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ABSTRACT

Restructuring as a Signal: A Simple Formalization*

Several studies stressed that contrary to initial expectations, state-owned firms at the beginning of transition undertook painful measures to adjust to the new economic environment. This Paper investigates this behaviour in a simple game, a theoretic framework. It is argued that the massive amount of lay-offs created by state-owned firms during the initial phase of transition can be interpreted as a signal directed to the banking sector in order to obtain more favourable financing conditions for the subsequent process of restructuring. The conclusions are strongly supported by Polish firm level empirical evidence.

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NON-TECHNICAL SUMMARY

Recent empirical evidence from transitional economies has stressed that state-owned firms implemented, during the initial stages of transition, heavy and costly restructuring measures, mainly in terms of reductions of the labour force. This is a somewhat puzzling fact as many theorists and policy advisors warned that state-owned firms would have resisted forms of restructuring, which would cause a slowing of the 'speed of transition'.

Another puzzling aspect emphasized by the empirical literature is that there have been substantial differences in the restructuring behaviour of firms that were operating within the same sector and were therefore, in principle, subject to analogous shocks in terms of demand, trade etc.

In this Paper we provide a theoretical framework to explain those two aspects i.e. why state-owned firms restructured more than expected and why similar firms adopted different restructuring choices.

We distinguish between defensive and strategic restructuring: the former identifies all those measures implemented in order to guarantee the immediate survival of the firm (reduction of costs and of production scale through lay-offs, closing of non-productive plants and the reorganization of the existing production line). The latter refers to a more radical and deep form of restructuring addressed to a firm's long-run development and growth through the introduction of new technologies, new production processes and new investments.

The two types of restructuring cannot be considered separate: when deciding about defensive restructuring measures, managers most likely will also consider what has to be done in the subsequent strategic restructuring phase, while on the other hand the outcome of the strategic restructuring measures will depend to some extent on the previous defensive restructuring choices.

We therefore analyse jointly the two forms of restructuring by introducing another player into the picture: the banking sector.

The strategic restructuring choice can in fact be seen as an investment decision that involves the relationship with financial institutions and that entails the usual problems of asymmetric information and market failure. In this case what banks cannot observe is the managers' quality. The quality of the managers in turn affects their restructuring decisions. In particular, good managers face lower adjustment costs during the defensive restructuring phase and choose safer strategic investment projects with respect to bad managers.

The relationship between banks and firms is modelled as a standard signalling game where firms can use their initial defensive restructuring choices to signal their quality to the banking sector in order to obtain a more favourable contract for the subsequent strategic restructuring phase.

It is found that in a separating equilibrium some firms (i.e. firms managed by 'good' managers) may signal their type with an excess of short term restructuring; that is, laying off too many workers at the beginning of the adjustment process.

The predictions of the model are confronted with firm level evidence from Poland and are supported by the recently implemented Enterprise Restructuring Programme where it appears that contracts between state-owned firms and banks take exactly the form envisaged in the model.

1 Introduction

One of the most striking aspects of the first years of the transition process is the massive increase in unemployment that accompanied economic reforms. The majority of the literature explains this increase in unemployment within models of "sectorial flows" in which a transitional economy is viewed as composed of a strongly inefficient contracting state sector characterized by low productivity of labour and an efficient growing, high productivity private sector. The labour force follows an allocation process from the first to the second sector and unemployment arises because the outflow from the state sector is greater than the absorbing capacity of the private sector. Examples of these models are works by Aghion and Blanchard (1994), Atkeson and Kehoe (1996), Blanchard (1997), Castanheira and Roland (1996), Chadha and Coricelli (1996), Gavin (1997), and Rodrik (1995).

Recent empirical estimates by Konings, Lehmann and Schaffer (1996)[1] are consistent with the flow approach stressing that flows into unemployment come essentially from the state sector while flows out of unemployment are driven by the growth of the private sector.

Nevertheless when one turns from the macroeconomic level to the microeconomic level to analyze the roots of this phenomenon, most studies warn that the resulting "speed of transition" is likely to be very low. The reason is that in transitional economies workers have a high decision making power in state owned firms and it is "optimal" for them to slow down the speed of transition and wait for private sector growth in order to have better chances to find a match there[2].

At a theoretical level it is therefore difficult to explain a high dynamism of the state sector, and these arguments have been reflected in suggestions by analysts and policy advisors which from the beginning stressed the urgency

[1] See also Svejnar (1996) for a survey

[2] In this general framework Aghion and Blanchard (1994) stress the role of unemployment benefits, Atkeson and Kehoe (1996) analyse the effects of social insurance, while Rodrik (1995) emphasizes the role of government policy and of consensus to reforms.

of fast privatization of state-owned firms in order to force them to change. In fact privatizations have been all but fast with the most important "waves" being implemented in the Czech Republic and in Poland only in 1994 and 1995 respectively.
Despite all these considerations, recent firm level empirical evidence [see in particular Belka, Estrin, Schaffer and Singh (1995), Carlin, Van Reenen and Wolfe (1995), Konings et al. (1996), Pinto, Belka and Krajewski (1993) and Pinto and Van Wijnbergen (1995)] stress that, unexpectedly, state owned firms implemented from the beginning heavy and costly restructuring measures. These were mostly in terms of reductions of the labour force.
A second aspect stressed by empirical evidence is that there have been substantial differences in restructuring behaviour of firms that were operating within the same sector and therefore in principle subject to analogous shocks in terms of demand, terms of trade etc. The macroeconomic models previously mentioned fail to account for these behavioral differences.

In this paper we provide a simple theoretical framework to explain those aspects: why firms restructured more than expected and why observationally similar firms adopted different restructuring choices.

Firstly we define precisely what are the actions and measures implied by the restructuring process. Following Grosfeld and Roland (1995) we distinguish between *defensive* and *strategic* restructuring; the former identifies all those measures implemented in order to guarantee the immediate survival of the firm (reduction of costs and of production scale through lay-offs, closing of non-productive plants and the reorganization of the existing production line). The latter refers to a more radical and deep form of restructuring addressed to a firm's long run development and growth through the introduction of new technologies, new production processes and new investments.
Firms in our model are heterogeneous and the heterogeneity derives from differences in managers' quality; those differences in turn result in different choices during the restructuring phase. In particular we show that firms

managed by "good" managers face lower adjustment costs during the defensive restructuring phase and choose less risky strategic restructuring projects with respect to firms managed by "bad" managers.

The two types of restructuring cannot be considered as separated: when deciding about defensive restructuring measures, managers most likely will also consider what has to be done in the subsequent strategic restructuring phase, while on the other hand the outcome of the strategic restructuring measures will depend to some extent on the previous defensive restructuring choices.
We therefore subsequently analyse jointly the two forms of restructuring by introducing into the picture another player: the banking sector.
The strategic restructuring choice can in fact be seen as an investment decision that involves the relationship with financial institutions and that entails the usual problems of asymmetric information and market failure. In this case what banks cannot observe is the managers' quality. The relationship between banks and firms is modelled as a standard signalling game where firms can use their initial defensive restructuring choices to signal their quality to the banking sector in order to obtain a more favourable contract for the subsequent strategic restructuring phase.
It is found that in a separating equilibrium some firms may signal their type with an excess of short term restructuring; that is, laying off too many workers at the beginning of the adjustment process.
The predictions of the model are confronted with firm level evidence from Poland and are strongly supported by the recently implemented Enterprise Restructuring Programme where it appears that contracts between state-owned firms and banks take exactly the form envisaged in the model.

The remainder of the paper is organized as follows: section 2 presents the relevant aspects of defensive and strategic restructuring; section 3 spells out the formal model; section 4 compares the predictions of the model with the empirical evidence; section 5 discusses the role of the private sector; section

6 concludes. All proofs and technical aspects are confined to the Appendix.

2 Defensive and strategic restructuring

As stressed in the introduction a puzzling aspect of many transitional economies has been that observationally similar firms (i.e. belonging to the same sector, and in principle subject to similar terms of trade and demand shocks) showed different economic performance during the initial stages of transition. This different behaviour may not seem surprising if observed in western-type economies, nevertheless it is less obvious in transitional economies where the same productive model was applied quite rigorously over entire economies and where within the same sector there were virtually no technological differences between firms. If there are unobservable differences between firms, then those have to be related in some way to the human capital employed, that is in differences between managers, workers, or a combination of the two (i.e. how the decision making process is allocated within the firm).

In this work we will assume that differences in firms' performance reflect differences in managers' qualities, i.e. how different managers implement different phases of firms' restructuring process. The results are however quite general and our story can be easily turned into a story in which different firms' performances are due to different degrees of workers' influence (for example degree of unionisation) over the decision making process.

2.1 Defensive restructuring

The pre-transition production process of Eastern European firms resulted in an outcome analogous to that which characterized the "tragedy of the commons": each firm was employing more than the optimal employment level and each worker was paid the average product[3].

[3]This is one of the paradoxes of the planned system since a well known solution to the problem of the commons is to have a central planner able to internalize the externalities.

We will take this to be the starting point of our analysis; more formally let us consider a standard concave production function $y = f(n)$ in which labour is the only factor of production; each firm starts the transition process employing an amount of labour, n_0 at which the wage rate is equal to the average product and that exceeds the optimal employment level n^* characterized by the usual marginal conditions. The optimal behaviour of each firm, once the constraints of the planning system are dismantled, is to reduce employment by $n_0 - n^*$. For the sake of simplicity we shall call $n_0 - n^*$ the optimal level of lay-offs and denote it by l^*.

In absence of any adjustment cost each firm would immediately fire l^* workers to optimize the production process. On the other hand any casual observation of labour market adjustment during the early phase of transition would emphasize the difficulties encountered by firms in achieving their optimal level of employment. The existence of adjustment costs during this process implies that firms do not achieve the first best allocation l^*; they instead end up in a second best optimum l^{**}, with $l^{**} < l^*$, the inequality widening the higher are the adjustment costs.

We approximate defensive restructuring with lay-offs. This is a strongly simplifying assumption. We do not claim that restructuring can be identified only with the creation of unemployment, nevertheless firm level empirical evidence shows that among the short run defensive responses, lay-offs have been the most frequently used. Moreover the level of lay-offs created by each firm, being easily identifiable and measurable constitutes an ideal signal to be used as a proxy for restructuring.

Finally we assume that firms' differences are reflected in different adjustment costs. For the sake of simplicity we assume that there are only two types of firms: a type g managed by good managers and a type b managed by bad managers; a good type of firm faces lower adjustment costs than a bad type of firm.

The paradox arose because the aims of the central planner in the communist system were typically different from that of achieving Pareto efficiency; in the production process these aims were rather oriented to the maximization of labour employment.

The relationship between managers' quality and adjustment costs can be derived from several sources; for instance managers of state owned firms were likely to be state officials rather than professionals hired from the market and not all of them perceived the radical change in incentives determined by reforms. One can therefore assume that some managers behaved actively in the interests of the firm, while others continued to spend efforts to cultivate political relations, lobbying etc. When faced with the prospect of firing part of an heterogeneous labour force, more efficient managers would be able on average to fire less productive workers in higher proportion than less efficient managers. This would effectively result in higher firing costs for firms with less efficient managers[4].

The profit function of a firm that faces adjustment costs in the reduction of the labour force can be approximated by the following expression[5]

$$\Pi(\cdot) \cong \Pi^* - al - \frac{1}{2}g(l^* - l)^2 \tag{1}$$

Where as previously explained l denotes the implemented level of lay-off and l^* the optimal level of lay-off (the one associated with the optimal employment level n^*); Π^* (the level of profits associated with n^*), a, g are constants, in particular a depending on the linear term and g depending on the quadratic term.

Assuming differences in firing costs and considering for simplicity that the two types of firm have the same production function, equation (1) can be rewritten as:

[4]Alternatively if the decision about firing involves effort one can immagine that good managers have lower effort costs than bad managers.

[5]This expression can be derived from a quadratic Taylor expansion around n^* (and considering that $(n - n^*) = (l^* - l)$) of the expression for profits of a firm that faces adjustment costs.

$$\Pi_\theta = \zeta - \alpha_\theta l - \frac{1}{2}\gamma(l^* - l)^2 \tag{2}$$

where the subscript $\theta = g, b$ denotes the type of the firm and ζ, α, γ are constants[6]. The index subscript for α illustrates the effect of different firing costs: firms of type g managed by "good" managers will face lower firing costs than firms of type b; therefore $\alpha_g < \alpha_b$[7].

The efficient level of lay-offs for each firm is derived maximizing (2) with respect to l, which gives the first order conditions:

$$\hat{l_\theta} = l^* - \frac{\alpha_\theta}{\gamma},$$

where it can be easily checked that $\hat{l}_g > \hat{l}_b$, that is, the more efficient firms will lay off more workers than the less efficient ones.

2.2 Strategic Restructuring

The initial lay-off decision have mainly to do with the defensive restructuring phase but this is only a part of the complex transformation that State-Owned firms have to face during the initial stages of transition. In the long run if those firms want to be economically viable they need to implement some more profound forms of strategic restructuring.

Differences in managers' qualities, other than affecting the cost of defensive restructuring, can considerably affect the outcome of the strategic restructuring phase; in particular they can play a decisive role in the choice of the

[6] l is interpreted as being normalized by the initial level of sales, to avoid capturing effects generated simply by the dimension of the firms.

[7] The assumptions that firing costs affect only the linear term and that firms have the same production function is only for simplifying matters. One could have assumed different production functions (this would have effected the squared term that depends on $f''(\cdot)$) without modifying any of the conclusione.

type of the investment project by the firm.

Let us suppose that the strategic investment project is chosen by a manager who cares about two aspects: the expected return of the project (he is rewarded with a share of its return) and the cost of bankruptcy. The latter term can be thought of as the loss in reputation following bankruptcy; managers in fact can use their performance in the implementation of the strategic restructuring project to build a reputation for themselves for a possible future job in the private sector[8].

Managers with different abilities effectively face different bankruptcy costs because they most likely attribute different weights to the "outside options" created by the private sector. In particular bad managers that are more involved with the old bureaucracy will attribute less importance to future possibilities of finding a job in the private sector resulting in effectively lower perceived bankruptcy costs.

Differences in bankruptcy costs can result in turn in differences in the choice of the type of project.

For simplicity we assume that the strategic restructuring project requires an investment I, it is entirely financed by a loan[9] on which a (gross) interest rate r has to be paid, and yields a random return R if successful (probability p) and 0 if non successful (probability $1-p$). We measure risk in terms of mean preserving spreads; it follows that $\partial p/\partial R < 0$; we additionally assume $\partial^2 p/\partial R^2 \leq 0$.

Managers are characterized by a standard utility function twice differentiable $U(W)$, with $U'(W) > 0$ and $U''(W) < 0$, where W = wealth.

Wealth depends on their compensation and on the event of bankruptcy that yields a (monetary) fixed bankruptcy cost $c_b < \alpha I r$. The term c_b can be thought as the cost in monetary terms that derives from the loss of reputation associated with bankruptcy.

[8] Pinto and Van Wijnbergen (1995) and Pinto et al. (1993) provide ample evidence of these reputational effects.

[9] We will specify in the next section where precisely this loan comes from.

Finally managers' compensations are in form of performance-related pay constituted by a fixed wage ω plus a fraction α of the firm's profits (that is the project return).
The choice of the type of project is in this case the choice of the degree of risk associated with it; given the specifications adopted it is a choice about R as a riskier project are characterized by a higher R (and a lower p)

$$\begin{aligned} \underset{R}{\text{Max}} \quad EU(\cdot) &= pU(W_1) + (1-p)U(W_2) \\ &= p(R)U(\omega + \alpha(R - Ir)) + (1 - p(R))U(\omega - c_b) \end{aligned} \tag{3}$$

The optimal choice of R is given by the first order condition

$$\frac{\partial U(W_1)}{\partial W_1} p(R) + \frac{\partial p(\cdot)}{\partial R} \left(U(W_1) - U(W_2)\right) = 0 \tag{4}$$

Proposition 1 *Managers that face lower bankruptcy costs choose riskier projects.*

Proof:
Let $\hat{R}$ be the value of R that solves (4). To see how the optimal choice $\hat{R}$ changes in response to changes in c_b we can compute the derivative:

$$\frac{\partial \hat{R}}{\partial c_b} = -\frac{\frac{\partial p(\cdot)}{\partial R}\frac{\partial U(\cdot)}{\partial W_2}}{\partial^2 EU / \partial R^2}$$

Given that $\frac{\partial^2 EU}{\partial R^2} < 0$, the sign of the derivative is completely determined by the sign of the numerator that is negative. Therefore $\partial \hat{R}/\partial c_b < 0$, that is lower bankruptcy costs would induce the manager to choose a riskier project.□

3 The game

In the previous sections we have shown that differences in managers' qualities result in different firing costs and (in presence of mean preserving spreads in project returns) in different choices of strategic restructuring projects.
But the two types of restructuring cannot be considered as separated: when deciding about defensive restructuring measures, managers most likely will also consider what has to be done in the subsequent strategic restructuring phase; on the other hand the outcome of the strategic restructuring measures will depend to some extent on the previous defensive restructuring choices.

In this section we combine the analysis of the two forms of restructuring by introducing into the picture another player: the banking sector; strategic restructuring can in fact be seen as a form of investment that, in order to be financed, involves necessarily a relationship with banks.

Banks would like to screen between firms and offer to different firms different types of contract. Nevertheless they are not able to observe the managers' type; that is, they are not able to assess the dimension of adjustment costs and to assess the incentives for each firm to select a particular strategic investment project. What banks can observe is the outcome of the defensive restructuring phase, that is the level of lay-offs generated by each firm. This in turn gives to firms an incentive to use their initial restructuring choices as a signal to resolve the informational problem.
The game used here is a standard signalling game with the following structure:

- There is a single period divided in two stages
- Prior to players' moves nature determines the firms' types (θ) assigning a probability λ to each type. In our simple example, as there are only two types it will be assumed that $\lambda = prob(\theta = \theta_g)$ and $(1 - \lambda) = prob(\theta = \theta_b)$.

- At the beginning of the period firms choose the amount of defensive restructuring that they want to implement and then ask for a loan from the bank
- Banks observe the restructuring choice by firms and simultaneously make an offer of a loan B.
- Firms decide whether or not to accept the offer.
- If the offer is accepted, firms use the loan to implement an investment oriented to strategic restructuring.
- At the end of the period firms get a return from the investment and repay the loan

3.1 A general setting

In section 2.2 we showed that bad managers will choose riskier projects than good ones; maintaining the same technical assumptions (explained below), and building on considerations set out in the previous paragraph, this allow us to express the return from strategic restructuring as depending on:

a) the amount of restructuring previously undertaken
b) the type θ of the manager
c) some stochastic factor ϵ

We can therefore write the return R as $\tilde{R} = R(l, \theta, \tilde{\epsilon})$. In particular it will be convenient to make the following assumptions:

Assumption 1 *The return to strategic restructuring takes the form:*

$$R(l, \theta, \tilde{\epsilon}) = \tilde{R}_\theta \left[\kappa - \frac{1}{2} (l^* - l)^2 \right] \tag{5}$$

with $\kappa > 1$, where $\tilde{R}_\theta$ is distributed on the support $\left[0, \bar{R}\right]$ with a distribution $F(R, \theta)$ and a density $f(R, \theta)$.

Assumption 2 *Given two distributions $F_b(R)$ and $F_g(R)$, they are characterized by the following two properties:*
a) $F_b(R)$ is a mean preserving spread of $F_g(R)$
b) $F_b(R)$ and $F_g(R)$ exhibit the single crossing property.

The requirements of Assumption 2 on the distribution $F(R, \theta)$ are precisely stated in the Appendix.
Assumptions 1 and 2 state that the return from strategic restructuring differs among firms in two aspects:
1) *Risk* with bad firms having a more risky distribution of returns than good firms.
2) *Deviations from efficiency*: the closer the firm has gone during the defensive restructuring phase to the efficient level of lay-offs, the higher will be the return from strategic restructuring.

We note that Assumptions 1 and 2 are based on the same technical specifications adopted in section 2.2, i.e., fixed investment size (I) entirely financed by a loan and mean preserving spreads in project returns. The only difference is that here we do not restrict our attention to only two outcomes but we consider a more general distribution of project returns.
From Assumption 2 one can show

Lemma 1 *If $F_b(R)$ is a mean preserving spread of $F_g(R)$ and the two distributions have the single crossing property then*

$$E\left[R \mid z \leq R \leq \bar{R} \mid F_b(\cdot)\right] \geq E\left[R \mid z \leq R \leq \bar{R} \mid F_g(\cdot)\right] \qquad \forall \;\; 0 \leq z \leq \bar{R}.$$

Proof: see the Appendix.

Assuming that each strategic restructuring process needs a fixed investment I that has to be entirely financed by debt, with limited liability the firms' return from investment is given by

$$E\Pi_\theta = E\max\left\{R_\theta\left[\kappa - \frac{1}{2}\left(l^* - l\right)^2\right] - rB, 0\right\} \tag{6}$$

Where $B = I$ is the amount of loan given by the bank to the firm and r is the (gross) contractual interest rate. Making use of (6) the overall payoff function of the firm deriving from the defensive and the strategic restructuring decision is the following:

$$\Phi_\theta = \zeta - \alpha_\theta l - \frac{1}{2}\gamma(l^* - l)^2 + \int_{R^*}^{\bar{R}} R_\theta\left[\kappa - \frac{1}{2}\left(l^* - l\right)^2\right] dF_\theta(R) - rB[1 - F_\theta(R^*)] \tag{7}$$

where R^* satisfies

$$R^* = \frac{rB}{\left[\kappa - \frac{1}{2}\left(l^* - l\right)^2\right]} \tag{8}$$

Equation (7) defines a set of iso-profit curves for the firm. In the (r, l) space the iso-profit curves are concave in l.
Maximizing Φ_θ with respect to l we obtain:

$$\bar{l}_\theta = l^* - \frac{\alpha_\theta}{\gamma + \psi_\theta} \tag{9}$$

where

$$\psi_\theta = \int_{R^*}^{\bar{R}} R_\theta dF_\theta(R) \tag{10}$$

From Assumption 2 and from Lemma 1 from it can be easily derived that

$$\psi_b = \int_{R^*}^{\bar{R}} R_b dF_b(R) \geq \psi_g = \int_{R^*}^{\bar{R}} R_g dF_g(R) \tag{11}$$

Assumption 3 *We will adopt the following restrictions:*
a) The two distributions are such that $\frac{\psi_b+\gamma}{[1-F_b(R)]} > \frac{\psi_g+\gamma}{[1-F_g(R)]}$
b) Parameters values are such that $\frac{\gamma-\mu}{1-F_b(R^*)} > \frac{\gamma-\mu}{1-F_g(R^*)}$.

Where μ is defined in the appendix.
Assumption 3 guarantees that the iso-profit curves for the good type of firm are more open parabolae than those of the bad type of firm; in other words the "single crossing property" holds, guaranteeing the existence of a perfect (bayesian) Nash equilibrium of the game.

We now turn to the banking sector: banks are assumed to operate in an oligopolistic market where Bertrand competition drives profits to 0. Let ρ be the (gross) deposit interest rate. The bank's zero profit condition can be expressed as

$$E\Pi_\theta^B = Br[1 - F_\theta(R^*)] + \int_0^{R^*} R\left[\kappa - \frac{1}{2}(l^* - l)^2\right] dF_\theta(R) - \rho B = 0 \tag{12}$$

Also the banks' iso-profit curves are parabolae, but they are convex in l with a minimum at $l = l^*$.
To check the parabola's slope we have to refer to the marginal rate of substitution between r and l.

$$\left.\frac{\partial r}{\partial l}\right|_{\pi_\theta^B=0} = \frac{-\left(\int_0^{R^*} RdF_\theta(R)\right)(l^* - l)}{B[1 - F_\theta(R^*)]} = \delta_\theta \tag{13}$$

Proposition 2 *If assumption 3 holds, then:*
i) the bank zero profit lines are steeper for the good type of firm than for the

bad type.
ii) at $l = l^*$ the zero profit line for the bad type lies above the zero profit line for the good type.

Proof: see the Appendix.

Banks are therefore rewarding firms for getting close to l^* during the defensive restructuring phase by charging a lower interest rate. Moreover the reduction in interest rate banks are willing to accept for any given increase in l is higher for the good type of firm than for the bad type.

Consider first, as a benchmark, the *symmetric information case*: the bank is perfectly able to discriminate between firms' types. There is no incentive problem and the equilibrium level of lay-off (denoted by $\tilde{l}_\theta$) is identified with the tangency point between banks' and firms' iso-profit lines.

Proposition 3 *The equilibrium level of lay-off $\tilde{l}_\theta$ is greater for the good type than for the bad type and lies between the level l that maximizes* (7) *($\bar{l}_\theta$) and l^*.*

Proof: see the Appendix.

Figure (1) gives a graphical representation. Note that the levels of firms' iso-profit lines are decreasing in r.
In the following we are implicitly assuming that banks are willing to lend at different interest rates to both types of firm; it could be argued that this is not necessarily the case and that banks may not be willing to lend at all to the bad type of firm. The current formulation is justified by the fact that the main point here is to stress the use of defensive restructuring for signalling purposes; from the literature on signalling games we know that types should not be too different in order to have effective mimicking and separating incentives[10]. Moreover this allows us to explain different behaviour of firms

[10]See Fudenberg and Tirole (1991, Ch.8, and 11).

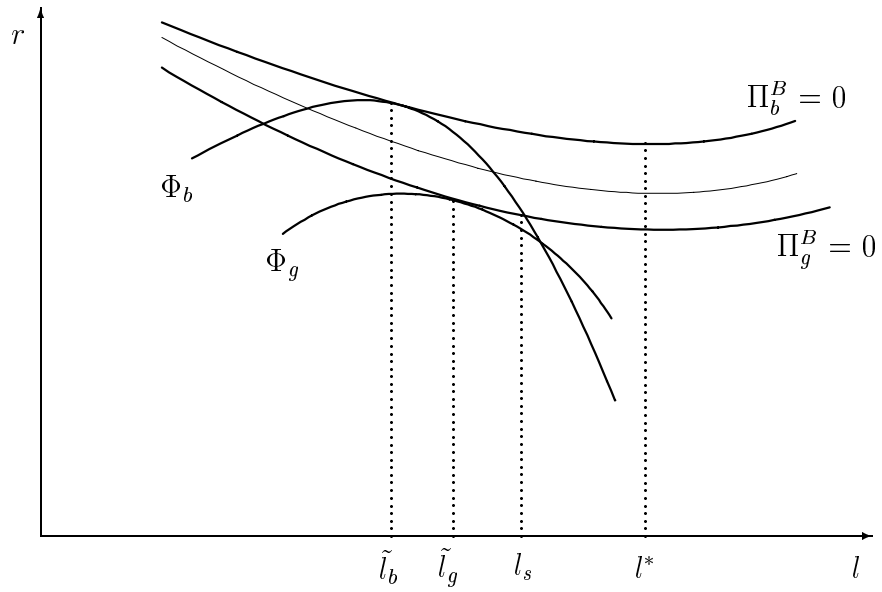

Figure 1: Separating Equilibrium

operating within the same sector and therefore theoretically very similar[11]. In case of *asymmetric information*, however the pair of contract $(\tilde{l}_b, \tilde{l}_g)$ is no longer sustainable as the bad type of firm would increase profits by mimicking the good type and choosing $l = \tilde{l}_g$; moreover at $\tilde{l}_g$ if both types apply for the loan the bank would make a loss as $\tilde{l}_g$ lies below the dotted line of the zero profit condition for the bank in case of pooling.
With asymmetric information $\tilde{l}_g$ cannot therefore be an equilibrium; however, as well known in the literature on signalling games, banks' beliefs about firms' types may allow several different equilibria, both separating and pooling, to be sustained.

Proposition 4 *If Assumptions 1 through 3 hold, there is at least one separating equilibrium in which the good type of firm signals its type by choosing a*

[11]The case in which the bad type do not receive any money at all from the banking sector can always be seen as a particular case of this more general framework.

higher level of lay-off. If moreover we apply refinements based on equilibrium dominance, there is a unique separating equilibrium identified by l_s in figure (1).

The separating equilibrium must satisfy the pair of incentive compatibility constraints

$$\Phi_g(l_s, r_g(l_s)) \geq \Phi_g(\tilde{l}_g, r_b(\tilde{l}_g)) \quad (14)$$

$$\Phi_b(\tilde{l}_b, r_b(\tilde{l}_b)) \geq \Phi_b(l_s, r_g(l_s)) \quad (15)$$

That is the good type does not have an incentive to choose $l = \tilde{l}_g$ and being believed to be bad and the bad type does not have an incentive to mimic the good one choosing $l = l_s$. There are several of these separating equilibria that however can be pareto-ranked. The pareto efficient separating equilibrium is that one in which the incentive compatibility constraint (15) holds with equality. Such an equilibrium is depicted in figure (1). Note that there is an "outperformance" effect in l_s : in order to separate from the bad type, the good firm has to create lay-offs in excess to the efficient level $\tilde{l}_g$.
The intuition behind this result is the following: from equation (2) we know that without the investment project the good type of firm would lay-off $\hat{l}_g > \hat{l}_b$ workers; however the efficiency cost (the term represented by γ) for the firm to exceed $\hat{l}_g$ is the same for both firms. The possibility of investing in strategic restructuring introduces an additional element that affects the squared term: the more l exceeds $\hat{l}_\theta$ by getting closer to l^* the lower are the advantages of investing in a project with a riskier return and therefore ceteris paribus the bad type of firm would require a higher reduction of r to match a given increase in l. If this second effect is sufficiently high (this is guaranteed by Assumption 3) the good type of firm has the incentive to "overshoot" the full information outcome in order to separate from the bad type.

There are also several pooling equilibria in which both types choose the same level of l and are being offered the same interest rate by the bank. One of

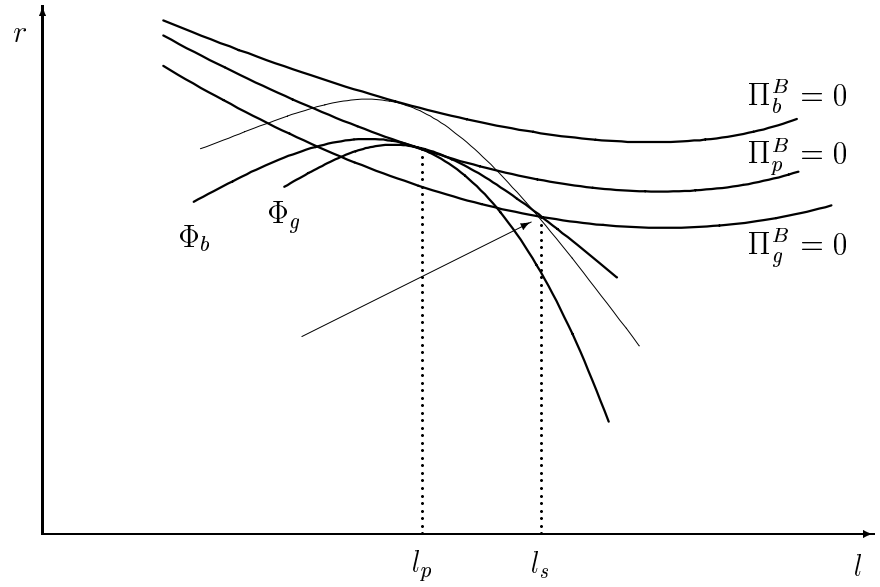

Figure 2: Pooling Equilibrium

these equilibria is depicted in figure (2) and is represented by l_p. In figure (2) there is also depicted the area (indicated by the arrow) that represents the set of possible deviations from l_p by the good type that meet the requirements of the intuitive criterion (see Cho and Kreps (1987) and Kreps and Sobel (1994)), and that therefore can be used to eliminate an equilibrium like l_p.

4 Empirical Evidence

There are two types of empirical evidence that support the predictions of the model.

4.1 Direct Evidence

In its simplest form the model lead to the following prediction: we should observe credit contracts to be contingent upon the level of lay-offs. The recently

implemented Polish Enterprise Restructuring Program (ERP) [12] provides full support to this claim.

Implemented over a three year horizon between 1993 and 1996 the ERP was aimed at restructuring banks' portfolios and at the resolution of the bad debt problem inherited by State-Owned enterprises from the pre-transition period. In contrast to other programs adopted in Poland and other countries, the ERP was based on strict economic criteria. The aims of the ERP were twofold: on one side it established the condition for the implementation of successful long term restructuring programs, and on the other it helped banks to learn risk assessment and to develop monitoring techniques. Within this program State Owned enterprises could initiate conciliatory procedures with banks in order to have a rescheduling of the existing debt or an extension of new credit. These measures were subject on the presentation of a restructuring program by the firm that had to be approved by the bank. The restructuring programs were typical examples of defensive restructuring with much emphasis on the reduction of the labour force. The contracts written between banks and firms were therefore contingent upon the level of defensive restructuring that had to be implemented. The fact that we observe such contracts is *per se* evidence of an underlying problem of asymmetric information between banks and firms, that the contract tries to resolve. Of course such empirical evidence cannot show whether it is the informed (firms in our case) or the uninformed part (banks) to move first, in which case our signalling model would be turned into a screening model. Since the basic results would be the same in either case we preferred to focus on the signalling case to stress the importance of firms' active rather than passive response to the changing economic environment.

[12] Belka and Krajewska (1997) provide an assessment of the ERP based on a survey conducted on firms that adopted it.

4.2 Indirect Evidence

Although the model does not say much about firms' profitability, if good firms are laying off workers in excess of their optimal level, in the initial stages of the transition they should be characterized by lower output and lower profitability than bad firms. We should then observe initially a negative correlation between banks' credit and firms' profitability, while this relationship should turn positive. This is exactly what found by Pinto and Van Wijnbergen (1995) in Poland. One could argue that this is nothing more than evidence of hardening of budget constraints (i.e. budget constraint were initially soft and then progressively became hard), however Grosfeld and Nivet (1997) show that firms that experienced highest fall in output and employment during the initial stages of transition and that were characterized by initial negative profitability, subsequently experienced a sustained growth of output, labour productivity and profit margins. On the other side those firms that had a low fall in output and employment and were characterized by positive initial profitability experienced a steady decline in profit margin and a much lower output and labour productivity growth.

Finally it has to be stressed that this work has important implications for empirical work, in relation to studies of wages and employment; in particular it suggests that estimated elasticities of labour demand in transition economies may be low because "good" firms are shedding labour faster than they would for signalling purposes. Further empirical work on this matter is certainly needed.

5 The Private Sector

Despite being focused on the state sector, the model could be extended to the private sector where signalling effects play an important role when we consider the relationship between banks and private firms in the decision on how to finance a given investment project.

It is well known from the literature of financial market imperfection that when there are multi-dimensional contracts that specify, other than the interest rate, some other variable such as the level of collateral [Bester (1985)] or the dimension of the loan [Milde and Riley (1988)], it is always possible to determine the conditions for which there can be a separating non rationed equilibrium in contrast with the pooling rationed one.
The work by Milde and Riley in particular provides a "natural" extension to our framework: in their paper it is shown that in presence of mean preserving spreads in the distribution of project returns, it is possible to obtain a separating equilibrium in which good firms signal their type by underinvesting [13].
Under very similar assumptions about project returns we can therefore think about a general framework in which state owned firms create "excess" lay-offs and private firms create very few new jobs in order to signal their types. The results of this general framework are perfectly compatible with the "macroeconomic" flow approach discussed in the introduction, and, although it does not exhibit full dynamics, it is able to account for the inflow and the outflow in unemployment in the early stages of transition.

6 Conclusions

Despite being stylized and very simple the analysis conducted in this paper gives an explanation of the high dynamism and success of state-owned firms in reducing employment in the first phases of the transition process and of the different behaviour of observationally similar firms.
We have identified the conditions for which state owned firms may use defensive restructuring as a signal to obtain more favourable credit deals with banks during the subsequent strategic restructuring phase. It turns out that the same conditions would create an incentive for private firms to use short term defensive investment as a signal for their quality.

[13] In the Milde and Riley case underinvesting means choosing smaller loan contracts.

Both these signalling effects would lead to excessive dynamism of the state sector in laying off workers and excessive prudence by the private sector in implementing decisive (and labour creating) investment projects. The joint effect of these two forces can provide a good explanation of the impressive rise of unemployment during the earlier phases of transition.
Evidence from Enterprises Restructuring Program recently implemented in Poland show that the type of contract envisaged in the model was widely adopted.

A Appendix

A.1 Proof of Lemma 1

In line with Rothschild and Stiglitz (1970) we adopt the following definition:

Definition 1 *Given two distributions $F_b(R)$ and $F_g(R)$ defined over the same support $\left[0, \bar{R}\right]$, $F_b(R)$ is a mean preserving spread of $F_g(R)$ if the following two properties hold:*

i They have the same mean,:

$$\int_0^{\bar{R}} R dF_b(R) = \int_0^{\bar{R}} R dF_g(R)$$

ii For any $z \in \left[0, \bar{R}\right]$ then

$$\int_0^z F_b(R) dR \geq \int_0^z F_g(R) dR$$

or, alternatively

$$\int_z^{\bar{R}} [1 - F_b(R)] dR \geq \int_z^{\bar{R}} [1 - F_g(R)] dR$$

Definition 2 *If two distributions $F_b(R)$ and $F_g(R)$ exhibit the single crossing property, there is a $0 \leq \hat{R} \leq \bar{R}$ such that*

$$F_b(R) \geq F_g(R) \qquad \text{for } R \leq \hat{R}$$

and

$$F_b(R) \leq F_g(R) \qquad \text{for } R \geq \hat{R}$$

From Lemma 1, if $F_b(R)$ is a mean preserving spread of $F_g(R)$ and the two distributions have the single crossing property, then for any $z \in [0, \bar{R}]$

$$\frac{\int_z^{\bar{R}} R dF_b(R)}{1 - F_b(z)} \geq \frac{\int_z^{\bar{R}} R dF(R)}{1 - F_g(z)} \tag{A4}$$

Proof:

Consider initially the case in which $0 \leq z \leq \hat{R}$, then using the formula of integration by parts we have

$$\int_z^{\bar{R}} R dF_b(R) = \bar{R} - zF_b(z) - \int_z^{\bar{R}} F_b(R) dR = z[1 - F_b(z)] + \int_z^{\bar{R}} [1 - F_b(R)] dR$$

Analogously for $F_g(R)$ we have

$$\int_z^{\bar{R}} R dF_g(R) = \bar{R} - zF_g(z) - \int_z^{\bar{R}} F_g(R) dR = z[1 - F_g(z)] + \int_z^{\bar{R}} [1 - F(R)] dR$$

From the definition of mean preserving spread and noting that for $0 \leq z \leq \hat{R}$, $[1 - F_b(R)] \leq [1 - F_g(R)]$ equation (A4) follows.
For $\hat{R} \leq z \leq \bar{R}$, however $[1 - F_b(R)] \geq [1 - F_g(R)]$ and equation (A4) not necessarily holds; to prove Lemma 1 completely note that given the definition of mean preserving spread and the assumption of a single crossing point, if

equation (A4) holds, then

$$\frac{\int_0^z RdF_b(R)}{F_b(z)} \leq \frac{\int_0^z RdF_g(R)}{F_g(z)} \tag{A5}$$

with the first inequality implying necessarily the second and vice versa.
We can then apply to the interval $[\hat{R}, \bar{R}]$ the same procedure followed previously. Integrating by parts in equation (A5),

$$\int_0^z RdF_b(R) = zF_b(z) - \int_0^z F_b(R)dR$$

and

$$\int_0^z RdF_g(R) = zF_g(z) - \int_0^z F_g(R)dR$$

From the definition of mean preserving spread and from the fact that for $\hat{R} \leq z \leq \bar{R}$, $F_b(R) \leq F_g(R)$ then equation (A5) follows and the proof is complete. □

A.2 Proof of Proposition 2

Part i): if $|\delta_b| < |\delta_g|$ it must be the case that

$$\frac{\int_0^{R^*} RdF_b(R)}{[1 - F_b(R^*)]} < \frac{\int_0^{R^*} RdF_g(R)}{[1 - F_g(R^*)]} \tag{A6}$$

Using the fact that

$$\int_0^{R^*} RdF_\theta(R) = \mu - \int_{R^*}^{\bar{R}} RdF_\theta(R) \tag{A7}$$

where, by definition of mean preserving spread

$$\mu = \int_0^{\bar{R}} R dF_b(R) = \int_0^{\bar{R}} R dF_g(R)$$

Inequality (A6) can therefore be rewritten as

$$\frac{\int_{R^*}^{\bar{R}} R dF_b(R) - \mu}{[1 - F_b(R^*)]} > \frac{\int_{R^*}^{\bar{R}} R dF_g(R) - \mu}{[1 - F_g(R^*)]} \tag{A8}$$

It is easy to check that (A7) holds whenever assumption 3 is satisfied.

Part ii): at $l = l^*$

$$r = \frac{\rho B - \kappa \int_0^{R^*} R dF_\theta(R)}{B[1 - F_\theta(R^*)]}$$

Our claim is that

$$\frac{\rho B - \kappa \int_0^{R^*} R dF_b(R)}{B[1 - F_b(R^*)]} > \frac{\rho B - \kappa \int_0^{R^*} R dF_g(R)}{B[1 - F_g(R^*)]}$$

that making use of equation (A7) can be rewritten as:

$$\frac{\kappa}{B} \frac{\left(\frac{\rho B}{\kappa} - \mu\right) + \int_{R^*}^{\bar{R}} R dF_b(R)}{[1 - F_b(R^*)]} > \frac{\kappa}{B} \frac{\left(\frac{\rho B}{\kappa} - \mu\right) + \int_{R^*}^{\bar{R}} R dF_g(R)}{[1 - F_g(R^*)]} \tag{A9}$$

As $\rho B \leq \kappa \mu$ equation (A9) holds whenever assumption 3 is satisfied. □

A.3 Proof of Proposition 3

The efficient level of l is defined by the tangency point between the banks' and the firms' iso-profit curves. Differentiating the firms' iso-profit curves, by the implicit function theorem we get

$$\left.\frac{\partial r}{\partial l}\right|_{\Phi_\theta=\text{constant}} = \frac{-\alpha_\theta + \left(\gamma + \int_{R^*}^{\bar{R}} R dF_\theta(R)\right)(l^* - l)}{B[1 - F_\theta(R^*)]}$$

and we know that for the banks

$$\left.\frac{\partial r}{\partial l}\right|_{\pi_\theta^B=0} = \frac{-\left(\int_0^{R^*} R dF_\theta(R)\right)(l^* - l)}{B[1 - F_\theta(R^*)]}$$

The efficient level of l is such that

$$\left.\frac{\partial r}{\partial l}\right|_{\Phi_\theta=\text{constant}} = \left.\frac{\partial r}{\partial l}\right|_{\pi_\theta^B=0}$$

making use of equation (A7) the efficient level of lay-off

$$\tilde{l}_\theta = l^* - \frac{\alpha_\theta}{\gamma + \mu} \tag{A10}$$

is such that a) $\tilde{l}_\theta > \bar{l}_\theta$ for any type
b) $\tilde{l}_g > \tilde{l}_b$ as $\alpha_b > \alpha_g$. □

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