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Economic Reform and Dynamic Political Constraints

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In this paper, we examine the impact of political constraints on economic reform plans, with special reference to the transition from centrally planned to market economies. We analyse the problem of an agenda-setting reform-minded Government facing a bureaucracy or industrial sector for which allocative efficiency requires redundancies and an increase in work intensity. The Government also tries to minimize the rents conceded to its heterogeneous workforce. We examine two types of political constraints: unanimity rule and majority rule, both in a one-period and a two-period horizon. The main results are the following. First of all, we show how adverse selection and time-consistency may generate the widely-observed feature of *gradualism* as an ingredient of an optimal reform. Second, under a majority rule, it is shown to be possible for the Government to obtain a *majority vote for a reform scheme that intertemporally hurts majority interests*. Indeed, the Government can improve rent extraction through the strategic use of the threat of future proposals: the group which expects to be in the minority tomorrow may accept concessions, while its votes can be used to extract rents from another group. These results suggest that, in a dynamic context, democratic constraints should not be overestimated as an obstacle against efficiency-enhancing economic reforms. The results of this paper may throw some light on the political economy of current reforms in Eastern Europe.

1. INTRODUCTION

Governments, and political decision-makers in general, always face political constraints when elaborating reform proposals. They know that the need to overcome potential opposition from various groups of the population constrains proposals for change. Political constraints vary, depending on the specific institutional structure of society, and are clearly different under a military dictatorship than under a parliamentary democracy. The role of political constraints seems particularly important in Eastern Europe today, where new democratic governments face the huge task of achieving the transition to a market economy. While the introduction of democracy may have removed some important obstacles to economic change (namely, the veto-power of a powerful nomenclatura under communist one-party rule), fears are expressed that it could potentially jeopardize economic reforms which may, during the transition period, hurt a majority of the population.[1]

What can economic theory tell us about optimal economic reform under political constraints? This paper starts addressing this ambitious question by looking at structural reform, focusing on a *restructuring* of economic sectors which requires massive redundancies and a significant rise in labour productivity. Our model illustrates the case of planning

1. See Roland (1991) on the role of numerous hidden rents enjoyed by large portions of the population, especially in industrial sectors, as a source of resistance to change, and on their implications for devising sequencing tactics during the transition process.

bureaucracies in the East, or old obsolescent industries faced with international competition both in the East and the West. When designing politically acceptable structural reforms, Governments are typically faced with a tradeoff between the *budgetary cost* of the reform and its degree of *allocative efficiency*: massive redundancies might yield rapid efficiency gains, but at a great budgetary cost, whereas gradual plans for restructuring involve less in terms of compensation payments, but imply a slower move towards allocative efficiency. When the workforce is heterogeneous, it is moreover optimal, from both points of view, to try to induce the exit of workers with the best relative outside opportunities: inducing them to leave will be both less expensive and more productive.

Section 2 presents our model, which uses the dynamic adverse selection paradigm (see, for example, Caillaud *et al.* (1988), to analyse the problem of a Government faced with this heterogeneous workforce. We model the Government as the *agenda-setter* (in the Romer and Rosenthal (1979) sense) who holds the initiative for offering reform plans, possibly at several points in time. Any plan can be implemented provided it receives political approval. We distinguish two levels of political constraints: *unanimity* or *majority*, among workers inside the sector at the time the reform plan is proposed. Sections 3 to 6 examine these two rules in turn, first in a static, one-offer, case and then in a dynamic, two-offer, case.

Our first insight concerns *gradualism.* In a static problem, limiting redundancies in comparison to the allocative optimum may be profitable for the Government: exit fees can be lower, because only workers with the highest relative outside opportunities must be compensated. When such a "partial" reform is the static optimum, the dynamic case will exhibit gradualism, because it becomes sequentially optimal for the Government to keep shrinking the workforce, through a new reform plan, once the first reform has been enforced. While this insight is not theoretically new (see, for example, the literature on bargaining, ratcheting or contract renegotiation under adverse selection), it illustrates how dynamic adverse selection may yield gradualism as an optimal reform path.

Our main new theoretical insight concerns the role of dynamics under majority rule. We show that, in the absence of pre-commitment, the Government may end up with a *higher payoff* than by committing itself to a single offer. The possibility of proposing new reforms tomorrow allows the Government to "play the minority of tomorrow against the minority of today" and get a 66% approval for a reform lowering the payoff of 66% of the working population of the sector in comparison to the initial status quo. Indeed, workers who expect to be in the minority of losers in the future, when a reform will be proposed after a rejection of today's proposal, are prepared to make *concessions* from the initial status quo in order to avoid this outcome. These concessions can be used by the Government to put another group of workers in the minority and to lower the cost of reform even more. We therefore have a case where repeated offers can improve rent extraction, compared to the one-offer case.

It is interesting to compare this result with the traditional results of the literature on bargaining or contracting theory under adverse selection. From that literature, we know that, under a stationary environment, it is optimal for the uninformed party to *commit* to a *single take-it-or-leave-it offer* for the entire time-horizon. Not being able to commit to a single offer only lowers the payoff of this party (see for example Gul, Sonnenschein and Wilson (1986) and Hart and Tirole (1988) for the case of a durable-good monopoly, Dewatripont (1989) for labour contract renegotiation or Laffont and Tirole (1988, 1990) on ratcheting and renegotiation in procurement). The same effect is found in our model when the Government needs *unanimity* to implement its reform. Intuitively, under such a decision, the workers' expectations of future reforms only make it harder to convince them to vote for early reforms, because they know they can only gain from unanimously approved reforms in the future. Contrary to the above-mentioned bargaining and contracting literatures, a key ingredient for our result under majority rule is that participation or political approval constraints are *endogenously altered* over time, rather than being *exogenously given.*

The use of repeated proposals by the Government to improve its own payoff has been analysed in general voting problems with myopic voters by McKelvey (1976), and has been extended, in a more specific context, by Rosenthal (1989) to the case of rational voters facing a budget-maximizing Government. In this respect, our results complement Rosenthal's approach by allowing for *endogenous changes* in the voting population, since we assume that workers who leave today do not vote on tomorrow's proposals. Such endogenously-shifting voting populations have been considered by Roberts (1989). He analyses, in an infinite-horizon framework, the problem of a union whose workers can vote to move along an exogenously given wage-employment schedule. His main focus however, is different from ours, since he concentrates on "unraveling" seniority-based layoff decisions and on hysteresis behaviour in the face of business cycle shocks.

From the point of view of economic reform, our approach illustrates how political constraints may be weakened through dynamic agenda control. The resulting lesson is that the explicit majority rule introduced in democratic reforms may in some cases allow a reform-minded Government to obtain a majority vote for measures hurting majority interests in comparison to the status quo, by credibly threatening to shift majorities in the future.

This paper is only a first step in the analysis of the political economy of economic reform. After briefly summarizing our results, Section 7 discusses directions for research.

2. THE MODEL

In this paper, we present a simple model of structural adjustment in an economy in transition. We concentrate on the case of *a sector which must be made smaller*, either because of decreased protection from international competition or because the function fulfilled by this sector has become less important in the emerging economic system (e.g. the planning bureaucracy). Typically, such a structural adjustment requires (i) *raising productivity*, and (ii) retaining in the sector workers whose *comparative advantage* is not to leave. For example, workers may differ in their valuation of leisure, or in their desire to adapt to the new organizational mode implied by the higher productivity requirement. Such individual attributes are however private information, so that the reform-minded Government will have to induce workers to reveal them through monetary incentives.

For the sake of simplicity, we assume the initial working population in the sector to be composed of *three groups*, each of unit mass, of identical and infinitesimally small workers,[2] who will differ in their disutility of work. Three groups of workers is the smallest number allowing one to meaningfully talk about endogenous majorities in favour of or against reform plans.

Again for simplicity, we assume *productivity* to be *common* to all workers in the sector, and to be a *choice variable* for the Government. It is denoted by e and can take two values: $e=1$ (low productivity), and $e=2$ (high productivity). Specifically, prior to the reform, all three groups of workers are in the sector, each producing group output $q(1)$. It is an option for the Government to reorganize production so that each worker

2. Assuming a continuum of workers simplifies the analysis because *individual* worker actions will not reveal any information to the Government.

in the sector produces $q(2) > q(1)$. Such a reorganization is assumed to be technologically irreversible. Moreover, there is no shirking by workers in this model as productivity is fully determined by technology.

By normalization, each worker's outside opportunity is zero. When working in the sector, a worker's utility is his wage minus e times his unit disutility of effort if required productivity is $q(e)$. Workers are defined by unit disutilities of effort, which can take three values, $\underline{x} < x < \bar{x}$. We shall thus talk about the $\underline{x}$ group, the x group and the $\bar{x}$ group of workers, and we shall equivalently talk about the Government setting productivity or effort targets. The initial situation in the sector is thus one where all three groups work at $e = 1$, and for a wage $w > \bar{x}$. Respective utility levels are thus $(w - \bar{x})$, $(w - x)$ and $(w - \underline{x})$.

We assume the following *institutional rules*:

(a) The Government is the *agenda-setter*. It is thus free to make any reform proposals.
(b) Workers only have the right to give their opinion on reform proposals, but the Government needs the approval of an *exogenously given* percentage of workers to implement the reform.
(c) The objective of the Government is the same as in the *regulation framework*, that is, maximization of net allocative surplus (output minus disutility of effort) minus the distortionary cost of monetary payments to workers remaining or leaving the sector (since these are implicitly financed by taxation). We call λ this cost per unit of monetary payments.[3]

In the initial situation, the value of the Government's objective function is thus:

$$3q(1) - (\underline{x} + x + \bar{x}) - \lambda 3w.$$

In order to simplify the analysis, we do not take a general equilibrium viewpoint in which the Government is endogenous, or where individuals can vote on the agenda-setting procedure or the precise majority rule needed to implement reforms. This allows us to avoid the usual indeterminacies in voting problems. Moreover, it makes sense given that our focus is *sectoral* instead of *macroeconomic*, since the group of workers under analysis forms only a minority of the working population. It is thus reasonable to assume that these workers face a given set of institutional rules, even though they are strong enough for the Government to have to take their opinion into account. The necessity of approval of a given percentage of these workers could be seen either as an explicit institutional rule or as a way to model worker bargaining power. Finally, the Government's objective function is utilitarian, and thus takes into account distortions induced by taxation. When these distortions can be reduced, all individuals typically share the benefits. Since workers inside the sector under analysis make up only a small fraction of the population, they can reasonably ignore this feedback on their standard of living.

We can now define allocative efficiency. We assume:

$$(1+\lambda)x \geqq q(1) \geqq q(2) - q(1) \geqq (1+\lambda)\underline{x}. \tag{1}$$

Under (1), allocative efficiency is achieved when only the $\underline{x}$ group remains in the sector and individuals are asked to produce $q(2)$. Indeed, consider for example raising productivity from $q(1)$ to $q(2)$ for the $\underline{x}$ group. In order to compensate them for the increased effort, their wage would have to rise by $\underline{x}$, with a distortionary cost of $\lambda\underline{x}$. This total cost of $(1+\lambda)$ $\underline{x}$ is however lower than the additional output $q(2) - q(1)$. By similar

3. One could also multiply output by $(1+\lambda)$ if it saves taxes, but not if it is a non-marketable public good. This is simply a question of normalization in any case.

arguments, one can see that it is better for the x and $\bar{x}$ group to leave the sector rather than to produce $q(1)$ or $q(2)$.

In a static (one-period) framework, given informational constraints (the distribution of worker types is common knowledge, individual types are private information), a reform scheme is a triple (w_1, e_1, b_1) specifying a wage and a productivity level in the sector as well as an exit bonus. Workers choose between (w_1, e_1) and b_1 if this reform is accepted. Otherwise, they keep working at $e=1$ and wage w, which is the status quo.[4] In a two-period framework, a reform scheme in the first period is a sextuple $(w_1, e_1, b_1, w_2, e_2, b_2)$, where b_t is the exit bonus received when leaving at t. Similarly, a second-period reform scheme is a triple (w_2', e_2', b_2'). In case of rejection at $t=2$, (w_2, e_2, b_2) is executed if the initial reform was accepted, otherwise the initial status quo prevails.

As political constraints will oblige the Government to compensate potential losers, allocative efficiency may only be attainable at high costs. Moreover, as the three types of workers are indistinguishable, the compensation schemes offered must be incentive compatible. As a consequence, second-best solutions will not necessarily imply full reform, with groups x and $\bar{x}$ ousted from production. Other reform schemes may be, on the whole, more attractive.

We assume voting to be costless. Given that, under less-than-unanimity rule, an individual vote has no impact on the outcome, there are of course two equilibrium outcomes to each voting game: acceptance and rejection. We however disregard coordination failures, by assuming that voters play *weakly dominant strategies* when voting: even though individual voters are small, they are assumed to vote according to their best interest. We furthermore assume this to happen in a *time-consistent* way, that is individuals cannot "threaten" to deviate from weakly dominant strategies in the future in order to obtain better deals from the Government.

In the following sections, we analyse in turn the unanimity and majority cases, each time in a one-period and a two-period framework. Both unanimity and majority rules seem to be relevant ways of looking at political constraints, and the comparison of outcomes under the former and the latter allows to show the effect of the relaxation of political constraints on allocative outcomes. Unanimity might seem less relevant than majority for understanding the effects of political constraints. However, not only is unanimity required in many institutional contexts, but one might also view it as a way to model consensual decision-making, whereas majority rule can be seen as a way to examine more conflictual contexts. The degree of consensus or conflict in society, that is, the degree of polarization, plays an important part in recent advances in political economy, especially in a macroeconomic framework, in the context of public debt decisions (Alesina and Tabellini (1990)) or delays in stabilization programmes (Alesina and Drazen (1991)).

3. STATIC FRAMEWORK, UNANIMITY RULE

In this one-period problem, the Government's reform proposal (w_1, e_1, b_1) must leave everybody as well off as in the status quo in order to be accepted. Under such a unanimity rule, two types of reforms could be optimal:

Full Reform (F):

$$w_1 = w + \underline{x},\ e_1 = 2,\ b_1 = w - x.$$

4. In the status quo, workers prefer $(w, e=1)$ to leaving with a zero bonus.

Partial Reform (P): Two possible cases can be considered:

$$w_1 = w, \qquad e_1 = 1, \qquad b_1 = w - \bar{x},$$

$$w_1 = w + x, \qquad e_1 = 2, \qquad b_1 = w - \bar{x}.$$

Note that these reforms involve wage and bonus payments which are minimized subject to the incentive and full compensation constraints. A *full reform* involves keeping only $\underline{x}$ in the sector. From (1), we know that raising their effort to 2 while raising their wage by $\underline{x}$ to compensate them is efficient. Inducing exit by x and $\bar{x}$ while compensating all of them requires $b_1 \geqq w - x$. This leaves x as well off as in the status quo, while giving $\bar{x}$ (which are indistinguishable from x) an extra rent of $(\bar{x} - x)$ in comparison to the status quo. One can check that all incentive constraints are strictly satisfied with this reform plan. The value of the Government's objective function, $V(F)$, will be:

$$V(F) = (q(2) - 2\underline{x}) - \lambda(w + \underline{x} + 2(w - x)).$$

A *partial reform* involves keeping $\underline{x}$ and x in the sector, in which case $e_1 = 1$ or $e_1 = 2$ can be optimal since, by (1), $(1+\lambda)x > q(2) - q(1) > (1+\lambda)\underline{x}$. A partial reform implies an allocative cost in comparison to a full reform, but allows b_1 to drop to $w - \bar{x}$, since only $\bar{x}$ must be compensated. The advantage of a partial reform is thus that no group of workers gains any rent in comparison to the status quo. Once again, all incentive constraints are satisfied, and the value of the Government's objective function, $V(P)$, is:

$$V(P) = \text{Max}\,\{2q(1) - \underline{x} - x - \lambda(3w - \bar{x});\, 2q(2) - 2\underline{x} - 2x - \lambda(3w - \bar{x} + 2x)\}.$$

Note that we concentrate here on reforms in which individuals make *deterministic* choices. More general reforms could involve individuals being offered *lotteries.* For example, under partial reform with $e_1 = 2$, there is too much inefficiency relative to what is required by incentive compatibility to have x stay: the x group could be offered a lottery of either ($e_1 = 2$, $w_1 = w + x$) or ($e_1 = 0$, $b_1 = w - x$) where, provided the probability of the first option is high enough, the $\bar{x}$ group will not be induced to prefer this lottery to a bonus of $w - \bar{x}$. Note also that under full reform and partial reform with $e_1 = 1$, there is no room for such an improvement, because the incentive compatibility (IC) and full compensation constraints are already binding.

Beyond the aspect of realism, our focus on deterministic reforms is made for simplicity, and is justified by the fact that the insights developed below are robust to generalizations to random reforms (see our discussion in Section 4 and footnote 13 in Section 6).

Reforms P and F are thus the optimal deterministic reforms. Note that one can check that P dominates the status quo (which yields a Government payoff of 3 $q(1) - (\underline{x} + x + \bar{x}) - 3\lambda w$): one does better than the status quo by inducing $\bar{x}$ to exit with a bonus of $w - \bar{x}$. Reforms P and F also dominate reforms where *identical* individuals make *different deterministic* choices in terms of exiting or not. Indeed, given the linearity of our technology, such reforms are not optimal.

Proposition 1 compares P and F:

Proposition 1. *Under* (1), *when x tends to $\underline{x}$, partial reform dominates full reform, and the opposite is true when x tends to $\bar{x}$.*

Proof.

$$V(P)-V(F)=\text{Max}\,\{(q(2)-2(1+\lambda)x)+\lambda(\bar{x}+\underline{x}-2x);\\ (q(1)-(1+\lambda)x)-(q(2)-q(1)-(1+\lambda)\underline{x})+\lambda(\bar{x}-x)\}.$$

In both expressions, the last term is the difference in rents conceded to the various groups, while the other terms reflect the allocative loss of P versus F (which is positive by (1), which implies $q(2)<2(1+\lambda)x$, $q(1)<(1+\lambda)x$ and $q(2)-q(1)>(1+\lambda)\underline{x}$). When x tends to $\bar{x}$, the difference in rents also becomes favourable to $F(\bar{x}+\underline{x}-2x<0$ then, while $\bar{x}-x\to 0)$, which dominates. When x tends to $\underline{x}$ instead, having $e_1=2$ for $\underline{x}$ and x is almost allocatively optimal $(q(2)\to 2(1+\lambda)x)$, and P dominates through better rent extraction $(\bar{x}+\underline{x}-2x>0)$. ||

The intuition underlying Proposition 1 follows standard adverse selection arguments (see Caillaud *et al.* (1988)). The problem of full as well as partial reform here is that compensation of x allows $\bar{x}$ to grab extra rents. When x is induced to leave, it must receive $w-x$ as bonus, so that $\bar{x}$ gains $\bar{x}-x$ in comparison to the status quo. One way to reduce the rents enjoyed by $\bar{x}$ is to have allocative inefficiency for x; that is, keep them working. This involves an allocative cost which has to be balanced against the rents enjoyed by $\bar{x}$, which go to zero under partial reform. Partial reform tends to dominate when x tends to $\underline{x}$: the allocative cost becomes small, while the rent extraction gain $(\bar{x}-x)$ becomes large. Otherwise, full reform will tend to dominate. For example, if one assumes

$$2(q(2)-q(1))<\underline{x}+x+2\lambda x, \tag{2}$$

then $e_1=1$ is optimal under partial reform. In this case, $V(P)-V(F)=2q(1)-q(2)-(x-\underline{x})+\lambda(\bar{x}+\underline{x}-2x)$, so that P dominates iff

$$x<\tfrac{1}{2}(\underline{x}+\bar{x})-\frac{1}{2\lambda}(q(2)-2q(1)+(x-\underline{x})). \tag{3}$$

This condition reveals that partial reform is better than full reform if x is smaller than half the distance between $\underline{x}$ and $\bar{x}$ minus a fraction of the allocative surplus of having only $\underline{x}$ working at $e_1=2$ instead of having $\underline{x}$ and x working at $e_1=1$.

4. UNANIMITY RULE IN A TWO-PERIOD PROBLEM WITHOUT COMMITMENT

The previous section stressed the possibility of the optimality of a partial reform over a full reform when its ability to do better in terms of rent extraction more than compensates its poorer performance in terms of allocative efficiency. In a two-period problem without commitment, partial reforms will become ***gradual reforms***: once the $\bar{x}$ group is induced to leave in period 1, it becomes optimal in period 2 to induce the x group to leave, with a bonus $b_2=w-x$. Such gradualism will of course be anticipated by $\bar{x}$, who will exit in period 1 only if their bonus leaves them better off than by exiting in period 2.

The idea that, in a dynamic context without commitment, partial reforms will give way to gradual ones is a familiar idea from sequential bargaining under incomplete information (see for example Gul *et al.* (1986)) or from contract theory, both in the case of short-term contracts and ratcheting (see Laffont and Tirole (1988*a*)) or long-term contracts with renegotiation (see Dewatripont (1989), Hart and Tirole (1988) and Laffont and Tirole (1988*b*)). In all these cases, information revealed in early stages of the game (acceptance of bargaining offers, or execution of contracts) reveals information about the type of the privately informed party, and opens the way for further moves toward allocative efficiency.

The same is true here, where decisions to remain in the sector in period 1 reveal information about worker types, and allow the Government to complete the initial partial reform. Having a unanimity rule means that the problem is similar to the two-party long-run contracting problem with voluntary renegotiation. This paper is the first, to our knowledge, to apply these concepts to the study of problems of economic reform.[5]

We now want to characterize the optimal Perfect-Bayesian equilibrium (PBE) from the point of view of the Government. The Government will offer reform $(w_1, e_1, b_1, w_2, e_2, b_2)$ in period 1, and can offer reform (w_2', e_2', b_2') in period 2. Let us call $(\tilde{w}_2, \tilde{e}_2, \tilde{b}_2)$ the resulting period-2 outcome, which will be correctly anticipated in equilibrium. In case the initial plan is rejected, the status quo prevails in period 1, and it is in the interest of all workers to stay in the sector. In period 2, $(\tilde{w}_2, \tilde{e}_2, \tilde{b}_2)$ is then accepted as detailed in Proposition 1, since the environment is stationary. In order to have an initial proposal accepted, the Government must thus make an offer such that $(w_1, e_1, b_1, \tilde{w}_2, \tilde{e}_2, \tilde{b}_2)$ leaves all workers as well off as under rejection followed by the continuation equilibrium offer the Government will make in period 2.

For simplicity, let us assume condition (2) is satisfied, so that $e_1 = 1$ is optimal under partial reform. Let us consider the following gradual reform:

Gradual Reform (G):

$$w_1 = w, \qquad e_1 = 1, \qquad b_1 = (w - \bar{x}) + (w - x);$$
$$w_2 = w + \underline{x}, \qquad e_2 = 2, \qquad b_2 = w - x.$$

In the first period, the $\bar{x}$ group will leave with bonus b_1. In the second period, the x group will leave with bonus b_2. The wage increases to $w + \underline{x}$ in order to keep the $\underline{x}$ group in the sector. For reasons of incentive compatibility, the first-period bonus must be at least $w - \bar{x} + b_2$. If this were not the case, group $\bar{x}$ would not separate from x in the first period. The objective function of the Government becomes:

$$V(G) = (2q(1) - (\underline{x} + x) - \lambda(2w + (w - \bar{x}) + (w - x)) + (q(2) - 2\underline{x}) - \lambda((w + \underline{x}) + (w - x)).$$

Proposition 2 compares G with full and partial reforms, which simply repeat F and P of Section 3 twice (F becomes $w_1 = w_2 = w + \underline{x}$, $e_1 = e_2 = 2$ and $b_1 = 2\ (w - x)$, while P becomes $w_1 = w_2 = w$, $e_1 = e_2 = 1$ and $b_1 = 2(w - \bar{x})$).

Table I first summarizes workers' net gains from the various reforms over the two periods (with $e = 1$ until the x group has left):

Proposition 2. (i) *If, in the static problem,* $V(F) > V(P)$, *full reform is optimal and can be sustained as unique PBE in the two-period problem without commitment.*

TABLE I

Net gains in comparison to the status quo (maintained over two periods)

Reform	Gains of $\underline{x}$ group	Gains of x group	Gains of $\bar{x}$ group
F	0	0	$2(\bar{x} - x)$
P	0	0	0
G	0	0	$\bar{x} - x$

5. See Dewatripont and Maskin (1990) for applications of contracting and renegotiation under adverse selection.

(ii) *If, in the static problem, $V(P) > V(F)$, partial reform dominates gradual reform which, in turn, dominates full reform. While partial reform cannot be sustained as a PBE, gradual reform can be sustained as unique PBE.*

Proof. See the Appendix. ‖

The intuition underlying Proposition 2 can be described as follows. First, when full reform is optimal in the one-period problem, replicating it twice is the two-period optimum without commitment. It is also a PBE since, once allocative efficiency has been achieved, there is no additional possibility for a Pareto-improving reform. The second part of Proposition 2 concerns a case where the rent extraction problem is important enough for partial reform to dominate full reform in the static problem. In this case, gradual reform, which is an average of full and partial reforms realized over time, dominates a strategy of full reform imposed from the beginning. From the Government's point of view gradual reform is not as good as partial reform maintained over the two periods, but such a reform is not sustainable without exogenous commitment powers. The absence of commitment thus has the same adverse effect as in the voluntary ex-post renegotiation literature. In fact, under a stationary economic environment, it is well-known that a multi-period optimum with commitment is simply the replication of the one-period optimum in each period (see for example Hart and Tirole (1988)). Thus, if no random reform dominates P, replicating P twice would be the optimum with commitment in our problem. The optimum without commitment could still involve some randomness, so that G might not be the overall optimal reform. *Still, when $V(P) > V(F)$ in the static problem, the optimal reform has to be gradual,* in that some x workers do not exit with probability one at $t = 1$. The key to Proposition 2 is that repeating F twice, which is the optimal full reform, is not the best the Government can achieve when $V(P) > V(F)$.

The result of Proposition 2 could be extended to a stationary infinite-horizon problem to generate Coasian dynamics, since we are in the same framework as the durable-good monopoly problem (Gul *et al.* (1986)), Hart and Tirole (1988)[6]). This means that the extent of gradualism, that is, the length of time before allocative efficiency is attained, depends on the frequency with which reform plans can be offered by the Government. Typically, delay between offers will be non-trivial, and so will be the importance of gradualism.

5. STATIC FRAMEWORK AND MAJORITY RULE

We now come back to a one-period problem and relax the Government's political acceptance constraint from unanimity to a majority rule where one group may be hurt. (This Section is in the same spirit as Lewis *et al.* (1990), which we discuss below). With only three groups of identical size, this means any majority rule between 50% and 66%. As mentioned in Section 2, workers are assumed to play weakly dominant strategies when voting (which breaks their indifference when they expect to have no decisive influence on the outcome of the vote).

Moving to majority rule expands the set of potentially optimal reforms as follows:

Full Reforms,

$F_{\underline{x}}$ ($\underline{x}$ *hurt*): $w_1 = w - x + 2\underline{x},\ e_1 = 2,\ b_1 = w - x,$

F_x (x *hurt*): $w_1 = w + \underline{x},\ e_1 = 2,\ b_1 = \max\{w - \bar{x},\ w + \underline{x} - 2x\}.$

6. The unanimity case is equivalent to Hart and Tirole's "rental model with long-term contracts and voluntary renegotiation" which they prove to be equivalent to the usual "sale model" of durable goods.

Partial Reforms,
P (*nobody hurt*): $w_1 = w,\ e_1 = 1,\ b_1 = w - \bar{x}$,
P_x (x *hurt*): $w_1 = \max\{w + \underline{x},\ w - \bar{x} + 2x\},\ e_1 = 2,\ b_1 = w - \bar{x}$,
$P_{\bar{x}}$ ($\bar{x}$ *hurt*): $w_1 = w + x,\ e_1 = 2,\ b_1 = w + x - 2\bar{x}$.

As before, these reforms already involve minimal wage and bonus payments subject to IC and political constraints. *Full reforms* involve keeping only the $\underline{x}$ group in the sector. It is then optimal (by (1)) to set $e_1 = 2$.[7] One option is to hurt this $\underline{x}$ group in comparison to the status quo. This means not hurting the others (and thus $b_1 \geqq w - x$) while setting w_1 just high enough not to induce $\underline{x}$ to exit (and thus $w_1 \geqq 2\underline{x} + b_1$), which yields $F_{\underline{x}}$. Another option is to hurt a group other than $\underline{x}$. Under full reform, it is not possible to hurt $\bar{x}$ without hurting x, so that the only other potential option is F_x. In that case, w_1 protects $\underline{x}(w_1 \geqq w + \underline{x}$, to compensate them for their higher effort), while b_1 is set so as to protect $\bar{x}(b_1 \geqq w - \bar{x})$ and to induce x to exit $(b_1 \geqq w_1 - 2x)$.

Three types of *partial reforms* are possible. One possibility is to keep $\underline{x}$ and x working at $e_1 = 1$. In such a case, no group can be hurt in comparison with the status quo, since we must have $w_1 \geqq w$, and thus, by IC, $b_1 \geqq w - \bar{x}$. This yields P as the optimum, as in Section 3. On the other hand, no group strictly gains in comparison with the status quo, which is not the case under full reform if $b_1 > w - \bar{x}$, or below when $e_1 = 2$ and $w_1 > w + \underline{x}$. Indeed, another possibility is to have a partial reform with $e_1 = 2$. One option is to hurt $\bar{x}$ compared to the status quo. This means not hurting the others (so that $w_1 \geqq w + x$), while setting b_1 just high enough to induce $\bar{x}$ to exit $(b_1 \geqq w_1 - 2\bar{x})$, which yields $P_{\bar{x}}$. Another option is to hurt x or $\underline{x}$. Under partial reform, it is not possible to hurt $\underline{x}$ without hurting x, which leaves P_x as final option: b_1 is set to compensate $\bar{x}$ $(b_1 \geqq w - \bar{x})$, while w_1 is set to compensate $\underline{x}$ $(w_1 \geqq w + \underline{x})$ and to induce x not to exit $(w_1 \geqq w - \bar{x} + 2x)$.

These five reform schemes exhaust the potential *deterministic* optima.[8] Proposition 3 shows that each of them can indeed be the optimal deterministic reform. Define first $\hat{q} = q(1)/(1+\lambda)$ and $\tilde{q} = (q(2) - q(1))/(1+\lambda)$. Condition (1) tells us $\underline{x} < \tilde{q} < \hat{q} < x < \bar{x}$. Proposition 3 considers $\underline{x}$, $\tilde{q}$, $\hat{q}$ and $\bar{x}$ as given and shows the various configurations of optimal reforms when x moves from $\hat{q}$ to $\bar{x}$.

TABLE II

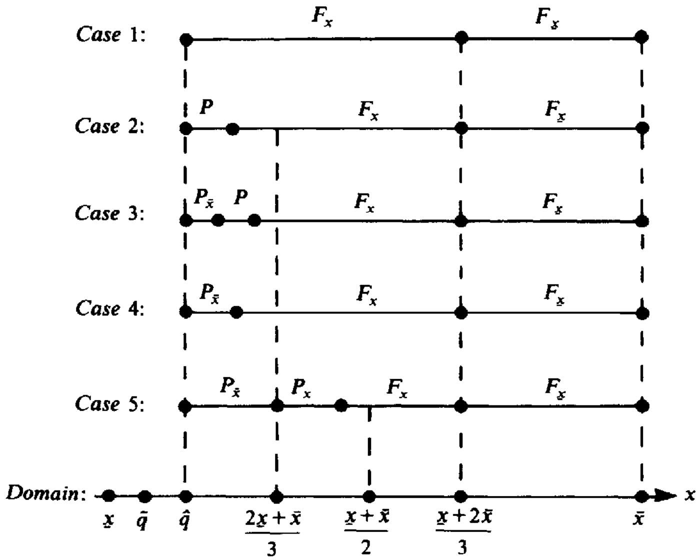
Net gains in comparison to status quo payoffs

Reform	Restriction on parameters	Gains of $\underline{x}$ group	Gains of x group	Gains of $\bar{x}$ group
$F_{\underline{x}}$	—	$-(x - \underline{x})$	0	$\bar{x} - x$
F_x	$2x > \underline{x} + \bar{x}$	0	$-(\bar{x} - x)$	0
F_x	$2x < \underline{x} + \bar{x}$	0	$-(x - \underline{x})$	$(\bar{x} + \underline{x} - 2x)$
P	—	0	0	0
P_x	$2x > \underline{x} + \bar{x}$	$(2x - \underline{x} - \bar{x})$	$-(\bar{x} - x)$	0
P_x	$2x < \underline{x} + \bar{x}$	0	$-(x - \underline{x})$	0
$P_{\bar{x}}$	—	$x - \underline{x}$	0	$-(\bar{x} - x)$

7. This is not only allocatively efficient, but also relaxes IC constraints, since the x group has less incentive to remain in the sector.

8. One can check that keeping all workers in the sector is suboptimal: the two options are $w_1 = w$ and $e_1 = 1$, or $w_1 = w + x$ and $e_1 = 2$, respectively dominated by P and $P_{\bar{x}}$: one can do better than keeping everybody by having $\bar{x}$ leave with $b_1 = w - e_1\bar{x}$. Moreover, as in Section 3, reforms where identical individuals make different *deterministic* choices on exit are also suboptimal, given the linearity of our technology.

***Proposition* 3.** *Under majority rule, depending on parameter values, the possible static optima are given by one of these five cases*:



Proof. See Appendix. ‖

The appendix provides a proof and an extensive discussion of Proposition 3. We concentrate here on the underlying intuition to highlight its main features:

(i) As in Proposition 1, partial reform dominates full reform only if x is close enough to $\underline{x}$ (so that the allocative cost of keeping x working is small) and if λ is not too small. Otherwise, the rent extraction motive becomes unimportant, and we are in fact in Case 1.

(ii) Depending on parameter values, *any two-group majority can emerge at the optimum*. From Proposition 3, it is clear that, for x close to $\underline{x}$, the Government seeks and obtains the approval of the two groups which are most *similar* in terms of disutility of effort. On the other hand, when x is close to $(\underline{x}+\bar{x})/2$, the Government seeks and obtains the approval of the two *extreme* groups, and the x group is hurt.

The intuition for full reforms (F_x *vs.* $F\underline{x}$) and for partial reforms (P_x *vs.* $P_{\bar{x}}$) is very similar. Consider full reforms first. $F_{\underline{x}}$ hurts $\underline{x}$ by setting $b_1 = w - x$ and $w_1 = w - x + 2\underline{x}$, so that x are as well off as in the status quo, $\bar{x}$ gain $(\bar{x} - x)$, and $\underline{x}$ lose $(x - \underline{x})$.[9] In contrast, F_x sets $w_1 = w + \underline{x}$ and $b_1 = w - \bar{x}$.[10] Now $\underline{x}$ and $\bar{x}$ are as well off as in the status quo, while x lose $(\bar{x} - x)$. Comparing with $F_{\underline{x}}$, the $\underline{x}$ group gains $(x - \underline{x})$, while the *two other groups* lose $(\bar{x} - x)$. Hurting x thus has the additional advantage for the Government to extract more rents from $\bar{x}$, since it involves lowering b_1 which two groups end up choosing. The two full reforms only differ in terms of rent extraction, by an amount equal to

9. See Table II for a summary of the net gains of the various reforms for the three groups of workers.
10. For $2x > \underline{x} + \bar{x}$, the case on which we concentrate for the sake of intuition.

$(x-\underline{x})-2(\bar{x}-x)$, which means that they are equivalent at $3x=\underline{x}+2\bar{x}$. For x larger than that value, taking away $(x-\underline{x})$ from $\underline{x}$ becomes so important that $F_{\underline{x}}$ dominates, while, in the opposite case, F_x dominates[11].

The same argument is valid, mutatis mutandis, for partial reforms, where $P_{\bar{x}}$ sets $w_1=w+x$ and $b_1=w+x-2\bar{x}$, while P_x sets $b_1=w-\bar{x}$ and $w_1=w+\underline{x}$[12] (which is lower by $(x-\underline{x})$ in comparison to $P_{\bar{x}}$: the x group is hurt but the extra rents enjoyed by $\underline{x}$ in comparison to the status quo have also disappeared). These two partial reforms only differ in terms of rent extraction, by an amount $(\bar{x}-x)-2(x-\underline{x})$. For x lower than $(2\underline{x}+\bar{x})/3$, taking away $(\bar{x}-x)$ from $\bar{x}$ under $P_{\bar{x}}$ dominates, while in the opposite case P_x dominates.

(iii) Finally, the Government may find it optimal to propose a *partial reform which hurts no one* in comparison to the status quo (P). Indeed, the only way to hurt a single group under partial reform is to set $e_1=2$. Otherwise, if two groups keep working at $e_1=1$ and at least one must be compensated, one must have $w_1 \geqq w$. But this means that exiting workers cannot be hurt either. Such a partial reform P becomes attractive when setting $e_1=2$ under partial reform is too expensive (because $q(2)-q(1)$ is too low) and when x is not too high (then, full reform involves a limited allocative gain in comparison to P, and gives extra rents to $\bar{x}$ in comparison to P, because b_1 is then above $w-\bar{x}$).

While these are the three main insights of Proposition 3, the appendix details the reasons for the exact configurations of possible optima. In our view, the most interesting results of Proposition 3 lies in (ii) above, which explains the tradeoffs behind the various majority choices by the Government. These results have a similar flavour as those of Lewis, Feenstra and Ware (1990), who consider a static problem of optimal agricultural reform starting from a status quo of output subsidization. Their framework is more complex than ours, with a uniform distribution of worker types and individualized output levels. They show that the type of majority the Government seeks depends on the nature of worker heterogeneity. When they differ mainly in productivity *within* the sector, the Government finds it profitable to seek the support of the less productive workers. Conversely, when they differ mainly in terms of *outside* opportunities, the more productive workers make up the majority. Finally, when both sources of heterogeneity are important, majorities of "extremes" may emerge. While various assumptions distinguish the two models, our simplified three-group framework makes the tradeoffs behind the various majority choices quite transparent. Moreover, it allows us to extend the analysis to a dynamic framework, which is the purpose of Section 6.

6. MAJORITY RULE WITH TWO PERIODS AND NO COMMITMENT

As in Section 4, we now extend the static framework of the previous Section to a two-period problem without commitment. We keep the assumption of a majority rule between 50 and 66%. Under partial reform, with only two groups of identical size as the second-period voting population, we break potential ties by requiring a majority rule *strictly* above 50%. As in Section 4, workers compare the initial reform plan with the status quo followed by a second-period reform proposal, which is described in Section 5. As explained in

11. For $3x<\underline{x}+2\bar{x}$, F_x dominates $F_{\underline{x}}$. Moreover, for $2x<\underline{x}+\bar{x}$, $b_1>w-\bar{x}$ in F_x (otherwise, with $w_1 \geqq w+\underline{x}$, the x group would have no incentive to exit).

12. For $2x<\underline{x}+\bar{x}$, which is the relevant case of comparison, because only then can partial reforms dominate (see Proposition 3).

Section 2, we assume that workers play time-consistent weakly dominant strategies when voting.

The main insight of this Section can be explained in relation to Section 4 which required unanimity for the implementation of a reform plan. In that case, having two proposals instead of one could only hurt the Government: it made it harder to convince voters to support the initial proposal, because they could only gain in comparison to the status quo in the case where initial rejection was followed by a new proposal. Under majority rule, this is no longer the case: some voters expect to lose in comparison to the status quo if the initial reform is rejected. It is then possible for the Government to include this second-period minority in its first-period majority, and use it to hurt another group of workers who become the first-period minority. This Section details the cases where such a strategy is profitable, and whether and when it allows the Government to achieve a payoff in the two-offer case without commitment which is higher than in the one-offer case.

As in Section 4, we seek to characterize the optimal PBE for the Government. We still denote by $(w_1, e_1, b_1, w_2, e_2, b_2)$ and (w_2', e_2', b_2') the period-one and period-two reform proposals, and $(\tilde{w}_2, \tilde{e}_2, \tilde{b}_2)$ the (correctly predicted) continuation equilibrium in period two. For simplicity, we assume parameter values which yield Case 4 of Proposition 3,[13] that is, $P_{\bar{x}}$, F_x and $F_{\underline{x}}$ are the only possible static optima. This leaves us with a set of reforms which is rich enough, both from the point of view of allocation of labour and of political majorities. We successively consider the cases where the static optimum involves full reform and partial reform.

Full reform as static optimum

In this case, the static optimum is thus $F_{\underline{x}}$ if $3x > 2\bar{x} + \underline{x}$ and F_x if $3x < 2\bar{x} + \underline{x}$. We define F_{ij} as a cost-minimizing first-period reform proposal which (i) *is made under the threat of F_j in period two (with $j \in \{\underline{x}, x\}$) in case of rejection*; (ii) *hurts group i (with $i \in \{\underline{x}, x, \bar{x}\}$) in comparison to rejection followed by F_j*; *and* (iii) *seeks allocative efficiency from period one on.*

When F_x is the static optimum, we shall be particularly interested in comparing F_{xx} with $F_{\underline{x}x}$. Similarly, when $F_{\underline{x}}$ is the static optimum, we shall compare $F_{\underline{x}\underline{x}}$ with $F_{x\underline{x}}$. The reason for such comparisons is that the above reforms will turn out to include the optimal ones. All the above reforms involve the same allocation of labour ($e_1 = e_2 = 2$, with x and $\bar{x}$ exiting at $t = 1$). They thus differ only in terms of their total monetary payments to workers, which we call M_{ij} for reform F_{ij}.

First, concerning $F_{\underline{x}\underline{x}}$ and F_{xx}, the best one can hope for is to replicate $F_{\underline{x}}$ and F_x twice, that is:

$$M_{\underline{x}\underline{x}} = 4(w - x) + 2(w - x + 2\underline{x});$$

$$M_{xx} = 4(w - \bar{x}) + 2(w + \underline{x}) \quad \text{for } 2x \geqq \underline{x} + \bar{x},$$

or

$$= 4(w + \underline{x} - 2x) + 2(w + \underline{x}), \qquad 2x \leqq \underline{x} + \bar{x}.$$

When the static optimum is F_i, then F_{ii} is politically viable, since it simply doubles the gains and losses of F_i. Since only one group loses, it will be the only one opposing F_{ii}

13. For example, we exclude P by assuming $2\,(q(2) - q(1)) \geqq (1 + \lambda)(\underline{x} + x)$ (see Lemma 4 in the Appendix) and P_x by assuming $\varepsilon < 0$ at $3x = 2\underline{x} + \bar{x}$ (see Proposition A.2 in the Appendix).

in period one. And since only one group strictly gains in F_i in comparison to the status quo, replicating F_i twice is the best one can do in F_{ii} (IC and political constraints remain binding, as in F_i).

When the static optimum is $F_{\underline{x}}$, one can also compute $F_{x\underline{x}}$, which protects $\underline{x}$ and $\bar{x}$ in comparison to rejection followed by $F_{\underline{x}}$. In $F_{\underline{x}}$, the $\bar{x}$ group gains $(\bar{x}-x)$ and the $\underline{x}$ group loses $(x-\underline{x})$ in comparison to the status quo (since $b_1 = w-x$ and $w_1 = w-x+2\underline{x}$). In $F_{x\underline{x}}$, we must thus have:

$$b_1 \geqq 2(w-\bar{x})+(\bar{x}-x) = 2(w-x)-(\bar{x}-x),$$
$$w_1+w_2 \geqq 2(w+\underline{x})-(x-\underline{x}) = 2(w-x+2\underline{x})+(x-\underline{x});$$

so that:

$$\begin{aligned} M_{x\underline{x}} &= 2b_1+w_1+w_2, \\ &= 2(2(w-x)-(\bar{x}-x))+2(w-x+2\underline{x})+(x-\underline{x}). \end{aligned}$$

One thus sees that b_1 gives the $\bar{x}$ group its status quo payoff plus $(\bar{x}-x)$, as in $F_{\underline{x}}$, and w_1+w_2 gives the $\underline{x}$ group its status quo payoff minus $(x-\underline{x})$, as in $F_{\underline{x}}$ (the wage is raised to compensate for higher effort in both periods in comparison to the status quo). On the other hand, the overall loss of the x group is of $(\bar{x}-x)$ in comparison to the status quo, and thus also in comparison to $F_{\underline{x}}$.

Similarly, when F_x is the static optimum, $F_{\underline{x}x}$ only protects x and $\bar{x}$ in comparison to rejection followed by F_x. For $2x \geqq \underline{x}+\bar{x}$, we have an exit bonus of $w-\bar{x}$ and a wage of $w+\underline{x}$ in F_x. The x group thus loses $\bar{x}-x$ in comparison to the status quo, while the $\bar{x}$ group receives its status quo payoff. In $F_{\underline{x}x}$, we must thus have:

$$b_1 \geqq (w-x)+(w-\bar{x}).$$

On the other hand, since $F_{\underline{x}x}$ does not seek to gain the votes of the $\underline{x}$ group, w_1+w_2 is simply set at the minimum level which keeps them from exiting:

$$w_1+w_2 \geqq b_1+4\underline{x}.$$

This gives us:

$$\begin{aligned} M_{\underline{x}x} &= 2b_1+w_1+w_2, \\ &= 2(w-x+w-\bar{x})+(w-x+w-\bar{x}+4\underline{x}) \quad \text{for } 2x \geqq \underline{x}+\bar{x}. \end{aligned}$$

When $2w \leqq \underline{x}+\bar{x}$, the only change in F_x is that the exit bonus becomes $w+\underline{x}-2x$, and one can derive:

$$M_{\underline{x}x} = 2(2(w-x)+(\underline{x}-x))+(2(w-x)+(\underline{x}-x)+4\underline{x}) \quad \text{for } 2x \leqq \underline{x}+\bar{x}.$$

Table III summarizes workers' net gains of the various reforms *over the two periods.* Proposition 4 now compares the four F_{ij}'s detailed above:

Proposition 4. *Assume that, in the one-offer case, full reform is optimal. Then, for* $3x \geqq 2\bar{x}+\underline{x}$, $F_{\underline{x}\underline{x}}$ *can be supported as a unique PBE and dominates* $F_{x\underline{x}}$. *But, for* $3x \leqq 2\bar{x}+\underline{x}$, $F_{\underline{x}x}$ *can be supported as a unique PBE and dominates* F_{xx}.

Proof. Let us first compare the various F_{ij}'s, i.e. the various M_{ij}'s, the only elements by which they differ. For $3x \geqq 2\bar{x}+\underline{x}$, the choice is between $F_{\underline{x}\underline{x}}$ and $F_{x\underline{x}}$, and one can check that $M_{\underline{x}\underline{x}} - M_{x\underline{x}} = 2(\bar{x}-x)-(x-\underline{x}) \leqq 0$. For $3x \leqq 2\bar{x}+\underline{x}$, the choice is between F_{xx} and $F_{\underline{x}x}$. When $2x \geqq \underline{x}+\bar{x}$, $M_{\underline{x}x} - M_{xx} = 2\underline{x}+\bar{x}-3x < 0$, and, when $2x \leqq \underline{x}+\bar{x}$, $M_{\underline{x}x} - M_{xx} = \underline{x}-x < 0$. Thus, $F_{\underline{x}\underline{x}}$ dominates $F_{x\underline{x}}$ for $3x \geqq 2\bar{x}+\underline{x}$, and $F_{\underline{x}x}$ dominates F_{xx} for $3x \leqq 2\bar{x}+\underline{x}$.

TABLE III

Net gains in comparison to the status quo (maintained over two periods)

Reform	Restriction on parameters	Gains of $\underline{x}$ group	Gains of x group	Gains of $\bar{x}$ group
$F\underline{x}\underline{x}$	$3x > \underline{x} + 2\bar{x}$	$-2(x-\underline{x})$	0	$2(\bar{x}-x)$
$Fx\underline{x}$	$3x > \underline{x} + 2\bar{x}$	$-(x-\underline{x})$	$-(\bar{x}-x)$	$(\bar{x}-x)$
Fxx	$\frac{\underline{x}+\bar{x}}{2} < x < \frac{\underline{x}+2\bar{x}}{3}$	0	$-2(\bar{x}-x)$	0
$F\underline{x}x$	$\frac{\underline{x}+\bar{x}}{2} < x < \frac{\underline{x}+2\bar{x}}{3}$	$-(\bar{x}+x-2\underline{x})$	$-(\bar{x}-x)$	$(\bar{x}-x)$
Fxx	$2x < \underline{x} + \bar{x}$	0	$-2(x-\underline{x})$	$2(\bar{x}+\underline{x}-2x)$
$F\underline{x}x$	$2x < \underline{x} + \bar{x}$	$-3(x-\underline{x})$	$-(x-\underline{x})$	$2\bar{x}+\underline{x}-3x$

Can $F_{\underline{x}\underline{x}}$ be supported as a PBE in the first case? The offer by the Government can for example involve $w_1 = w_2 = w - x + 2\underline{x}$, $b_1 = 2(w-x)$ and $b_2 = 0$. If only $\underline{x}$ remain in the sector, $\tilde{w}_2 = w_2$ (there is no way to offend anyone because everybody is identical; the efficient (e_2, w_2) will thus be executed as such), and an individual from group x or $\bar{x}$ cannot make any difference on the next-period vote by staying in the sector. Taking b_1 is thus better than (w_2, b_2) for x and $\bar{x}$. As for $F_{\underline{x}x}$, the same discussion remains valid, for example with $w_1 = w_2 = w - x + 2\underline{x} + (x - \underline{x})/2$.

It remains to establish that $F_{\underline{x}\underline{x}}$ and $F_{\underline{x}x}$ can be supported as *unique* PBE's. The above-mentioned arguments showed that no *single* individual found it in its interest to deviate. But could *groups* of individuals gain by coordinating on another behaviour after acceptance of the first-period reform? The answer is no, provided b_1 is raised by an arbitrarily small amount in $F_{\underline{x}\underline{x}}$ and $F_{\underline{x}x}$ to make it strictly optimal for x and $\bar{x}$ to leave at $t=1$ instead of taking $w_1 + w_2$. In fact, for some x (or $\bar{x}$) to choose w_1 over b_1, they must expect $b_1 \leqq w_1 - 2x + \max\{\tilde{w}_2 - 2x, \tilde{b}_2\}$ (respectively, $b_1 \leqq w_1 - 2\bar{x} + \max\{\tilde{w}_2 - 2\bar{x}, \tilde{b}_2\}$). That is, each x (or $\bar{x}$) who deviates must expect, at $t=2$, more than $\max\{w_2 - 2x, b_2\}$ (respectively $\max\{w_2 - 2\bar{x}, b_2\}$). But this cannot happen. Assume for example that b_2 has been chosen so that $b_2 < w_2 - 2\bar{x}$, that is, everybody prefers $(w_2, e_2 = 2)$ to b_2. Then, either the Government could push for a *partial reform* at $t=2$, with $w_2' = \tilde{w}_2 = w_2$ at $b_2' = \tilde{b}_2 = w_2 - 2\bar{x}$ (there is no way to hurt a single group); or it could alternatively push for a *full reform* at $t=2$, where either the $\underline{x}$ group is hurt (if they are a minority), at $b_2' = \tilde{b}_2 = w_2 - 2x$ and $w_2' = \tilde{w}_2 = w_2 - 2x + 2\underline{x}$, or where nobody is hurt (if the $\underline{x}$ group is the majority), at $b_2' = \tilde{b}_2 = w_2 - 2x$ and $w_2' = \tilde{w}_2 = w_2$. Note that, in none of these cases do we find the x group receiving more than $\max\{w_2 - 2x, b_2\}$ (in fact, in no reform considered in Proposition 3 do they strictly gain in comparison to the status quo). They will thus not find it in their interest to stay in the sector at $t=1$. In such a case, it will be optimal for the Government to push for $w_2' = \tilde{w}_2 = w_2$ and $b_2' = \tilde{b}_2 = w_2 - 2\bar{x}$ in case some $\bar{x}$ have stayed in the sector at $t=1$. But, then, they do not receive more than $\max\{w_2 - 2\bar{x}, b_2\}$, so that deviating is not optimal for them either. There is thus no PBE where some x or $\bar{x}$ remain in the sector at $t=1$ after $F_{\underline{x}\underline{x}}$ and $F_{\underline{x}x}$ have been accepted. These are thus unique PBE's. ||

Proposition 4 tells us that, *whenever full reform is the static optimum, the initial plan will always be opposed by* $\underline{x}$ (*even when the static optimum is* F_x). Moreover, having two offers without commitment is either equivalent or strictly better than having only one offer. To understand this, remember that $b_1 = w - x$ and $w_1 = w - x + 2\underline{x}$ in $F_{\underline{x}}$ while, in F_x, $b_1 = w - \bar{x}$ and $w_1 = w + \underline{x}$.[14] The tradeoff is thus: does one lower b_1 by $(\bar{x} - x)$ (in F_x), or does one lower w_1 by $(x - \underline{x})$ (in $F_{\underline{x}}$)?

In $F_{\underline{x}}$, the winner is the $\bar{x}$ group, who gain $(\bar{x} - x)$, and the loser is the $\underline{x}$ group, who lose $(x - \underline{x})$. In $F_{\underline{x}\underline{x}}$, gains and losses are doubled. In $F_{x\underline{x}}$ instead, one hurts x in period 1, while protecting $\underline{x}$ and $\bar{x}$ in comparison to rejection plus $F_{\underline{x}}$. Protecting $\underline{x}$ and $\bar{x}$ means that, in comparison to the status quo, $\bar{x}$ have to gain $(\bar{x} - x)$, and $\underline{x}$ can lose at most $(x - \underline{x})$.[15] Thus, $F_{x\underline{x}}$ is really an average of $F_{\underline{x}}$ and F_x so that, by the linearity of our problem, it is dominated by $F_{\underline{x}\underline{x}}$.

This is not true when F_x is the static optimum, where one can hurt $\underline{x}$ much more. In F_x, there is no winner and one strict loser, the x group, who loses $(\bar{x} - x)$ (since $b_1 = w - \bar{x}$). While F_{xx} doubles x's loss, $F_{\underline{x}x}$ does better. On the one hand, it keeps x's loss at $(\bar{x} - x)$, thus raising b_1 by $(\bar{x} - x)$ for x and $\bar{x}$ in comparison to F_{xx}. On the other hand, the slightly higher rents conceded to x and $\bar{x}$ are more than compensated by the wage cut on $\underline{x}$ who lose $(\bar{x} - x) + 2(x - \underline{x})$ compared to F_{xx}. One can hurt $\underline{x}$ more than in $F_{\underline{x}\underline{x}}$: now $w_1 + w_2 = 2(w - x) - (\bar{x} - x) + 4\underline{x}$. This is possible because b_1 is lower by $(\bar{x} - x)$ than with $F_{\underline{x}x}$ and the lower the bonus the lower the minimum incentive compatible wage for $\underline{x}$.

The idea of $F_{\underline{x}x}$ is thus to "buy cheaply" the votes of the x group, who know that, in case of rejection, they lose afterwards anyway. Being able to lower their payoff in comparison to the status quo has two advantages: it also lowers the rents to be conceded to $\bar{x}$, and it allows one to cut even further the wage bill of the $\underline{x}$ group. The same advantage does not exist when $F_{\underline{x}}$ is the static optimum, because, then, if one wishes to make x the initial losers (that is, choose $F_{x\underline{x}}$), having to protect $\underline{x}$ and $\bar{x}$ in period 1 effectively limits the amount of rents one can extract from x. Note also that another way to see the difference between $F_{\underline{x}\underline{x}}$ and $F_{\underline{x}x}$ is that, while in the first case, nobody votes for a plan that is worse for them than the status quo, in $F_{\underline{x}x}$ the group x ends up voting for a plan in which they concede $(\bar{x} - x)$.

Proposition 4 also establishes that $F_{\underline{x}\underline{x}}$ and $F_{\underline{x}x}$ can be sustained as unique PBE's. This is first because, once only the $\underline{x}$ group remains in the sector at $t = 2$, there is no way for the Government to play one group against another, because all voters are identical. Since the two reform plans are incentive compatible, each of them is a PBE, because an individual worker deviation has no consequence on future votes. For the reform plans to be *unique* PBE's, one must then check that *coordinated* deviations cannot be equilibria either. This is because one can prove that the x and $\bar{x}$ groups cannot hope to strictly improve their payoff by collectively staying in the sector in period one after the initial reform has passed and influencing the second-period vote.

Proposition 5 completes Proposition 4 by establishing the optimality of $F_{\underline{x}\underline{x}}$ and $F_{\underline{x}x}$. While it provides a significant characterization result, its proof is tedious and not very illuminating.

Proposition 5. *When $F_{\underline{x}}(F_x)$ is the static optimum, $F_{\underline{x}\underline{x}}(F_{\underline{x}x})$ is optimal in the two-offer case without commitment.*

Proof. See Appendix. ||

The insight of Propositions 4 and 5 that the Government can do better in some cases with two offers than with one take-it-or-leave-it offer contradicts the results which can

14. For $2x > \underline{x} + \bar{x}$, the case on which we focus here for the sake of intuition.
15. See Table III for a summary of the net gains of the various reforms for the three groups of workers.

be found in the bargaining or contracting literature. We stressed in Section 4 that this did not happen under unanimity, which is a case parallel to voluntary contract renegotiation. The case of majority rule is somehow in-between this case and that of ratchet models. In the latter, the Government is not committed to respecting any long-run contract while, here, it needs the approval of a majority of workers to implement any new reform plan. A key difference is however that, in ratchet models, a take-it-or-leave-it offer allows the Government to threaten the other party with the worst possible outcome, namely its exogenous individual-rationality payoff. This is not the case in a voting problem, since the status quo payoff is not the worst that can happen to workers: they can lose more, in terms of higher effort or lower wages and bonuses, in reform proposals where they are in the minority. This is why the expectation of future offers may induce concessions, in contrast to the bargaining or contract literature.

The driving force behind our result is the ability of the Government to credibly threaten to switch majorities. This ability depends on the time dependence of our problem, specifically, our finite-horizon assumption. Under a stationary infinite-horizon problem, majority switches could take place only in the presence of multiple equilibria. Otherwise, a rejection would be followed by the same equilibrium proposal by the Government. Only if the Government were *indifferent* between several reform proposals could it threaten to "break the tie" in the future in a way which would be contingent on previous votes.

In terms of economic reform, our finite-horizon assumption can be justified for example by the finiteness of Government terms or by the obsolescence of capital goods which end up not being replaced in the case of declining demand. One could even extend the analysis by modifying the exogenous environment parameters between the two periods.

Partial reform as the static optimum

Let us end this section with the case where $P_{\bar{x}}$ is the static optimum. Here, we have the same problem as in the case of unanimity: replicating $P_{\bar{x}}$ twice (we shall call this solution $P_{\bar{x}\bar{x}}$) is not time-consistent, because once the $\bar{x}$ have left at $t=1$, it becomes optimal to have x leave at $t=2$. Under unanimity, we had two results: optimality of partial reform in the static case led to *gradualism* with two periods and no commitment, and to an outcome which was *strictly worse* than the replication of the optimal static partial reform. These two results are preserved under majority rule even though, as with F_{xx} above, the Government will end up lowering the payoff of *two-thirds* of the population in comparison to the status quo.

We will show that the optimal reform will be gradual and will hurt x in comparison to the status quo followed by $P_{\bar{x}}$. Remember that $P_{\bar{x}}$ can be optimal only for $3x \leqq 2\underline{x}+\bar{x}$, and involves an effort of 2, a wage of $w+x$ and a bonus of $w+x-2\bar{x}$ so that, in comparison to the status quo, $\underline{x}$ gain $(x-\underline{x})$, $\bar{x}$ lose $(\bar{x}-x)$, and x do not gain or lose anything. We shall be interested in the following gradual reform plan:

$$\bar{x} \text{ leave at } t=1,\ x \text{ leave at } t=2,$$

$$e_1=e_2=2,$$

$$w_1+w_2=2(w+\underline{x})+(x-\underline{x}),$$

$$w_1+b_2=2(w+\underline{x})+(x-\underline{x})-2x,$$

$$b_1=2(w+\underline{x})+(x-\underline{x})-2x-2\bar{x}.$$

Let us call this plan $G_{x\bar{x}}$, since the plan is proposed under the threat of $P_{\bar{x}}$, and has the same "flavour" as P_x, since reform is partial at $t=1$, and will then be opposed by x.

Indeed, w_1+w_2 gives $\underline{x}$ the status quo payoff plus what they gain under $P_{\bar{x}}$. Then, w_1+b_2 and b_1 are computed to satisfy incentive compatibility. Under w_1+b_2, x lose in comparison to the status quo (while $P_{\bar{x}}$ keeps their status quo payoff), since $w_1+b_2=2w-(x-\underline{x})<2w$, while they work as much as under the status quo. Finally, b_1 is set at the minimum level that induces $\bar{x}$ to leave at $t=1$, but this gives them extra rents in comparison to the status quo followed by $P_{\bar{x}}$ in which they lose $(\bar{x}-x)$ (their payoff would then be $(w-\bar{x})+(w+x-2\bar{x})<b_1=2(w-\bar{x})-(x-\underline{x})$, since $x-\underline{x}<\bar{x}-x$). Proposition 6 establishes the optimality of $G_{x\bar{x}}$.

Proposition 6. *Assume that $P_{\bar{x}}$ is the static optimum. Then, $G_{x\bar{x}}$ can be sustained as a unique PBE, and is optimal in the two-offer case without commitment. It is however worse than the time-inconsistent reform $P_{\bar{x}\bar{x}}$.*

Proof. See Appendix. ||

The arguments used to prove Proposition 6 are similar to the ones used in the proofs of Propositions 4 and 5. The main difference here in comparison to cases where full reform was optimal in the static case is the *cost* of having two offers without commitment. This cost is similar to the unanimity case: for x close to $\underline{x}$, a partial reform with $e_1=e_2=2$ is optimal, in order to extract a lot of rents from $\bar{x}$. Lack of commitment however tends to bring the effort of the x group down to zero at $t=2$, thus limiting rent extraction from $\bar{x}$.

In contrast to unanimity, there is an advantage to having two offers and that is hurting *two groups* in comparison to the status quo: here, the Government "buys cheaply" the votes of the $\bar{x}$ group, who are threatened by $P_{\bar{x}}$, in order to hurt x too. This stands in contrast with $P_{\bar{x}\bar{x}}$, where only the $\bar{x}$ group is hurt. This advantage of having two offers is however dominated by the cost of limited commitment.

The Proposition also tells us that gradualism is good, as under unanimity, when partial reform is optimal in the static case. Finally, it is shown that $G_{x\bar{x}}$ can be sustained as a unique PBE: under strict majority rule, the second-period outcome is stable (the Government cannot get away with hurting anybody more than it already does), and the $\bar{x}$ group would lose by staying at $t=1$, either individually or collectively.[16]

7. POTENTIAL APPLICATIONS OF THE MODEL

The model analysed in this paper and the results derived from it can be used to try to shed light on some aspects of economic reforms and their policy implications.

One of the main results is that the presence of informational asymmetries provides reasons for gradualism in the shrinkage of outdated industries or sectors. Gradualism is desirable when significant worker heterogeneity makes rent extraction problems relevant. This can be the case when the Government has little knowledge about the degree of adaptability of individual workers to new production or organization methods, and has reasons to believe they differ strongly in these respects. Gradual policies have been used in Europe when shrinking obsolescent sectors such as coal mines or the steel industry.

16. Note that, as in Section 4, Propositions 4 to 6 restrict attention to deterministic reforms where identical individuals make identical choices about exiting or not. As in Section 4, the desirability of gradualism does not depend on such a restriction, because these reforms would involve some x or $\bar{x}$ workers staying at $t=1$ (and possibly $t=2$). Direct full reforms are certainly dominated when $P_{\bar{x}}$ is the optimal static reform, as proved in Proposition 6. Also unaffected by our restriction is the main result of this Section, namely the possibility to use the threat of future reforms to extract concessions in the initial reform. The only result which could be affected is the fact that, when $P_{\bar{x}}$ is the static optimum, the Government cannot do as well as $P_{\bar{x}\bar{x}}$ with two periods and no commitment, through the use of more sophisticated gradual reforms. Such a possibility only reinforces the main conclusion of this Section.

This issue of gradualism is also highly relevant in Central and Eastern Europe, where the transition to market economies requires huge industrial restructuring and labour redeployment. Restructuring policies are clearly subject to political constraints as they will involve large parts of the population. Here too, gradualism can prove less costly since, under the central planning system, workers enjoyed numerous hidden rents. The tradeoff between rapid but costly restructuring and more gradual policies, cheaper in terms of exit bonuses and working in favour of balanced budget policies, is central in the policy debates in the former GDR where the transition process is the most advanced.[17] It will also be central to the future policy choices in the other post-socialist countries.

To avoid any confusion, the model developed in this paper only encompasses one dimension of the transition process in Eastern Europe, that of restructuring, perhaps the most politically difficult phase of transition (Roland (1991)). A multi-dimensional analysis of all important phases of transition, (including privatization, institutional and legal reform, price liberalization and stabilization, as well as restructuring) should capture the complementarity of reforms and the comprehensive nature of transition. (One could perhaps use the framework of Milgrom and Roberts (1990).) Indeed, these ideas have often been emphasized by economists such as Kornai, Eastern reform economists or Western comparative economists, and have recently been very forcefully expressed by leading Western advisers to Eastern European governments (Sachs (1990)). The issue of "big bang" versus "gradualism" is also different if one examines stabilization (van Wijnbergen (1991)) instead of economic restructuring, as in this paper.

The result on changing majorities and the possibility of damaging majority interests in a majority vote, though theoretically interesting and intriguing, may seem somewhat remote from the current policy debates around Eastern Europe. This is partly due to the abstract formulation of the model. Applying the model to the Eastern European context, in the case of full reforms, our result can roughly be translated as follows. At some point, a Government's push for restructuring implies massive redundancies. Only modest wage increases will be allowed to compensate for the higher productivity, and exit bonuses will be low. A majority will be less well off during the transition period, but these plans will still be accepted. Workers with only average outside opportunities who know they will have to leave their job may be resigned to accepting these plans, fearing that if they joined a coalition with those workers who demand higher wage increases, they would only end up with an even lower bonus.

The main objection one might raise against such a "divide and rule" scheme is that some Eastern European governments are too weak and lack the necessary legitimacy to implement such policies. But then, one of the main lessons of this paper is to emphasize the value of legitimacy by showing how stable governments can, in a democratic setting, overcome the potentially massive opposition of vested interests in order to achieve allocative efficiency.

8. CONCLUDING REMARKS

This paper has modelled structural reform processes using the tools of dynamic adverse selection models. It has generated several insights concerning the political economy of such reforms:

(i) It has shown how *gradualism* can emerge as a sequentially optimal reform path when the budgetary cost of reform is a significant determinant of optimality.

17. See also Dewatripont and Roland (1991).

(ii) It has analysed the *majority choice* of reform-minded Governments in a simple three-group framework. We have seen that, when two groups of workers tend to be *similar* (x tending to $\underline{x}$, or to $\bar{x}$), the Government seeks to gain their votes and chooses to hurt the remaining group (when x tends to $\bar{x}$, both are compensated for leaving, and the wage for $\underline{x}$ grows less than their productivity; when x tends to $\underline{x}$, both are compensated for higher productivity, while the $\bar{x}$ group is induced to leave without full compensation). Instead, when the intermediate group is not similar to either of the two extremes (x tending to $(\underline{x}+\bar{x})/2$), the Government seeks the votes of these extremes and hurts the intermediate group. The advantage of doing so however is also to limit the payoff of one extreme group (through a lower exit fee if x leave with $\bar{x}$, or a lower wage if x stay with $\underline{x}$).

(iii) The dynamic majority rule case has turned out to be particularly interesting. We have seen in that case how the threat of future reforms can allow the Government to play the minority of tomorrow against another minority today, and to obtain a majority vote on measures hurting majority interests. From the point of view of economic reform in Eastern Europe, this means that democratic reforms are not necessarily a cause of inertia, provided the government is in firm control of the agenda.

These insights are only a first step in the analysis of economic reforms under dynamic political constraints, and further developments are necessary. It would be interesting to generalize our insights to more general worker heterogeneity and to a multi-period framework, to investigate general upper bounds on the proportion of people one can hurt in comparison to the status quo. Another interesting question is the effect of bundling or aggregating reform proposals for different sectors. If the distribution of worker types varies strongly across sectors, or across firms within individual sectors, then the government may prefer individualized proposals to a single reform proposal. But, just as the threat of future proposals allows one to extract concessions for current reforms, one might examine whether the bundling of proposals and the threat of reform in one sector might allow one to extract concessions in another sector in the case where there is interdependency between reform outcomes. More generally, one might examine if the bundling of different reform proposals, affecting individual welfare in different ways, could allow an increase in the government's payoff. Finally, the dynamic agenda-setting framework could be adopted to study large-scale reforms other than economic restructuring. This subject is very topical in light of current changes now occurring in Eastern Europe.

APPENDIX

Proof of Proposition 2. Let us start with part (ii). It is straightforward to check that $V(G)$ is the average of the full and partial reform Government payoffs. When, in the static problem, $V(P)>V(F)$, gradual reform is thus better than full reform but worse than partial reform in the two-period problem.

That partial reform cannot be sustained as an equilibrium is clear: once the $\bar{x}$ group has left, offering $(w_2', e_2', b_2')=(w+\underline{x}, 2, w-x)$, which induces x to leave, is better for the Government, and acceptable for all workers, than keeping $\underline{x}$ and x inside the sector with $w_2=w$ and $e_1=1$.

Reform G is instead sustainable as a PBE, because:

—if G has been accepted and only the $\bar{x}$ group has left in period 1, the Government cannot offer a new plan which does better for everybody than the continuation of G in period 2, since this continuation is allocatively efficient.

—if G has been accepted, it is optimal to leave if and only if one is of type $\bar{x}$ in period 1, and of type x in period 2 (indeed, this is incentive compatible under G). Moreover, even if some $\bar{x}$ workers remain in the sector in period 1, the Government cannot improve its payoff by offering anything else than $w_2 = w + \underline{x}$ and $b_2 = w - x$ (which would be taken by any x or $\bar{x}$ worker left in the sector) which would be acceptable to all remaining workers. It is thus an equilibrium decision for $\bar{x}$ workers to leave at $t = 1$, and for other workers to stay at that time.

—finally, when G is proposed at $t = 1$, it is an optimal strategy for each worker not to veto it, because each gains the same amount in G and under the status quo followed by P in period 2. Indeed, under P, with $e_2 = 1$ (which, by assumption, is the static optimum), all workers are exactly as well off as in the status quo while, under G, two groups are as well off as in the status quo, and the $\bar{x}$ group even gains $(\bar{x} - x)$ in comparison to the status quo.

The above arguments even imply that G is sustainable as the ***unique*** PBE: since (w_2, e_2, b_2) is allocatively efficient, we shall have $(w_2', e_2', b_2') = (w_2, e_2, b_2)$ whatever the exit decisions at $t = 1$ if G has been accepted: there is thus no other continuation equilibrium, where *groups* of $\bar{x}$ workers would remain in the sector in the hope of a more favourable deal than (w_2, e_2, b_2) in period 2. This completes the proof of part (ii).

Concerning part (i), similar arguments as the ones developed above for G can be used to show that F repeated twice can be sustained as unique PBE. In particular, exiting at $t = 1$ once the plan has been accepted is a good idea for x and $\bar{x}$ workers, who cannot hope for $b_2 > w - x$ at $t = 2$. And voting for full reform is optimal at $t = 1$, since it doubles the gains of F for each worker; it is thus better than the status quo followed by F, which is what workers have to expect if the initial plan is voted down at $t = 1$.

Finally, when $V(F) > V(P)$ in the static problem, full reform dominates partial as well as gradual reforms. G is the average over time of P and F. It concedes no rents in comparison to the status quo to $\underline{x}$ and x, and concedes $(\bar{x} - x)$ to $\bar{x}$. This is just like having the status quo followed by F. There is thus no acceptable gradual reform which could extract more rents from any group of workers. Since we assumed (2) to be satisfied, G is thus the optimal gradual reform which, in turn, means that F, repeated twice, is the optimal deterministic reform when $V(F) > V(P)$ in the static problem. ||

We now provide a proof and an extensive discussion of Proposition 3, which corresponds to Propositions A1 to A4 below. First define $\tilde{S}^* = q(2) - 2(1 + \lambda)\underline{x}$ as the allocatively efficient surplus and $S^* = \tilde{S}^* - 3\lambda w$. This will allow us to write in an easily comparable fashion the Government objective function for the five possible reforms:

$$V(F_{\underline{x}}) = S^* + 3\lambda x.$$

$$V(F_x) = S^* + \lambda(\underline{x} + 2\bar{x}) \quad \text{if } 2x \geqq \underline{x} + \bar{x},$$

$$= S^* + \lambda(4x - \underline{x}) \quad \text{if } 2x \leqq \underline{x} + \bar{x}.$$

$$V(P) = S^* - ((q(2) - q(1)) - (1 + \lambda)\underline{x}) + (q(1) - (1 + \lambda)x) + \lambda(x + \underline{x} + \bar{x}).$$

$$V(P_x) = S^* + (q(2) - 2(1 + \lambda)x) + \lambda(2x + \bar{x}) \quad \text{if } 2x \leqq \underline{x} + \bar{x},$$

$$= S^* + (q(2) - 2(1 + \lambda)x) + \lambda(2\underline{x} + 3\bar{x} - 2x) \quad \text{if } 2x \geqq \underline{x} + \bar{x}.$$

$$V(P_{\bar{x}}) = S^* + (q(2) - 2(1 + \lambda)x) + \lambda(2\underline{x} + 2\bar{x} - x).$$

We first compare the two pairs of reforms with identical allocation of labour: $F_{\underline{x}}$ and F_x, and P_x and $P_{\bar{x}}$ (with $e_1 = 2$, in contrast to P):

Lemma 1. $V(F_x) \geqq V(F_{\underline{x}})$ *iff* $3x \leqq \underline{x} + 2\bar{x}$.

Proof. *If* $2x \leqq \underline{x} + \bar{x}$, $V(F_x) - V(F_{\underline{x}}) = \lambda(x - \underline{x}) > 0$. If $2x \geqq \underline{x} + \bar{x}$, $V(F_x) - V(F_{\underline{x}}) = \lambda(\underline{x} + 2\bar{x} - 3x) \geqq 0$ iff $3x \leqq \underline{x} + 2\bar{x}$. ||

When one hurts $\underline{x}$, the nearer x is to $\bar{x}$, the lower the exit bonus $(w - x)$ and the extra rent $(\bar{x} - x)$ accruing to $\bar{x}$, and the more one can hurt $\underline{x}$ and still give them the incentive to keep working. The lower the x, the lower these advantages. It then becomes interesting to hurt x instead of $\underline{x}$ in order to restrict the extra rent of $\bar{x}$ to zero. For $3x \leqq \underline{x} + 2\bar{x}$, rent payments become lower compared to $F_{\underline{x}}$.

Lemma 2. $V(P_{\bar{x}}) \geqq V(P_x)$ *iff* $3x \leqq 2\underline{x} + \bar{x}$.

Proof. If $2x \geqq \underline{x} + \bar{x}$, $V(P_x) - V(P_{\bar{x}}) = \lambda(\bar{x} - x) > 0$. If $2x \leqq \underline{x} + \bar{x}$, $V(P_x) - V(P_{\bar{x}}) = \lambda(3x - \bar{x} - 2\underline{x}) \geqq 0$ *iff* $3x \geqq \bar{x} + 2\underline{x}$. ||

Under partial reform with $\bar{x}$ hurt, the nearer x is to $\underline{x}$, the lower the wage can be, and thus the bonus. Hurting x instead of $\bar{x}$ would mean giving excessively high compensation rents to $\bar{x}$. On the other hand, wages could not be lowered too much without hurting $\underline{x}$. This becomes less true when x is higher. P_x then becomes the best solution: paying lower wages to the two groups working at the cost of a higher rent to the third group is then better under partial reform.

Lemma 3. *$V(F_x) \geqq V(P)$ for $3x \geqq 2\underline{x} + \bar{x}$.*

Proof. If $2x \geqq \underline{x} + \bar{x}$, $V(F_x) - V(P) = (q(2) - q(1) - (1+\lambda)\underline{x}) - (q(1) - (1+\lambda)x) + \lambda(\bar{x} - x) > 0$. The first and third expressions between parentheses are positive and the second is negative. If $2x \leqq \underline{x} + \bar{x}$ but $3x \geqq 2\underline{x} + \bar{x}$, $V(F_x) - V(P) = (q(2) - q(1) - (1+\lambda)\underline{x}) - (q(1) - (1+\lambda)x) + \lambda(3x - 2\underline{x} - \bar{x}) \geqq 0$. Indeed, the first and third expressions are non-negative while the second is non-positive. ‖

P can be inferior to F_x because of the allocative loss from keeping a low level of effort *and* from keeping x working. Moreover, nobody loses under P whereas under F_x, the x group loses (but $\bar{x}$ may strictly gain). However, for x sufficiently close to $\underline{x}$, P may be better than F_x: on the one hand, the two solutions are then almost equivalent from an allocative point of view and, on the other hand, F_x implies high bonus payments with extra rents to $\bar{x}$ in comparison to P (indeed, under F_x, $b_1 = \max\{w - \bar{x}, w + \underline{x} - 2x\} > w - \bar{x}$ for x close to $\underline{x}$).

In fact, $F_{\underline{x}}$ and F_x involve the optimal allocation of labour. Proposition A.1 tells us when they are optimal:

Proposition A.1. *For $\underline{x} + \bar{x} \leqq 2x$, full reform is optimal. For $3x \leqq \underline{x} + 2\bar{x}$, F_x is optimal. Otherwise $F_{\underline{x}}$ is optimal.*

Proof. Lemma 1 tells us which solution is better among $F_{\underline{x}}$ and F_x. The proposition will be proved if we show that, for $2x \geqq \underline{x} + \bar{x}$, F_x is better than P_x, other reform schemes being dominated in this region, as shown in Lemmas 1 to 3. For $\underline{x} + \bar{x} \leqq 2x$, $V(F_x) - V(P_x) = -(q(2) - 2(1+\lambda)x) + \lambda(2x - \underline{x} - \bar{x}) > 0$, because the first expression between parentheses is negative and the second is non-negative. ‖

The higher is x, the higher the allocative loss in keeping them working. More specifically, in the region $\underline{x} + \bar{x} \leqq 2x$, F_x dominates P by Lemma 3. Moreover, the exit bonus under the partial reform P_x (which dominates $P_{\bar{x}}$) is the same as under the full reform F_x and wages are even higher. The $\underline{x}$ are thus paid more than in F_x and the extra wages for keeping x working at a high effort level exceed the gain from a higher output level. Full reform is thus optimal.

For $2x \geqq \underline{x} - \bar{x}$, we see that the results are independent of λ or the values of $q(1)$ or $q(2) - q(1)$, provided they satisfy $(1+\lambda)x \geqq q(1) \geqq q(2) - q(1) \geqq (1+\lambda)\underline{x}$. The same is not true for $2x \leqq \underline{x} + \bar{x}$, as is shown in the next three propositions, where it may become better to distort the allocation of labour. In fact, we shall distinguish two cases, $3x \leqq 2\underline{x} + \bar{x}$ and $3x \geqq 2\underline{x} + \bar{x}$.

Proposition A.2. *For $\frac{1}{3}(\bar{x} + 2\underline{x}) \leqq x \leqq \frac{1}{2}(\bar{x} + \underline{x})$, the optimum will be P_x if $\varepsilon \equiv \lambda(\bar{x} + \underline{x} - 2x) + (q(2) - 2(1+\lambda)x) \geqq 0$; otherwise, it will be F_x.*

Proof. By Lemmas 1 to 3, only P_x and F_x are left as possible optima on that region.

$$V(P_x) - V(F_x) = \lambda(\bar{x} + \underline{x} - 2x) + (q(2) - 2(1+\lambda)x). \quad \|$$

Similarly, as in the result of Proposition A.1, the higher the x, the higher the allocative loss from keeping them working. However, if, for $2x < \underline{x} + \bar{x}$, wages under F_x and P_x are the same, the exit bonus is higher under F_x. Even though there is an allocative loss from keeping x working, when x comes closer to $\underline{x}$, this allocative loss becomes smaller whereas the gain in bonus payment over F_x becomes greater.

Recall however from Lemma 2 that $P_{\bar{x}}$ becomes better than P_x for x sufficiently close to $\underline{x}$. The general optimality of $P_{\bar{x}}$ in that region is now demonstrated.

Proposition A.3. *Taking $\underline{x}$ and $\bar{x}$ as given, and making sure we keep $(1+\lambda)x \geqq q(1) \geqq q(2) - q(1) \geqq (1+\lambda)\underline{x}$, $P_{\bar{x}}$ becomes optimal for x tending to $\underline{x}$.*

Proof. By Lemmas 1 to 3, only P, $P_{\bar{x}}$ and F_x are left as candidates (by Lemma 2, $P_{\bar{x}}$ dominates P_x for $3x \leqq 2\underline{x} + \bar{x}$). We have the following expressions:

$$V(P_{\bar{x}}) - V(P) = (q(2) - 2(1+\lambda)x) + (q(2) - q(1) - (1+\lambda)\underline{x}) - (q(1) - (1+\lambda)x) + \lambda(\bar{x} + \underline{x} - 2x),$$

$$V(P_{\bar{x}}) - V(F_x) = (q(2) - 2(1+\lambda)x) + \lambda(2\bar{x} + 3\underline{x} - 5x).$$

When $x \to \underline{x}$, we also have $q(1) \to (1+\lambda)x$, $q(2)-q(1) \to (1+\lambda)x$, $q(2)-q(1) \to (1+\lambda)\underline{x}$, and $q(2) \to 2(1+\lambda)x$, so that all brackets with $q(.)$'s tend to zero, and $V(P_{\bar{x}}) - V(P) \to \lambda(\bar{x}-\underline{x}) > 0$ and $V(P_{\bar{x}}) - V(F_x) \to 2\lambda(\bar{x}-\underline{x}) > 0$. ||

When x is almost indistinguishable from $\underline{x}$, it is allocatively almost identical to having a partial reform with a low or high level of effort, or a full reform, along with the necessary wage adjustments. On the other hand, compared to P or F_x, $P_{\bar{x}}$ is the only reform scheme that hurts $\bar{x}$ and thus minimizes bonus payments.

Lemma 4. *For* $3x < (\bar{x}+2\underline{x})$, $V(P) \geqq V(P_{\bar{x}})$ *iff* $\varepsilon' \equiv \lambda(\bar{x}+\underline{x}-2x) + (2(q(2)-q(1)) - (1+\lambda)(\underline{x}+x)) \leqq 0$.

Proof. $V(P_{\bar{x}}) - V(P) = \lambda(\bar{x}+\underline{x}-2x)(2(q(2)-q(1)) - (1+\lambda)(\underline{x}+x))$. ||

$P_{\bar{x}}$ has a lower exit bonus. Moreover, if the gain from increasing the effort for $\underline{x}$ more than compensates the loss from increasing the effort for x, $P_{\bar{x}}$ is better than P. On the contrary, the cost of increasing the effort for x may be so high as to make P a better solution. The extent of the decrease in marginal productivity is crucial here in discriminating between the two reform schemes.

Lemma 5. *Taking all parameters except x as given, either there is no x such that* P_x *is optimal, or there is no x such that P is optimal.*

Proof. One can check that ε and ε' are decreasing in x, so that, if P and P_x have to ever dominate $P_{\bar{x}}$ and F_x on their respective regions, they must dominate it at $3x = 2\underline{x}+\bar{x}$, that is, one must have $\varepsilon \geqq 0 \geqq \varepsilon'$ for that value of x. This is however impossible, because, for a given x,

$$\varepsilon - \varepsilon' = q(2) - 2(1+\lambda)x - 2(q(2)-q(1)) + (1+\lambda)(\underline{x}+x)$$

$$= [q(1) - (1+\lambda)x] - [q(2) - q(1) - (1+\lambda)\underline{x}] < 0. \quad ||$$

From Lemma 4, marginal productivity of effort must be strongly decreasing for P to dominate $P_{\bar{x}}$. On the other hand, from Proposition A.2, for P_x to dominate F_x, marginal productivity must be almost non-decreasing and as high as possible, without however changing the conditions for allocative efficiency. The two requirements are contradictory.

Proposition A.4. *For* $3x < (2\underline{x}+\bar{x})$, $P_{\bar{x}}$, *P or* F_x *can be optimal.*

Proof. By Proposition A.3, $P_{\bar{x}}$ will be optimal if x tends to $\underline{x}$. On the other hand, for $3x$ close to $2\underline{x}+\bar{x}$ (value at which $V(P_{\bar{x}}) = V(P_x)$, F_x will dominate if $\varepsilon' > 0$ and $\varepsilon < 0$, since all these $V(\cdot)$'s are continuous. This can happen without problem, since we know, from the proof of Lemma 5, that $\varepsilon < \varepsilon'$.

Finally, P can dominate if $\varepsilon' < 0$, and $V(P) - V(F_x) = (q(1) - (1+\lambda)x) - (q(2) - q(1) - (1+\lambda)\underline{x}) + \lambda(\bar{x}+2\underline{x}-3x) \equiv \varepsilon'' > 0$. One can check that the best chance for $\varepsilon' < 0$ is for $q(2)-q(1) \to (1+\lambda)\underline{x}$ and $q(1) \to (1+\lambda)x$. When that happens, $\varepsilon'' \to \lambda(\bar{x}+2\underline{x}-3x) > 0$, and $\varepsilon' \to \lambda(\bar{x}+\underline{x}-2x) + (1+\lambda)(\underline{x}-x)$, which is negative when $\lambda(\bar{x}+2\underline{x}-3x) < (x-\underline{x})$, which can happen too. ||

Propositions A.1 to A.4 taken together are equivalent to Proposition 3 in Section 5, which contains the overall intuition for the possible configurations of optima as x goes from $\hat{q}$ to $\bar{x}$.

Proof of Proposition 5. For each case, we compare the allocatively efficient $F_{\underline{x}\underline{x}}$ or $F_{\underline{x}x}$ with the equilibrium $(w_1, e_1, b_1, \tilde{w}_2, \tilde{e}_2, \tilde{b}_2)$, which has to be incentive compatible (IC). Each time, we shall compare $M_{\underline{x}\underline{x}}$ or $M_{\underline{x}x}$ with the payments of the other solutions, and show that $M_{\underline{x}\underline{x}}$ or $M_{\underline{x}x}$ is lower, after adjusting for the difference in labour allocation.

Case A: $3x \geqq \underline{x}+2\bar{x}$, so the basis of comparison is $F_{\underline{x}\underline{x}}$, with $M_{\underline{x}\underline{x}} = 6w - 6x + 4\underline{x}$. We already know $F_{\underline{x}\underline{x}}$ dominates $F_{x\underline{x}}$. Moreover, a full reform at $t=1$ hurting $\bar{x}$ through a low b_1 is infeasible because it would automatically hurt x even more. $F_{\underline{x}\underline{x}}$ is thus the optimal full reform (and of course dominates full reform with $e_1 = 1$ and/or $e_2 = 1$). Clearly, $F_{\underline{x}\underline{x}}$ is also better than keeping everybody at $t=1$ (at $e_1 = 1$ or $e_1 = 2$), followed then by $F_{\underline{x}}$.

Two more possibilities have to be considered: partial reform, with $e_1 = 1$ or $e_1 = 2$. In both cases, the x group will leave at $t = 2$. Two groups will have to be protected, while the third payoff will be determined by IC. First, $e_1 = 2$:

(i) the x group is hurt at $t = 1$ in comparison to rejection plus $F_{\underline{x}}$. This implies:

$$w_1 + \tilde{w}_2 \geqq 2(w + \underline{x}) - (x - \underline{x}),$$

$$b_1 \geqq (w - x) + (w - \bar{x}),$$

and, by IC,

$$w_1 + \tilde{b}_2 \geqq (w - x) + (w - \bar{x}) + 2x \quad \text{(otherwise, } x \text{ take } b_1\text{)}.$$

Total payments are thus $\geqq (6w - 6x + 4\underline{x}) + (3x - \underline{x} - 2\bar{x}) + 2x > M_{\underline{x}\underline{x}} + 2x$, so this reform is worse than $F_{\underline{x}\underline{x}}$ because $q(2) < 2(1 + \lambda)x$ (here the x group has $e_1 = 2$ instead of $e_1 = 0$ in $F_{\underline{x}\underline{x}}$).

(ii) the $\underline{x}$ group is hurt at $t = 1$ in comparison to rejection plus $F_{\underline{x}}$. This implies:

$$w_1 + \tilde{b}_2 \geqq 2w,$$

$$b_1 \geqq (w - \bar{x}) + (w - x),$$

and, by IC,

$$w_1 + \tilde{w}_2 \geqq 2w + 2\underline{x} \quad \text{(otherwise, } \underline{x} \text{ take } w_1 + \tilde{b}_2\text{)}.$$

Total payments are thus $\geqq (6w - 6x + 4\underline{x}) + (3x - 2\underline{x} - \bar{x}) + 2x > M_{\underline{x}\underline{x}} + 2x$ as in (i).

(iii) the $\bar{x}$ group is hurt at $t = 1$ in comparison to rejection plus $F_{\underline{x}}$: the problem here is that it implies $w_1 + \tilde{b}_2 \geqq 2w$, so that $\bar{x}$ cannot lose here in comparison to (ii), which dominates (iii).

Under partial reform with $e_1 = 1$ and $F_{\underline{x}}$, only x can be hurt by proposing to them a wage and bonus just big enough to keep them working in period 1. We have:

$$w_1 + \tilde{w}_2 \geqq 2w + 2\underline{x} - (x - \underline{x}) - \underline{x},$$

$$b_1 \geqq (w - x) + (w - \bar{x}),$$

and, by IC,

$$w_1 + \tilde{b}_2 \geqq (w - x) + (w - \bar{x}) + 2x - x.$$

So the lower bound on payments is as in (i) above $-(x - \underline{x})$. This is worse than (i) above, by the assumption that $2(q(2) - q(1)) \geqq (1 + \lambda)(\underline{x} + x)$ made to rule out P as a static optimum (see footnote 13). Note that $\bar{x}$ cannot be hurt in period 1, since effort is low and they are already hurt in period 2. And $\underline{x}$ cannot be hurt because effort is low. Other solutions thus involve higher payments for the same allocative surplus.

We have considered all partial reforms, all dominated by $F_{\underline{x}\underline{x}}$, which is optimal.

For $3x \leqq \underline{x} + 2\bar{x}$, $F_{\underline{x}x}$ becomes the basis of comparison, and it is the optimal immediate full reform (it dominates F_{xx}, and hurting $\bar{x}$ would hurt x too, which is not politically feasible), and is also clearly better than keeping everybody at $t = 1$. Partial reforms remain to be considered, in a similar way as above.

Case B: $\frac{1}{2}(\underline{x} + \bar{x}) \leqq x \leqq \frac{1}{3}(\underline{x} + 2\bar{x})$, so that $M_{\underline{x}x} = 6w - 3\bar{x} - 3x + 4\underline{x} \leqq M_{xx} = 6w - 4\bar{x} + 2\underline{x}$.

First, consider partial reforms with $e_1 = 2$:

(i) the x group is hurt, so that:

$$w_1 + \tilde{w}_2 \geqq 2(w + \underline{x})$$

$$b_1 \geqq 2(w - \bar{x})$$

and, by IC,

$$w_1 + \tilde{b}_2 \geqq 2(w - \bar{x}) + 2x.$$

Total payments $\geqq 6w + 2\underline{x} - 4\bar{x} + 2x = M_{xx} + 2x$, which is even worse than M_{xx}, since $q(2) \leqq (1 + \lambda)2x$.

(ii) the $\underline{x}$ group is hurt, so that:

$$w_1 + \tilde{b}_2 \geqq 2w - (\bar{x} - x),$$

$$b_1 \geqq 2(w - \bar{x}),$$

and, by IC,

$$w_1+\tilde{w}_2 \geqq 2w-(\bar{x}-x)+2\underline{x}.$$

Total payments $\geqq 6w+2\underline{x}-4\bar{x}+2x$, as in (i).

(iii) the $\bar{x}$ group is hurt, so that:

$$w_1+\tilde{w}_2 \geqq 2(w+\underline{x}),$$

$$w_1+\tilde{b}_2 \geqq 2w-(\bar{x}-x),$$

and, by IC,

$$b_1 \geqq 2w-(\bar{x}-x)-2\bar{x}.$$

Total payments $\geqq 6w+2\underline{x}-4\bar{x}+2x$, as in (i).

Then, consider partial reforms with $e_1=1$:

(i) the x group is hurt, so that:

$$w_1+\tilde{w}_2 \geqq 2w+\underline{x},$$

$$b_1 \geqq 2w-2\bar{x},$$

and, by IC

$$w_1+\tilde{b}_2 \geqq 2w-2\bar{x}+x.$$

Total payments $\geqq 6w+2\underline{x}-4\bar{x}+2x-(x+\underline{x})$. It is the same as in (i) above, minus $(x+\underline{x})$, and thus worse than (i) under the assumption that $2(q(2)-q(1)) \geqq (1+\lambda)(x+\underline{x})$, made to rule out P as static optimum.

(ii) the $\underline{x}$ group is hurt, so that:

$$b_1 \geqq 2(w-\bar{x}),$$

$$w_1+\tilde{b}_2 \geqq 2w-(\bar{x}-x)-x,$$

and, by IC,

$$w_1+\tilde{w}_2 \geqq 2w-(\bar{x}-x)-x+2\underline{x}.$$

Total payments $\geqq 6w-4\bar{x}+2\underline{x}=M_{xx}$, with an allocative surplus $2q(1)+q(2)-3\underline{x}-x$.

$$\begin{aligned} V(F_{\underline{x}x}) &= (2q(2)-4\underline{x})-\lambda(6w-3\bar{x}+4\underline{x}-3x) \\ &\geqq (2q(1)+q(2)-3\underline{x}-x)-\lambda(6w-4\bar{x}+2\underline{x}) \\ &\Leftrightarrow [q(2)-q(1)-(1+\lambda)\underline{x}]-[q(1)-(1+\lambda)x]+\lambda(2x-\underline{x}-\bar{x}) \\ &\geqq 0, \end{aligned}$$

which is true.

(iii) the $\underline{x}$ group cannot be hurt because effort is low, so hurting x or $\bar{x}$ is strictly better. We have considered all partial reforms, all dominated by $F_{\underline{x}x}$, which is optimal for $\frac{1}{2}(\underline{x}+\bar{x}) \leqq x \leqq \frac{1}{3}(\underline{x}+2\bar{x})$.

Case C: F_x is optimal in the static case, but $2x \leqq \underline{x}+\bar{x}$, so that $M_{\underline{x}x}=6w+7\underline{x}-9x$, and $M_{xx}=6w+6\underline{x}-8x=M_{\underline{x}x}+(x-\underline{x})$.

First, consider partial reforms with $e_1=2$:

(i) the x group is hurt, so that:

$$w_1+\tilde{w}_2 \geqq 2(w+\underline{x}),$$

$$b_1 \geqq (w-\bar{x})+(w+\underline{x}-2x),$$

and, by IC,

$$w_1+\tilde{b}_2 \geqq 2(w+\underline{x})-2x.$$

Total payments $\geqq 6w+7\underset{\sim}{x}-9x-(2\underset{\sim}{x}+\bar{x}-3x)+2x=M_{xx}-(\underset{\sim}{x}+\bar{x}-2x)+2x$, with a gain of surplus of $q(2)-2x$. The total gain over M_{xx} is $\lambda(\bar{x}+\underset{\sim}{x}-2x)+(q(2)-2(1+\lambda)x)$, i.e. ε which is negative by the assumption made to exclude P_x as a static optimum (see footnote 13 and Proposition A.2).

(ii) the $\underset{\sim}{x}$ group is hurt, so that:

$$b_1 \geqq 2(w-x)+\underset{\sim}{x}-\bar{x},$$
$$w_1+\tilde{b}_2 \geqq 2w-(x-\underset{\sim}{x}),$$

and, by IC,

$$w_1+\tilde{w}_2 \geqq 2w-(x-\underset{\sim}{x})+2\underset{\sim}{x}.$$

Total payments $\geqq 6w-4x+5\underset{\sim}{x}-\bar{x}$, as in (i) above.

(iii) the $\bar{x}$ group is hurt, so that:

$$w_1+\tilde{w}_2 \geqq 2(w+\underset{\sim}{x}),$$
$$w_1+\tilde{b}_2 \geqq 2w-(x-\underset{\sim}{x}),$$

and, by IC,

$$b_1 \geqq 2w-(x-\underset{\sim}{x})-2\bar{x}.$$

Total payments $\geqq (6w+7\underset{\sim}{x}-9x)+2x+(5x-3\underset{\sim}{x}-2\bar{x})=M_{\underset{\sim}{x}x}+2x+(5x-3\underset{\sim}{x}-2\bar{x})$, which is worse than $M_{\underset{\sim}{x}x}$ for $V(P_{\bar{x}})<V(F_x)$, which is true by assumption.

Finally, consider partial reforms with $e_1=1$:

(i) the x group is hurt, so that:

$$w_1+\tilde{w}_2 \geqq 2w+\underset{\sim}{x},$$
$$b_1 \geqq 2w+\underset{\sim}{x}-2x-\bar{x},$$

and, by IC,

$$w_1+\tilde{b}_2 \geqq 2w+\underset{\sim}{x}-2x.$$

The lower bound on total payments differs from (i) above only by $2\underset{\sim}{x}$, which is worse than (i) because of our assumption $2(q(2)-q(1)) \geqq (1+\lambda)(x+\underset{\sim}{x}) \geqq x+\underset{\sim}{x}+2\lambda\underset{\sim}{x}$.

(ii) the $\underset{\sim}{x}$ group is hurt, so that:

$$b_1 \geqq 2w+\underset{\sim}{x}-2x-\bar{x},$$
$$w_1+\tilde{b}_2 \geqq 2w-x-(x-\underset{\sim}{x}),$$

and, by IC,

$$w_1+\tilde{w}_2 \geqq 2w-x-(x-\underset{\sim}{x})+2\underset{\sim}{x}.$$

Total payments $\geqq 6w+5\underset{\sim}{x}-\bar{x}-6x$, which is dominated by $F_{\underset{\sim}{x}x}$ (given $2x \leqq \underset{\sim}{x}+\bar{x}$): the objective function here is $[2q(1)+q(2)-x-3\underset{\sim}{x}]-\lambda[6w+5\underset{\sim}{x}-\bar{x}-6x]$. This minus $V(F_{\underset{\sim}{x}x})$ *equals* $(q(1)-(1+\lambda)x)-(q(2)-q(1)-(1+\lambda)\underset{\sim}{x})+\lambda(\underset{\sim}{x}+\bar{x}-2x)<0$.

(iii) the $\bar{x}$ group cannot be hurt because effort is low, so (iii) is dominated by (ii) or (i).

We have considered all partial reforms, all dominated by $F_{\underset{\sim}{x}x}$ when $2x \leqq \underset{\sim}{x}+\bar{x}$ and when F_x is the static optimum. ‖

Proof of Proposition 6. We proceed in three steps:

(a) we show that $V(P_{\bar{x}\bar{x}}) \geqq V(G_{x\bar{x}})$,
(b) we prove the optimality of $G_{x\bar{x}}$ in the absence of commitment,
(c) we establish that $G_{x\bar{x}}$ can be sustained as unique BPE.

(a) $V(G_{x\bar{x}})=3q(2)-2x-4\underset{\sim}{x}-\lambda(6w+3\underset{\sim}{x}-x-2\bar{x})$.

$V(P_{\bar{x}\bar{x}})=4q(2)-4x-4\underset{\sim}{x}-\lambda(6w+6x-4\bar{x})$.

$V(P_{\bar{x}\bar{x}})-V(G_{x\bar{x}})=q(2)-2(1+\lambda)x+\lambda(3\underset{\sim}{x}+2\bar{x}-5x)$,

which is >0 iff $V(P_{\bar{x}})>V(F_x)$, which proves (a).

(b) We have to compare $G_{x\bar{x}}$ with other gradual reforms, full reforms, and delayed reforms (which keep everybody at $t=1$, in order to apply $P_{\bar{x}}$ at $t=2$).

(i) *Other gradual reforms*: Note that, in $G_{x\bar{x}}$, the x group is hurt and, by IC, it is already impossible to avoid giving $\bar{x}$ extra rents in comparison to the status quo plus $P_{\bar{x}}$. It is thus impossible to hurt $\bar{x}$ without hurting x. What is possible is to hurt solely $\underline{x}$ in comparison to the status quo plus $P_{\bar{x}}$. This would yield, with $e_1 = e_2 = 2$:

$$w_1 + \tilde{b}_2 \geqq 2w;$$
$$b_1 \geqq 2(w - \bar{x}), \quad \text{by IC;}$$
$$w_1 + \tilde{w}_2 \geqq 2(w + \underline{x}), \quad \text{by IC.}$$

The payoffs of $\bar{x}$ and $\underline{x}$ are determined by IC, and x will vote against the plan, because $P_{\bar{x}}$ would offer them *more* than the status quo, which is what they receive here. Total payments $\geqq 6w + 2\underline{x} - 2\bar{x}$, which is higher than in $G_{x\bar{x}}$, for the same allocative surplus, and thus worse. Having an effort of 1 at $t = 1$ or $t = 2$ would be even worse, both allocatively (by our assumptions) and in terms of rent extraction from $\bar{x}$ (they can be left worse off only if $e = 2$ for x at some period). $G_{x\bar{x}}$ is thus the optimal gradual reform.

(ii) *Full reforms*: If one does not want to hurt x, one cannot hurt $\bar{x}$ either. Hurting $\underline{x}$ then gives (with $e_1 = e_2 = 2$ being optimal):

$$b_1 \geqq 2(w - x),$$
$$w_1 + \tilde{w}_2 \geqq 2(w - x) + 4\underline{x}.$$

The total surplus is then $\leqq 2q(2) - 4\underline{x} - \lambda(6w - 6x + 4\underline{x})$, and one can check that it is lower than $V(G_{x\bar{x}})$ for $q(2) - 2(1+\lambda)x + \lambda(3\underline{x} + 2\bar{x} - 5x) > 0$.

The other full reform involves hurting x($e_1 = e_2 = 2$ is still optimal):

$$w_1 + \tilde{w}_2 \geqq 2(w + \underline{x}) + (x - \underline{x}),$$
$$b_1 \geqq 2(w + \underline{x}) + (x - \underline{x}) - 4x \quad \text{by IC.}$$

In fact, $\bar{x}$ are strictly better off with b_1 than with the status quo plus $P_{\bar{x}}$ (where they get $2(w - \bar{x}) - (\bar{x} - x)$), since $4x < \underline{x} + 3\bar{x}$. This full reform involves total payments $\geqq 6w + 3\underline{x} - 5x$, and is thus more expensive than the above one. $G_{x\bar{x}}$ thus dominates full reforms.

(iii) *Delayed reforms*: In $G_{x\bar{x}}$, $\bar{x}$ receive extra rents in comparison to the status quo plus $P_{\bar{x}}$. The way to avoid that is to delay the reform, that is, keep everybody at $t = 1$, with $e_1 = 1$ (and $w_1 = w$) or $e_1 = 2$ (and $w_1 \geqq w + x$, to make $\underline{x}$ and x happy) and to implement $P_{\bar{x}}$ at $t = 2$. With $e_1 = 1$, we have:

$$w_1 + \tilde{w}_2 = 2w + x,$$
$$w_1 + \tilde{b}_2 = 2w + x - 2\bar{x}.$$

The total surplus is then $3q(1) + 2q(2) - \bar{x} - 3x - 3\underline{x} - \lambda(6w + 3x - 2\bar{x})$. When one subtracts $V(G_{x\bar{x}})$ from this expression, one gets $(2q(1) - x - \bar{x} - 2\lambda x) - (q(2) - q(1) - (1+\lambda)\underline{x}) - 2\lambda(x - \underline{x}) < 0$, so that $G_{x\bar{x}}$ dominates this delayed reform.

With $e_1 = 2$, we have:

$$w_1 + \tilde{w}_2 = 2w + 2x,$$
$$w_1 + \tilde{b}_2 = 2w + 2x - 2\bar{x}.$$

The total surplus is then $5q(2) - 2x - 4x - 4x - \lambda(6w + 6x - 2x)$. When one subtracts $V(G_{xx})$ from this expression, one gets $(2q(2) - 2x - 2\bar{x} - 4\lambda x) - 3\lambda(x - \underline{x}) < 0$, so that $G_{x\bar{x}}$ dominates this other delayed reform too. This proves (b).

(c) Assume the Government offers a plan $e_1 = e_2 = 2$, $w_1 = w_2 = w + \underline{x} + (x - \underline{x})/2$, $b_2 = w + \underline{x} + (x - \underline{x})/2 - 2x + \eta$, and $b_1 = 2(w + \underline{x}) + (x - \underline{x}) - 2x - 2\bar{x} + 2\eta$, with η arbitrarily small but positive (to make all incentive constraints strictly satisfied). In this case, if the majority required to change the status quo is strictly above 50%, $(\tilde{w}_2, \tilde{b}_2) = (w_2, b_2)$ if only $\underline{x}$ and x stay at $t = 1$. Indeed, (w_2, b_2) leads to an efficient outcome, and there is no way for the Government to hurt anybody in comparison to this outcome. This plan can be sustained as a PBE, because no *individual* $\underline{x}$ can change (w_2, b_2) by staying at $t = 1$ instead of leaving, and because staying makes them worse off then.

This plan would not be sustainable as a unique PBE if a *group* of $\bar{x}$ workers could do better by staying at $t = 1$ instead of leaving. But this cannot happen, because they cannot hope for $\tilde{w}_2 > w_2$ or $\tilde{b}_2 > b_2$ at $t = 2$. Indeed, $e_2 = 2$ is already technologically given, and the Government would be interested only in lowering w_2 or b_2. Leaving at $t = 1$ is thus strictly optimal for $\bar{x}$. This proves (c) and completes the proof of Proposition 6. ‖

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