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ABSTRACT

Privatisation in Poland: What Was the Government Trying to Achieve?

This paper uses the sequencing of privatisation to infer the objective pursued by the Polish government in the privatisation of its large manufacturing firms in the second half of the 1990's. We construct a model of mixed oligopoly, and use it to evaluate the privatisation process; our analysis is based on the assumption that firms which furthered the government's objective function the most would be chosen to be privatised first. Our empirical analysis identifies the features of the firms that were chosen for early privatisation, and suggests that the welfare maximisation was more important than the desire to maximise the revenues from privatisation and the government's budget, or to minimise employment losses.

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Non technical Summary

Following the end of the communist regimes, countries in central-eastern Europe privatised many of their formerly state-owned enterprises. The manner and the effects of privatisation have been widely discussed in literature with various conclusions on the outcomes and the effectiveness of the programmes implemented. A logical measure of judging the success of privatisation is how aligned the outcome of the privatisation programme was to the government objective function. However, the true goal of a government is not necessarily the same as the openly declared and reported objective, which may be itself dictated by tactical and strategic considerations. The aim of this paper is to determine the objectives of the Polish privatisation programme. Our approach is based on the observation that in Poland, just as in most other countries, not all firms were privatised at the same time, instead, privatisation took place gradually. To the extent that the privatisation of different firms had different effects on the government objective function, we make the assumption that the government chose to privatise first those firms whose privatisation would have the stronger positive effects on its objective function. With this assumption, we use the observed characteristics of the firms that were privatised at various dates to compare alternative assumptions regarding the functional form of the government unobserved objective function: in other words we attempt to "reverse engineer" the Polish government objective function, inferring it from its actions.

We study the privatisation process of the largest firms, and concentrate on the second half of the 1990's. While, for smaller firms privatisation followed the preferences of management, workers' councils and administrative agencies, the privatisation of the largest firms was probably taken strategically, with the Ministry of Ownership Changes in charge of the programme at country-wide level. By the second half of the 1990's the most "urgent" privatisations had already taken place, and the government was probably both freer to pursue its own objectives through the privatisation process and also more likely to predict the consequences of privatising any given firm, having learnt from the previous experience. The data come from the economic magazine *Nowe Zycie Gospodarcze*, which publishes annually a list of the largest 500 Polish enterprises. The dataset reports the ownership of each firm, which allows us to determine if and when a state-owned firm was privatised. We also evaluate the firm and industry level variables from this dataset.

We construct a theoretical model, based on the standard analysis of oligopoly markets where public and private firms both supply, and modified to account for the presence of foreign firms, which were more efficient than domestic ones. We then use this model to assess the effects of the privatisation of firms with differing

characteristics on a number of potentially plausible objective functions for the government: industry welfare, consumer benefit, employment, contribution to government budget and privatisation revenue. Finally, we determine the effect of changes in the model parameters on each of the hypothesised government objective functions using a mixture of algebraic manipulations and calibrations based on the sample data.

In the empirical part of the paper, we estimate the probability of privatisation as a function of the firm's individual characteristics, such as relative cost, and the characteristics of the industry in which the firm operates, such as industry size, the proportion of foreign and private domestic firms and the degree of competition. Our econometric results point to welfare and consumer benefit maximisation rather than concern for maintaining employment, maximising privatisation revenues, or contribution to budget as the more likely objective that the government was pursuing. Moreover, our analysis also suggests that the sequencing of privatisation was scheduled strategically: the government did not just decide which firms to privatise, but also which firms should be privatised early, which later.

1 Introduction

Following the end of the communist regimes, countries in central-eastern Europe privatised many of their formerly state-owned enterprises. The manner and the effects of the privatisation programmes have differed from one country to another, generating a literature studying these differences (Earle *et al.* 1993, Frydman *et al.* 1999, EBRD 1999, Svejnar, 2002, Megginson and Netter 2001, Parker and Saal 2003, Brown *et al.* 2006 among others). A logical measure of the success of privatisation is how aligned the outcome of the privatisation programme was to the government objective function: knowledge of this is not immediate, since the reality of politics implies that the true goal of a government is not necessarily the same as the openly declared and reported objective.[1]

In this paper we attempt to "reverse engineer" the Polish government privatisation programme, inferring the government's objective function from its actions. As in other countries, Polish firms were not all privatised at the same time. This was due to political constraints (Roland 2000) and practical reasons, such as the sheer logistic difficulty of privatising an entire economy in one go. To the extent that the privatisation of different firms had different effects on the government objective function, we take as an assumption that the government choose to privatise first firms whose privatisation would have the stronger positive effects on its objective function. With this assumption, we use the observed characteristics of the firms that were privatised at various dates to compare alternative assumptions regarding the functional form of government unobserved objective function.

We study the privatisation process of large firms operating in oligopolistic markets. In contrast to smaller firms, typically the target of management/worker buyouts, where the decision to privatise was determined by the initiative of management and workers' councils, it seems safe to posit that the privatisation of large firms is likely to have been determined via a process of strategic decision making at a national level, with the Ministry of Ownership Changes overseeing and controlling their privatisation and providing information on the relative position of individual enterprises in the domestic market

[1] Privatisation in Eastern Europe was variously justified to improve efficiency, promote competition, raise government revenues, contribute to the development of financial markets, secure the irreversibility of the reforms, pursue equity considerations (e.g. Estrin 1994, Hare 1994). The Polish government official aim was to transfer state assets to improve economic efficiency and to offer all citizens the benefit of participating in the shareholder culture (Ministry of Ownership Change 1995).

(OECD 1992). This is also the reason why we choose to concentrate on the second half of the 1990's; by this time, the most "urgent" privatisations had already taken place, and the government was probably both freer to pursue its own objectives through the privatisation process, and also more likely to predict the consequences of privatising any given firm, having learnt from the previous experience. The established model of mixed oligopoly (De Fraja and Delbono 1989) can be adapted to the analysis of the firms we study (the largest 500 manufacturing enterprises listed yearly in the economic magazine Nowe Zycie Gospodarcze), which includes many large state-owned firms operating in oligopolistic market in competition with private firms. We adapt the model to account for the presence of large foreign firms.

We take the time of privatisation as the dependent variable, and regress it against variables at firm level, such as cost, and at industry level, such as industry size, the proportion of foreign and private domestic firms and the degree of competition. Our results suggest that the hypothesis that the government was pursuing consumer's surplus and more generally social welfare fits the data marginally better than the assumptions that it was trying to increase revenues from privatisation or its total budget, or to minimise employment losses.

The paper is organised as follows: in Section 2, we present a theoretical oligopoly model, which is analysed in the four subsections in a variety of possible industry structures. Section 3 considers a variety of possible preferences for the government and studies the impact of parameters on the likelihood of the firms in the industry being privatised earlier. The empirical analysis, where the correspondence of the predictions of the theoretical analysis with the Polish programme is verified, is in Section 4 and 5. The features of the firms chosen for early privatisation are identified and compared with the existing literature in Section 5. Section 6 concludes.

2 The Model

The theoretical framework used by the existing papers on the sequencing of privatisation (Glaeser and Scheinkman 1996, Gupta *et al.* 2001, Husain and Sahay 1992) does not capture the mixed oligopoly nature of the Polish industrial sector of the early 1990's. We therefore extend the model developed by the mixed oligopoly literature (De Fraja and Delbono 1989, Cremer *et al.* 1989). On the demand side consumers preferences are represented by a linear demand

function, normalised to

$$a - p. \tag{1}$$

The modelling is richer on the supply side. Supply requires upstream and downstream production: this captures the fact that some firms in our dataset operate in the producers' market, other supply final consumers. In each stage, there is an exogenously given number of firms in the industry, $N \geqslant 1$. Firms in the downstream industry need to purchase their input from the upstream industry, and so the cost in the downstream industry is given by the equilibrium price in the upstream industry.[2] The composition of the industry differs in the two stages: in one stage all firms are identical and (for definiteness) private profit maximisers. In the other stage, of the N firms, n_f are foreign owned, n_d are private firms owned by home-based shareholders, and the rest, $m = (N - n_f - n_d)$ are state owned. Private firms have an efficiency advantage over state firms;[3] foreign firms have in turn an efficiency advantage over private domestic firms.[4] To keep things simple, we assume that there is no fixed cost.[5] Formally, private foreign firms have 0 marginal (and average) production cost, and state-owned firms and private domestic firms have constant marginal and average cost given by c and μc, respectively. This makes $\mu \in (0, 1)$ a measure of the similarity between private and public domestic firms, and $(1 - \mu)$ a measure of the efficiency gains from privatisation. In our setting, the natural interpretation of variable costs is labour cost, that is the inverse of the labour productivity of the domestic (private and public) firms relative to the foreign firms.

[2] We also assume that the firms in the downstream industry take the price charged by the firms in the downstream industry as given. An alternative assumption would be that all firms, downstream and upstream choose their action simultaneously. The qualitative features of the equilibrium would not change much, and there are no theoretical reasons to prefer one formulation over the other.

[3] This assumption has an established tradition in the mixed oligopoly literature: Cremer *et al.* (1989) introduced it explicitly, and De Fraja and Delbono (1989) provided a plausible justification when all firms have access to the same technology: to the extent that there are decreasing returns to scale, and that the public firms produce more than the private firms, then marginal cost is higher in the former.

[4] This is evident from the data, and it may be due to economy of scale, for example in the procurement of inputs, to access to superior technology, or to a self selection process by which only the efficient firms choose to operate abroad.

[5] Fixed costs only affect the overall profitability of a firm, and therefore its decision to remain in the industry, and not its operational decisions, and hence it has no effect on the other firms operating in the industry: with this viewpoint, the very observation of a firm being active indicates that its fixed costs are low enough.

Private firms maximise profits. With regard to state owned firms, we assume them to maximise employment, which in the present set-up is equivalent to maximising output, subject to a break even constraint. State owned firms were run by the managers of a centrally planned economy, who had therefore operated throughout their career under objectives of this type. Privatisation is intended to change drastically the *modus operandi* of the productive sector of the nation, and it seems therefore natural to assume that the Ministry of Ownership Changes pursued goals different from the "traditional" state-owned objectives of the communist era.

The imperfectly competitive nature of the market is captured by the assumption of Cournot competition: in the mixed oligopoly tradition, firms choose their output. The three types of firms are denoted by different subscripts: the domestic firms with subscript i (mnemonics for internal) and the foreign firms with subscript f (for foreign), public firms with h. A generic firm will be indexed by j.

To carry out comparisons, we need to consider four regimes: private firms up-stream and down-stream and pre and post privatisation. We denote each regime with a double superscript: thus $U0$ is the pre-privatisation (time 0) case where the public firms are in the upstream sector. Analogously $D0$, $U1$, $D1$; for example, $D1$ is the post-privatisation (time 1) case where the public firms were in the downstream sector. For the sake of simplicity, we do not consider the case where only some firms in an industry are privatised. In the next four subsections we consider each regime in turn.

2.1 $D0$: public firms are in the downstream sector.

In the downstream industry, given cost parameters and the objective functions of the three types of firms, we have an N-player game, where each firm takes as given p_u^{D0}, the equilibrium price in the upstream industry. The optimisation problem of the firms in the downstream sector is given by:

$$\max_{q_h} q_h \qquad \text{s.t.: } q_h \left(a - \sum\nolimits_{j=1}^{N} q_j - c - p_u^{D0} \right) \geqslant 0 \qquad h = 1, ..., m, \quad (2)$$

$$\max_{q_f} q_f \left(a - \sum\nolimits_{j=1}^{N} q_j - p_u^{D0} \right) \qquad f = m+1, ..., m+n_f, \quad (3)$$

$$\max_{q_i} q_i \left(a - \sum\nolimits_{j=1}^{N} q_j - \mu c - p_u^{D0} \right) \qquad i = m+n_f+1, ..., N. \quad (4)$$

These are the maximisation problems for each of the public firms (indexed by h), each of the foreign firms (indexed by f), and each of the domestic private

firms (indexed by i), respectively. (3) and (4) are standard. According to (2), each state-owned firm acts to maximise its output subject to a break-even constraint. In the upstream industry the N firms play a standard Cournot game, taking as given the demand function obtained as the equilibrium in the downstream industry, when the price charged by the firms in the upstream industry is p_u^{D0}.

Proposition 1 *The equilibrium of the game played by the N firms in the downstream industry, is the simultaneous solution to problems (2)-(4), given by:*

$$q_{hd}^{D0} = \frac{\frac{N}{N+1}(a-c) - ((N-m)(1-\mu) + \mu n_f)\, c}{m} \qquad h = 1, ..., m, \quad (5)$$

$$q_{fd}^{D0} = c \qquad f = m+1, ..., m+n_f, \quad (6)$$

$$q_{id}^{D0} = (1-\mu)\, c \qquad i = m+n_f+1, ..., N, \quad (7)$$

where q_{hd}^{D0} (respectively q_{fd}^{D0}, respectively q_{id}^{D0}) denotes the quantity produced by each of the public (respectively foreign, respectively domestic private) firms. In the upstream industry, all firms produce quantity

$$q_{uj}^{D0} = \frac{a-c}{N+1} \qquad j = 1, ..., N.$$

Proof. Standard: begin from the equilibrium in the downstream industry. The Lagrangean of each of the m public firms is $q_h - \lambda_h \left(a - \sum_{j=1}^{N} q_j - c - p_u^{D0}\right) q_h$, where λ_h is the Lagrange multiplier for public firm h, $h = 1, ..., m$, and where firms take the price p_u^{D0} as given. The Nash equilibrium is given by the solution in $(q_h, \lambda_h, q_i, q_f)$ of the first order conditions of problems (5)-(7):

$$1 - \lambda_h \left(a - Q - c - q_h - p_u^{D0}\right) = 0 \qquad h = 1, ..., m, \quad (8)$$

$$q_h \left(a - Q - c - p_u^{D0}\right) = 0 \qquad h = 1, ..., m, \quad (9)$$

$$a - Q - q_f - p_u^{D0} = 0 \qquad f = m+1, ..., m+n_f, \quad (10)$$

$$a - Q - q_i - \mu c - p_u^{D0} = 0 \qquad i = m+n_f+1, ..., N, \quad (11)$$

where $Q = \sum_{j=1}^{N} q_j$: the first two lines are the conditions relating to the public firms, the third (fourth) the first order condition of the foreign (private domestic) firms. Using the fact that each firm of each type behaves in the same way to write $Q = (mq_h + n_f q_f + (N - n_f - m)\, q_i)$, derive the equilibrium: $q_f = c$, $q_i = -\mu c + c$, $q_h = -\frac{cN - cN\mu + cn_f\mu - cm + cm\mu - a + c + p_u^{D0}}{m}$. From which:

$$Q = a - c - p_u^{D0}. \quad (12)$$

(12) is the demand function in the upstream industry. Plug it into the standard Cournot equilibrium of an N-firm oligopoly to obtain the individual quantities in the upstream

industry, $\frac{a-c}{N+1}$ and price $p_u^{D0} = \frac{a-c}{N+1}$; substitute into the downstream industry quantity for the public firms to establish the result. ■

It is now straightforward to calculate the equilibrium value of each industry variable. Total quantity is $Q_d^{D0} = Q_u^{D0} = \frac{N}{N+1}(a-c)$, and price $p_d^{D0} = c$. Profits are 0 for state-owned firms, and $\pi_{fd}^{D0} = c^2$ for foreign upstream firms, $\pi_{id}^{D0} = (1-\mu)^2 c^2$ for private domestic upstream firms and $\pi_{uj}^{D0} = \frac{(a-c)^2}{(N+1)^2}$ for downstream firms. Consumer's surplus is $C^{D0} = \frac{(a-c)^2}{2}$. Other measures of interest in the comparisons are the domestic total profit given by $(N-m-n_f)(1-\mu)^2 c^2 + N\frac{(a-c)^2}{(N+1)^2}$, and the tax receipts from foreign firms: $tn_f c^2$; the total tax receipt is simply $\left((N-m-n_f)(1-\mu)^2 c^2 + N\frac{(a-c)^2}{(N+1)^2} + n_f c^2\right) t$.

2.2 $U0$: public firms are in the upstream sector.

Next suppose instead that the N firms downstream are all private, and that there are m public firms in the upstream sector of the industry. Downstream firms with a constant marginal cost equal to y, produce quantity $\frac{a-y}{N+1}$, and so the upstream demand curve is $\frac{N}{N+1}(a-p)$.

Proposition 2 *The equilibrium of the game played by the N firms in the upstream industry, is given by the following choice of quantities for each of the public, domestic and foreign firms respectively.*

$$q_{hu}^{U0} = \frac{N}{N+1}\frac{a-((N-m)(1-\mu)+1+n_f\mu)c}{m} \qquad h=1,...,m, \quad (13)$$

$$q_{fu}^{U0} = \frac{N}{N+1}c \qquad f=m+1,...,m+n_f, \quad (14)$$

$$q_{iu}^{U0} = \frac{N(1-\mu)}{N+1}c \qquad i=m+n_f+1,...,N. \quad (15)$$

In the downstream sector, we have:

$$q_{jd}^{U0} = \frac{a-c}{N+1} \qquad j=1,...,N. \quad (16)$$

Proof. Given the downstream industry demand function $\frac{N}{N+1}(a-p)$, we have inverse demand: $p = a - \frac{N+1}{N}Q$, and so the game between the N firms is:

$$\max_{q_h} q_h \quad \text{s.t.: } q_h\left(a - \frac{N+1}{N}\sum_{j=1}^{N} q_j - c\right) \geqslant 0 \qquad h=1,...,m, \quad (17)$$

$$\max_{q_f} q_f\left(a - \frac{N+1}{N}\sum_{j=1}^{N} q_j\right) \qquad f=m+1,...,m+n_f, \quad (18)$$

$$\max_{q_i} q_i\left(a - \frac{N+1}{N}\sum_{j=1}^{N} q_j - \mu c\right) \qquad i=m+n_f+1,...,N. \quad (19)$$

for public, foreign and domestic private firms. The Nash equilibrium is the solution in $(q_h, \lambda_h, q_f, q_i)$ of the first order conditions:

$$\begin{aligned}
1 - \lambda_h \left(a - \frac{N+1}{N} Q - c - \frac{N+1}{N} q_j \right) = 0 \qquad & h = 1, ..., m, \\
q_h \left(a - \frac{N+1}{N} Q - c \right) = 0 \qquad & h = 1, ..., m, \\
a - \frac{N+1}{N} Q - \frac{N+1}{N} q_f = 0 \qquad & f = m+1, ..., m+n_f, \\
a - \frac{N+1}{N} Q - \frac{N+1}{N} q_i - \mu c = 0 \qquad & i = m+n_f+1, ..., N,
\end{aligned}$$

where, as before, λ_h is the Lagrange multiplier for public firm h, and $Q = \sum_{j=1}^{N} q_j$. Use symmetry to write $Q = (mq_h + n_f q_f + (N - n_f - m) q_i)$ and derive the equilibrium as (13)-(15). From them we can derive the total supply in the upstream industry $Q_u^{U0} = \frac{N}{N+1}(a-c)$, and the equilibrium price in the upstream industry is $p_u^{U0} = c$. (16) follows. ■

Total quantity (both in the downstream and in the upstream industry) is $Q_u^{U0} = Q_d^{U0} = \frac{N}{N+1}(a-c)$, and the price paid by consumers in the final market is $p_d^{U0} = \frac{a+Nc}{N+1}$. The profit of each downstream firm is $\pi_d^{U0} = \frac{(a-c)^2}{(N+1)^2}$ and the profit of each upstream domestic (foreign) firm is $\pi_{ui}^{U0} = (1-\mu)^2 c^2$ ($\pi_{uf}^{U0} = c^2$). Consumer's surplus is $C^{U0} = \left(\frac{N}{N+1}\right)^2 \frac{(a-c)^2}{2}$. The other measures of interest are the domestic total profit, given by $\frac{N(a-c)^2}{(N+1)^2}$ in the downstream industry and $(N - m - n_f)(1-\mu) c^2$ in the upstream industry, and the tax receipts from foreign firms, $tn_f \left(\frac{(a-c)^2}{(N+1)^2} + c^2 \right)$, which is the same as in the previous subsection. The total tax receipt is $t \left(\frac{N(a-c)^2}{(N+1)^2} + (N - m - n_f)(1-\mu) c^2 + n_f \left(\frac{(a-c)^2}{(N+1)^2} + c^2 \right) \right)$.

2.3 $D1$: privatisation of downstream public firms.

We now analyse the market equilibrium following privatisation. We do not consider the adjustment process, but study the equilibrium of an industry where instead of there being n_f foreign owned firms, n_d domestic private firms, and m state owned firms, there are n_f foreign owned firms, producing at cost 0, and $n_d + m = N - n_f$ domestic private firms, producing at cost μc: privatisation brings about an increase in efficiency, the cost parameter for the privatised firm goes down from c to μc. This is to be traded-off against the decrease in allocative efficiency due to the oligopolistic nature of the market.

The equilibrium is the solution to the game:

$$\max_{q_f} q_f \left(a - \sum\nolimits_{j=1}^{N} q_j - p_u^{D1} \right) \qquad f = 1, ..., n_f, \tag{20}$$

$$\max_{q_i} q_i \left(a - \sum\nolimits_{j=1}^{N} q_j - \mu c - p_u^{D1} \right) \qquad i = n_f + 1, ..., N, \tag{21}$$

where p_u^{D1} is the price charged by the firms in the upstream industry.

Proposition 3 *The equilibrium of the game played by the N firms in the downstream industry, simultaneously solving the problems (20)-(21) is given by:*

$$q_{fd}^{D1} = \frac{aN^2 + \mu c \left(N^2 + N + 1\right)(N - n_f)}{N\left(N+1\right)^2} \qquad f = 1, ..., n_f, \tag{22}$$

$$q_{id}^{D1} = \frac{aN^2 - \mu c \left(N^2 \left(n_f + 1\right) + \left(N + 1\right) n_f\right)}{N\left(N+1\right)^2} \qquad i = n_f + 1, ..., N, \tag{23}$$

for foreign and domestic firms respectively. In the upstream industry, all firms produce quantity

$$q_{uj}^{D1} = \frac{aN - \left(N - n_f\right)\mu c}{\left(N+1\right)^2} \qquad j = 1, ..., N.$$

Proof. The proof is, as before, algebraic manipulation of the first order conditions for problems (20)-(21). This is now simpler than before, since there is no public firm. The first order conditions (10) and (11) still apply (with $m = 0$) and solving them gives the quantities for given price p_u^{D1}:

$$q_i = \frac{a - p_u^{D1} - \left(1 + n_f\right)\mu c}{N+1}, \tag{24}$$

$$q_f = \frac{a - p_u^{D1} + \left(N - n_f\right)\mu c}{N+1}, \tag{25}$$

giving inverse demand $p_u = a - \frac{N - n_f}{N}\mu c - \frac{N+1}{N}Q$. The equilibrium for a symmetric game with this demand function has $q_u^{D1} = \frac{aN - (N - n_f)\mu c}{(N+1)^2}$ and $p_u^{D1} = \frac{aN - (N - n_f)\mu c}{N(N+1)}$. Substitute the latter into (24) and (25) to establish the result. ■

From this proposition it is straightforward to calculate the equilibrium value of all industry variables, as well as welfare: so we have total quantity $Q_d^{D1} = Q_u^{D1} = N\frac{aN - \left(N - n_f\right)\mu c}{(N+1)^2}$, price $p_d^{D1} = \frac{(2N+1)a + cN\mu\left(N - n_f\right)}{(N+1)^2}$, profits for each of the upstream firms $\pi_u^{D1} = \frac{\left(aN - \mu c\left(N - n_f\right)\right)^2}{N(N+1)^3}$ and for the foreign downstream firms $\pi_{df}^{D1} = \left(\frac{aN^2 + \mu c\left(N^2 + N + 1\right)\left(N - n_f\right)}{N(N+1)^2}\right)^2$, for the domestic

downstream firms $\pi_{di}^{D1} = \left(\frac{aN^2-\mu c\left(N^2\left(n_f+1\right)+(N+1)n_f\right)}{N(N+1)^2}\right)^2$. Consumer's surplus is $CS^{D1} = \frac{1}{2}\left(N\frac{aN-\left(N-n_f\right)\mu c}{(N+1)^2}\right)^2$.

2.4 $U1$: privatisation of upstream public firms.

In the final case, the m public firms operating in the upstream industry are privatised, so that there are n_f foreign firms, and $(N-n_f)$ private domestic firms in the upstream part of the industry, supplying an N private firm downstream oligopolistic industry. The upstream demand curve is still $\frac{N}{N+1}(a-p)$, and the equilibrium is described in the next result.

Proposition 4 *The equilibrium of the game played by the N firms in the upstream industry satisfies:*

$$q_{uf}^{U1} = \frac{N}{(N+1)^2}\left(a+\left(1+n_f\right)\mu c\right) \qquad f = 1,...,n_f, \tag{26}$$

$$q_{ui}^{U1} = \frac{N}{(N+1)^2}\left(a-\left(1+n_f\right)\mu c\right) \qquad i = n_f+1,...,N. \tag{27}$$

In the downstream part, we have:

$$q_{dj}^{U1} = \frac{aN-\left(N-n_f\right)\mu c}{(N+1)^2} \qquad j = 1,...,N. \tag{28}$$

Proof. Omitted. ■

Total quantity is $Q_u^{U1} = Q_d^{U1} = N\frac{aN-\left(N-n_f\right)\mu c}{(N+1)^2}$, and the price paid by consumers in the final market is $p_d^{U1} = \frac{(2N+1)a+N\left(N-n_f\right)\mu c}{(N+1)^2}$. The profit of each downstream firm is $\pi_d^{U1} = \frac{\left(aN-\mu cN+n_f\mu c\right)^2}{(N+1)^4}$ and of each upstream domestic (respectively foreign) firms $\pi_{ui}^{U1} = N\frac{\left(a-\left(1+n_f\right)\mu c\right)^2}{(N+1)^3}$ (respectively $\pi_{uf}^{U1} = \frac{N\left(a+\left(N-n_f\right)\mu c\right)^2}{(N+1)^3}$). Consumer's surplus is $C^{U1} = \frac{1}{2}\left(N\frac{aN-\left(N-n_f\right)\mu c}{(N+1)^2}\right)^2$.

3 The government's preference.

In Poland, firms were privatised sequentially; if we assume that the government choose to privatise first the firms which had the greatest positive impact on its payoff function, we can use information about the firms' characteristics to compare a number of a priori plausible government payoff functions. A simple

example may help explain our approach. Suppose that firms differed only in size. As we show below, in our model, social welfare is increased more and employment is reduced less by the privatisation of a small firm, whereas government revenues are increased more by the privatisation of a large firm. Our assumption is that a government whose objective is welfare maximisation or employment losses minimisation would privatise small firms first. If we observe in practice that, on average, larger firms are privatised earlier (that is that the coefficient for size is positive in a regression with "privatisation date" as the dependent variable), we would conclude that privatisation revenues and minimising employment losses were more likely than maximising industry welfare to have constituted the government objective.

Formally, if we denote by $U(\cdot)$ a candidate payoff function for the government, and by $U_j^0(\cdot)$ (respectively $U_j^1(\cdot)$) the value of the government utility when firm j is public (respectively private), the gain in utility for privatising firm j is given by the difference $\Delta_j^U(\cdot) = U_j^0(\cdot) - U_j^1(\cdot)$. For a given parameter of interest, x, and a given possible utility function, $U(\cdot)$, we calculate the derivative

$$\frac{\partial \Delta_j^U(\cdot)}{\partial x}. \tag{29}$$

If this is positive (negative), then, given two firms identical in every other respect, we expect the firm with a higher (lower) value of the parameter x to be privatised first.

We consider five possible functional forms for the government objective function.

1. Industry Welfare. The standard microeconomic measure of industry welfare (which ignores possible income effects) given by the sum of consumer's surplus, the firms' profits, and government revenues from taxation. After-tax profits earned by foreign firms do not increase the country welfare and are therefore subtracted from the total.

The gain in welfare following privatisation is given by

$$\Delta_j^U(\cdot) = \frac{1}{2}\left(N\frac{aN-(N-n_f)\mu c}{(N+1)^2}\right)^2 + N\frac{(aN-\mu c(N-n_f))^2}{N(N+1)^3} + tn_f\left(\frac{aN^2+\mu c\left(N^2+N+1\right)(N-n_f)}{N(N+1)^2}\right)^2 + (N-n_f)\left(\frac{aN^2-\mu c\left(N^2(n_f+1)+(N+1)n_f\right)}{N(N+1)^2}\right)^2 - \left(\frac{(a-c)^2}{2} + N\frac{(a-c)^2}{(N+1)^2} + tn_f c^2 + (N-m-n_f)(1-\mu)^2 c^2\right),$$

when the public firms are in the downstream industry, and by

$$\Delta_j^U(\cdot) = \frac{1}{2}\left(N\frac{aN-(N-n_f)\mu c}{(N+1)^2}\right)^2 + tn_f\frac{N(a+(N-n_f)\mu c)^2}{(N+1)^3} + + (N-n_f)N\frac{(a-(1+n_f)\mu c)^2}{(N+1)^3} + N\frac{(aN-\mu cN+n_f\mu c)^2}{(N+1)^4} - \left(\left(\frac{N}{N+1}\right)^2\frac{(a-c)^2}{2} + tn_f c^2 + (N-m-n_f)(1-\mu)^2 c^2 + N\frac{(a-c)^2}{(N+1)^2}\right),$$

when the public firms are in the upstream industry.

2. Consumer benefit. In this second specification, which can be interpreted as a special case of the above, we let the government care only about the surplus of the final consumers. In the linear set-up considered here there is a monotonic relationship with the price, we take the negative of the downstream industry price as the government payoff:

$$\Delta_j^U(\cdot) = -\left(\frac{(2N+1)a + cN\mu(N-n_f)}{(N+1)^2} - c\right),$$
$$\Delta_j^U(\cdot) = -\left(\frac{(2N+1)a + N(N-n_f)\mu c}{(N+1)^2} - \frac{a+Nc}{N+1}\right),$$

for the two cases of public firms in the downstream and upstream sector of the industry.

3. Employment. In many countries, a major worry of the government agencies in charge of the privatisation process was the overall level of employment in the industry. Large job losses, especially if concentrated in specific industries may derail the privatisation process or lead to loss in electoral support: the government may therefore wish to privatise first firms operating in industries where

domestic employment losses are limited. The dynamics of large restructuring following privatisation is beyond the scope of the present model,[6] and, as before, we limit ourselves to carrying out a comparative statics comparison of the pre- and post-privatisation equilibrium. Given that we posited marginal cost as the reciprocal of labour productivity, the ratio between output and marginal cost is the "excess" employment in domestic firms (employment is normalised to 0 for foreign firms). We have:

$$\Delta_j^U(\cdot) = (N - n_f)\,\mu c\left(\frac{aN^2 - \mu c\left(N^2(n_f+1) + (N+1)\,n_f\right)}{N(N+1)^2}\right) -$$
$$\left(\frac{N}{N+1}(a-c) - ((N-m)(1-\mu) + \mu n_f)\,c + (N - n_f - m)(1-\mu)\,\mu c\right)c,$$

for the case of public firms in the downstream industry, and

$$\Delta_j^U(\cdot) = \frac{N}{(N+1)^2}(a - (1+n_f)\,\mu c)(1-\mu)\,c -$$
$$\left(\frac{N}{N+1}[a - ((N-m)(1-\mu) + 1 + n_f\mu)\,c] + (N - n_f - m)\,\mu\frac{N(1-\mu)}{N+1}c\right)c,$$

when the public firms are in the upstream industry.

4. Contribution to budget. The next two objective functions are variations on the theme that the more important consideration underlying privatisation decision was to raise revenues. This may be justified because increasing privatisation revenues allows the government either to reduce taxes and increase the provision of goods and services, or, more cynically, strategically to direct public expenditure to gain political advantage. The contribution to the budget is given by sum of the changes in tax revenues and the receipts from privatisation. The latter can be measured by the discounted present value of the future stream of profits which can be obtained from the privatised firms, since this is (proportional to) the maximum that buyers are willing to pay for a given firm. With an interest rate of r, the proceeds are $\frac{m}{r}\pi_{di}^{D1}$ and $\frac{m}{r}\pi_{ui}^{U1}$ for the two cases when the privatised firms are in the downstream and in the upstream industry respectively. So the government payoff when the public firms are in

[6] The ensuing level of unemployment is also an important consideration in establishing the optimal path of privatisation in Katz and Owen 1993.

the downstream industry is:

$$\frac{m}{r}\left(\frac{aN^2-\mu c\left(N^2\left(n_f+1\right)+(N+1)n_f\right)}{N(N+1)^2}\right)^2+ \tag{30}$$
$$t\left[N\frac{\left(aN-\mu c\left(N-n_f\right)\right)^2}{N(N+1)^3}+n_f\left(\frac{aN^2+\mu c\left(N^2+N+1\right)\left(N-n_f\right)}{N(N+1)^2}\right)^2+\right.$$
$$\left.\left(N-n_f\right)\left(\frac{aN^2-\mu c\left(N^2\left(n_f+1\right)+(N+1)n_f\right)}{N(N+1)^2}\right)^2\right]-$$
$$t\left[N\frac{(a-c)^2}{(N+1)^2}+n_fc^2+\left(N-m-n_f\right)(1-\mu)^2c^2\right].$$

And, correspondingly, for the upstream case:

$$\frac{m}{r}\frac{N\left(a-\left(1-n_f\right)\mu c\right)^2}{(N+1)^3}+t\left(n_f\frac{N\left(a+\left(N-n_f\right)\mu c\right)^2}{(N+1)^3}+\left(N-n_f\right)N\frac{\left(a-\left(1+n_f\right)\mu c\right)^2}{(N+1)^3}+\right. \tag{31}$$
$$\left.N\frac{\left(aN-\mu cN+n_f\mu c\right)^2}{(N+1)^4}\right)-t\left(n_fc^2+\left(N-m-n_f\right)(1-\mu)^2c^2+N\frac{(a-c)^2}{(N+1)^2}\right)$$

5. Privatisation Revenue. Just as maximisation of consumer's surplus can be seen as a special case of maximisation of industry welfare, maximisation of the government budget can be specialised by assuming that the government tries to maximise the revenues from privatisation. Three possible sets of reasons, not mutually exclusive, may be thought of as plausible for this assumption: it may be that the agency in charge of the privatisation process and its managers are rewarded explicitly by a contract, or implicitly by the market, on the basis of the amount of privatisation revenues (the first terms in equations (30) and (31)), because the information on changes in tax revenues following their policies is too difficult to extract from the observed data. Or it may be that the government would not be able to divert resources already earmarked in the overall budget, and that the added flexibility of the privatisation revenues allows the government to pursue new expenditure programmes. Finally, as noted by Gupta *et al.* (2001), there may be political benefits in allocating share to certain sectors of the populations. Formally, (30) and (31) are replaced by their respective first term only.

We can now determine the sign restrictions that the parameters of the model would satisfy if each of the objective functions considered above were the government's true objective function.

Table 1 presents the results in each of the five cases considered above. To obtain them we use a rather lengthy mixture of algebraic manipulations and

calibrations, using the sample averages reported in Table 2, available on request as an appendix. In the other rows, the signs under a variable are the signs of the partial derivatives of the change in the various government objective functions the row refers to. The last row in the table, which refers to the empirical estimations carried out in Section 5, is the vector of signs in our empirical estimation.

1. Welfare. The first line in Table 1 gives the effects of changes in the parameter values on welfare. The signs have an intuitive explanation. Consider first a, the overall size of the industry. The negative sign under it in the "welfare" row indicates that an increase in this measure makes it less likely that privatisation of a firm in the industry increases welfare: other things equal, the price increases with the size of the industry in a private oligopoly, but is constant in a mixed oligopoly, where, as shown above, it is given by the public firms' costs. Therefore, the larger the industry, the less likely it will be that the privatisation will result in a price reduction, and any increase in profit will be more than compensated by the loss in consumers' welfare. The sign under c indicates that, in our model, industries where c is higher are more likely to give rise to an increase in welfare when privatised. This is natural, as a higher value of c indicates a lower efficiency of the domestic industry, and hence the gains from privatisation are higher. A higher value of μ reduces the likelihood of having benefits from privatisation: the higher μ, the more similar the private domestic firms are to the public firms, and given our assumption that the privatised firms will be, efficiency-wise, similar to domestic private firms, a lower μ implies smaller gains in efficiency to be set against the lower competitiveness of the industry. The only thing that changes with privatisation in an industry with a higher tax rate is the total profit of the industry, which increases welfare, and explains the sign of t. N next: naturally, privatising firms in a more competitive industry increases the likelihood that the benefit of privatisation (higher efficiency) offsets the cost (a less competitive environment). The higher the proportion of foreign firms, ϕ_f, the less likely it is that privatisation be beneficial. This is because a higher proportion of the higher profits of the industry following privatisation are siphoned off abroad and do not contribute to welfare; with regard to the sign of ϕ_m the more public firms there are, the higher the overall inefficiency in the industry, and more likely it is that privatisation will be beneficial. Finally privatisation is more likely to be beneficial in an upstream industry, since the beneficial effects of higher efficiency trickle down to the downstream part as

well, while the converse is not true.

2. Consumer benefit: Most signs are similar to those obtained in the case above. This is not surprising, consumer benefit being a major component of welfare, and the intuition for them is also similar. The one difference is in the sign of ϕ_f: a higher values of ϕ_f implies that more of the additional profits leave the country. While this is a bad thing when the government objective is industry welfare, it is irrelevant when the government is only concerned with lowering the price paid by the final consumers, and so the sign is different.

3. Employment: The effect of industry size on employment is similar to the effect on welfare: in larger industries a decrease in employment is more likely following privatisation, simply because there is more "room for improvement". The effect of c is non-linear. This is natural: if c is low, the public firms are relatively efficient anyway, privatisation is more likely to reduce the total output in the industry, which, with low c, is a proxy for employment. Conversely, for relatively inefficient industries, with high c, cuts in employment following privatisation are more likely, since the gains in efficiency translate in employment losses. Other signs are ambiguous in general reflecting the balance between the change in output, and the reduced number of employees necessary to produce any given output, which are both consequences of privatisation. For privatisation to bring about an increase in employment, the change in output must be positive and large. The effect of differences in μ is ambiguous: it increases employment in the downstream industry but not in the upstream industry. The effect of competition is generally to increase employment, but if there are many firms operating in an upstream industry, this effect might become negative. A large foreign sector reduces employment in a downstream industry, but increases it in an upstream one. When the state sector is large, the industry is over-staffed, and privatisation lowers employment. In contrast to other hypothesised government objectives, the sign on the downstream dummy is positive, indicating that the effect on employment is going to be less damaging if privatisations take place in a downstream rather than upstream sector.

4. Contribution to budget. The sign of a is a simple consequence of the observation that more revenue is raised by selling larger firms. There are two effects at play with regard to c: when c is low, privatisation brings about a large increase in profits, and hence both the government budget and the revenues from the sale of firms are reduced by a higher value of c. But, for high c, privatisation reduces the other firms' profits, because the newly privatised

$\Delta U($		$a,$	$c,$	$\mu,$	$t,$	$N,$	$\phi_f,$	$\phi_m,$	δ)
Welfare		–	+	–	+	+	–	+	–
Consumer welfare		–	+	–	0	+	+	0	–
Employment	downstream	–	$\underset{+}{-}$	+	0	+	–	–	+
	upstream	–	$\underset{+}{-}$	–	0	$\underset{+}{-}$	+	–	
Contribution to budget	downstream	+	$\underset{+}{-}$	–	+	–	–	+	–
	upstream	+	+	+	+	–	+	+	
Privatisation revenues	downstream	+	–	–	+	–	–	+	–
	upstream	+	–	–	+	–	+	+	
Estimated values (specification 4)	downstream	–	+	+	+	$\underset{-}{+}$	+	+	–
	upstream	–	– (ins)	–	–	$\underset{-}{+}$	+	+ (ins)	–

Table 1: Theoretical and estimated parameter signs.

firms will be more competitive and hence they lower the profits and the tax take. Consider N now. The government budget depends on the profit change: the higher the number of firms, the more likely that there is a loss in profits due to privatisation (inefficient firms are replaced by more efficient firms, and the mark-up decreases with N). The role of ϕ_f is shown to depend on whether the privatised firms are in the upstream or downstream industry, and finally, clearly, the more public firms there are, the more likely it is that privatisation will bring about an increase in the budget.

5. Privatisation Revenue. The signs are very similar to the case where the objective function is the contribution to the budget. The main difference is in the effects of c: when the whole budget is the government's objective, a higher value of c enhances the likelihood of privatisation affecting positively the objective function, and vice versa when privatisation revenues are the government's goal. This is because the profit made by the private domestic firms (which enhances the objective function of the government in case 4 but not in case 5) is increased more by privatisation when c is higher.

4 Data

Poland is a good testing ground for the model presented above, because the privatisation programme was gradual, and a few years into its implementation there still remained a substantial public sector. We focus on the largest firms to isolate the role of the government, which can be assumed to have organised the

Parameter	Description	Average	St. dev.
a	market size (sales of top firms in the same industry, billions of zloty)	1.2893	2.2129
c	cost disadvantage of public vis-à-vis foreign firms in the same industry	0.0022	0.0026
μ	cost disadvantage of domestic private vis-à-vis foreign firms in the same industry	0.7667	7.4584
t	tax rate (the ratio of net tax to sales)	0.0320	0.0423
N	number of firms in the industry	35.9730	34.6433
ϕ_f	proportion of foreign firms in the industry	0.1735	0.1288
ϕ_m	proportion of public firms in the industry	0.6202	0.2138
δ	downstream dummy (=1 for a downstream industry)	0.3514	0.4774

Table 2: Definitions and descriptive statistics.

programme strategically to pursue its objectives, in contrast to privatisations of smaller firms, where employees and management played an important role in deciding whether to privatise.

The data come from the economic magazine Nowe Zycie Gospodarcze, which publishes annually a list of the largest 500 Polish enterprises. The dataset reports the ownership of each firm, which allows us to determine if and when a state-owned firm was privatised.[7] We analyse the period when the largest number of privatisations among the largest firms occurred, namely 1995 and 1996, and we do not extend the study beyond 1999, as very few large manufacturing firms were privatised after that year. From the original set of 500 firms, we take the subset of firms which were in public ownership in 1995, which could be traced throughout the relevant period, and for which we have sufficient information to calculate the required parameters. This leaves 147 firms, of which 92 are privatised between 1996 and 1999, while the remaining firms remain public.

Table 2 reports descriptive statistics for our parameters. We construct the industry level variables, such as the proportion of the various types of firms in the industry, directly from the dataset itself. This is preferable to using information from the statistical yearbooks, as they are at a very aggregated level, corresponding to 2-digit NACE industries (following the European Community Classification of Economic Activity). Thus, for a given firm, the size parameter of its industry, a, is given by the total sales of all the firms classified by Nowe Zycie Gospodarcze as belonging to the same 4-digit industry. The relative efficiency parameters c and μ are calculated using the reported data on labour productivity of all state-owned, private domestic and foreign firms: these are relative values, measured against the average for all foreign or private domestic

[7] We have also verified the cases of privatisation against the information published by the Ministry of Ownership Changes in the Privatisation Progress Reports.

firms in a given industry. For the original 4-digit NACE classification it is often the case that an industry is dominated by state-owned firms. For this reason, the sizes of the state, private and foreign sectors are evaluated at the most suitable level of disaggregation, either two or three digit, depending on the sector. Other variables are described in Table 2.

5 Empirical results.

We estimate the probability of privatisation as a function of the firm's individual characteristics and of the characteristics of the industry where the firm operates; the results are given in Table 3. The theoretical model predicts different effects, depending on whether the firm to be privatised operates in the downstream or upstream stage of the industry, and so we interact the parameters of the theoretical model with a dummy taking value 1 for a downstream firm. Moreover, the effect of c and N on employment and on the contribution to budget depends on the size of these parameters, and so we include quadratic terms for them. The coefficient for c^2, however, is always insignificant, and so we have omitted it from the estimation. For robustness, we have tested four different specifications, with a probit or ordered probit procedure, in each case using the cluster option to account for correlation between firms operating in the same industry. The values that the dependent variable can take in each specification are summarised in the note to Table 3. In the first specification it is a binary choice: either privatise in 1996 or not. In the second specification it is also a binary choice, with the years from 1996 to 1999 bunched together. The next two specifications consider a finer timing. In the third column, we carry out an ordered probit regression with five possible values (privatised in 1996, 1997, 1998, 1999, or remaining state-owned throughout the whole period). The last column is a coarser version of specification 3, with three categories only: firms privatised in 1996, later (between 1997 and 1999) or never. We chose this aggregation as it corresponds to the largest differences between threshold parameters (not reported in Table 3) in specification 3.

Different specifications give similar estimates indicating a degree of robustness. The first specification has fewer significant parameters than the third and the fourth. This suggests that the government did not just decide which firms to privatise, but also that sequencing was important, and that the process of privatisation should be regarded as staged over a number of years, with some firms designated for early, others for late privatisation.

	[1]		[2]		[3]		[4]	
	coefficient	z value	coefficient	z value	coefficient	z value	coefficient	z value
a	-0.1370**	-3.32	-0.0753**	-3.00	-0.1100**	-4.58	-0.1100**	-4.51
a*downstream	-0.0317	-0.13	-0.1750*	-2.25	-0.2220**	-4.01	-0.2200**	-3.85
c	-0.0275	-1.18	-0.0282	-0.93	-0.0311	-1.28	-0.0319	-1.30
c*downstream	0.0146	0.62	0.0782*	2.40	0.0464*	2.10	0.0447*	1.98
μ	-0.1492**	-2.78	-0.0589	-1.44	-0.1083**	-3.50	-0.1020**	-3.56
μ*downstream	1.3903*	2.06	0.6664**	3.25	0.8724**	5.61	0.8771**	5.03
t	-10.9071	-1.54	-20.3190*	-2.27	-15.5382*	-2.07	-16.2952*	-2.24
t*downstream	-5.7566	-0.26	28.3445*	2.34	17.2245	1.86	19.2958*	2.09
N	-0.1373**	-3.62	-0.0721	-1.52	-0.1091**	-3.42	-0.1109**	-3.43
N squared	0.0028**	2.67	0.0016	1.30	0.0021**	2.72	0.0022**	2.70
N*downstream	0.1241*	2.01	0.1429	1.14	0.1407	1.45	0.1490	1.51
N squared *downstream	-0.0024**	-2.66	-0.0021	-1.83	-0.0023*	-2.33	-0.0024*	-2.31
ϕ_f	4.3598**	5.47	2.2866**	2.99	3.4071**	5.68	3.4861**	5.86
ϕ_f * downstream	-2.3086	-0.78	6.7227	1.72	4.3432	1.63	4.7459	1.68
ϕ_m	1.1129*	2.09	-0.4443	-0.96	0.3979	1.05	0.5329	1.34
ϕ_m * downstream	2.8951	1.05	6.6606**	2.57	5.6297**	2.77	5.8618**	2.71
δ	-5.4501	-1.55	-9.6466**	-2.78	-8.3781**	-3.18	-8.7748**	-3.17
Log likelihood	-74.3104		-77.5109		-159.8330		-135.0130	
Pseudo R^2	0.2312		0.2024		0.1344		0.1538	

In all cases the number of observations is 147. The dependent variable can take the following values in the four specifications:
[1]: (i) privatised in 1996, (ii) not privatised in 1996. **[2]**: (i) privatised in 1996-99, (ii) not privatised in 1996-99.
[3]: (i) privatised in 1996, (ii) privatised in 1997, (iii) privatised in 1998, (iv) privatised in 1999, (v) not privatised in 1996-99.
[4]: (i) privatised in 1996, (ii) privatised in 1997-99, (iii) not privatised in 1996-99.
** and * indicate significance at the 1% and 5% level respectively.

Table 3: Probit and ordered probit estimates of the probability of privatisation.

We can now interpret our estimation as an indicator of the objective function the government was following in its privatisation programme. To do so we need to compare the observed signs with the direction of different effects predicted by the theoretical model. For a firm in an upstream industry the sign can be seen directly from Table 3, whereas, for a firm in the downstream stage, the overall effect has to take account of the coefficient on the interaction term with the downstream dummy. The last row of Table 1, introduced in Section 3, summarises the significant signs obtained in specification 4, so that estimated effects can be compared with the theoretically predicted signs under alternative government objectives. With the proviso that one would not expect all the estimated signs to match the theoretical predictions for one of the objective functions, on balance, the observed signs point to welfare and consumer benefit maximisation rather than concern for maintaining employment, privatisation revenues, or budget contribution.

From the same table, parameters which are statistically significant may serve as an indication of the features of firms chosen for privatisation. For example,

the positive coefficient for ϕ_f suggests that firms operating in industries with a large foreign sector are more likely to be privatised sooner.

Two of the parameters, c and μ, measure the efficiency of a firm to be privatised and may shed light on whether it should be the best or the worse enterprises that should be privatised first. This has been an issue in the theoretical debate on the sequencing of privatisation. On the one hand, Roland (1994) takes a political economy point of view and maintains that the best firms should be privatised first: they are more likely to perform well after privatisation, thereby enhancing support for further privatisation. On the other hand, Gupta *et al.* (2001) show that a government should privatise the worse firms first in order to improve allocation efficiency. Ahuja and Majumdar (1998) also argued that worse firms should be privatised first, as a superior sequence, maximising the overall productivity and technical efficiency gains. In our theoretical model, privatising less efficient firms will increase welfare and consumer benefit, and this prediction is partially supported by the empirical results, given by the estimates of c for a downstream industry and of μ for an upstream industry. This also lends support to the Gupta *et al.* (2001) and the Ahuja and Majumdar (1998) models.

Glaeser and Scheinkman (1996) express the concern that potential gains from privatisation might be forfeited if firms with market power are privatised. In our model, market structure and market power are captured by parameters a and N. Parameter a is significant and negative for a downstream as well as an upstream industry. For the industry size N, there is a U-shaped relationship with the turning point around 25 firms, much below the mean value of 35 firms reported in Table 2. This indicates that for industries with relatively few firms the effect of N is negative but it becomes positive for the mean industry. Thus, the estimates of parameters a and N turn out to be consistent with welfare and consumer benefit maximisation, showing that the choice of firms for privatisation in Poland was also partly driven by market power considerations.

The downstream dummy is consistently negative in all our specifications, indicating that downstream industries in Poland were privatised at later stages. In contrast to this, Gupta *et al.* (2001) found that Czech firms in downstream industries were privatised first. In their analysis, operating in a downstream industry is used as a proxy for uncertainty. According to Glaeser and Scheinkman's (1996) model of informational gains to privatisation, industries most affected by uncertainty, should be privatised first. Gupta *et al.* (2001) therefore interpret their empirical findings as lending support to Glaeser and

Scheinkman's (1996) theoretical prediction. In our model, the differences between downstream and upstream industries are due to different effects on allocative efficiency, rather than their differing degree of exposure to shocks and uncertainty.[8] Privatising upstream industries first is consistent with most government objectives, since improved efficiency of an upstream industry is also passed onto a downstream industry.

6 Concluding Remarks.

We analyse empirically the question of which objective function the Polish government was pursuing in the mid 1990's with the privatisation process of its state owned firms. The theoretical foundation for the analysis is a mixed oligopoly model which we develop from the existing literature, and the underlying assumption on the behaviour of the government is that it choose to privatise first those firms whose privatisation would have the strongest impact on its payoff. The results give some support to the hypothesis that the government was concerned more with welfare and consumer benefit than with maximising contribution to budget or revenue from privatisation.

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