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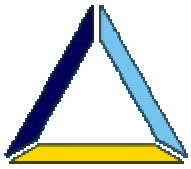

Working Paper No. 17

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Competition and Technical Efficiency of Ukrainian Manufacturing Enterprises

October 2002

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1 Introduction

There is a widely held belief that fierce competition improves the efficiency of production, which is clearly an extrapolation of the well-established fact that competition has a positive influence on efficient resource allocation. The intuition, which leads to this conclusion is related to the existence of a positive rent in monopolized markets and the corresponding possibilities for slack by managers and employees. Considerations of the relative propensities and of the potentials to enhance technical efficiency of the firms under different market structures resulted in a great variety of theoretical models. However, the relationships are far more complex and far less obvious than would appear at first sight.

The information environment, which provides opportunities to monitor and compare performance parameters, is likely to improve with an increase in the number of market agents. Holmstrom (1982), Nalebuff and Stiglitz (1983), and Mookherjee (1984) developed a set of arguments in favour of better managerial incentives in less concentrated markets. Hart's (1983) model suggests that the imperfect sensitivity of managers to monetary rewards secures the positive influence of competition on managerial efforts. In particular, if the total and marginal costs are positively correlated between two types of firms (managerial and entrepreneurial) and the number of entrepreneurial firms is sufficient large to affect the market, then managers have fewer opportunities for slack. Conversely, a perfect managers' sensitivity to changes in income leads to the opposite result as was shown by Scharfstein (1988). The concept that historical performance determines the future rewards of managers, is at the core of the model of Meyer and Vickers (1997). They demonstrated that the sensitivity of managers to a positive economic rent is rather low, in particular at the beginning of their careers. The extension of this model to an n-agents framework by Nickel (as cited in Nickel, 1996) showed that managerial incentives increase with an increase in n. The theoretical model based on a principal-agent relationship suggested by Willing (1987), relates an increase in elasticity of demand to an increase in the principal's pressure on managers. However, a corresponding decrease in individual demand for the firms has the opposite effect. In this case, the direction of the impact of competition depends on the relative magnitudes of the mentioned effects. The probability of bankruptcy, which is higher in competitive markets, can also enhance managerial efforts as described by Schmidt (1994 and 1997). At the same time, fierce competition reduces profits and might negatively influence the incentives for cost-reducing projects. Martin (1993) and Horn et al (1994) provided models where competition is associated with a reduction in managerial efforts. For

instance, in Martin's model, which is based on Cournot-type competition, marginal revenue decreases as the number of firms increases, thus the owner has fewer incentives to reward a manager for developing cost-saving technologies. A number of studies (see for example, Smirlock and Marshall (1983), Dickens and Katz (1987) and Stewart (1990)) focus on the impact of competition on employee effort as well. They have shown that an increase in monopolistic rent is correlated with an increase in employee slack either directly or indirectly due to the impact on trade union activities. Finally, the peculiarities of a monopolistic market structure, which include the maintenance of entry barriers, such as excess capacities, may represent an additional source for production inefficiencies.

As for empirical evidence: the significant gap in productivity between Eastern and Western Europe, better international performance of industries subject to enhanced domestic competition (Porter 1990), and the observed productivity gains resulting from industrial deregulation, particularly in the airline industry (Graham et al 1983), provide arguments in favour of competition. At the same time, quantitative evaluation methods provide less obvious results. This can partially be attributed to methodological shortcomings. Commonly used cross-sectional data are poor tools to evaluate the various "technological opportunities, which differ substantially across industries and tend to be correlated with market concentration" (Nickell, 1996, p. 729). The use of fixed effects in panel data, like in Geroski (1990) enables to reveal a negative relationship between the level of market power and innovative activity. Nickel (1996) uses panel data and "present[s] evidence that competition… is associated with higher rates of total factor productivity growth" (p. 741). A significant number of studies of the relationship between competition and technical efficiency is based on the frontier production function technique (see Caves and Barton 1990 for a literature survey).

The East-European transition economies present an excellent opportunity for empirical studies. However, some peculiarities of these economies, like high initial economic concentration, administrative entry barriers, soft budget constraints, etc. require careful selection of the parameters of the model. Recent empirical studies on the relationship between competition and production efficiency in transition economies have produced differing results. Dutz and Vagliasindi (1999), have found that an effective competition policy results in an increase in the number of efficient market agents. Carlin et al (2001), using survey data from 25 transition countries to test the impact of competition on enterprise restructuring, found a significant, but non-monotonic effect of competition on the growth of sales and on labour productivity. At the same time, Bevan et al (1999), analysing restructuring of enterprises in transition economies, concluded that "it is unclear whether a definitive answer is likely to emerge from studies of [transition economies]" (p.13).

As it can be seen from this brief outline of theoretical and empirical findings, the argument of a positive influence of competition on production efficiency remains a topic for discussion. This paper makes an attempt to empirically test the relationship between the level of competition and technical efficiency at the sub-industry level, that is, to evaluate the anticipated disciplining effect of competition on the behaviour of entrepreneurs in the transition economy of Ukraine.

2 Competition policy in Ukraine

The first ***Ukrainian legislation concerning competition*** was a 1991 resolution of the Verkhovna Rada of the Ukrainian Soviet Socialist Republic concerning monopolistic activity and promotion of competition. At that time the Ukrainian constitution explicitly obliged the government to assure economic competition (article 42). The main concerns were the prevention of (1) market power abuse, (2) unjustified restrictions on competition, and (3) unfair competition. The Law of Ukraine "On the protection of economic competition", of January 11, 2001, defines "legal grounds for the maintenance and protection of economic competition, for the limitation of monopolies in economic activities and… [is] directed towards ensuring the efficient functioning of the economy of Ukraine on the basis of the development of competitive relations". This law concentrates mainly on the first two concerns, that is, on the issues of market power abuse and on restrictions to competition. The third concern is the subject of the Law of Ukraine "On protection against unfair competition" of June 07, 1996. Apart from these competition laws of general application, the Law of Ukraine "On natural monopolies" of April 20, 2000 outlines the major management principles applicable to natural monopoly segments. Finally, the legal basis for establishing an antitrust authority is provided by the Law of Ukraine, No. 3629-12 of November 26, 1993 "On the Antimonopoly Committee of Ukraine" (AMC). Overall, the competition-related legislation in Ukraine appears to maintain a balance between the structural and conduct-oriented approaches. In particular, from the structural standpoint, anticompetitive business practices can be avoided by preventing increases of market concentrations beyond a certain threshold. Although increases in the economic concentration cannot be unconditionally rejected by the AMC, thresholds are defined in the legislation. Conduct-oriented elements can be observed in mandated cost-benefit analyses for mergers, acquisitions and other actions that might affect market structure. In particular, market concentrations may be authorized where the cost of restricted competition is outweighed by benefits to society at large.

Major shortfalls of the Ukrainian legislation include the following: (1) issues of state aid distribution are addressed in too generala fashion[1], (2) the possibility of preferential treatment of state enterprises compared to private ones is not excluded[2], and (3) excessively broad legal definitions provide opportunities for their discretionary interpretation and might lead to discrimination of entrepreneurs by the state. As to compliance with international principles the Ukrainian legislation can be said to basically correspond to the requirements of the European Union's antitrust policies.

[1] Although Article 15 of the Law "On the protection of economic competition" prohibits "the granting of privileges for particular agents or groups of agents, which can provide them with advantages over their competitors, leading to competition restriction", this quite general statement does not address the subsidization issue directly.

[2] Public enterprises or enterprises with a significant state share definitely have better access to the state aid since the recipient and the donor of the funds is the same institution. In particular, the share of state enterprises in total payables in 2000 was about 44% (at the beginning of 2002 it was 37%), which is almost twice as large as their share in production.

However, there is a significant gap between the existing legal framework and its actual implementation.

The Ukrainian ***antitrust authority*** is the Antimonopoly Committee of Ukraine (AMC), which was established in 1994 as a collegial body. According to law, the AMC is a central executive authority of Ukraine with a special status, which makes it formally independent of political influence and of the influence of business groups. It reports to the President and is accountable to Parliament. The chairman of the AMC is appointed and dismissed by the President of Ukraine, with approval by the Verkhovna Rada, for a seven year term. Deputy-chairmen and state (authorized) representatives are appointed by the President of Ukraine on application by the Prime Minister for the same terms. The AMC is financed out of central state revenues on the basis of a separate budget, which further decreases its potential dependence. Cases concerning violations of competition legislation can be initiated by the AMC[3] or by private parties. In order to provide transparency the legislation mandates publication of every AMC decision "by the defendant at his expense". The right to call into question any decision of the Committee confirms the sound democratic principles underlying its activities[4].

Though the Law provides the AMC with significant authority to monitor and protect competition, its actual power seems quite limited. First of all, any AMC decision can be vetoed by the Cabinet of Ministers of Ukraine. This is a sign of an implicit domination of industrial over competition policy. Another problem concerns insufficient financing of the AMC's activities, which reduces the possibility of attracting highly qualified specialists, especially into the regional branches of the AMC. This negatively influences the performance of the Ukrainian antitrust authority on the regional level, particularly in those fields that require specialised knowledge of entrepreneurial activities or markets.

The ***regulatory authorities*** represent the major problem of Ukrainian competition-related institutions. Historically, all bodies of executive power on the national and regional levels were deeply involved with different types of regulation. Recent administrative reforms, however, have only affected the quantitative component of regulatory authorities, and have done little to the quality of the regulatory system.

Imperfections in the regulatory environment in Ukraine are mainly related to the fact that the regulatory and business functions, not only at the municipal and local authority levels, but at the central authority level as well[5], are performed by the same bodies. The key policy shortfalls are the following: (1) economic activity[6] of the state authorities responsible for

[3] If fines or other AMC orders are not met voluntarily, the courts are mandated to enforce these decisions.

[4] This appeal process is not a serious problem for the policymaking. According to the former AMC chairman O.Zavada, the court approves only about 20% of all appeals, which constitutes about 1.5% of all AMC decisions.

[5] For instance, the State Committee on Communication and Informatisation is simultaneously responsible for regulation in the telecommunication sector and for the execution of state corporate rights in the OJSC "Ukrtelecom".

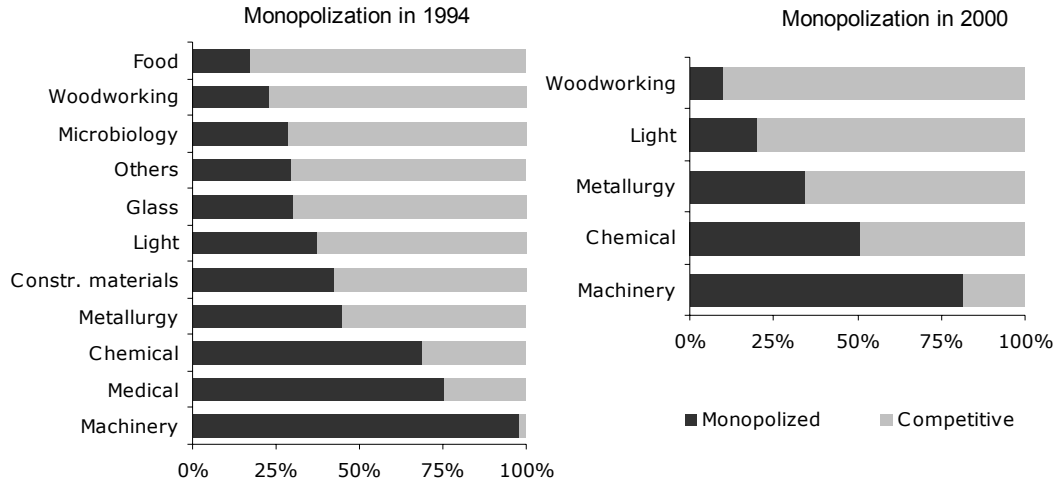
[6] In particular, in construction and trade industries costs related to the licensing procedure may contribute up to 30% of total costs.

regulation is unsystematic and non-transparent, (2) regulatory power is frequently delegated to business entities[7], and (3) regulatory authorities often also manage state corporate rights.

The ***implementation of competition policy in Ukraine*** started with the breakdown of the Soviet economic system, which brought a previously unknown phenomenon to Ukrainian markets – competition. Former state-owned enterprises faced significant pressure both from foreign rivals due to trade liberalization and from domestic ones due to the entry of new firms. However, most newly created firms were too small to affect market structures significantly. Besides, the implementation of competition policy was hampered by the slow pace of introducing appropriate legislation, and the high level of unionisation in the economy, and by a poorly developed regulatory framework. As a result, the overall monopolization level in the economy in 1994 was about 60% (Annual report of the AMC, 1994). Over 400 enterprises had market shares in excess of 35% on 460 national product markets, most of which were for consumer goods. Currently, the overall level of the economy monopolization is about 40% (State program of the economic and social development in Ukraine in 2003).

Graph 1

Monopolization of industries in the Ukrainian manufacturing sector[8].



Sources: Annual reports of the AMC; authors' calculation

Between 1994 and 2002, the most highly monopolized industries also showed the least demonopolisation progress. Specifically, significant market power persists in the industries related to natural monopolies, as well as in the metallurgy, machinery, chemical, fuel-chemical, and oil-and-

[7] De jure prohibition of the delegation of regulatory authority that may influence economic concentration does not by itself guarantee that such a delegation can de facto not take place, either because of lack of antitrust knowledge by the delegating authority or because there are other real interest in the background.

[8] According to the estimates of the Antimonopoly Committee of Ukraine. The estimates are based on the percent of the monopolized product groups (monopolization is assumed if at least one firm has a market share in excess of 35%) in the total number of product groups in the sector.

gas sectors. The degree of monopolization across the sectors can be seen in Graph 1.

Within the manufacturing sectors the level of market concentration across sub-industries varies considerably. Also, several regional markets still have a relatively high degree of monopolization.

3 Model

There are several approaches to an empirical evaluation of the relationship between the level of competition and enterprise efficiency. These approaches differ with respect to the ways of measuring the level of economic concentration and efficiency, as well as data disaggregation levels. For instance, many older and also some more recent studies use simple ratios, like labour productivity or intermediate input efficiencies as efficiency measures. Although these "single-ratio" measures proved to be "very informative but [they] can also be quite misleading, because each measure only considers a single input in isolation" (Coelli, 1996). An alternative approach, suggested by Farrell (1957), considers all factors of production simultaneously. The idea behind that approach is to measure the relative efficiency of a firm in an industry by comparing its output to the output, which can be produced by the most efficient firm, given the same bundle of inputs. A further extension of this idea used by numerous authors resulted in two estimation methods: (1) mathematical programming (known as Data Envelopment Analysis)[9], and (2) econometric estimation (known as the Stochastic Frontier Production Function approach). While both approaches have their drawbacks and limitations, SFPF was chosen for this paper, taking into account the poor quality of data in a transition economy.

The stochastic frontier production function model used in this paper is similar to the one used by Coelli (1996) to analyse the technical efficiency in Australian coal-fired electricity generation. However several crucial changes have to be mentioned.

First of all, an SFPF estimation is performed within each of the eight selected two-digit industries, excluding the power sector, on the basis of 5-digit sub-industry data. The relative efficiencies (of the sub-industries) are calculated with respect to the best 5-digit sub-industry(ies). In addition, the cross-industries' heterogeneities in capital are controlled by two-digit industry dummy variables in the overall regression.

Secondly, since sub-industries are compared within two-digit sectors, one implicit assumption should be noted: the capital and labour elasticities are allowed to vary at the two-digit industry level and are assumed to be similar across different five-digit sub-industries within the same industry. In other words, similarities of technologies between different sub-industries

[9] The major drawback of the DEA method is in its high sensitivity to data measurement errors.

allow verification of relative performances of each sub-industry by comparing their factors productivity[10].

Third, instead of using the book value of the capital employed, a proxy for the capital utilized was used (see section The Data). This is justified by several peculiarities of the Ukrainian economy: (1) the large inherited capital stock, (2) the dramatic fall in demand, and (3) the resulting under utilization of capacities justify using a proxy for the capital utilized instead of its book value (see section The Data).

The model uses a simple Cobb-Douglas production function with the sub-industry value added serving as a dependent variable. The general form of the SFPF specification is

$$Y_i = f(X_i, \beta) e^{V_i - U_i}, \quad (1)$$

where

i = 1,…, N, where N is the total number of industries;

Y_i is the value added of the ith sub-industry;

X_i is an input vector, namely capital and labour;

β is a vector of the parameters to be estimated;

V_i is a symmetric random error, and

U_i is a positive random error, which accounts for the technical inefficiency.

The U_i[11] are assumed to be random variables, which are independently distributed as truncations at zero of a normal distribution with a mean M_i and a variance σ^2, where $M_i = g(Zi, \delta)$. Z_i is a vector containing sub-industry specific factors (in the model only competition is included) and a constant; δ is a vector of the parameters to be estimated; and g(.) is a suitable functional form, usually assumed to be linear.

Thus, the production process is assumed to be described by the following function:

$$\ln(VA_{it}) = \beta_0 + \beta_1 \ln(K_{it}) + \beta_2 \ln(L_{it}) + v_{it} - u_{it}, \mathrm{i} = 1,2,..., \mathrm{N}, \mathrm{t} = 1,2,$$

with u_{it} = ($\mathrm{M_{it}}$, σ_u^2), which are non-negative random variables associated with technical inefficiencies, such that the distribution of u_{it} is obtained by truncation at zero of the normal distribution and $\mathrm{M_{it}} = \delta_0 + \delta_1 Concentration_{it}$;

where

- VA_{it} = the value added for the i^{th} sub-industry in the t^{th} year;

[10] An overall economy regression was run using dummy variables to control for heterogeneous technologies of production.

[11] One of the major weak points of the SFPF approach is the necessity to impose an explicit assumption as to the distributions of the random terms.

- K_{it} = a proxy variable for the capital used in the production (more details in the section "The Data" below);
- L_{it} = labour (employees) measured as the yearly average number of employees;
- "ln" refers to the natural logarithm;
- the v_{it} are iid $N(0,\sigma^2)$ random errors, which are assumed to be distributed independently of the u_{it}.

Following Battese and Corra (1977), σ_v^2 and σ_u^2 are replaced with

$\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$. This transformation has advantages in the estimation process, where γ can be searched between zero and one to obtain a suitable starting value for an iterative maximization process. Values of all unknown parameters in the above stochastic frontier production function are simultaneously estimated by the maximum likelihood. Such a one-stage approach is preferable to the often-used two-stage approach (where individual inefficiencies obtained in the first stage using the SFPF are then regressed on firm (industry) specific parameters using OLS methods), because the latter experience inconsistency in the underlying assumptions concerning error terms, i.e. the first stage inefficiency terms are assumed to be iid, but this is not true for the second stage regression.

4 Data

The data employed in the econometric estimation is represented by a balanced (full) panel with the number of cross-sectional observations varying from 10 to 282, depending on the economic sector (broad definition of industry). The time-series component covers two years 1996-97.

The cross-sectional part of the data is constructed using the industrial register for Ukrainian manufacturing firms, which includes over 8,000 enterprises in all manufacturing sectors according to the General Classifier of Economy (ZKNG), except for the power generation branch. The data on individual firms is grouped into 282 five-digit sub-industries.

The variables in the econometric specification all appear in natural logarithmic form.

Capital. As was pointed out above, the balance sheet data on capital can hardly serve as a variable in a production function because of the under utilization of capacity in the Ukrainian economy and the poor economic validity of the capital employed as measured by its book (non-market)

value. For these reasons, power consumption was used as a proxy for the capital utilized in production[12].

Labour. The official company reports were used for labour data. The labour indicator suffers from the problem of hidden unemployment. However, we expect that the labour force is relatively more flexible and should adjust more quickly than the book value data for capital.

Value Added. Since data on intermediate inputs is unavailable at this time, the balance sheets of individual firms were used to retrieve the data on value added in production. This allows for construction of a production function without a control variable for intermediate inputs. The value added was adjusted for price fluctuations using the industrial producers index at the three-digit industry disaggregation level.

Concentration indexes. Market concentration was evaluated using two types of concentration ratios: The Herfindahl-Hirschman index (HHI) and the concentration ratio C4. The concentration indices are calculated as follows:

$$HHIj = \sum_{i=1}^{n} \left(\frac{Sales_{ij}}{\sum_{i=1}^{n} Sales_{ij}} \right)^2$$, where *j* is the index for a five-digit sub-industry, *i* is the index for the i^{th} firm, and *n* is the number of firms in a given sub-industry. Thus, the index is in the range (0,1], with 1 indicating a monopoly.

The *C4* index represents the joint market share of the four largest firms in a particular sub-industry and has a range of (0,1], where a higher value of the index indicates a higher level of monopolization.

Table 1
Summary statistics of the data

VARIABLE	MEAN	STD.DEV.	MAX	MIN
VA	59,345.82	149,828.02	1,550,843.27	37.50
K	226,414.22	884,345.90	10,256,350.00	50.00
L	12,573.18	25,943.76	332,098.00	24.00
HHI	0.35854	0.29721	1.00000	0.00476
C4	0.77493	0.24601	1.00000	0.05834

The concentration ratios are not adjusted for exports and imports, and were calculated at the national level. In other words, the sales totals of all

[12] This approximation implicitly assumes a homogeneous structure of capital within each two-digit industry. In other words, a unit of capital is assumed to be powered by the same amount of electricity in each of the 5-digit sub-industries.

firms in the Ukrainian Industrial Register are assumed to represent the complete sub-industries' markets.

Summary statistics of the variables are presented in Table 1.

5 Results

For estimation of the SFPF model, the FRONTIER 4.1 software was used. The results of the model estimation are presented in Table 2.

As it can be seen from this table, only the food-processing and construction materials industries revealed a robust positive influence of market concentration on technical inefficiency of production. The woodworking, chemical, metallurgy, and other manufacturing industries only weakly support the hypothesis of a positive influence of competition on technical efficiency. Machinery presents no clear evidence of the influence of market structure on productive efficiency: different concentration indicators have opposite signs and are not statistically significant. A particularly striking result was obtained for the light industry: a strong negative impact of market concentration on the technical inefficiency. One possible explanation of this phenomenon is that the Ukrainian light industry has experienced a very high ratio of toll (give-and-take raw material) transactions, which might affect the market structure. Thus, foreign consumers might be well advised in securing their contracts when dealing with Ukrainian producers. Such guarantees are likely to be quite reliable when contracting with a single firm. Under these conditions, an efficient firm will become even more efficient and grow by acquiring additional market power, thus positively affecting market concentration. At the same time, this does not provide a full explanation of the obtained empirical results, and requires further research.

The overall regression only partially supports the hypothesis of a favourable influence of competition. The four-firm concentration ratio appears to have a positive, but insignificant influence on the technical inefficiency parameter. In turn, HHI revealed a positive and statistically significant effect on technical inefficiency. Although the HHI index better uses "information on the total number of firms present" (Bevan et al 1999. p. 12) in terms of their size distribution, there are no uncontested arguments concerning its advantages over the C4 ratio.

Table 2
Estimation Results

Coefficient	Machinery		Woodwork		Light		Food		Chemical		Metallurgy		Construction Materials		Other Manufacturing		Overall	
	14		15		17		18		13		12		16		19			
Intercept (β_0)	0.378	-0.171	0.888	1.732	1.756	1.426	2.221	1.673	2.046	2.319	2.025	2.091	1.628	1.678	1.293	0.914	1.061	1.100
se	*0.242*	*0.296*	*1.211*	*1.045*	*0.440*	*0.563*	*0.743*	*0.571*	*0.613*	*0.770*	*0.635*	*0.681*	*0.008*	*0.087*	*0.891*	*0.658*	*0.255*	*0.189*
ln(cap)	0.587	0.547	0.442	0.478	0.328	0.303	0.306	0.400	0.507	0.454	0.044	0.075	0.548	0.534	0.455	0.501	0.524	0.489
se	*0.042*	*0.090*	*0.188*	*0.150*	*0.094*	*0.081*	*0.103*	*0.106*	*0.135*	*0.125*	*0.060*	*0.051*	*0.022*	*0.028*	*0.099*	*0.108*	*0.043*	*0.036*
ln(lab)	0.372	0.463	0.463	0.319	0.668	0.739	0.615	0.546	0.311	0.351	0.991	0.932	0.314	0.326	0.579	0.593	0.451	0.496
se	*0.059*	*0.117*	*0.261*	*0.220*	*0.120*	*0.094*	*0.106*	*0.130*	*0.208*	*0.198*	*0.094*	*0.081*	*0.027*	*0.017*	*0.137*	*0.144*	*0.060*	*0.049*
Intercept (δ_0)	-8.337	0.147	-1.547	-0.342	2.084	2.008	-8.084	-2.910	-15.456	-2.242	-49.15	-25.306	-1.770	-1.283	-1.393	0.682	0.249	0.383
se	*9.833*	*0.952*	*1.325*	*0.260*	*0.416*	*0.615*	*3.877*	*1.694*	*13.846*	*3.497*	*31.815*	*26.435*	*0.587*	*0.786*	*2.063*	*1.180*	*0.254*	*0.135*
Concentration (C4)	6.891		2.301		-0.823		8.188		15.598		31.405		1.709		2.876		0.384	
se	*8.455*		*1.690*		*0.388*		*3.939*		*13.066*		*22.130*		*0.614*		*1.955*		*0.331*	
Concentration (HHI)		-0.225		2.415		-1.857		4.513		3.436		23.118		1.742		0.959		0.337
se		*0.405*		*1.172*		*0.385*		*1.912*		*2.906*		*21.937*		*0.903*		*1.108*		*0.101*
σ^2	0.966	0.351	0.305	0.310	0.217	0.165	1.160	0.479	1.477	1.080	17.546	8.205	0.625	0.746	1.070	1.067	0.572	0.545
se	*0.476*	*0.039*	*0.140*	*0.103*	*0.045*	*0.025*	*0.406*	*0.153*	*0.664*	*0.784*	*8.820*	*8.034*	*0.140*	*0.246*	*0.558*	*0.579*	*0.054*	*0.025*
γ	0.699	0.000	0.071	0.000	1.000	1.000	0.742	0.258	0.858	0.808	0.997	0.991	1.000	1.000	0.852	0.912	0.216	0.098
se	*0.168*	*0.001*	*0.126*	*0.000*	*0.583*	*0.000*	*0.116*	*0.223*	*0.079*	*0.164*	*0.003*	*0.010*	*0.000*	*0.000*	*0.160*	*0.145*	*0.115*	*0.016*
Log-likelihood	-196.3	-197.2	-16.8	-16.7	-28.6	-22.6	-52.5	-48.3	-57.1	-54.9	-42.2	-39.4	-18.6	-17.7	-42.4	-43.8	-632.5	-626.2
Mean efficiency	0.81	0.93	0.83	0.87	0.27	0.27	0.76	0.88	0.60	0.58	0.58	0.62	0.66	0.65	0.42	0.36	0.49	0.47
Cross-section	110	110	10	10	22	22	27	27	27	27	21	21	29	29	18	18	282	282
Time-series	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total observations	**220**	**220**	**20**	**20**	**44**	**44**	**54**	**54**	**54**	**54**	**42**	**42**	**58**	**58**	**36**	**36**	**564**	**564**

Table 3 reproduces the monopolization levels of the Ukrainian manufacturing sector as estimated by the Antimonopoly Committee of Ukraine.

Table 3
Relationship between monopolization and mean sectoral efficiency

Industry	Monopolization 1994	Monopolization 2000	Mean efficiency (1996-98)
Machinery	0.977419355	0.816129032	0.81-0.93
Chemical	0.688888889	0.505555556	0.60-0.58
Metallurgy	0.449275362	0.342995169	0.58-0.62
Constr. Materials	0.421052632	-	0.66-0.65
Light	0.37414966	0.204081633	0.27-0.27
Woodworking	0.229357798	0.100917431	0.83-0.87
Food	0.171428571	-	0.76-0.88

Sources: Antimonopoly Committee of Ukraine; authors' calculation

As it can be seen, the mean efficiencies obtained from the SFPF estimation in general follow the pattern of more highly monopolized industries having lower mean efficiencies. Again, the only exceptions are the machinery and light industries: the former has a relatively higher level of efficiency and the latter has an unexpectedly low efficiency. This is contrary to the expectation, which assumed a positive relationship between competition and technical efficiency. Thus, there is a weak support for the hypothesis that competition is favourable for efficient production at the cross-industry level.

6 Conclusions

While competition is definitely important for efficient resource allocation, its influence on the efficiency of the production process is still an issue of discussion. Numerous theoretical and empirical studies have addressed this issue and their results provide only partial support for the benevolent nature of the "invisible hand". In this paper, the authors have made a trial to evaluate the effect of competition on technological efficiency within Ukrainian manufacturing enterprises.

The results of the stochastic frontier production function approach provide some evidence that competition is a good thing for the efficiency of production. Within the sector a weak positive relationship between competition and technical efficiency in general corresponded to the same relationship between sectors, with the exception of machinery and light industry. In all other industries the competition has a positive, however, not always statistically significant influence on technical efficiency. The overall manufacturing sector regression also provides evidence in favour of competition, particularly, when the market power is measured by the Herfindahl-Hirschman index. The unclear relationship between competition and productivity in the machinery sector, as well as the negative effect of competition on efficiency within light industry can, to some extent, be explained by the peculiarities of the transition process. Non-linearity in the

competition effect and low resource mobility, accompanied by capital hoarding strategies, pervasive ownership structures, underdevelopment of bankruptcy procedures (i.e. high exit barriers), high rates of implicit and explicit subsidies, which are not reported in the balance sheets are the issues that must be considered as important factors influencing the true level of competition and observed efficiency.

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