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ABSTRACT

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The behaviour of an oligopolistic industry in a transition economy is analysed, assuming that the firms are labour-managed and the economy is open to international trade. The output of these firms is assumed to be of lower quality than the output of Western firms. Cournot equilibrium in the presence of bottlenecks is derived. Such bottlenecks may be particularly damaging because firms respond by cutting exports disproportionately. This may explain why countries, such as those in the former Soviet Union, which have faced serious supply bottlenecks, have failed to develop exports, while the economies of Central Europe, where materials are more freely available, have seen rapid export growth.

JEL Classification: D21, P31
Keywords: transition, labour management, Cournot oligopoly, exports

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NON-TECHNICAL SUMMARY

In this paper, we build a model of firms in the transition economies, which draws on a number of critical features of the reform processes that have hitherto been largely ignored. First, we assume that firms are owned and controlled by their managers and workers, because it has been widely observed that reliance on 'mass production' in most countries in the region has led 'insiders' to obtain control of the bulk of privatized firms. The second feature of transition, which drives our model, is the rapid opening of these countries to trade with OECD countries at very low tariffs. Early reform typically involved a simultaneous liberalization of both domestic prices and international trade, with the explicit aim of controlling domestic monopoly power, which was otherwise seen as likely to hinder rapid supply responses. This led to a very rapid increase in both exports from and imports to the transition economies, especially those in Central Europe, from notably the European Union. Exports from transition economies have been concentrated at the lower quality end of the product range, however, while imports into these countries have included both high and low quality products.

We bring these factors together in a model of enterprise in transition economy, which uses a 'revised' Ward-Vanek framework of labour management e.g. with the firms maximizing a weighted product of employment and earnings. Firms are assumed to operate in an industry with an oligopolistic market structure (Cournot), supplying a product produced at two levels of quality – low and high. Firms in the transition economy produce the low quality goods and those in developed market economies the higher one. Transition economies are assumed to operate on competitive world markets for both the lower and higher quality goods.

We first solve the model and point out differences between the behaviour of these firms and conventional profit – maximizing ones; for example, the transition firms after supply in the short run in response to changes in capital costs. Our main concern, however, is to create the model to analyse the effects of bottleneck in materials supplies. These are widely regarded as having been an important feature of transition economies, especially in the early years in Central Europe and perhaps more chronically in the former Soviet Union. The model suggests that such bottlenecks may induce firms to cut exports before domestic production. More seriously, we identify circumstance in which the effects are discontinuous and large scale; when a 'small' reduction in material supply can lead to a 'huge' fall in exports. This situation does not arise when firms are profit maximizing and thus is a direct consequence of privatization policies that have favoured insiders. The discontinuous effect may explain why countries which have faced ongoing

supply problems, such as those in the former Soviet Union, have failed to expand their manufacturing exports. Their performance in this area stands in stark contrast to the strong export performance in recent years in Central Europe, where materials have, in recent years, been more freely available.

Output and Exports in Transition Economies: A Labour Management Model

1. Introduction

In this paper we explore how important features of the transition process might interact to generate some of the enterprise supply behaviour that we have seen in recent years. The first element of transition underlying our modelling is widespread insider ownership and control, which we formalize in the context of a "revised" Ward-Vanek model of labour-management. The second is the immediate opening of most transition economies to trade with OECD countries at very low tariffs (see e.g. World Bank (1996), EBRD (1995, 1996, 1997)), with the resulting growth in exports, at least in much of Central Europe (see e.g. Gros and Gonciarz (1994)). We bring these features together in a Cournot model with price discrimination between low and high quality products: we assume that the output of firms in the transition economy is currently of lower quality than that of firms in Western economies. After characterizing the equilibrium for the firm and industry, we use the framework to consider an important feature of economies in transition - bottlenecks in the supply of raw materials (see e.g. Blanchard and Kremer (1997), Roland and Verdier (1997)). We find that, under these assumptions, constraints on material supplies may lead enterprises to cut exports before domestic production. Thus "perversity" in export performance may be a damaging implication of privatization policies which have favoured insiders. Moreover, we identify circumstances in which the effects are discontinuous and large scale: a "small" reduction in material supplies can lead to a "large" fall in exports. Thus the model predicts a relationship between supply bottlenecks and export performance. It may

therefore explain why countries which have faced supply problems, such as in the former Soviet Union, have failed to expand manufacturing exports. This is in contrast to the economies of Central Europe where materials are more freely available and export performance has typically been very strong (see EBRD (1997)).

Though original in conception and application, our framework builds on several important strands of the earlier literature. The original labour-management model (see Ward (1958), Vanek (1970), Meade (1972)) assumed the enterprise maxim and to be average earnings per worker, but more recent analysts have been critical of this assumption, particularly when employment adjustment is a central concern (see e.g. Ben-Ner and Estrin (1991), Prasnikar, Svejnar, Michajlek and Prasnikar (1992) and Bonin, Jones and Putterman (1993)). We allow firms in transition to be motivated by a weighted product in employment and earnings (see also Blanchard (1997)), which nests within it the traditional self-management case.

Cournot equilibrium in the labour-managed economy is discussed, for example, in Hill and Waterson (1983), Neary (1984), Laffont and Moreaux (1985) and Neary and Ulph (1997))[2] and mixed oligopoly models are treated in, e.g. Cremer and Crémer (1992) and Delboro and Rossini (1992). These papers assume income maximization and do not consider trade. Indeed, there is only a modest literature on labour-managed firms operating in foreign markets, in competition with profit-maximizing firms (see Mai and Hwang (1989), Okuguchi (1991) and Horowitz (1991)). None of these papers covers the issue of price discrimination in a mixed oligopoly, which is at the core of this paper, let alone in a “revised Ward” framework. However, Katz and Berrebi (1980) provide the basic result for the price discriminating labour-managed monopolist, on the assumption of income maximization.

The assumption of labour-management for the transition economies derives from the widespread apparent insider control as well as ownership of enterprises. As noted by Earle and Estrin (1996), for the countries where data are available it is clear that reliance on mass privatization has led to dominant "insider" ownership in most firms. In countries as diverse as Romania, Poland and Russia, the data suggest that the bulk of the shares are owned by managers and workers who appear to control the enterprise (see e.g. Blasi *et al* (1997)). In addition, most analysts of state-owned firms in the immediate post-transition era (see, e.g., Pinto *et al.* (1993)) have noted that the collapse of effective control by the state allowed workers and managers to assume dominance over decision-making; a process which has proved extremely hard to reverse. This has led many Western observers also to regard the state sector in transition economies as labour-managed (see e.g. Commander and Coricelli (1995), Blanchard (1997)), and, especially in the early years of transition, it is these firms which continue to provide the bulk of exports (see, e.g. EBRD (1995), Belka *et al.* (1994))[3].

Our main concern is to analyse the impact of supply bottlenecks in an open economy. The start of the transition typically involved simultaneous price and trade liberalization (see e.g. Gros and Steinherr (1995)), though the trade element was highly contentious (see e.g. McKinnon (1991)). Domestic market structures were usually severely imperfect (see e.g. Estrin and Cave (1993)) and opening the economy to free trade was seen as an important way to control domestic monopoly power (see Lipton and Sachs (1990)). Hence we have assumed an oligopolistic market structure for the economy in transition (though our main results also apply for monopoly). Our analysis also draws on the evidence that exports from transition economies have been concentrated at the lower quality end of the product range, while imports have included both high and low quality western products (see Landesmannn and Burgstaller (1997), Brenton and Gros (1997)). Moreover, while exports from some transition economies have grown very rapidly (see

Carlin and Landesmann (1997)), Aturupane *et al* (1997) demonstrate that in the period between 1990 and 1995, trade was predominantly in vertically differentiated products with the transition economies exporting lower quality labour intensive products (see also EBRD (1997)). In the work which follows, we therefore model an industry with a product produced at two quality levels, with firms in transition economies producing the low quality level and these in developed market economies the higher one. Thus the transition economy is assumed to manufacture goods of lower quality, but not to import them. We abstract from other low cost low quality suppliers who would in practice provide competition on the world market, in order to focus attention on the interaction between the West and transition economies. However, we reflect the broader availability of low quality goods on the world market by assuming that their export price is exogenous to firms in the transition economies. Transition economies are also assumed to be price takers for the higher quality goods.

In the following section, we characterize the equilibrium for the firm and the industry in a transition economy in the absence, and then the presence, of exports. We go on to compare the results with the capitalist case, before analysing in the third section the impact of material supply bottlenecks on exports. The broader implications of our analysis are drawn in the final section.

2. The Basic Model

We abstract from questions of competition between transition or developed economies by assuming a single economy of each type. We thus assume two types of economy, developed and transition, manufacturing in an industry at two quality levels. Firms in the transition economy produce at a lower quality level, while firms based in the developed market economy make the good at a higher quality level; for reasons discussed above the transition economy

exports the lower quality good, and imports the higher quality one[4].

Domestic demand in the transition economy for the lower quality good is

$$Q = \alpha - p + \gamma p_f \;; \quad \alpha, \gamma > 0 \tag{1}$$

where p is the unit price of the lower quality good, while p_f is the unit price of the higher quality good, in domestic currency. α and γ are constants, γ being a measure of the cross-elasticity of demand between the two qualities of good. As $\gamma \to 0$ product differentiation is greater. Equation (1) can be rewritten,

$$p = (\delta - Q) \tag{2}$$

where

$$\delta \equiv \alpha + \gamma p_f \tag{3}$$

Assuming that the import price p_f is given, the demand curve (2) facing domestic producers in the transition economy is linear, with a vertical intercept that is increasing in p_f. Furthermore, as noted above, we assume that in the export market, domestic producers are 'small', and so can sell unlimited quantities at the given domestic currency unit price p_e.

For our specification of technology, we use for convenience a Leontief production function. All the main results in this paper can be derived with a more general specification of technology, though less tractably. Moreover, Leontief technology makes it particularly simple to introduce material supply constraints in the subsequent section[5]. Thus there are N (≥ 1) domestic producers, each with production function,

$$q^i = \min\, a^i(l^i,\ k^i/b^i), \quad a^i, b^i > 0, \quad i = 1,2,\ldots,N \tag{4}$$

Firm i produces q^i units of output employing l^i workers. Its fixed capital stock is k^i and so output can be no greater than the full capacity level $a^i k^i / b^i \equiv \bar{q}^i$. Firm i supplies q_h^i to the home market and q_e^i to the export market, where

$$q^i = q_h^i + q_e^i \tag{5}$$

We assume each firm *i* to be labour-managed, with the general objective function (see Ben-Ner and Estrin (1991)),

$$u^i = (y^i)^\sigma (l^i)^{1-\sigma}, \qquad ½ < \sigma \leq 1 \tag{6}$$

where y^i is net income per worker,

$$y^i = (pq_h^i + p_e q_e^i - rk^i)/l^i \tag{7}$$

and r is the (positive) rental on capital[6]. If the weight σ in (6) is unity, we have the Illyrian firm of Ward (1958). If $\sigma<1$, we have a 'revised' Illyrian firm in which there is a willingness to sacrifice some net income per worker for additional employment. Svejnar (1982) associates the weight in the utility function with attitudes to risk among worker owners. We make the restriction that $\sigma>½$ both on grounds of realism and because degenerate solutions are thereby avoided[7].

2.1 Home Sales Only

In the home market we assume that the *N* firms engage in Cournot competition, whereas in the foreign market they face the fixed nominal price p_e. Suppose, first, that any firm i does not export at all. The Cournot solution in this case is derived in Appendix A. Any firm *i* chooses q_h^i to maximize u^i, subject to (2)-(4), (6) and (7), given $\Sigma_{j\neq i} q_h^j$ and the constraints $q^i \leq \bar{q}^i$ and $q_e^i = 0$. The solution is

$$q_h^i = \min(\hat{q}_h^i, \bar{q}^i) \tag{8}$$

where

$$\hat{q}_h^i = ½\{(1-\sigma)\Delta^i + [(1-\sigma)^2(\Delta^i)^2 + 4(2\sigma-1)rk^i]^{½}\} \tag{9}$$

$$\Delta^i \equiv \delta - \sum_{j\neq i} q_h^j \tag{10}$$

Given that $\sigma>½$, the square root in (9) is real. The firm produces $\hat{q}_h^i$ unless prevented from doing so by the capacity constraint. If $\sigma=1$, no weight being put on employment in the objective function, then $\hat{q}_h^i=(rk^i)^{½}$. Since the marginal revenue product of labour in the home market is

$$MRP_h^i = (\Delta^i - 2q_h^i)a^i \tag{11}$$

the "revised" model nests the familiar labour-management case in which $y^i=MRP_h^i$. If, however, $\sigma<1$, with the capacity constraint not binding, it is shown in the Appendix[8] that provided inequality (A2) is satisfied (which is necessary for y^i to be positive), we deduce the familiar utility maximizing result that in equilibrium, average earnings exceed the marginal revenue product of labour.

Let $\hat{l}_h^i$ denote the employment corresponding to output $\hat{q}_h^i$. The value of $\hat{l}_h^i$ is illustrated in Figure 1, where the relationships shown are found by substituting (2), (6), (10) and $q_e^i=0$ into (7) to obtain

$$y^i = (\Delta^i - a^i l^i)a^i - rk^i/l^i \tag{7'}$$

Because of the Cournot assumption Δ^i is a parameter for i. $(\Delta^i - a^i l^i)a^i$ is the derived residual demand for labour, which is plotted along with the rectangular hyperbola rk^i/l^i, the cost of capital per unit of labour. y_h^i is the only positive if $l_{h0}^i<l_h^i<l_{h1}^i$ in the figure (this is equivalent to (A1) in the Appendix). If $\sigma=1$, then $\hat{l}_h^i = (rk^i)^{½}/a^i$, which is located at the level of l_h^i at which $(\Delta^i - a^i l_h^i)a^i$ and rk^i/l_h^i are parallel. If $\sigma<1$, $\hat{l}_h^i > (rk^i)^{½}/a^i$. If the capacity constraint bites, l_h^i is set below $\hat{l}_h^i$, in which case it is necessary that $k^i/b>l_{h0}^i$ for y^i to be positive.

Figure 1: The employment decision when exports are zero (FIGURE HERE)

The signs of the comparative statics for firm *i* are easily derived from (8) and (9), taking into account that (A2) must be satisfied. These signs are shown in Table 1. It is reassuring that if $\sigma=1$, the 'standard' Ward-Vanek case, it is well-known that, for an internal solution, output is increasing in both k^i and r[9]. Even in the "revised" labour management case, with $1>\sigma>1/2$, the same result obtains because there is still sufficient weight on y^i in the objective function.

TABLE 1

EFFECTS ON q_h^i OF VARIATION OF PARAMETER VALUES

parameter value raised	$\hat{q}_h^i<\bar{q}^i$	$\hat{q}_h^i\geq\bar{q}^i$
k^i	+	+
r	+	0
σ	-	0
a^i	0	+
Δ^i	+/0*	0

* + if $\sigma<1$, 0 if $\sigma=1$

If the capacity constraint bites, $d\hat{q}^i/dk^i$ remains positive, but variation of interest rates has no effect. It is not surprising, given the tendency of the traditional labour managed firm to restrict output, that a greater weight σ on earnings in the objective function is associated with less output, at least if the capacity constraint does not bind; of course it has no effect if it does bind. However, with a non-binding capacity constraint, output is independent of the efficiency parameter a^i in the production function. Intuitively, this is because, on the one hand, pursuit of

the employment objective alone is independent of a^i, while, on the other, maximization of y^i leads to $\hat{q}_h^i = (rk^i)^{½}$, a solution that is independent of a^i. But capacity output is increasing in a^i, so if the capacity constraint binds, $d\hat{q}_h^i/da^i>0$.

Finally, consider the effect of a greater value of Δ^i, the residual inverse demand facing *i*. Suppose first that the capacity constraint does not bite. If $\sigma=1$ there is no effect on output: in terms of Figure 1, the residual demand for labour curve, $(\Delta^i - a^i l_h^i)a^i$ shifts vertically upwards, so that the level of l_h^i at which it is parallel with $(rk^i)^{½}/a^i$ is unaffected. But if $\sigma<1$, with the firm valuing employment somewhat, a greater residual demand allows any given level of employment to be achieved at a smaller marginal cost in terms of earnings, and so output is raised. Referring back to the definitions of parameters in (1), (3) and (10), we therefore have that if $\sigma<1$ and the capacity constraint does not bite, employment is positively related to the demand intercept α, the measure of cross elasticity of demand γ and the import price p_f.. If the capacity constraint bites, however, output is independent of Δ^i. From (10), $d\Delta^i/dq_h^j<0$ $(i\neq j)$. The last row of the table therefore implies that, provided the capacity constraint does not bind, $d\hat{q}_h^i/dq_h^j<0$ for $\sigma<1$, but $d\hat{q}_h^i/dq_h^j=0$ for $\sigma=1$. We show in Appendix A that $d^2\hat{q}^i/dq_h^{j2}>0$ for $\sigma<1$.

Given these results for the firm, we now turn to the industry, using the simplifying assumption of a duopoly of identical firms. The solution is analysed in Appendix B and illustrated in Figure 2. Given that the capacity constraints do not bite, equilibrium outputs are

$$\hat{q}_h^1=\hat{q}_h^2=\{(1-\sigma)\delta + [(1-\sigma)^2\delta^2 + 4(2\sigma-1)\sigma rk]^{½}\}/2\sigma \qquad (12)$$

Figure 2: Industry equilibrium when exports are zero (Figure 2 here)

where $k^1=k^2\equiv k$. The figure is drawn on the assumptions that $\sigma<1$ and R^i denotes *i*'s reaction curve, q_h^M is the monopoly output (N=1) and $\delta-2(rk)^{½}$ is the maximum value that q_h^i may take

for the best response $\hat{q}_i^h$ $(i \neq j)$ to be real (see Appendix A)[10]. As shown in Appendix B, there is a unique stable equilibrium at *E*. When $\sigma = 1$, each firm *i* has the straight line reaction curve $\hat{q}_i^h = (rk)^{1/2}$ and the equilibrium is at E'. If, for any $\sigma \varepsilon (1/2, 1]$, capacity constraints enter the picture, the part of each reaction curve that involves output greater than the capacity level is simply deleted from the figure.

Consider the comparative statics of the industry equilibrium from equation (12). Any parameter change affects each reaction curve in the manner described in Table 1 for an individual firm. Thus, the industry equilibrium outputs adjust as the shown in the table.

2.2 Sales to Both Home and Export Markets

We now go on to consider exports at the level of the firm and the industry. With the introduction of exports into the model, firm *i* chooses q_h^i and q_e^i to maximize u^i subject to eqs. (2)-(5) and (7), and given $\Sigma_{j \neq i} q_h^j$. Since Δ^i, as defined by eq. (10), remains a parameter for firm *i*, MRP_h^i is again given by eq.(11), while *i*'s marginal revenue product in the export market, is

$$MRP_e^i = a^i p_e \tag{13}$$

Given the set of outputs chosen by all other firms $j \neq i$, firm *i* is, in effect, a price-discriminating monopolist, facing a downward-sloping (residual) marginal revenue product curve in the home market and a horizontal marginal revenue product curve in the export market. As shown in Katz and Berrebi (1980), an internal solution for firm *i* (if it exists) satisfies[11]

$$MRP_h^i = MRP_e^i \tag{14}$$

The rationale for this result is that, for any total output produced by *i*, it is worth allocating supplies between the two markets such that total revenue is maximized. Substituting into (14) from (13) and then (11), *i*'s supply of goods to the domestic market is derived:

$$q_h^i = ½(\Delta^i - p_e) \tag{15}$$

Each unit supplied by *i* to the export markets yields two benefits. First, it enables the fixed cost rk^i to be spread over more units of output. Second, it requires the employment of additional labour, which is a benefit if $\sigma<1$. Thus, given the determination of q_h^i by (15), *i* will devote all its remaining capacity to exports:

$$q_e^i = \bar{q}^i - q_h^i \tag{16}$$

This solution is illustrated in Figure 3. $(\Delta^i - a^i l_h^i)a^i$ and rk^i/l_h^i are reproduced from Figure 1, and MRP_h^i and MRP_e^i are added. The marginal revenue product curves intersect at point A, so that the amount of labour devoted to supplying the home market is OB[12]. The maximum amount of labour that can be employed productively ($l^i = \bar{q}^i/a^i$) is shown as OC, so that BC is the amount employed in making exports.

Figure 3. The internal solution with positive exports (INSERT HERE)

Clearly, two types of corner solution are also possible, with MRP_h^i<(>)MRP_e^i at the solution, in which case *i* produces entirely for the export (home) market. First, if MRP_h^i starts below MRP_e^i, *i* produces only exports, with $q_e^i = \bar{q}^i$. Second, suppose the case shown in Figure 3 holds, but with the amendment that point C lies to the left of B. The firm does not then have the capacity to satisfy eq. (14), instead setting $q_h^i = \bar{q}^i$. Apart from the corner solutions a further possibility may also be noted: the value of u^i underlying (14) may be less than that obtaining when *i* produces solely for the home market. This can occur because (14) describes a local optimum, but not necessarily a global one[13]. Firm *i* will then set q_h^i according to eq.(8). We return to this case in Section 3.1.

Concentrating, however, on the internal solution (14), and assuming that it represents a global optimum, the comparative statics for firm *i* are shown in Table 2. Higher values of k^i, r and σ have no effect on MRP_h^i or MRP_e^i and so leave output unchanged; but in the case of a higher k^i, capacity output $\bar{q}^i$ is raised so that there is a positive effect on exports q_e^i. A higher value of the productivity parameter a^i raises both marginal revenue product curves in equal proportions, leaving q_h^i unaffected; but since $\bar{q}^i$ is raised, so too is q_e^i. A higher value of Δ^i,

TABLE 2

COMPARATIVE STATICS FOR FIRM *i* WHEN BOTH MARKETS ARE SUPPLIED

parameter value raised	**effect on**	
	q_h^i	q_e^i
k^i	0	+
r	0	0
σ	0	0
a^i	0	+
Δ^i	+	-
p_e	-	+

the residual inverse home demand facing *i*, raises the MRP_h^i-curve, causing *i* to divert output from the export to the home market. Note that, given the definition of Δ^i (eq.(10)), we have from (15) that along *i*'s reaction curve $dq_h^i/d(\Sigma_{j\neq i}q_h^j) = -½$[14]. Finally, a higher value of p_e raises the MRP_e^i-curve, causing a diversion of *i*'s output from the home to the export market[15].

Now that we have characterized the possible solutions for the individual firm, we can consider the industry. Denote the set of firms that supply a positive amount to the home (export) market, but nothing to the export (home) market, by H (E), and the set that supplies both markets by *HE*. First, we show that if any firms belong to set E, then all firms belong to set *E*. Denote the home supply of any firm $i \in H$ by $q_h^i(H)$ and so on. Then, using (11) and (13), if any firm belongs to set E the inequality in marginal revenue products reduces to

$$\varphi \equiv \delta - \sum_{j \in H} q_h^j(H) - \sum_{g \in HE} q_h^g(HE) - p_e < 0 \tag{17}$$

However, for any firm $i \in H$ we obtain, similarly,

$$\varphi \geq q_h^i(H) \tag{18}$$

(17) and (18) together yield $q_h^i(H) < 0$; but, by assumption, $q_h^i(H) > 0$. Hence, (17) and (18) cannot hold simultaneously. Similar reasoning applies if $i \in HE$. It follows that either all firms belong to set *E* with sets *H* and *HE* empty, or set *E* is empty and one of *H* and *HE* may also be empty.

This leaves four possible types of equilibrium.

Case (i) All firms engage only in exports. (For each firm i a corner solution holds, with $MRP_h^i < MRP_e^i$ at $q_h^i = 0$.) Each firm produces at its capacity level. Hence, $dq_e^i/dk^i > 0$ and $dq_e^i/da^i > 0$.

Case (ii) All firms supply only the home market. (For each firm i either a corner solution holds, with the capacity constraint preventing eq. (14) from holding, or (14) is a local, but not a global optimum.) This case was examined in the previous sub-section.

Case (iii) All firms supply both markets. (Eq. (14) holds and is a global optimum for each firm i.) We saw from Table 2 that *i*'s reaction curve is a straight line, with $dq_h^i/d(\sum_{j \neq i} q_h^j) = -½$. It follows that there is a unique stable equilibrium for the industry. Furthermore, if all firms are homogeneous, the comparative statics signs listed in Table 2 also apply at the industry level.

Case (iv) Some firms supply the home market only (they face the conditions specified in Case (ii)), while others supply both markets (as specified in Case (iii)). We illustrate this case with a simple example.

Assume that there are just two firms, 1 and 2, in the industry and that in the equilibrium 1 sells only in the home market, while 2 sells in both markets. (Such an equilibrium may occur, for example if $\bar{q}^1 < \bar{q}^2$; for specific conditions, see Appendix C.) q_1^h Is therefore given by eq. (8), while, from (10) and (15), $q_2^h = ½ (\delta - q_1^h - p_e)$. Solving for q_1^h and q_2^h simultaneously, the comparative statics signs listed in Table 3 are obtained. We now discuss these signs briefly.

TABLE 3

INDUSTRY COMPARATIVE STATICS WHEN FIRM 1 SUPPLIES ONLY THE HOME MARKET, BUT FIRM 2 SUPPLIES BOTH MARKETS

	if $q_1^h = \bar{q}_1$				if $q_1^h = \hat{q}_1$			
parameter value raised	q_h^1	q_h^2	$q_h^1 + q_h^2$	q_e^2	q_h^1	q_h^2	$q_h^1 + q_h^2$	q_e^2
k^1	+	-	+	+	+	-	+	+
k^2	0	0	0	+	0	0	0	+
r	0	0	0	0	+	-	+	+
σ	0	0	0	0	?	?	?	?
$a^1 = a^2$	+	0	+	+	0	0	0	+
δ	0	+	+	-	+/0*	+	+	-
p_e	0	-	-	+	+/0*	-	-	+

* + if $\sigma<1$, 0 if $\sigma=1$.

Suppose, first, that 1 produces at its capacity level in the equilibrium ($q_1^h = \bar{q}_1$). If 1 has a larger capital stock k^1, it produces more for the home market, displacing some home sales by 2, which therefore supplies more exports. If, instead, 2 has a larger capital stock k^2, the sole effect is that it exports more (eq.(16)). Variations of r and σ have no effect; but if the efficiency parameter a^i is greater (we set $a^1 = a^2$ for brevity), 1 supplies more to the home market and 2 supplies more to the export market. Greater domestic demand, in the form of a higher δ, causes 2 to switch sales from the foreign to the domestic market, while a higher foreign price p_e has the opposite effect.

Alternatively, suppose $q_1^h = \hat{q}_1$ in equilibrium. The effects of a larger k^1 are qualitatively the same as in the previous paragraph, but because of the traditional 'labour-management' response of firm 1, rather than because 1 can produce more output. For the same reason, variation of r has effects of the same sign as those resulting from variation of k^1. Nonetheless, an increase in k^2 has the same type of effects as when $q_1^h = \bar{q}_1$. However, variation of σ now affects the equilibrium, though the complexity of eq. (9), in conjunction with interaction with firm 2's behaviour, prevents us from signing the effects. Variation of a^1 does not affect q_1^h, since a^1 does not enter eq. (9); but a greater a^2 enables 2 to export more. An increase in δ or p_e has effects of the same sign as when $q_1^h = \bar{q}_1$, except in one respect: since 1 is not capacity-constrained, it can raise q_h^1 in response (although it chooses not to do so if $\sigma = 1$ - see eq. (9)).

2.3 Comparison with Profit Maximizing Firms

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It is natural to enquire how the results would be changed if all the firms behaved as 'normal' capitalist firms. We therefore conclude this section briefly by exploring that case, and then refer to it again below as a point of comparison. With capitalist firms, each firm i maximizes profits,

$$\pi^i \equiv pq_h^i + p_e q_e^i - rk^i - wl^i \qquad (6')$$

where w is the (externally given) market wage rate. Again making the Cournot assumption, if i produces only for the home market, we have, parallel to (8),

$$q_h^i = \min\left[\tfrac{1}{2}(\Delta^i - w/a^i),\ \bar{q}^i\right] \qquad (8')$$

When exports are introduced, however, the internal solution for capitalist firms satisfies the same condition (eq. (14), equality of marginal revenue products) as in the labour-management case, with exports again derived a residual. There are also corner solutions, with $q_h^i=0$ if $MRP_e^i \geq MRP_h^i$ throughout; and with $q_e^i=0$ either if the capacity constraint prevents attainment of the internal solution or if $w>a^i p_e$ (exports are loss-making)[16].

Turning to the industry level, it is found that (17) and (18) are again satisfied. For comparative purposes, we can also develop a two-firm example, with firm 1 belonging to set H and firm 2 to set HE. If, in this example, it is the capacity constraint that prevents firm 1 from satisfying eq. (14) (and exporting), then the solution is identical to when there is labour management. The left-hand half of Table 3 therefore applies. Alternatively, if 1 does not export because $w > a^1 p_e$ we have from (8') that $q_h^1 = \tfrac{1}{2}(\Delta^1 - w/a^1)$ and from (15) that $q_h^2 = \tfrac{1}{2}(\delta - q_h^1 - p_e)$, so that, using (10), we can solve for the equilibrium outputs:

$$q_h^1 = (\delta - 2w/a^1 + p_e)/3$$

$$q_h^2 = (\delta + w/a^1 - 2p_e)/3 \tag{19}$$

Eq. (19) gives the comparative statics signs listed in Table 4. For brevity, and because this is 'textbook' case, we do not explain these results. Instead, we compare them briefly with the results in the right-hand half of Table 3.

TABLE 4

INDUSTRY COMPARATIVE STATICS UNDER PROFIT-MAXIMIZATION WHEN FIRM 1 CANNOT EXPORT PROFITABLY, BUT FIRM 2 SUPPLIES BOTH MARKETS

Parameter value raised	q_h^1	q_h^2	$q_h^1+q_h^2$	q_e^2
k^1	0	0	0	0
k^2	0	0	0	+
r	0	0	0	0
$a^1=a^2$	+	-	+	+
δ	+	+	+	-
p_e	+	-	-	+
w	-	+	-	-

With profit-maximization, variation of firm 1's capital stock k_1 or of the interest rate r has no effect on outputs, contrasting strongly with the 'labour-management' effects shown in Table 3. Also, the entries for variation of the labour productivity parameters a^1 and a^2 differ markedly between the tables. In particular, a^1 now has an effect (see (19)): a higher value of a^1 causes firm 1 to supply more to the home market, displacing some output by firm 2 from the home market into the export market. Finally, the entries for variation of k^2,δ and p_e in Table 4 are the same as those in Table 3 (given, in the cases of δ and p_e, that $\sigma < 1$).

3. Materials Bottlenecks

The literature suggests that bottlenecks in materials supply are an important feature of transition economies (see e.g. Blanchard and Kremer (1997), and Konings and Walsh (1998) for an application in Ukraine). To examine this issue, assume that each firm i also uses a quantity of materials m^i in production. We can then rewrite the production function as

$$q^i = \min a^i(l^i,\ k^i/b^i,\ m^i/c^i), \qquad a^i,\ b^i,\ c^i>0 \tag{4a}$$

If p_m is the unit price of materials, then we can define

$$\tilde{p}^i \equiv p - p_m c^i/a^i\ ;\quad \tilde{p}_e^i \equiv p_e - p_m c^i/a^i \tag{20}$$

For firm i, $\tilde{p}^i$ is the unit price received for supplying the home market, net of materials costs, and $\tilde{p}_e^i$ is the similarly adjusted export price. Corresponding to equation (7), we can therefore write income per head,

$$y^i = (\tilde{p}^i q_h^i + \tilde{p}_e^i q_e^i - rk^i)/l^i \tag{7a}$$

With the firm maximizing u^i, where y^i is given by (7a), the analysis of Section 2 still holds, but with $\tilde{p}^i$ and $\tilde{p}_e^i$ replacing p^i and p_e^i, respectively, and with each marginal revenue product reduced by $p_m c^i/a^i$. By the same token, the corresponding analysis with capitalist firms also goes through without change.

Suppose, however, that there is a constraint on materials supply to i, $m^i \le \bar{m}^i$. Assume first that if the constraint is binding, firm *i* adjusts l^i accordingly, so that no surplus labour is employed. This may be interpreted as the case of chronic supply problems, which are long term and therefore anticipated. Because of the materials constraint, $q^i \le a^i\bar{m}/c^i \equiv \bar{q}_m^i$. If $\bar{q}_m^i < \bar{q}^i$ (the capacity constraint imposed by the limited capital stock) the results of Section 2 still hold, but with $\bar{q}_m^i$ replacing $\bar{q}^i$ [17]. An important implication for firms in set *HE* is that, since exports are determined as a residual, the introduction of binding materials constraints into the model

causes these firms to cut their exports first.

This conclusion holds both with labour management and with the capitalist version of the model. However, there is another possibility, more damaging to the transition economy, which occurs only with labour management. Because the local optimum described by eqs. (14)-(16) is not necessarily a global optimum, a 'small' reduction in the availability of materials can lead to a 'large' reduction in exports and output.

To illustrate this possibility, assume that the N firms in the industry are homogeneous (superscript i will be omitted) and that the constraint on output imposed by materials supply is always greater than that imposed by the capital stock. If, then, an internal solution is achieved, (14)-(16) give $q_h=(\delta-p_e)/(N+1)$ and $q_e=\bar{q}_m-q_h$. The value of u in this case, which we denote by $u(HE)$ is found, using (2), (4a), (7a) and (20), to be

$$u(HE) = \left\{\left[\left(\frac{\delta-p_e}{N+1}\right)^2+\left(p_e-\frac{cp_m}{a}\right)\bar{q}_m-rk\right]\frac{a}{\bar{q}_m}\right\}^{\sigma}\left(\frac{\bar{q}_m}{a}\right)^{1-\sigma} \tag{21}$$

Assuming that $\sigma<1$, we therefore obtain

$$\frac{du(HE)}{d\bar{q}_m} \quad 0 \text{ as } \bar{q}_m \quad \frac{(2\sigma-1)\{[(\delta-p_e)/(N+1)]^2-rk\}}{(1-\sigma)(p_e-cp_m/a)} \tag{22}$$

and $d^2u(HE)/d\bar{q}_m^2>0$.

$u(HE)$ is plotted against $\bar{q}_m$ in Figure 4. It is assumed here that $[(\delta-p_e)/(N+1)]^2>rk$, so that, from (22), $u(HE)$ first slopes downward, then upward. Given that $\bar{q}_m>(\delta-p_e)/(N+1)$, each

Figure 4: Discontinuous adjustment of exports to a materials constraint [INSERT HERE]

firm exports $q_e=\bar{q}_m-(\delta-p_e)/(N+1)$[18]. As $\bar{q}_m\to(\delta-p_e)/(N+1)$ from above, $q_e\to 0$, so that $u(HE)\to u_o(HE)$ in the figure. However, if $q_e=0$, i.e. with home sales only, it is not optimal, in

general, to set $q_h = \bar{q}_m$. Rather, eq. (8) will be satisfied, though adjusted to take into account the materials constraint: $q_h = \min(\hat{q}_h, \bar{q}_m)$. The value of u in this solution for home sales only is denoted by $u(H)$ in the figure. Generally, $u(H) > u_o(HE)$. The value of $\bar{q}_m$ at which $u(HE) = u(H)$ is denoted by $\bar{q}_m^*$. It can be seen that if $\bar{q}_m > q_m^*$, marginal reductions in $\bar{q}_m$ cause marginal reductions in exports, but if $\bar{q}_m = q_m^*$, a marginal reduction in $\bar{q}_m$ causes each firm to switch to supplying the home market only.

To reinforce our argument we give a simple numerical example. Suppose $N=1$, $\sigma=0.75$, $\delta=12$, $p_e=4$, $r=0.1$, $k=10$ and $p_m=a=c=1$. Therefore $\bar{m}$ is measured in the same units as $\bar{q}_m$. It is found that $(\delta - p_e)/(N+1) = 4$, while the minimum point on the $u(HE)$-curve occurs at $\bar{q}_m = 10$. For home sales only, optimally chosen, we have $q_h \approx 3.16$ and $u(H) \approx 6.06$, from which we obtain $\bar{q}^* \approx 32.42$. Hence, if there is a marginal reduction of $\bar{m}$ (i.e., of $\bar{q}_m$) below 32.42, a firm's output will fall from 32.42 to 3.16, with exports falling from 28.42 to 0, and home sales falling from 4 to 3.16.

This type of discontinuous adjustment can be explained intuitively as follows. If a firm sells at home only, it achieves $y = \hat{y}$, $l = \hat{l}$ and $u = \hat{u}$, say. If, however, $MRP_e > \hat{y}$, all possible units of exports are always worth making, for they raise both y and l, and therefore u, above $\hat{y}$, $\hat{l}$ and $\hat{u}$, respectively. Discontinuous adjustment does not occur in this case. But now suppose that $MRP_e < \hat{y}$, in which case any exporting reduces earnings below $\hat{y}$. As a result, compared to not exporting at all, the export of a small amount may not be advantageous to the firm: the corresponding small increase in employment may not compensate the firm, in utility terms, for the lower earnings. However, if larger amounts of exports can be made, there is a correspondingly large increase in employment. Since there is a lower bound to the value that earnings may take (in eq.(21), $\{.\} = y$, and so as $\bar{q}_m \to \infty$, $y \to p_e - cp_m/a$) the l-component of utility eventually dominates. A large enough quantity of exports is worth undertaking. Note that this

argument rests on the assumption that there is some weight on employment in the utility function. In the Ward model, with $\sigma=1$, there is no discontinuous adjustment.

Now assume instead that the materials shortage is not foreseen. We may then suppose that l^i is already fixed, as specified in Section 2, for the period concerned. If *i* belongs to set *H* or set *E* it merely reduces its supply to the given market. If, however, *i* belongs to *HE*, it must decide how to apportion the cut in its supply between the markets. Since MRP_h^i is downward-sloping, but MRP_e^i is horizontal, exports will be cut first, as in the case of anticipated materials shortage. However, the possibility of discontinuous adjustment does not arise. In terms of the argument of the previous paragraph, if exporting causes a fall in y^i, there cannot be a compensating rise in l^i, for l^i is fixed when the relevant decision is to be made[19].

To summarize, we have found that shortage of materials in a transition economy, whether anticipated by firms or not, tends disproportionately to affect exports. Part of our argument relates to 'smooth' adjustment and results from the relative slopes assumed for MRP_h^i and MRP_e^i. This part of the argument holds equally for capitalist firms and labour managed ones. But we have also identified another possibility, that of discontinuous adjustment, that has potentially more damaging effects for the transition economy. This cannot occur with capitalist firms. It relates only to labour management and can occur only if some weight is put on employment in the utility function and if the materials shortage is anticipated[20].

4. Conclusions

We have analyzed the behavior, at the level of firms and industry, of a transition economy open to international trade. Our key assumptions are an oligopolistic market structure, where we assume: (a) firms follow a Cournot decision rule; (b) there is product differentiation, with firms in transition economies supplying output at lower quality than that of Western firms; and (c) labor management at the enterprise level. The first two assumptions are not particularly strong, given that all transition economies emerged from central planning with a few large firms in each sector, and an orientation to industrial production with limited concern for product quality or international standards. The assumption of labor management is potentially more stringent. However, mass privatization has provided insiders, notably workers, with dominant ownership stakes in most transition countries. Our concern with output and employment adjustment, given the high unemployment in many transition economies (see Commander and Coricelli (1995)), leads us to use a "revised" labor-management model which explicitly includes employment as an enterprise objective. We also derive our results in comparison with the traditional capitalist firm.

The most significant results from the perspective of policy relate to the impact of material supply bottlenecks. These were very common in the early years of transition and we find that they can hinder a country's export efforts because such shortages, whether or not they are anticipated, are shown to have a disproportionate effect on exports. Such bottlenecks have been especially serious in the former Soviet Union, and may still be so in the successor states. The logic of this paper suggests that these material supply problems might help to explain the relatively poor manufacturing export performance of Russia and elsewhere in the former Soviet Union, relative to the Central European economies, which have been much less subject to material supply bottlenecks.

Appendix A The General Case for Home Sales Only

Set q_e^i=0 in (7). Using (2), (7) and (10), $y^i = -[(q_h^i)^2 - \Delta^i q_h^i + rk^i]/l^i$. Given that $rk^i > 0$, it follows that $y^i > 0$ if

$$\tfrac{1}{2}\{\Delta^i - [(\Delta^i)^2 - 4rk^i]^{1/2}\} < q_h^i < \tfrac{1}{2}\{\Delta^i - [(\Delta^i)^2 - 4rk^i]^{1/2}\} \tag{A1}$$

We assume that the square root here is real:

$$(\Delta^i)^2 - 4rk^i > 0 \tag{A2}$$

Also, we restrict our discussion throughout to cases in which (A1) is satisfied.

Ignoring the capacity constraint for now, consider the choice of the optimum q_h^i, given the Cournot assumption. From (2), (6), (7) and (10), and given that $y^i > 0$, the first-order condition is found to be (9) in the text, but with the square root taking either sign. However, it is found that only the positive square root satisfies the second-order condition. When the capacity constraint is also allowed for, eq. (8) is obtained, but it must also be taken into account that (given that there are fixed capital costs) the capacity constraint may be so tight that (A1) cannot be satisfied, in which case a real solution $\hat{q}_h^i$ does not exist.

Using (2), (4), (7) and (11) we find that $MRP_h \quad y^i$ as $(rk^i)^{1/2} \leq q_h^i$. Assuming that $q_h^i = \hat{q}_h^i$, substitution from eq. (8) then yields

$$MRP_h^i \quad y^i \text{ as } 4rk^i(1-\sigma)^2 \quad (\Delta^i)^2 \ (1-\sigma)^2 \tag{A3}$$

Hence, if σ=1, $MRP_h^i = y^i$; but if $\sigma < 1$, (A2) and (A3) yield the result that $MRP_h^i < y^i$.

Finally, consider how $\hat{q}_h^i$ is related to q_h^j. From (9), if σ=1 the two are independent. But suppose σ<1. From (9),

$$\frac{d\hat{q}_h^{\,i}}{dq_h^{\,j}} = -\tfrac{1}{2}(1-\sigma)\{1+(1-\sigma)\Delta^i[(1-\sigma)^2(\Delta^i)^2+4(2\sigma-1)rk^{\,i}]^{-1/2}\} < 0$$

$$(\sigma<1) \qquad \text{(A4)}$$

$$\frac{d^2\hat{q}_h^{\,i}}{dq_h^{\,j}} = 2(2\sigma-1)(1-\sigma)^2 rk^{\,i}[(1-\sigma)^2(\Delta^i)^2 + 4(2\sigma-1)rk^{\,i}]^{-3/2} > 0$$

Appendix B Industry Equilibrium for Home Sales Only (N=2)

Substituting into (A2) from (10), if N=2 a real solution for $q_h^{\,i}$ is found only if $q_h^{\,j} \le \delta - 2(rk)^{1/2}$ $(j \ne i)$. Substituting into (9), if $q_h^{\,j} = \delta - 2(rk)^{1/2}$, then $q_h^{\,i} = (rk)^{1/2}$ $(i \ne j)$.

From (9)

$$(q_h^{\,i})^2 - (1-\sigma)(\delta - q_h^{\,j})q_h^{\,j} + (1-2\sigma)rk = 0, \quad i \ne j \qquad \text{(A5)}$$

Write (A5) first for i=1, j=2 and then for j=1, i=2. Subtracting the second of the resulting equations from the first, we obtain $(q_h^{\,1} - q_h^{\,2})[q_h^{\,1} + q_h^{\,2} - \delta(1-\sigma)] = 0$. Hence, in equilibrium either (a) $q_h^{\,1} = q_h^{\,2}$ or (b) $q_h^{\,1} + q_h^{\,2} = \delta(1-\sigma)$. But, substituting (b) into (A5) first for i=1, j=2 and then for j=1, i=2, we obtain $q_h^{\,1} = q_h^{\,2}$. Therefore (b) reduces to (a): the unique real solution is $q_h^{\,1} = q_h^{\,2}$.

From (A5), along 1's reaction curve R^1,

$$d\hat{q}_h^{\,1}/dq_h^{\,2} = -(1-\sigma)\hat{q}_h^{\,1}/[2\hat{q}_h^{\,1} - (1-\sigma)(\delta - q_h^{\,2})] \qquad \text{(A6)}$$

Suppose $\sigma<1$. From (A4), we then have $d\hat{q}_h^{\,1}/dq_h^{\,2}<0$ and so, in (A6), $2\hat{q}_h^{\,1} - (1-\sigma)(\delta - q_h^{\,2})>0$. Using $\hat{q}_h^{\,1} = q_h^{\,2}$, we therefore obtain from (A6) that

$$d\hat{q}_h^{\,1}/dq_h^{\,2} \quad -1 \text{ as } \hat{q}_h^{\,1} \quad (1-\sigma)\delta/2 \qquad \text{(A7)}$$

Writing (9) with N=2 and $\hat{q}_h^{\,1} = q_h^{\,2}$ and using the resulting equation to eliminate $\hat{q}_h^{\,1}$ in the second inequality in (A7), we obtain $d\hat{q}_h^{\,1}/dq_h^{\,2} > -1$. Similarly, $d\hat{q}_h^{\,2}/dq_h^{\,1} > -1$ and so the equilibrium $\hat{q}_h^{\,1} + \hat{q}_h^{\,2}$ is stable. From (A5), this solution is eq. (12) in the text.

Appendix C. Conditions for Industry Equilibrium in Case (iv)

By assumption, firm 1 belongs to set H and firm 2 to set HE. Hence, $MRP_h^1 > MRP_e^1$ and $MRP_h^2 = MRP_e^2$, and so, from (10), (11) and (13), $\delta - q_h^2 - 2q_h^1 > p_e$ and $\delta - q_h^1 - 2q_h^2 = p_e$. Therefore $q_h^2 > q_h^1$, i.e., $(\delta - q_h^1 - p_e)/2 > q_h^1$, which reduces to $\delta - p_e > 3q_h^1$. Writing $\lambda \equiv q_h^1/\bar{q}^1$, we therefore have

$$\delta - p_e > 3\lambda\bar{q}^1 \tag{C1}$$

Since $q_h^2 = (\delta - q_h^1 - p_e)/2$ and $q_e^2 > 0$, we have $\bar{q}^2 > (\delta - q_h^1 - p_e)/2$ which can be rewritten

$$2\bar{q}^2 + \lambda\bar{q}^1 > \delta - p_e \tag{C2}$$

Writing $\bar{q}^2 \equiv \mu\bar{q}^1$ and combining (C1) and (C2),

$$2\mu + \lambda > (\delta - p_e)/\bar{q}^1 > 3\lambda \tag{C3}$$

For (C3) to hold it is necessary that $\mu > \lambda$, i.e., that $\bar{q}^2 > q_h^1$. Specifically, if $q_h^1 = \bar{q}_h^1$ in (8), it is necessary that $\mu > 1$, i.e., that capacity output is greater for firm 2 than firm 1. If, however, $q_h^1 = \hat{q}_h^1$ in (8), the interpretation of (C3) is less clear-cut.

References

Aturpane, Chris, Djankov, Simeon, and Hoekman, Bernard, "Determinants of Intra - Industry Trade between East and West Europe", World Bank Discussion Paper, August 1997.

Brenton, Paul, and Gros, Daniel, "Trade Reorientation and Recovery in Transition Economies", *Oxford Review of Economic Policy*, **13**, 2, 1997, pp 67-76.

Belka, Marek, Estrin, Saul, Schaffer, Mark, and Singh, Inderjit, "Enterprise Adjustment in Poland: Evidence from a Survey of 200 firms", paper presented at the Workshop on Enterprise Adjustment in Eastern Europe, World Bank, Washington, DC, 1995.

Belka, Marek, Krajewski, Stefan, and Pinto, Brian, "Transforming State Enterprises in Poland." *Brookings Papers on Economic Activity*, **20**: pp. 213-270, 1993.

Blanchard, Olivier, *The Economics of Post-Communist Transition.* Clarendon Lectures, Oxford: Clarendon Press, 1997.

Blanchard, Olivier, and Kremer, Michael, "Disorganization", *Quarterly Journal of Economics*, **111**, pp. 1091-1126, 1997.

Blasi, Josef R., Kroumova, Maya, and Kruse, Douglas, *Kremlin Capitalism*. Ithaca: Cornell University Press, 1997.

Bonin, John P., Jones, Derek C., and Putterman, Louis, "Theoretical and Empirical Studies of Producer Cooperatives - Will Ever the Twain Meet?." *Journal of Economic Literature*, **31**, 3: pp. 1290-1230, September 1993.

Carlin, Wendy, and Landesmann, Michael, "From Theory into Practice? Restructuring and Dynamics in Transition Economies", *Oxford Review of Economic Policy*, **13**, 2, 1997.

Commander, Simon, and Coricelli, Fabrizio, *Unemployment Restructuring and the Labor Market in Eastern Europe and Russia*, Washington DC, World Bank, EDI Development Studies, 1995.

Cooper, Richard N., and Gács, János, "Impediments to Exports in Small Transition Economies." MOCT-MOST, **7**, pp. 5-32, 1997.

Cremer, Helmuth, and Crémer, Jacques, "Duopoly with Employee-Controlled and Profit-Maximizing Firms: Bertrand vs Cournot Competition." *Journal of Comparative Economics*, **16**, 1:pp. 241-258, March 1992.

Delbono, Flavio, and Rossini, Gianpaolo, "Competition Policy vs Horizontal Merger with Public, Entrepreneurial, and Labor-Managed Firms." *Journal of Comparative Economics*,**16**, 2: pp. 226-240, June 1992.

Earle, John, and Estrin, Saul, "Employee Ownership in Transition", in Frydman, R., Gray, C. and Rapaczynski, A. (eds), *Corporate Governance in Central and Eastern Europe*, vol.2,

Oxford: Central European University Press, 1996.

Estrin, Saul (ed.), *Privatization in Central and Eastern Europe*. London: Longman, 1994.

Estrin, Saul, "Privatization" in Peter Boone, Stanislaus Gomulka and Richard Layard, *Lessons of Transition*, Cambridge, Mass.: MIT Press, forthcoming 1998

Estrin, Saul, and Ben-Ner, Avner, "What Happens when Trade Unions Run Firms? Unions as Employee Representatives and as Employers", *Journal of Comparative Economics*, **15,** 1, pp.65-88, March 1991.

Estrin, Saul, and Cave, Martin, *Competition Policy in Central and Eastern Europe*, London, Frances Pinter, 1993.

European Bank for Reconstruction and Development (EBDR), *Transition Report*, London, EBRD, 1995, 1996, 1997.

Gros, Daniel and Gonciarz, André, "A Note on the Trade Potential of Central and Eastern Europe", Brussels, Center for European Policy Studies manuscript, 1994.

Gros, Daniel, and Steinher, Alfred, *Winds of Change: Economic Transition in Central and Eastern Europe*, London, Longman, 1995.

Hill, Martyn, and Waterston, Michael, "Labor-Managed Cournot Oligopoly and Industry Output." *Journal of Comparative Economics*, **7**, 1: pp. 43-51, March 1983.

Horowitz, Ira, "On the Effects of Cournot Rivalry between Entrepreneurial and Cooperative Firms." *Journal of Comparative Economics*, **15**, 1: pp.115-121, March 1991.

Katsoulacos, Yannis, "Firms' Objectives in Transition Economies." *Journal of Comparative Economics*, **19**, 3: pp. 392-409, December 1994.

Katz, Eliakim, and Berrebi, Z.M., "On the Price-Discriminating Labor Cooperative." *Economics Letters*, **6**, pp. 99-102, 1980.

Koning, Josef and Walsh, Patrick, P., "Disorganization in the Transition Process: Firm Level Evidence from Ukraine", London: Center for Economic Policy Research, Discussion Paper No 1928, 1998.

Laffont, Jean-Jacques, and Moreaux, Michael, "Large-Market Cournot Equilibria in Labor-Managed Economies." *Economica*, **52**, 206: pp.153-165, May 1985.

Lipton David, and Sachs Jeffrey, "Creating a Market Economy in Eastern Europe: the Case of Poland", *Brookings Papers on Economic Activity*, I, Washington DC, The Brookings Institution, pp. 75-147, 1990.

Landesmann, Michael, and Burgstaller, Johann, "Vertical Product Differentiation in EU Market; the Relative Position of Eastern European Producers", Vienna Institute for Comparative Economic Studies (WIIW), Research Paper No 2348, February 1997.

Mai, Chao-Cheng, and Hwang, Hong, "Export Subsidies and Oligopolistic Rivalry between Labor-Managed and Capitalist Economies." *Journal of Comparative Economics*, **13**, 3: pp.473- 480, September 1989.

McKinnon, Roland, I., *The Order of Economic Liberalization: Financial Control in the Transition to a Market Economy*, Baltimore, Maryland: Johns Hopkins Press, 1991.

Mejstrik, Michal, *The Privatization Process in East-Central Europe*. Dordrecht: Kluwer Academic Press, 1997.

Meade, James E., "Theory of Labor-Managed Firms and of Profit Sharing." *Economic Journal*, **82**, 325, Supplement: pp.402-428, 1972.

Neary, Hugh M., "Labor-Managed Cournot Oligopoly and Industry Output: A Comment." *Journal of Comparative Economics*, **8**, 3: pp. 322-327, September 1984.

Neary, Hugh M., "The Labor-Managed Firm in Monopolistic Competition." *Economica*, **52**, 208: pp. 435-447, November 1985.

Okuguchi, Koji, "Labor-Managed and Capitalistic Firms in International Duopoly: the Effects of Export Subsidy." *Journal of Comparative Economics*, **15**, 3: pp. 476-484, September 1991.

Prasnikar, Janez, Svejnar, Jan, Michajlek, Dan, and Prasnikar, Vesna, "A Test of Enterprise Behavior under Jugoslav Self-Management", *Review of Economics and Statistics*, **76**, 4, pp. 728-741, November 1992.

Roland, Gerard, and Verdier, Thiery, "Transition and the Output Fall", London: Center for Economic Policy Research Discussion Paper, No 1636, May 1997.

Sertel, Murat R., "Workers' Enterprises in Imperfect Competition." *Journal of Comparative Economics*, **15**, 3: 698-710, September 1991.

Svejnar, Jan, "On the Theory of a Participatory Firm", *Journal of Economic Theory*, **27**, 2, pp. 313-330, August 1982.

Vanek, Jaroslav, *The General Theory of Labor-Managed Market Economies*. Ithaca, NY: Cornell University Press, 1970.

Ward, Benjamin M., "The Firm in Illyria: Market Syndicalism." *American Economic Review*, **48**, 4, pp. 566-89, 1958.

World Bank, *From Plan to Market*. World Development Report 1996, Washington DC: World Bank, 1996.

Endnotes

1. The authors are grateful to John Bonin, James Maw, and two anonymous referees for detailed and very helpful comments which have enabled them to improve the paper. Earlier versions of the paper were presented at a seminar at Heriot-Watt University and at a conference in Berlin organized by the Frankfurth Institute for Transformation Studies; comments from these meetings were also much appreciated. The authors accept full responsibility for remaining deficiencies in the paper.

2.See also Sertel (1991) and Neary (1985) on monopolistic competition.

3.Our assumption that the enterprise sector in the transition economy can be regarded as a set of labor-managed firms is clearly a generalization. In the past five years, some economies in transition, notably Poland and Hungary, have developed thriving private sectors, based primarily on *de novo* growth and on foreign direct investment respectively (see, e.g., Estrin (1994, 1998)). However, much of the growth in the private sector has come from small scale privatization in the retail, distribution and services sector; in most countries large scale industrial enterprises which have traditionally supplied the bulk of exports have remained in state hands (see World Bank (1996), EBRD (1997)).

4.If there were a group of transition economies, the model implies limited intragroup trade flows, perhaps because of tariff and non-tariff barriers. This conforms with the evidence: once energy and fuel trade is excluded, the flows of goods between transition economies are very modest (see, e.g. EBRD Transition Report (1995, 1996, 1997)).

5.The Leontief assumption has some appeal in transition economies, where the tradition of planning may have reduced managerial experience with factor substitution (see Blanchard

(1997)).

6.The payment "r" could either be to the state for the use of the capital stock, along the lines of the former "dividend" tax in Poland, or a market-determined cost of capital for privatized firms.

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7.Suppose, that in addition to the employment of l^i in production, as in the text, l_s^i workers are employed as surplus, so that the objective function becomes $u^i=(y^i)^\sigma(l^i+l_s^i)^{1-\sigma}$ where $y^i=(pq_h^i+p_eq_e^i-rk^i)/(l^i+l_s^i)$. Assume for now that σ may take any value in the range (0,1]. Then $\partial u^i/\partial l_s^i=(1-2\sigma).(pq_h^i+p_eq_e^i-rk^i)^\sigma.(1^i+l_s^i)^{-2\sigma}$. If $\sigma<½$, the value of $\partial u^i/\partial l_s^i$ is therefore increasing in l_s^i, i.e., l_s^i should be raised indefinitely. We exclude this degenerate solution by assumption in the text. Furthermore, we also exclude $\sigma=½$, because the firm would then be indifferent between all positive values of l_s^i. Note that our argument here is independent of whether one or both of q_h^i and q_e^i are chosen freely or whether they are determined by binding constraints.

8.Here, and throughout, we consider only those firms that produce a positive output equilibrium.

9.Note, however, that a sufficiently large increase in rk^i will cause the violation of (A2), so that there is no real solution for $\hat{q}_h^i$.

10.It is possible that $\delta-2(rk)^{½}<q_h^M$, but this makes no difference to the solution. (Note that for $q_h^j>\delta-2(rk)^{½}$ the best response by $i(i\neq j)$ is not $q_h^i=0$. Rather, there is no best response defined. Therefore, a segment of R^i coinciding with the q_h^j-axis does not exist.)

11.Katz and Berrebi (1980) show that the price discriminating income maximizing monopolist produces less than its profit maximizing counterpart, but may increase output with foreign demand.

12.Comparing Figures 1 and 3, whether OB exceeds or falls short of $(rk^i)^{½}/a^i$ depends on how the figures are drawn. Specifically, using (2), (4), (6), (11) and (14-16), it is found that $y^i > MRP_h^i (=MRP_e^i)$ as $l_h^i > (rk^i)^{½}/a^i$.

13.This can occur because u^i is not concave. E.g., suppose that, as in Figure 3, the full-capacity level of l^i, given by point C, lies to the right of where MRP_h^i meets the l^i-axis.

14.Recall that, apart from representing a smaller supply of goods to the home market by other domestic procedures $(j \neq i)$, a higher value of Δ^i represents the following: a higher demand intercept α; a greater cross-elasticity of demand parameter γ; and a higher price p_f for imports of the higher quality good.

15.Several of these results are in Katz and Berrebi (1980), though the impact of higher export prices on exports is ambiguous in their model.

16.Here, as throughout the paper, we disregard firms that produce zero output in equilibrium. Also, note that if the industry contains some labor-managed and some capitalist firms, our analysis of the behavior of an individual firm still holds. This is because we have made the Cournot assumption, which specifies that each firm takes the output of other firms as given,

regardless of the objective functions used by the other firms in determining their outputs. (see Cremer and Cremer (1992)).

17.Note, however, that a binding materials constraint, limiting output to $\bar{q}_m^i$, causes y^i to be lower than the alternative of a binding capital constraint, limiting output to $\bar{q}^i$, where $\bar{q}^i = \bar{q}_m^i$. When there are fewer materials available, capital cost rk^i is unaffected; but when there is a smaller amount of capital, rk^i is reduced.

18.We have also assumed in Figure 4 that $(\delta - p_e)/(N+1)$ is to the left of the minimum of the $u(HE)$ curve. Reversal of this assumption would not affect our conclusions significantly.

19.With an unanticipated shock eq.(21) applies with minor amendments. In the terms $a/\bar{q}_m$ and $\bar{q}_m/a$, the $\bar{q}_m$ is replaced by $\bar{q}$; but the other appearance of $\bar{q}_m$ in (21) is correct.

20.Another constraint that may affect a firm is a consequence of inexperience in export marketing and lack of relevant international contacts (see, e.g., Cooper and Gács, 1997). Firm *i* may therefore face the export constraint, $q_e^i \leq \bar{q}_e^i$. However, given that the firm anticipates this constraint when it makes its production decisions, and assuming that in the absence of the constraint the firm would belong to set HE, few clear-cut results emerge in this case. (The reason for this is that when $q_e^i = q_e^i$, the denominator of net earnings per head y^i becomes $l_h^i + q_e^i/a^i$. Unless the restriction $\sigma = 1$ is made, this complicates the analysis).

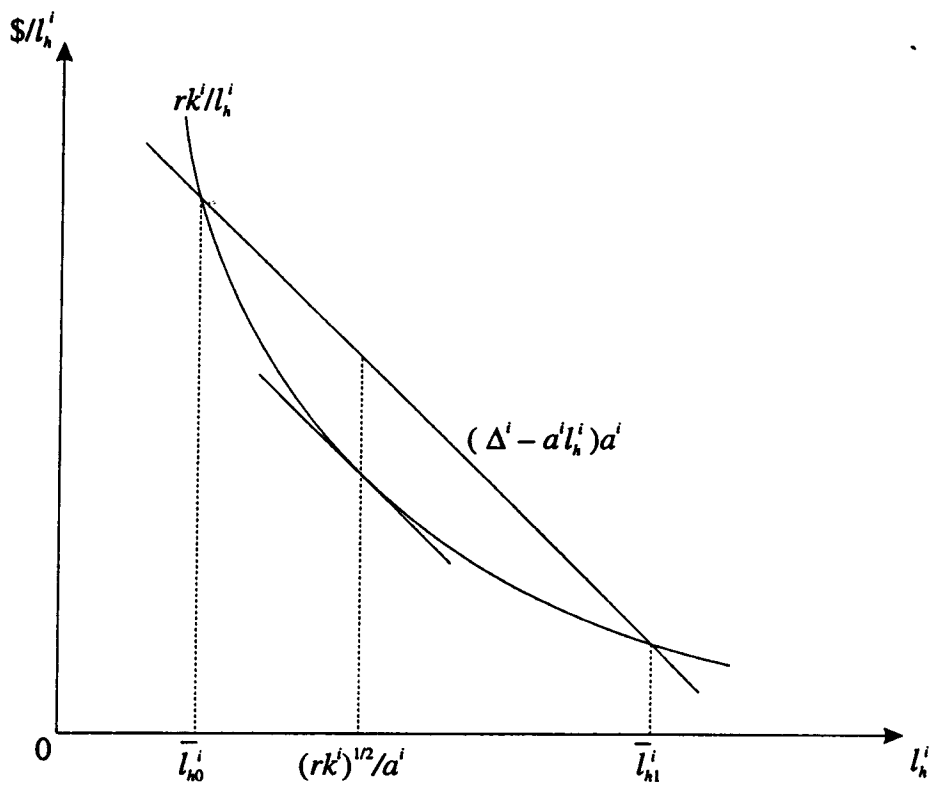

Figure 1. The employment decision when exports are zero.

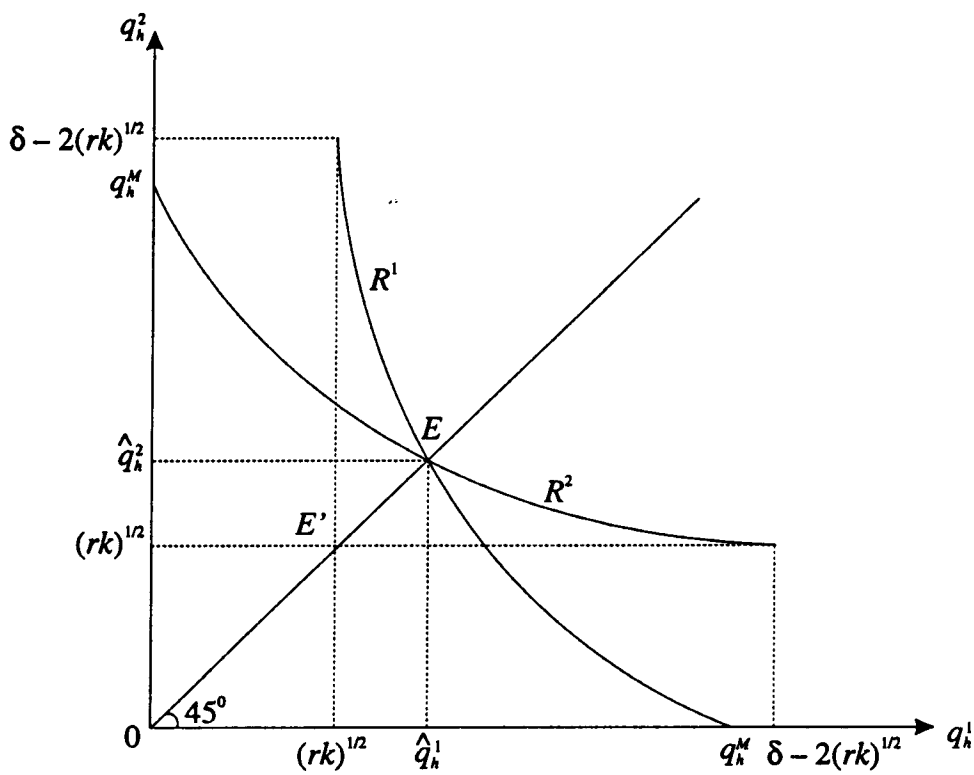

Figure 2. Industry equilibrium when exports are zero.

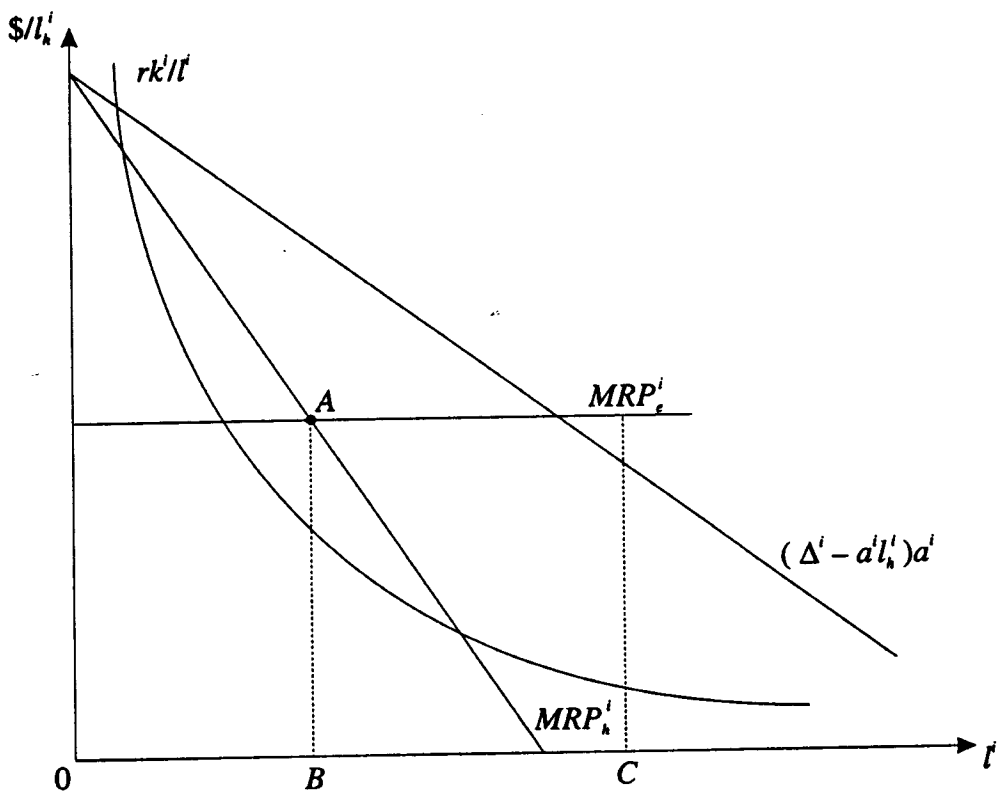

Figure 3. The internal solution with positive exports.

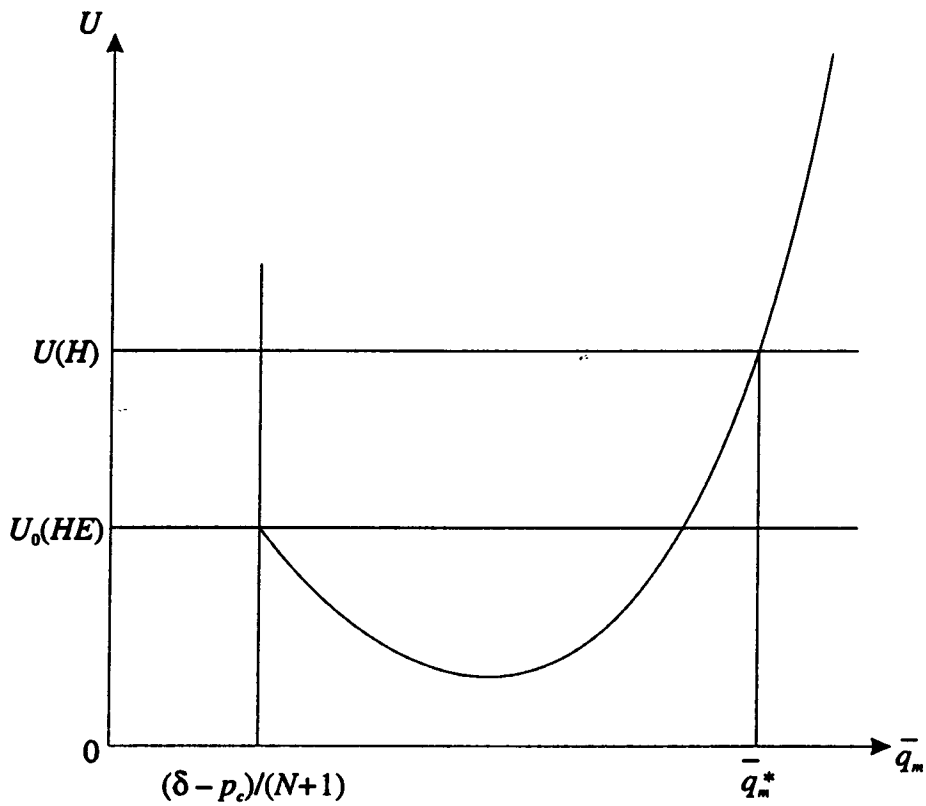

Figure 4. Discontinuous adjustment of exports to a materials constraint