nu)\left(\overline{\mu}\overline{p}^G + (1-\overline{\mu})\overline{p}^B\right)\right] \\
&-(1+\lambda)\left[\nu\left(\underline{\mu}\underline{t}^G + (1-\underline{\mu})\underline{t}^B\right) + (1-\nu)\left(\overline{\mu}\overline{t}^G + (1-\overline{\mu})\overline{t}^B\right)\right] \\
&+\alpha\left[\nu\left(\underline{\mu}\underline{U}^G + (1-\underline{\mu})\underline{U}^B\right) + (1-\nu)\left(\overline{\mu}\overline{U}^G + (1-\overline{\mu})\overline{U}^B\right)\right].
\end{aligned} \tag{5}$$

In what follows, we analyze how an incremental increase in the precision of the signal affects the optimal order and size of downsizing and social welfare.

Order of downsizing To retain a worker in the public sector, the government must compensate him for his production cost in the public sector and his opportunity cost associated with foregone employment in the private sector. Define the full marginal cost $MC^f(\theta, \sigma)$ as the sum of the two costs: $MC^f(\theta, \sigma) \equiv \theta + U^m(\theta, \sigma)$. Then, the social marginal cost of keeping a worker in the public sector is defined as

$$SMC^c(\theta,\sigma) \equiv (1+\lambda)MC^f(\theta,\sigma) \tag{6}$$

where the superscript c indicates complete information. The optimal number of workers to retain in the public sector is determined by equalizing the marginal social value of public production to the marginal social cost of keeping a worker. Obviously, it is optimal to lay off first the workers with the highest full marginal cost.

Let $\Delta MC^f(\sigma)$ denote the difference between the full cost of an inefficient worker having signal σ and that of an efficient worker having the same signal. Given σ, an inefficient worker has a larger production cost and a smaller opportunity cost than an efficient worker. Since, under Assumption 2, the difference between the two types' production costs is larger than the difference between their opportunity costs, $\Delta MC^f(\sigma)$ is always positive. Furthermore it turns out that, under our assumptions, $\Delta MC^f(\sigma)$ does not depend on σ:

$$\Delta MC^f \equiv MC^f(\overline{\theta},\sigma) - MC^f(\underline{\theta},\sigma) = \Delta\theta - (1-\xi)\Delta\mu\left(U^H - U^L\right) > 0. \tag{7}$$

Given signal σ, as the precision of the signal (ξ) increases, the difference between the two types' opportunity costs decreases, implying that ΔMC^f increases with ξ.

Since the opportunity cost of a worker having the good signal (the bad signal) increases (decreases) as the precision of the signal increases, an efficient worker having the good signal can have a larger full cost than an inefficient worker having the bad signal. More precisely, under Assumptions 1 and 2, there exists ξ^* in (0, 1) such that[18]

$$MC^f(\overline{\theta},\sigma^B) \gtreqqless MC^f(\underline{\theta},\sigma^G) \quad \text{for } \xi \lesseqqgtr \xi^*. \tag{8}$$

In the next proposition, we summarize the results on the optimal order of downsizing:

Proposition 1. *(order of downsizing) When downsizing is mandatory, under Assumptions 1 and 2 and under complete information about each worker's efficiency in the public sector, the optimal order of downsizing changes as the precision increases as follows:*

(a) *Regime I (when $\xi \leq \xi^*$): $(\overline{\theta}, \sigma^G)$, $(\overline{\theta}, \sigma^B)$, $(\underline{\theta}, \sigma^G)$ and $(\underline{\theta}, \sigma^B)$;*
(b) *Regime II (when $\xi > \xi^*$): $(\overline{\theta}, \sigma^G)$, $(\underline{\theta}, \sigma^G)$, $(\overline{\theta}, \sigma^B)$, and $(\underline{\theta}, \sigma^B)$.*

When the precision is zero, the signal does not affect the full cost and an inefficient worker has a larger full cost than an efficient worker. By continuity, for low precision (i.e., in Regime *I*), the order is first determined by the type and then by the signal as in Figure 1. For precision higher than ξ^* (i.e., in Regime *II*), an efficient worker with the good signal has a larger full cost than an inefficient worker with the bad signal and therefore the order is first determined by the signal and then by the type as in Figure 1. In this case, the government prefers to let go efficient workers with the good signal before inefficient workers with the bad signal.

Size of downsizing We now examine how changes in parameters affect the size of downsizing. An increase in the shadow cost of public funds (λ) increases the social marginal cost of retaining a worker and therefore increases the size of downsizing. The degree to which the government internalizes the workers' utilities (α) does not affect the size of downsizing since workers obtain no information rent (i.e., $U(\theta, \sigma) = U^m(\theta, \sigma)$) under complete information about the θ_is. An increase in the precision of the signal (ξ) can either increase or decrease the size of downsizing depending on whether the marginal worker has a good or bad signal. For instance, if the number of the workers to retain in the public sector is determined by equalizing the marginal

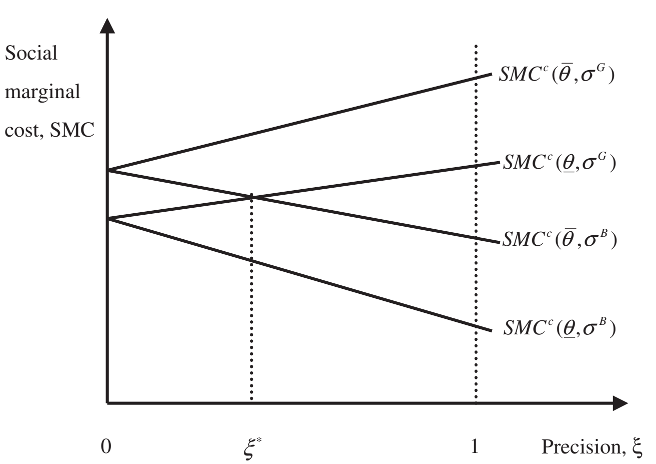

Figure 1. Social Marginal Cost of Retaining a Worker under Complete Information

value of public production to $SMC^c(\underline{\theta}, \sigma^B)$ ($SMC^c(\underline{\theta}, \sigma^G)$) the size of downsizing decreases (increases) with ξ since the opportunity cost of a worker having the bad (good) signal decreases (increases) with ξ.

Value of information We now examine how an incremental increase in the precision of the signal affects social welfare. The next proposition states that, from Blackwell's theorem,[19] an increase in the precision has a positive social value.

PROPOSITION 2. *(value of information) Under complete information about each worker's efficiency in the public sector and under mandatory downsizing, social welfare is increasing in the precision of the signal (ξ).*

PROOF. See Appendix. □

We note that Proposition 2 is valid even if Assumptions 1 and 2 do not hold. To understand why the society gains from an increase in the precision, we consider the case in which the size of downsizing is fixed (hence, the quantity of public production is fixed) and find:

$$\frac{dW}{d\xi} = (1+\lambda)\sum_{\theta=\underline{\theta}}^{\bar{\theta}}\left[p(\theta,\sigma^B) - p(\theta,\sigma^G)\right]\nu(\theta)\mu(\theta)(1-\mu(\theta))(U^H - U^L), \tag{9}$$

which is positive since we have $p(\theta, \sigma^B) \geq p(\theta, \sigma^G)$. Intuitively, an increase in the precision affects social welfare through two channels: workers' reservation utilities and transfers. Concerning the first, after an increase in the precision, the reservation utilities of the workers having the good signal increases while those of the workers having the bad signal decreases such that their net effect is zero. Concerning the second, the transfer to each worker is equal to his full marginal cost multiplied by his probability of being retained in the public sector. After an increase in the precision, the compensation to the workers having the good signal increases while the one to the workers having the bad signal decreases. Since $p(\theta, \sigma^B) \geq p(\theta, \sigma^G)$ holds for each type, there will be a net decrease in the total monetary transfer, which increases social welfare.

Asymmetric Information Case

In this section, we extend the analysis to the case with asymmetric information on the workers' production cost θ_is in the public sector. For the downsizing mechanism to induce truth-telling, it must satisfy the following incentive compatibility constraints:

$$(IC: \underline{\theta}, \sigma^G) \quad \underline{t}^G - \underline{p}^G\underline{\theta} + \left(1-\underline{p}^G\right)\underline{U}^{mG} \geq \bar{t}^G - \bar{p}^G\underline{\theta} + (1-\bar{p}^G)\underline{U}^{mG}, \tag{10}$$

$$(IC: \underline{\theta}, \sigma^B) \quad \underline{t}^B - \underline{p}^B\underline{\theta} + \left(1-\underline{p}^B\right)\underline{U}^{mB} \geq \bar{t}^B - \bar{p}^B\underline{\theta} + (1-\bar{p}^B)\underline{U}^{mB}, \tag{11}$$

$$(IC: \bar{\theta}, \sigma^G) \quad \bar{t}^G - \bar{p}^G\bar{\theta} + (1-\bar{p}^G)\overline{U}^{mG} \geq \underline{t}^G - \underline{p}^G\bar{\theta} + \left(1-\underline{p}^G\right)\overline{U}^{mG}, \tag{12}$$

$$(IC: \bar{\theta}, \sigma^B) \quad \bar{t}^B - \bar{p}^B\bar{\theta} + (1-\bar{p}^B)\overline{U}^{mB} \geq \underline{t}^B - \underline{p}^B\bar{\theta} + \left(1-\underline{p}^B\right)\overline{U}^{mB}. \tag{13}$$

We recall that the signal is public information.

The government maximizes social welfare (5) subject to the participation constraints, (1) to (4), and the incentive compatibility constraints, (10) to (13). The formal characterization of the optimal downsizing mechanism is presented in Appendix. We analyze below how an incremental increase in the precision of the signal affects the optimal order and size of downsizing, and social welfare.

Order of downsizing Since as usual the participation constraint is binding for the inefficient type, the transfer that an inefficient worker receives is equal to his full cost multiplied by his probability of being retained in the public sector (see (3) and (4)). Then, an efficient worker having signal σ can obtain a utility level equal to $p(\overline{\theta}, \sigma) \times \Delta MC^f + U^m(\underline{\theta}, \sigma)$ by pretending to be inefficient. Therefore, in order to induce truth-telling, the government should make his utility larger than his reservation utility by an amount $p(\overline{\theta}, \sigma)\Delta MC^f$:

$$U(\underline{\theta},\sigma) - U^m(\underline{\theta},\sigma) = p(\overline{\theta},\sigma)\Delta MC^f.$$

Since the information rent, defined by $U(\underline{\theta}, \sigma) - U^m(\underline{\theta}, \sigma)$, is increasing in the probability of retaining an inefficient worker ($p(\overline{\theta}, \sigma)$), the social marginal cost of retaining an inefficient worker is larger under asymmetric information than under complete information. Therefore, the social marginal cost of retaining a worker is given by:

$$SMC^a(\underline{\theta},\sigma) = SMC^c(\underline{\theta},\sigma) \quad \text{for } \sigma \text{ in } \{\sigma^G, \sigma^B\}, \tag{14}$$

$$SMC^a(\overline{\theta},\sigma^G) = SMC^c(\overline{\theta},\sigma^G) + (1+\lambda-\alpha)\frac{\nu}{1-\nu}\frac{\mu(\underline{\theta})}{\mu(\overline{\theta})}\Delta MC^f, \tag{15}$$

$$SMC^a(\overline{\theta},\sigma^B) = SMC^c(\overline{\theta},\sigma^B) + (1+\lambda-\alpha)\frac{\nu}{1-\nu}\frac{1-\mu(\underline{\theta})}{1-\mu(\overline{\theta})}\Delta MC^f, \tag{16}$$

where the superscript *a* represents asymmetric information. We note that the social marginal cost of retaining an efficient worker is the same regardless of whether or not the θ_is are known. However, we have

$$SMC^a(\overline{\theta},\sigma^G) > SMC^a(\overline{\theta},\sigma^B) \quad \text{from } \frac{\mu(\underline{\theta})}{\mu(\overline{\theta})} \geq \frac{1-\mu(\underline{\theta})}{1-\mu(\overline{\theta})}.$$

This fact together with $SMC^a(\underline{\theta}, \sigma^G) = SMC^c(\underline{\theta}, \sigma^G)$ implies that there exists a threshold ξ^{**} ($>\xi^*$) such that $SMC^a(\overline{\theta}, \sigma^B)$ is larger than $SMC^a(\underline{\theta}, \sigma^G)$ if and only if ξ is smaller ξ^{**}.[20]

We summarize our findings on the optimal order of downsizing in the next proposition:

PROPOSITION 3. *(order of downsizing) When downsizing is mandatory, under Assumptions 1 and 2 and under asymmetric information on each worker's efficiency in the public sector, the optimal order of downsizing changes as follows as the precision increases:*

(a) *Regime I (when $\xi \leq \xi^{**}$): $(\overline{\theta}, \sigma^G)$, $(\overline{\theta}, \sigma^B)$, $(\underline{\theta}, \sigma^G)$ and $(\underline{\theta}, \sigma^B)$;*
(b) *Regime II (when $\xi > \xi^{**}$): $(\overline{\theta}, \sigma^G)$, $(\underline{\theta}, \sigma^G)$, $(\overline{\theta}, \sigma^B)$, and $(\underline{\theta}, \sigma^B)$, where $\xi^{**} > \xi^*$ and regime II exists only if $\left((1+\lambda)+\lambda\frac{\nu}{1-\nu}\frac{1-\underline{\mu}}{1-\overline{\mu}}\right)\Delta\theta < (1+\lambda)(U^H - U^L)$ holds.*

Since asymmetric information increases the social marginal cost of retaining an inefficient worker, it becomes less likely that the government lets go the efficient workers with the good signal before the inefficient workers with the bad signal. Therefore, asymmetric information expands Regime I.

Size of downsizing Asymmetric information increases the size of downsizing when it is not optimal to lay off all the inefficient workers since it increases the social marginal cost of retaining an inefficient worker. This distortion from asymmetric information increases with λ and decreases with α: this is because giving information rents to workers becomes more costly as λ increases or as α decreases. As the degree of information asymmetry ΔMC^f increases with ξ, an increase in the precision of the signal may increase the size of downsizing by increasing the social marginal cost of retaining an inefficient worker.

However, asymmetric information does not affect the size of downsizing when it is optimal to lay off all the inefficient workers: then, the government can achieve the complete information outcome since efficient workers obtain no information rent.

Value of information We now study how an increase in the precision of the signal affects social welfare. We distinguish two cases: $\mu(\underline{\theta}) = \mu(\overline{\theta})$ and $\mu(\underline{\theta}) > \mu(\overline{\theta})$.

First, when $\mu(\underline{\theta}) = \mu(\overline{\theta})$ holds, we can still apply Blackwell's theorem. Hence, an increase in the precision has a positive social value.

Proposition 4. *(value of information) Under mandatory downsizing and under asymmetric information on each worker's efficiency in the public sector, if $\mu(\underline{\theta}) = \mu(\overline{\theta})$ holds, social welfare is increasing in the precision of the signal.*

Proof. See Appendix. □

However, in the case of $\mu(\underline{\theta}) > \mu(\overline{\theta})$, we cannot apply Blackwell's theorem since the information rent becomes a function of both the precision ξ and the signal σ: see Appendix for the detailed explanation. Since finding sufficient conditions for the value of information to be positive is beyond the scope of this paper,[21] we below illustrate a case where an increase in the precision decreases social welfare.

The transfer under asymmetric information is equal to the one under complete information plus the rent of asymmetric information. Given a level of public production, we have seen in Proposition 2 that an increase in ξ always increases social welfare if the government does not pay any rent. However, an increase in ξ increases the rent since it reduces the difference in both types' opportunity costs and thereby increases the difference in their full costs. For instance, let us exogenously fix the size of downsizing such that $1 - (1 - \nu)\overline{\mu}(1 - \overline{p}^G) = q$. Then, we have

$$\frac{dW}{d\xi} = \{(1+\lambda)(1-\nu)(1-\overline{\mu})\overline{\mu}(1-\overline{p}^G) - \lambda\nu[1-\underline{\mu}(1-\overline{p}^G)]\Delta\mu\}(U^H - U^L).$$

The first term in $\{\cdot\}$ represents the impact through the change in the transfer under complete information and the second term in $\{\cdot\}$ represents the impact through the change in rent. Therefore, $dW/d\xi$ is negative when downsizing is mild enough ($1 - \overline{p}^G$ small enough). We note that when there is massive downsizing such that all the inefficient workers are laid off, the government can achieve the complete information outcome and therefore, from Proposition 2, social welfare increases in the precision.

We summarize the results in the next proposition.

Proposition 5. *(value of information) Suppose $\mu(\underline{\theta}) > \mu(\overline{\theta})$. Under mandatory downsizing and asymmetric information on each worker's efficiency in the public sector:*

(a) *The social value of an increase in the precision of the signal may be positive or negative*;
(b) *Given a targeted size of downsizing*,
  (i) *When downsizing is mild, social welfare decreases in the precision*,
  (ii) *When downsizing is massive, social welfare increases in the precision.*

4. Voluntary Downsizing

In this section, we briefly consider the case of voluntary downsizing. Under voluntary downsizing, by refusing a downsizing offer, a worker of type θ can stay in the public sector with his current status and therefore obtain the status quo utility $U^p(\theta)$.[22] We introduce the following assumption regarding $U^p(\theta)$:

ASSUMPTION 3. $U^p(\theta) \geq U^m(\theta, \sigma)$ *for all* (θ, σ).

Assumption 3 means that the status quo utility in the public sector is higher than workers' outside opportunity whatever his labor market information such that no worker has the incentive to leave the public sector without compensation. Usually $U^p(\theta)$ is expected to be relatively high in developing countries since public sector wages tend to be higher than labor earnings outside of it and public sector jobs provide non-wage benefits such as health coverage and old-age pension which are not usually carried by the jobs available in the private sector (Rama, 1999).[23]

Consider first the case in which there is complete information on the θ_is. Under voluntary downsizing, the participation constraints are given as follows:

$$\left(PC: \underline{\theta}, \sigma^G\right) \quad \underline{t}^G - \underline{p}^G \underline{\theta} + \left(1 - \underline{p}^G\right) \underline{U}^{mG} \geq U^p(\underline{\theta}), \tag{17}$$

$$\left(PC: \underline{\theta}, \sigma^B\right) \quad \underline{t}^B - \underline{p}^B \underline{\theta} + \left(1 - \underline{p}^B\right) \underline{U}^{mB} \geq U^p(\underline{\theta}), \tag{18}$$

$$\left(PC: \overline{\theta}, \sigma^G\right) \quad \overline{t}^G - \overline{p}^G \overline{\theta} + \left(1 - \overline{p}^G\right) \overline{U}^{mG} \geq U^p(\overline{\theta}), \tag{19}$$

$$\left(PC: \overline{\theta}, \sigma^B\right) \quad \overline{t}^B - \overline{p}^B \overline{\theta} + \left(1 - \overline{p}^B\right) \overline{U}^{mB} \geq U^p(\overline{\theta}). \tag{20}$$

Since the social marginal cost of retaining a worker under voluntary downsizing is equal to the one under mandatory downsizing, the optimal order and size of downsizing is not affected by the nature of the political constraint (i.e., whether downsizing is mandatory or voluntary). Still, under complete information on the θ_is, social welfare increases in the precision regardless of the nature of the political constraint.

We now study the case of asymmetric information on the θ_is. Then, the government maximizes social welfare (5) subject to the participation constraints, (17) to (20), and the incentive compatibility constraints, (10) to (13).[24] As was explained in Section 2, when there is asymmetric information, an efficient worker obtains an information rent under the status quo before downsizing: $U^p(\underline{\theta}) - U^p(\overline{\theta}) = \Delta\theta$. Therefore, in order to lay off an efficient worker, the government has to compensate for his information rent and this in turn creates an incentive for an inefficient worker to pretend to be efficient. This increases the social marginal cost of laying off an efficient worker.

To provide an intuition, consider the case in which the government induces all efficient workers having signal σ to leave. Then, the government must give to each of them a transfer at least equal to $\underline{t}^\sigma = U^p(\underline{\theta}) - U^m(\underline{\theta}, \sigma)$: otherwise, they will prefer staying in the public sector. Given this transfer, by pretending to be efficient, an inefficient worker with signal σ can obtain an expected utility $\underline{t}^{\sigma} + U^m(\overline{\theta}, \sigma) = \Delta MC^f + U^p(\overline{\theta}) > U^p(\overline{\theta})$. Therefore, in order to induce truth-telling of the inefficient worker, the government should make his utility larger than $U^p(\overline{\theta})$ by an amount ΔMC^f. This argument holds as long as the probability of retaining efficient workers is smaller than one: then, by pretending to be efficient, an inefficient worker can obtain an information rent equal to $(1 - p(\underline{\theta}, \sigma))\Delta MC^f$. The fact that this rent is decreasing in the probability of retaining an efficient worker ($p(\underline{\theta}, \sigma)$) induces the government to retain more efficient workers under asymmetric information than under complete information: in other words, the social marginal cost of retaining an efficient worker is smaller under asymmetric information than under complete information. We note that the cost of retaining an inefficient worker is not affected by asymmetric information.

Finally, as under mandatory downsizing, an increase in the precision (ξ) of the signal increases social welfare for $\mu(\underline{\theta}) = \mu(\overline{\theta})$ while, for $\mu(\underline{\theta}) > \mu(\overline{\theta})$, an increase in the precision may increase or decrease social welfare. When $\mu(\underline{\theta}) > \mu(\overline{\theta})$, social welfare may decrease in the precision, since an increase in the precision increases the difference in both types' full costs and therefore increases the information rents of inefficient workers. In particular, when downsizing is massive such that most of the workers are laid off, social welfare is likely to decrease in the precision since then the information rents are large.

5. Extension: When Assumption 2 Does not Hold

We briefly discuss here the case when Assumption 2 does not hold (i.e., $\Delta\mu > \Delta\theta/(U^H - U^L)$). The inequality means that in the absence of the signals σ_is, the difference between the two types' production costs is smaller than the difference between their opportunity costs. This case happens when public sector workers' human capital is general enough ($\Delta\mu$ large) and the private sector is well developed and is discriminating workers strongly enough according to their efficiency ($U^H - U^L$ large). In this case, for $\xi = 0$, an inefficient worker's full marginal cost is smaller than that of an efficient worker since $\underline{\theta} + \underline{\mu}U^H + (1 - \underline{\mu})U^L > \overline{\theta} + \overline{\mu}U^H + (1 - \overline{\mu})U^L$ is equivalent to $\Delta\mu > \Delta\theta/(U^H - U^L)$. In contrast, for $\xi = 1$, given a signal, both types have the same opportunity cost and therefore an inefficient worker's full marginal cost is larger than that of an efficient worker. As a consequence, there exists a threshold $\hat{\xi}$ in (0, 1) such that given a signal, an inefficient worker's full cost is smaller than that of an efficient worker having the same signal if and only if $\xi < \hat{\xi}$ holds.

We can show that all the main results (except the one on the value of information) in the previous sections hold, regardless of whether Assumption 2 holds or not. First, under complete information on types, the optimal structure of downsizing is determined by the full cost of retaining a worker regardless of the nature of the political constraint. Second, when there is asymmetric information on types, workers can obtain information rents and this affects the social marginal cost of retaining a worker. To be more precise, we define the high-cost type (the low-cost type) as the type who has higher (lower) full cost between the two types. Then, under mandatory downsizing, a low-cost type can obtain an information rent by pretending to have high-cost and this raises the social marginal cost of retaining high-cost workers while, under voluntary downsizing, a high-cost type can obtain an information rent and this reduces the social marginal cost of retaining low-cost workers. Last, an increase in the precision of the signal can increase or decrease social welfare when there is asymmetric information on types. However, when the inefficient type is the low-cost type (i.e. Assumption 2 does not hold and $\xi < \hat{\xi}$), social welfare unambiguously increases with the precision since then an increase in the precision reduces the information rent by reducing the difference in both types' full costs.

6. Policy Implications

Which Type of Workers Should be Separated?

Downsizing mechanisms determine which types of workers will be matched with the private sector. Our analysis shows that in a socially optimal matching the workers having the largest full cost are laid off first, where the full cost of retaining a worker in the public sector is defined by the sum of his production cost in the public sector and his opportunity cost in the private sector. Since an efficient worker has a smaller production cost, but a larger opportunity cost than an inefficient worker, efficient workers should be retained in the public sector only if the difference in both types' opportunity costs is not large (i.e., when Assumption 2 holds). This will be the case if public sector workers' human capital is firm-specific rather than general. In transition economies, if the private sector is small and poorly performing, laying off first inefficient workers will be optimal since most of the separated workers will remain unemployed and therefore their opportunity costs will be small. In contrast, if the private sector is well developed and discriminates workers with respect to efficiency more than the public sector does, laying off first efficient workers will be optimal.

Interaction between Information and Political Constraints

Under complete information about each worker's efficiency, the political constraint does not affect the optimal structure of downsizing since the social marginal cost of retaining a worker is always equal to $(1 + \lambda)$ times the full cost whatever the political constraint. Under asymmetric information, the political constraint determines which types of workers obtain information rents and therefore affects the structure of downsizing. Consider the case when an efficient worker has a smaller full cost than an inefficient worker. Under mandatory downsizing, as long as inefficient workers are retained with a positive probability, efficient workers obtain information rents since inefficient workers have a higher production cost. This increases the social marginal cost of retaining an inefficient worker. In contrast, under voluntary downsizing, as long as efficient workers are laid off with a positive probability, inefficient workers obtain information rents since efficient workers have a higher status quo utility level. This decreases the social marginal cost of retaining an efficient worker. As a consequence, asymmetric information can only increase the size of downsizing under mandatory downsizing while it can only reduce the size under voluntary downsizing.

Gradualism versus Big-bang Strategy in Transition Economies

Transition economies differ in terms of the speed and sequencing of different reforms. One can distinguish countries where reforms were introduced gradually from countries where they were adopted by a big-bang strategy (Roland, 2000). Although we took a static partial-equilibrium approach, our analysis offers some insights about the choice between gradualism and big-bang. First, it suggests that a big-bang strategy inducing massive layoffs may be very costly when both the information and the political constraint are tight since the need to compensate for high status quo utility may induce even the inefficient workers to obtain information rents. Therefore, it would be desirable to find ways to induce political forces to accept mandatory downsizing. For instance, stronger social safety nets (such as unemployment benefits) can be used as a compensation for accepting mandatory downsizing.[25]

Second, our analysis shows that the degree of private sector development affects both the structure and the cost of downsizing. If the difference between the two types' opportunity costs increases with private sector development, it is optimal to start laying off inefficient workers (efficient workers) when the private sector is poorly (well) developed. Private sector development affects the cost of downsizing through two channels: opportunity costs and information rents. The more the private sector is developed, the higher are workers' opportunity costs and therefore the smaller are the transfers needed to induce voluntary separation. Therefore, it is optimal to sequence reforms such that reforms to expand the private sector precede downsizing.[26] To analyze the impact through information rents, consider the case in which it is optimal to start laying off inefficient workers. Then, a further development of the private sector will reduce the difference between the two types' full costs by increasing the difference in their opportunity costs. Therefore, in this case, private sector development has an additional benefit of reducing those rents.

Labor Market Information Acquisition and Downsizing

The social value of additional labor market information is always positive if there is no informational constraint: i.e., an increase in the precision of the information about workers' outside opportunities always increases social welfare. However, under asymmetric information on individual efficiency, an increase in the precision affects the information rents by reducing the difference in the two types' opportunity costs and may either increase or decrease social welfare depending on which type has a larger full cost. For example, if an efficient worker has a smaller full cost than an inefficient worker, a reduction in the difference between their opportunity costs increases information rents by increasing the difference between their full costs so that the value of information may be negative.

Other Applications

Our model can be applied to other situations where the government wants to introduce a new policy when agents are obtaining rents from the current policy: for instance, it can be applied to changes in European common agricultural policies,[27] reforms of protective trade policies or inducing agents to accept the installation of (local) public bads such as nuclear power plants, waste incinerators, prisons, etc. In these situations, the government faces an informational constraint (each agent has private information about parameters determining his rent under the status quo) and a political constraint (the government needs to induce a majority of the agents to accept the new policy). Furthermore, agents might face uncertainty about their payoffs under the new policy and the government can acquire information about factors affecting them.

7. Conclusion

We have studied the optimal downsizing mechanism under different informational and political constraints. The main insights from our analysis are as follows. First, the allocation of labor from the public to the private sector should be based on the full (marginal) cost of retaining a worker in the public sector, which is the sum of his production cost in the public sector and his opportunity cost in the private sector. Information acquisition about workers' opportunity costs allows the government to have more accurate information about workers' full costs and thereby affects the structure of downsizing. As long as there is complete information on workers' production costs in the public sector, the optimal structure and size of downsizing does not depend on whether downsizing is mandatory or voluntary since the nature of the political constraint does not affect the full costs.

Second, when there is asymmetric information on workers' production costs in the public sector, workers can obtain information rents and this affects the social marginal cost of retaining a worker. In particular, the nature of the political constraint determines which type of workers obtain information rents and thereby affects the structure and size of downsizing.

Last, the value for the government (the principal) of additional information about workers' opportunity costs may be negative since his objective function is directly affected by additional information through its effect on the information rents.

Appendix

Proof of Proposition 2

We can apply Blackwell's theorem at the level of each worker. To apply the theorem, we have to show that (i) the government's optimization program is well defined and (ii) an increase in the precision improves the information structure in Blackwell's sense.

(i) Given a worker with type θ and signal σ, the only uncertainty concerning him is whether or not he will be successful in the labor market. Let ω denote the state of nature in terms of job market performance, with $\omega \in \{H, L\}$.

The government's program at the level of a worker is given by:

$$\max_{p,t} E_{(\omega|\theta,\sigma)}\{pS'(q)-(1+\lambda)t+\alpha[t-p\theta+(1-p)[U^L+(U^H-U^L)1_{[\omega=H]}]]\}$$

subject to

$$E_{(\omega|\theta,\sigma)}\{t-p\theta+(1-p)[U^L+(U^H-U^L)1_{[\omega=H]}]\}$$
$$\geq E_{(\omega|\theta,\sigma)}[U^L+(U^H-U^L)1_{[\omega=H]}],$$

where we use (p, t) instead of $(p(\theta, \sigma), t(\theta, \sigma))$ to save space and q represents the quantity produced in the public sector by all the other workers. Since the transfer is determined by the binding participation constraint, the government has only to choose the probability to retain the worker in the public sector (p) to maximize social welfare. Therefore, the government's program is well defined as follows:

$$\max_p E_{(\omega|\theta,\sigma)}\{p[S'(q)-(1+\lambda)\theta]+(\alpha-p(1+\lambda))[U^L+(U^H-U^L)\mathbf{1}_{[\omega=H]}]\}.$$

(ii) The information structure with precision ξ is finer in Blackwell's sense than the information structure with precision $\xi-\Delta\xi$, with $\xi > \Delta\xi > 0$. To show this, let F^1 (respectively, F^2) denote the matrix of conditional probabilities when precision is ξ (respectively, $\xi-\Delta\xi$):

$$F^j \equiv \begin{bmatrix} P(\sigma=\sigma^G|\theta,\omega=H) & P(\sigma=\sigma^G|\theta,\omega=L) \\ P(\sigma=\sigma^B|\theta,\omega=H) & P(\sigma=\sigma^B|\theta,\omega=L) \end{bmatrix} \quad \text{for } j=1,2.$$

We have

$$F^1 = \begin{bmatrix} \xi + (1-\xi)\mu(\theta) & (1-\xi)\mu(\theta) \\ (1-\xi)(1-\mu(\theta)) & \xi + (1-\xi)(1-\mu(\theta)) \end{bmatrix},$$

$$F^2 = F^1 - \Delta\xi \begin{bmatrix} 1-\mu(\theta) & -\mu(\theta) \\ -(1-\mu(\theta)) & \mu(\theta) \end{bmatrix}.$$

Then, there exists a matrix B such that $F^2 = BF^1$, where B is given by:

$$B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} = I - \frac{\Delta\xi}{\xi} \begin{bmatrix} 1-\mu(\theta) & -\mu(\theta) \\ -(1-\mu(\theta)) & \mu(\theta) \end{bmatrix},$$

where $b_{ij} \geq 0$ and $b_{1j} + b_{2j} = 1$ for all i and $j \in \{1, 2\}$.

Proof of the Characterization of the Optimal Mandatory Downsizing Mechanism under Asymmetric Information

The government's program is to maximize social welfare (5) subject to (1) to (4) and (10) to (13). This program is quite standard and we solve it in two stages: we guess the binding constraints, maximize social welfare subject to these constraints and then check ex post that the derived solution satisfies all the neglected constraints.

The binding constraints are as follows. Given a signal, the participation constraint is binding for the inefficient type (PC: $\overline{\theta}$, σ) and the incentive compatibility constraint is binding for the efficient type (IC: $\underline{\theta}$, σ). Given $p(\theta, \sigma)$, from these constraints, we can derive the transfers as follows:

$$t(\overline{\theta}, \sigma) = p(\overline{\theta}, \sigma) MC^f(\overline{\theta}, \sigma),$$
$$t(\underline{\theta}, \sigma) = p(\underline{\theta}, \sigma) MC^f(\underline{\theta}, \sigma) + p(\overline{\theta}, \sigma)\Delta MC^f.$$

After inserting the transfers into the objective (5), from the first order derivative with respect to $p(\theta, \sigma)$, we find the social marginal cost of retaining a worker as in (14) to (16). The optimal quantity to produce q^* is determined by equalizing the marginal surplus from public production to the social marginal cost of retaining a worker. Then, all the workers whose social marginal cost is lower than that of the marginal workers will be retained and the probability of retaining the marginal workers will be chosen so that the total mass of the retained workers is equal to the optimal quantity q^*.

Finally, it is easy to check that the optimal mechanism characterized above satisfies all the neglected constraints.

Proof of Proposition 4

As in the proof of Proposition 2, we can apply Blackwell's theorem at the level of each worker. Since we proved in the proof that an increase in the precision improves the information structure in Blackwell's sense, we only need to show that the government's optimization program is well defined.

Given a worker with signal σ, the government is facing two kinds of uncertainties about him: his type θ and his performance in the labor market ω, with $\omega \in \{H, L\}$. The government has four instruments: $\underline{p}^\sigma$, $\overline{p}^\sigma$, $\underline{t}^\sigma$, $\overline{t}^\sigma$. Since the two transfers are determined by the binding inefficient type's participation constraint and efficient type's incentive compatibility constraint, the government can only choose $\underline{p}^\sigma$, $\overline{p}^\sigma$ to maximize social welfare. After expressing the transfers as functions of the probabilities and injecting them into the objective, we find that the government's program can be decomposed into two independent subprograms, the one for the efficient type and the one for the inefficient type, as follows:

$$\max_{\underline{p}^{\sigma}} E_{(\omega|\sigma)}\left\{\underline{p}^{\sigma}[S'(q)-(1+\lambda)\underline{\theta}]+\left[\alpha-\underline{p}^{\sigma}(1+\lambda)\right]\left[U^{L}+\left(U^{H}-U^{L}\right)\mathbf{1}_{[\omega=H]}\right]\right\};$$

$$\max_{\overline{p}^{\sigma}} E_{(\omega|\sigma)}\left\{\begin{array}{l}\overline{p}^{\sigma}[S'(q)-(1+\lambda)\overline{\theta}]+[\alpha-\overline{p}^{\sigma}(1+\lambda)][U^{L}+(U^{H}-U^{L})\mathbf{1}_{[\omega=H]}]\\ -(1+\lambda-\alpha)\overline{p}^{\sigma}\Delta\theta\dfrac{\nu}{1-\nu}\end{array}\right\}.$$

Hence, the government's optimization program is well defined.

Why Blackwell's Theorem Cannot be Applied When $\mu(\underline{\theta})>\mu(\overline{\theta})$

When $\mu(\underline{\theta})>\mu(\overline{\theta})$, the objective in the government's optimization program with respect to $\overline{p}^{\sigma}$ is given as follows:

$$\begin{array}{l}\overline{p}^{\sigma}[S'(q)-(1+\lambda)\overline{\theta}]+[\alpha-\overline{p}^{\sigma}(1+\lambda)][U^{L}+(U^{H}-U^{L})\mathbf{1}_{[\omega=H]}]\\ -(1+\lambda-\alpha)\overline{p}^{\sigma}[\Delta\theta-(1-\xi)\Delta\mu(U^{H}-U^{L})]\dfrac{\nu}{1-\nu}\left[\dfrac{\mu(\underline{\theta})}{\mu(\overline{\theta})}\mathbf{1}_{[\sigma=\sigma^{G}]}+\dfrac{1-\mu(\underline{\theta})}{1-\mu(\overline{\theta})}\mathbf{1}_{[\sigma=\sigma^{B}]}\right].\end{array}$$

If $\mu(\underline{\theta})=\mu(\overline{\theta})$ (i.e., $\Delta\mu=0$), the objective depends neither on ξ nor on σ and we can apply the theorem. However, if $\mu(\underline{\theta})>\mu(\overline{\theta})$, since both ξ and σ enter directly into the objective, we cannot apply the theorem. This is a general point about adverse selection models. An increase of information in Blackwell's sense does not lead necessarily to an increase of the decision maker's objective function, because in addition to the usual effect on beliefs it impacts directly the objective function through its effect on the information rent which is a function of the hazard rate.

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Notes

1. For instance, Haltiwagner and Singh (1999) study 41 public sector downsizing programs across 37 developing or transition countries. Public sector downsizing is an important issue in developed countries as well. For instance, according to a study of the civil service employment in seven OECD countries (Australia, Canada, France, Spain, Sweden, US, and UK), during the period of 1988–97, the civil service employment decreased by more than 12% in each of them except for France; it decreased by more than 40% in Sweden and, in US, Congress passed in 1994 legislation calling for a 12% cut in the total number of Federal civil service employees by 1999 (OECD, 1999).
2. Haltiwagner and Singh (1999) find that 20% among 41 downsizing programs experienced significant rehiring and Chong and López-de-Silanes (2002) find that nearly 35% among 400 firms did rehiring.
3. For instance, according to Roland (2000), political constraints to enterprise restructuring can easily be predicted in transition economies since the labor market was initially a seller's market and social services were concentrated inside enterprises.
4. For instance, Chong and López-de-Silanes (2002) classified downsizing programs into two categories (compulsory and voluntary) and find that 41.5% of their samples used the voluntary approach.

5. See Alderman, Canagarajah, and Younger (1996), Assaad (1999), Rama and MacIsaac (1999). Ruppert (1999), and Tansel (1998). For a brief survey, see Rama (1997). The papers typically attempt to capture how the losses are related to workers' observable characteristics such as wage in the public sector, education, seniority, marital status, sex etc.
6. For instance, in the downsizing of the Central Bank in Ecuador, Rama and MacIsaac (1999) found that the group with the lower efficiency in the public sector could have a 40 percentage higher welfare loss from separation than the group with the higher efficiency.
7. But they assume perfect correlation of the two productivities.
8. Sequencing or speed of reforms in transition economies has been usually studied from a dynamic general-equilibrium perspective: see Roland (2000, in particular chapters 2 and 3) for a survey.
9. θ_i can be interpreted as worker *i*'s disutility of effort.
10. Of course, it would be desirable to take the opportunity of downsizing to implement a reform of incentives in the public sector. However, this is rarely done and indeed it is often the political infeasibility of such a reform that leads to downsizing.
11. The superscript p indicates the public sector.
12. It is strictly positive since distortionary taxation inflicts a cost of $(1 + \lambda)$ units of account to taxpayers in order to levy 1 unit of account for the government.
13. The government may not fully internalize their utilities (i.e., $\alpha < 1$), for instance, when it finds that the workers have been already favored by generous wages and non-wage benefits in the public sector.
14. In this case, workers in the public sector receive the same wage and non-wage benefits regardless of their efficiency.
15. The superscript m represents market.
16. Our analysis can be easily extended to a more general case in which we have $U^m(\theta) \equiv \mu(\theta)U^H(\theta) + (1 - \mu(\theta))U^L(\theta)$.
17. Alternatively, p can be viewed as the share of part time in the public sector.
18. ξ^* is determined by $\Delta\theta \equiv [\Delta\mu + \xi^*(1 - \Delta\mu)]\ (U^H - U^L)$.
19. For the statement of the theorem, see Laffont (1989, p. 64).
20. From (6) and (7), ξ^{**} is given by

$$\xi^{**} = \frac{\left[(1+\lambda)+(1+\lambda-\alpha)\dfrac{\nu}{1-\nu}\dfrac{1-\underline{\mu}}{1-\overline{\overline{\mu}}}\right]\left[\Delta\theta-\Delta\mu\left(U^H-U^L\right)\right]}{\left(U^H-U^L\right)\left[(1+\lambda)-\left[(1+\lambda)+(1+\lambda-\alpha)\dfrac{\nu}{1-\nu}\dfrac{1-\underline{\mu}}{1-\overline{\overline{\mu}}}\right]\Delta\mu\right]}.$$

21. Laffont and Tirole (1993, pp. 123–4) consider information acquisition about the agent's type and find a sufficient condition under which a finer information structure results in an increase in the slope of the optimal incentive scheme.
22. $U^p(\theta)$ was introduced in Section 2: it is determined by the incentive scheme in place in the public sector, whose reform we do not envision.
23. Rama (1999) also mentions that effort levels tend to be lower in the public sector than outside of it while job security is higher. The fact that queuing for public sector jobs is quite general in developing countries also implies that public sector workers obtain utilities higher than their opportunity costs in the private sector (Assaad, 1999).
24. The proof characterizing the optimal mechanism under asymmetric information and under voluntary downsizing is omitted since it is similar to the one for mandatory downsizing in Appendix.
25. Aghion and Blanchard (1994) study how unemployment benefits affect the optimal speed of separating state employees in a dynamic macroeconomic model without political constraint.
26. Actually, enterprise restructuring tends to happen at later stages of transition in most countries (Roland, 2000, p17).
27. Our model can also be adapted to analyze the program for eliminating price supports for farmers (Lewis and Feenstra, 1989).