J Prod Anal (2006) 25:143–157
DOI 10.1007/s11123-006-7136-8

Corporate governance and firm's efficiency: the case of a transitional country, Ukraine*

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> "The entrepreneurship structure itself may be critical, with the classic issue of the separation of ownership from control being regarded as one of the earliest and most important sources of X-efficiency" (Button and Weyman-Jones, 1992, *American Economic Review*).

Abstract In this study, we look for empirical support for the hypothesis that there is a *positive* relationship between the levels of corporate governance quality across firms and the relative efficiency levels of these firms. This hypothesis is related to Leibenstein's idea of X-efficiency. We use the data envelopment analysis (DEA) estimator to obtain proxies for X-[in]efficiency of firms in our sample and then analyze them with respect to different ownership structures by comparing distributions and aggregate efficiencies across different groups. We also use truncated regression with bootstrap, following Simar and Wilson Estimation and influence in two stage, semi-parametric models of production process, Simar and Zelenyuk (2003) to infer on relationship of inefficiency to various indicators of quality of corporate governance, ownership variables, as well as industry and year specific dummies. The data is coming from seven industries in Ukraine.

JEL Classification C24, D24, G30, P27

Keywords Corporate governance · Efficiency · DEA · Ownership · Ukraine

*We would like to dedicate this paper to the memory of Christos Panzios — co-editor who handled our paper to almost the very end, whose suggestions and encouragement have helped us substantially improve our paper.

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Introduction

One of the currently hot topics in management theories and practices is the issue of corporate governance as an important determinant of a firm's performance. This issue has become most pronounced, perhaps, with the corporate scandals at Enron, WorldCom, and other giants, but as a theoretical concept it had been in economists' minds for at least a half of the century. Among the classical papers is certainly that of Leibenstein (1966), who by conceptualizing his notion of X-efficiency had been talking, essentially, in a language of corporate governance. His concept of X-efficiency has spurred a tremendous amount of literature, pro and con, and

also inspired us to look for an empirical confirmation/opposition of his ideas — now explicitly in the light of the corporate governance notion.

The objective of this paper is to investigate the relationship between various indicators of corporate governance quality across firms and the efficiency levels of these firms. We choose Ukraine as our empirical subject not only because we know this country perhaps more than of others, but mostly because a transitional country is a country where changes — including changes in corporate governance practices, ownership structures, etc. — are occurring, for a researcher, at a very attractive pace (although sometimes, it might seem slow to people who live there). In other words, transitional countries are the places where one can often observe changes and consequences with an 'unequipped eye' — changes that one can hardly see in economies operating close to a steady state.

Our main hypothesis is that the higher the quality of corporate governance (which is of course hard to measure) goes together with the efficiency of a firm. Our methodology for testing this hypothesis involves two stages. First, using the data envelopment analysis (DEA) estimator, we estimate efficiency of each firm relative to the so-called best-practice frontier. The resulting estimates serve us as proxies for what Leibenstein called "X-efficiency". These estimates are then, at the second stage, analyzed by comparing distributions and aggregate efficiencies across different ownership structures, and by regressing efficiencies on the firm specific variables, which we expect (based on theory) to influence the X-efficiency of each firm. Among these firm-specific variables are the proxies indicating good (or bad) corporate governance practices, shares of state and foreign ownerships, as well as industry and time dummies.

We find strong support for our main hypothesis: some proxies of corporate governance are found to be significant determinants of our proxy for X-efficiency. In addition, we find that the share of state ownership is *positively* related with our estimates of *inefficiency*. To our surprise, we also identify the positive and *significant* relationship between foreign ownership and inefficiency. Overall, we do find support for the argument that the quality of corporate governance at a firm, on average, goes together with higher performance of this firm, and this is regardless of whether the firm is foreign or local.

The concept of corporate governance, X-efficiency and the context of transitional countries

Whenever there is a division of ownership and management in a firm, it is likely that a well-known principal-agent problem (Jensen and Meckling, 1976) would arise. The owners/investors want to ensure that the professional managers that they hire would run the company in line with the best interests of the owners — working with greatest possible efficiency, maximizing the added value of the firm. On the other hand, the goal of managers or large shareholders might be to maximize their own benefits ignoring the interests of other owners, especially minor shareholders. A similar problem of interest confrontation may arise in the relationship between different levels of authority/ownership at virtually any level and dimension. When interests of managers and workers are not perfectly in line with those of owners, there could be a substantial loss in firm's efficiency. The core of the problem is the *asymmetry of information* across levels of authority/ownership — which is also the key issue addressed by the corporate governance theories and practices.

The notion of the corporate governance is quite comprehensive. It is often defined as a field in economics that investigates how to secure/motivate *efficient management* of corporations by the use of incentive mechanisms, such as contracts, organizational designs and legislation (Mathiesen, 2002). In the words of Shleifer and Vishny (1997) "[c]orporate governance deals with the ways in which suppliers of finance to corporations assure themselves of getting a return on their investment."

The issue of corporate governance has become extremely important in the last decades, when corporations have reached a remarkable output growth and at present produce more than 90% of all world output. On the background of well-known bankruptcies of transnational corporations (e.g. Maxwell Group, Enron, WorldCom, etc) the corporate governance problem is becoming one of the central issues in the aim of secure and continuous economic development in the world. As a result, economists, management scientists, governments and businesses all over the world have been extensively exploring the issue of effective corporate governance as a key determinant of firm's performance.

Besides such extreme outcome as bankruptcies, a major consequence of poor corporate governance practices is low utilization of employed resources. This problem can be viewed through Leibenstein's (1966) concept of 'X-[in]efficiency', which can be understood as the *difference* between a firm's potential and actually observed (realized) performance caused by (i) intra-plant motivational efficiency, (ii) external motivational efficiency and (iii) non-market input efficiency (Leibenstein, 1966). In principle, such difference can be measured via the Debreu's (1951) measure of capacity utilization or the Farrell's (1957) measure of efficiency. The concept of 'X-efficiency' and its measurement were also elaborated in Button and Weyman-Jones (1992), and the goal of our paper is to find empirical support (or rejection) of these ideas, with the Debreu–Farrell efficiency measurement approach, in the context of a *transitional* country.

Indeed, the issue of corporate governance in transitional economies is particularly important and interesting. In the countries of former Soviet Union (FSU), for example, the recent dominance of state ownership along with authoritarian-traditions of governance inherited from the past are currently in fight with modern styles of management coming from the West. The outcome of this fight determines the microstructure of industries as well as the infrastructure in these countries. As a result, the level of corporate governance also influences the macroeconomic development. In particular, by determining investor's rights, the quality of corporate governance in transitional countries can partially explain the differences in investment inflows and, consequently, in countries' growth rates. In this respect, Stiglitz's (1999) critique towards reforms in many transitional countries is enlightening:

> "The divergence of interests between the managers and shareholders in large publicly traded corporations has been a major source of the economics of agency contracts. Yet the hard lessons of the separation and control, and the resulting agency problems, have received insufficient attention in the standard western advice in spite of much discussion of 'the corporate governance problem.' ... Privatization is no great achievement – it can occur whenever one wants – if only by giving away property to one's friends. Achieving a private, competitive market economy, on the other hand, is a great achievement, but this requires an institutional framework, a set of credible and enforced laws and regulations." (Stiglitz, 1999, p. 10, 19)

Now, when private ownership appears in FSU countries, the establishment and enforcement of the proper corporate governance principles (appropriate information disclosure, proper treatment of shareholders, effectiveness of supervisory boards, etc) are vital for enhancing the development of enterprises as well as of the transition economy as a whole. Yet not many companies in FSU have transitioned to exercising good corporate governance. Why? Does the change bring more of pain than of gain?

The background of transitional economies is also intriguing in the light of foreign influence. On the one hand, there is rapidly growing *local (within FSU) capital* — often originated from criminal activities or/and funds and connections of former communist party — whose representatives seem like traditionally viewed the transparency as a nuisance. On the other hand, the *foreign capital* is also growing in transitional countries, and its owners normally consider the transparency as the key to success. The sever rivalry between these two types of business-styles in transitional countries can be seen with an unequipped eye. The competition or Adam Smith's "invisible hand" must direct and equilibrate this competition somewhere — but where? Will the locals converge to the 'Western' style of making business? Or the foreigners will convert to the style of locals: "*When in Rome do like Romans?*" An average of the two is more likely, but what would be the weights? — Perhaps the one where each will maximize their own performance, *given* beliefs of what *others* will do. The resulting Nash-type equilibrium, as it is well known, may or may not lead to Pareto optima. In fact, it is well possible that all firms, local and foreign, would eventually choose to be the least (or falsely) transparent, because it might be irrational doing otherwise if most other firms do not. On the level of individuals in the FSU, this type of "Prisoner's Dilemma" — when each player individually 'defects' rather than 'cooperate' — leading to a Pareto inferior outcome, has even engraved itself into a famous Russian proverb: "*No lie — No life!*" The danger for these countries is that a similar fate may wait upon the business level as well. In fact, such 'cheating' behavior of many businesses has often been more a rule rather than an exception at the very early stages of transition. (Readers can recall the

numerous Ponzy-type games overwhelming the countries in FSU). It is a challenge to investigate what the current situation is with respect to corporate governance in a transitional country: Is it helping firms to have greater efficiency relative to other firms?

To our knowledge, this study is the first attempt to empirically investigate the 'X-efficiency' across firms *explicitly* in the context of the *corporate governance* notion, at least for the case of a transitional country. We also hope to be provocative for more of similar and better studies for other transitional countries.[1] In evaluating the link between the quality of corporate governance and efficiency of enterprises, our main hypothesis is: '*There exist a positive relationship between the corporate governance quality and a firm's X-efficiency'*.

Besides corporate governance indicators, we also control for other factors that we expect may influence a firm's efficiency — the level of state and foreign ownership. We expect that the larger the share of *state ownership* in a firm the less efficient on average that firm would be. Andreeva (2003) using panel data estimation documented that privatization brought more efficiency to Ukrainian firms. On the other hand, Scherbakova (2003) using different methods found an indication that *state ownership* is characterized by relative efficiency at least in some periods of transition. Therefore, there is still no clear evidence whether an increase of state ownership at present will indeed worsen efficiency. In this respect, our work complements previous works by Brown and Earle (2000), Andreeva (2003) and Melnychenko (2002), in the part where we investigate the corporate governance problem of state ownership.

We also expect that *foreign ownership* positively affect firm's efficiency. This claim is often used as an argument for the promotion of FDI on the one hand as well as for the protection of local producers on the other. It will be interesting to see if foreign firms are truly more efficient then local firms and by how much. We will also control for the unobserved by us industry and year specifics — level of competition, types of regulations, subsidies, etc — by including the industry and year specific dummies. Certainly, any of these hypotheses may not be true for a particular enterprise and our goal is to investigate the overall tendency in the population, using the sample we obtain and the methods we describe below.

Methodology

Estimation of efficiency

The approaches for investigating the association between *ownership structure, corporate governance* and *firms' efficiency* can be classified into two main groups: (a) methods that estimate efficiency using a variant of the 'data envelopment analysis' (DEA[2]) estimator and (b) those using a variant of the stochastic frontier analysis (SFA) estimator. Both groups of methods accomplish three tasks (under different assumptions): (i) estimation of production (cost, revenue or profit) frontiers, (ii) estimation of (unobserved) inefficiency of each firm in the sample relative to this (estimated) frontier, and (iii) subsequent analysis of potential causes of firms' inefficiencies. In this study we choose the former approach.

The DEA-type estimators usually (not always) assume that all firms within an industry have *access* to the *same technology* for transforming a vector of N inputs, x, into a vector of M outputs, y. This technology is assumed to be characterized by the *technology set*, which in general terms is formally defined as[3]

$$T = \{(x, y) \in \Re_+^N \times \Re_+^M : \quad x \in \Re_+^N \text{ can produce } y \in \Re_+^M\}. \tag{1}$$

While having an *access* to the *same technology*, firms may or may not be on the *frontier* of this technology. How far a particular firm is from the frontier may depend on various factors, specific to this firm or certain types of firms. These may be endogenous factors, such as internal economic incentives determined by the ownership structure, management quality, etc, as well as exogenous factors such as different regulatory or demographic environments, etc. The distance from the actual allocation of each firm in technology set T towards the frontier of T is thus believed to represent

[1] An exception we know of is the study of Zheka (2005) who finds an indication that there is a positive relationship between corporate governance quality and firm's efficiency. The present paper takes study of Zheka (2005) as a stepping-stone (motivation, literature review and data) and extends it in many respects.

[2] The name, DEA, started with Charnes et al. (1978); roots go back to at least Farrell (1957) and Debreu (1951). Various extensions of this estimator and theoretical details can be found in Färe et al. (1994a,b).

[3] We assume the standard regularity conditions of the neo-classical production theory hold (see Färe and Primont (1995), for details).

the (X-)*inefficiency* of each firm caused by firms' specific endogenous or exogenous factors. Our goal is to *measure* such inefficiency and analyze its dependency on hypothesized factors, in particular factors suggested by the corporate governance theory (as well as other control variables).

Our analysis will follow the *two-stage* approach. At the *first stage*, discussed in this subsection, we estimate *efficiency scores* — proxies of "Leibenstein's X-efficiency" — for each firm j out of the sample of n firms, using the Farrell (1957) output oriented technical efficiency measure,

$$TE(x^j, y^j) = \max_{\theta}\{\theta : \quad (x^j, \theta y^j) \in T\}. \tag{2}$$

In practice, T is unobserved and is replaced with its *DEA-estimate*, $\hat{T}$,

$$\hat{T} = \Bigg\{(x, y) \in \Re_+^N \times \Re_+^M : \quad \sum_{k=1}^{n} z_k y_m^k \geq y_m, \quad m = 1, \ldots, M, \quad \sum_{k=1}^{n} z_k x_i^k \leq x_i, i = 1, \ldots, \mathrm{N}, \quad z_k \geq 0, \quad k = 1, \ldots, n\Bigg\}. \tag{3}$$

where $z_k \geq 0 (k = 1, \ldots, n)$ are the intensity variables over which optimization (2) is made. Geometrically, $\hat{T}$ is the smallest convex free disposal cone (in (x, y)-space) that contains the input-output data. It is a consistent estimator of the unobserved true technology set T under constant returns to scale (CRS).[4,5] In principle, we could have used other efficiency measures rather than (2), however this one was shown to satisfy a set of desirable mathematical properties, especially various forms of *continuity*, as well as (weak) monotonicity, commensurability, homogeneity and (weak) indication for all technologies satisfying certain regularity conditions (see Russell 1990, 1997 for details), and in this sense it is superior than others. This measure is also relatively easy to compute, straightforward in interpretation and, perhaps because of all this, it seems to be the most popular in practice.

The *estimates* of efficiency scores, call them $\hat{TE}_j$, resulted from replacing T with $\hat{T}$ in (2) are thus also consistent estimates of the true efficiency scores that would be obtained from (2) if T was observed. They are bounded between unity and infinity, with unity representing *estimated* perfect (technical) *efficiency* score, and $(1/\hat{TE}_j)$ is representing the estimated *relative %-level* of the (technical) *efficiency* of the firm $j (j = 1, \ldots, n)$, relative to the estimated best practice technology frontier, $\hat{T}$.

Analysis of determinants of efficiency

The goal of the *second* stage of the analysis is to investigate the dependency of the efficiency scores (estimated at the first stage) on firm specific factors such as ownership structure, indicators of quality of corporate governance, random noise, etc. This second stage analysis can be accomplished either on the individual (e.g., with case studies, field trips, etc) or, as we do here, on aggregate basis (analysis of moments or/and distributions, etc.). The main part of our second stage analysis is the use of regression methods for analyzing dependency between the efficiency and several hypothesized explanatory variables. For the case of regression analysis, we assume and test the following specification,

$$TE_j = Z_j\delta + \varepsilon_j, \quad j = 1, \ldots, n \tag{4}$$

where Z_j is a (row) vector of firm-specific variables for firm j that we expect to influence firms' efficiency score TE_j, defined in (2), through the vector of parameters δ, which we aim to estimate, together with some statistical noise, ε_j. A common practice in the DEA-literature for estimating such a model was to employ the Tobit estimator. Recently, Simar and Wilson (2003) have shown that the Tobit estimator is inappropriate for the context of model (4) and proposed an approach based on *truncated-regression* with bootstrap, illustrating (in Monte Carlo experiments) its good performance. In our paper we will use their approach, in particular their "Algorithm 2", which replaces the unobserved regressand in (4), TE_j, by the bias-corrected estimate of it (obtained using heterogeneous bootstrap), which we denote with $\hat{TE}_j^{bc}$. Moreover, since both sides of (4) are bounded by unity, the distribution of ε_j is restricted by the condition $\varepsilon_j \geq 1 - Z_j\delta$ and, for simplicity, we follow Simar

[4] Alternatively, the non-increasing returns to scale (NIRS) or variable returns to scale (VRS) would be modeled if constraint $\sum_{k=1}^{n} z_k \leq 1$ or $\sum_{k=1}^{n} z_k = 1$, respectively, is added to (3), however we will not focus in these here, as explained later.

[5] Proof of consistency also requires certain regularity conditions, see Kneip et al. (1998), for these conditions, the resulting rates of convergence and other details. The limiting distribution of the DEA estimator for the multi-output-multi-input case is provided by Kneip et al. (2003).

and Wilson (2003) here to assume that this distribution is truncated normal with zero mean, unknown variance and the (left) truncation point determined by this very condition. Formally, our econometric model is given by

$$T\hat{E}_j^{bc} \approx Z_j\delta + \varepsilon_j, \quad j = 1, \ldots, n, \tag{5}$$

where

$$\varepsilon_j \sim N(0, \sigma_\varepsilon^2), \text{ such that } \varepsilon_j \geq 1 - Z_j\delta, \quad j = 1, \ldots, n, \tag{6}$$

which we estimate by maximizing the corresponding likelihood function, with respect to $(\delta, \sigma_\varepsilon^2)$, given our data. Upon such estimation, we then use the parametric regression bootstrap (that incorporates information on the parametric structure (4) and distributional assumption (6)) in order to obtain the bootstrap confidence intervals for the estimates of parameters $(\delta, \sigma_\varepsilon^2)$. For the sake of brevity of this paper, we refer the reader to Simar and Wilson (2003) for details of the algorithm.

Data and empirical model

Our data comes from the database provided by the main Ukrainian stock exchange, First Securities Trading System (PFTS), and contains information from annual financial statements of all companies listed on PFTS in 2000–2001. We use information on total of 158 firms operating in seven industries (see the list below), over 2 years.[6] Only some firms appear in each period. We use 2000 as a base year and correct the data in 2001 for the inflation of 10% (*source:* World Development Indicators, 2002).

Since we only have financial data we proxy our output with '*total revenue*' and our inputs with major components of total costs available to us: '*labor cost', 'capital cost', 'other cost* or *operational costs*'. This means that what we can practically model is not the original Farrell (1957) *technical* efficiency, but efficiency that includes the technical and some types of allocative [in]efficiencies, depending on the level of aggregation/disaggregation of inputs and outputs we have. This is the best we could do however, which also conforms the standard empirical practice when researchers have to use aggregated (with prices) inputs and outputs in DEA formulation (for recent examples, see Färe et al. (1994a,b), Kumar and Russell (2002), Henderson and Russell (2004), to mention just a few). Some theoretical issues of aggregation/disaggregation over inputs or/and outputs are discussed in Färe and Grosskopf (1985), Färe and Zelenyuk (2002) and most recently in Färe et al. (2004). For our research question (obtaining a proxy for X-[in]efficiency), having the cost and revenue information as proxies for inputs and outputs may actually be even desirable. This is because the revenue and costs incorporate such important economic information as prices.

Such measurement of inputs and outputs also gives us some justification for pooling the data over industries for the first stage to measure efficiency of each firm under one 'best-practice frontier' using DEA. In this sense, technology set characterization (1) bears not the engineering, but a broader meaning — this is a set characterizing possibilities to make 'revenue' out of investments into major inputs, or in simple terms, to 'use money to make more money', regardless of particular engineering, managerial and other features of business. It seems natural for us to think that each enterprise is there to strive to have as much of *revenue* from given inputs as possible, regardless of the industry. Therefore, we choose the output oriented measure (although, due to CRS, the input oriented estimates would just be the reciprocals of the corresponding output oriented ones).

Noteworthy, such pooling of the data over industries gives us more confidence in the precision of DEA estimation — due to substantial increase in the sample size — which is very important for obtaining good estimates of the dependent variable for the second stage. For this reason we also pool over time and treat each observation as an independent realization from the same data generating process (including the same technology). Later, in the second stage we will attempt to disentangle the industry specific and the time effect in the regression context.[7]

[6] The data set also contained information on four more industries: Oil and Gas, Mining, Power Utilities, and Pharmaceuticals. These industries are perhaps the most 'politicized' in Ukraine, especially the first three, and we believe they require special research on each. For example, when we used these industries in the first (DEA) stage, the estimated mean efficiency score was about 14% (i.e., about 7%), which does not conform with a common sense. Further investigation of the data revealed that many of companies in those industries had revenue-to-cost ratio far beyond 3, while for the majority of all firms in the sample it was around 1. Such type of outliers are problematic for DEA and thus we choose to focus on all firms from all industries except these four.

[7] In principle, if we had larger sample sizes for each industry, we would use the group-wise heterogeneous extension of the Simar–Wilson (2003) approach. Application of this approach to our current data was computationally unstable — due to large

Table 1 Data Description (in millions of UAH)

		Mean	Median	Std. dev.	Min.	Max.
	Input variables:					
	Capital cost, capital depreciation, mln. UAH	12.12	1.88	28.88	0.0024	191.4
	Other (Operational) cost, mln. UAH.	305.35	26.27	908.00	0.043	7031.9
	Labor cost, the annual pay to workers, mln. UAH	21.76	3.21	56.78	0.012	0.45
	Total Cost, mln. UAH	339.23	33.68	987.55	0.095	7528.2
	Output variable: total Revenue, mln. UAH	292.92	24.45	809.74	0.03	5094.1
	Ownership variables:					
Foreign	The sum of the shares of the foreign owners in company ownership	16.02	0	24.8	0	87.08
State	The share of state ownership in company	17.42	0	27.6	0	100.00[8]

Industry	No of Firms	% Of total	Mean of Tot. Rev.	Median of Tot. Rev.	Std. dev. of Tot. Rev.	Min. of net Tot. Rev.	Max. of net Tot. Rev.
Chemical	18	11	231.93	111.17	253.99	9.57	798.39
Construction	30	19	22.45	7.36	28.38	0.04	92.87
Engineering	18	11	109.17	46.66	185.83	0.35	624.28
Metallurgy	18	11	1722.8	959.6	1794	5.8	5094.1
Services	25	16	4.88	2.067	6.09	0.1	24.23
Transport	23	16	0.29	146.2	383.3	0.8	1352.7
Food	26	16	66.69	24.04	91.65	0.03	315.87
Total	158	100	292.92	24.45	809.74	0.03	5094.1

Finally, we note that CRS is a very common assumption in economic theory and empirics. Besides this, our choice of CRS was also encouraged by desire to obtain greater discriminative power of DEA, which would result in larger variation of the regressand (than typically would be under VRS or NIRS) on the second stage of the analysis — where we would attempt to isolate the scale effect among others.

For specification of the *regression model* (5)–(6) we hypothesize that the efficiency level shall depend on the ownership structure. We also expect that efficiency level might be influenced by some industry specifics as well as, perhaps, time. Similarly as with the regressand, we understand that none of these variables can practically be measured with perfection, but rather each of them needs a reasonable proxy. For characterizing the ownership structure, we use the percentages of the *foreign* and *state* ownership (in logarithms) present at each enterprise. To capture the effect of time and industry specifics, we include the year and industry dummies. Finally, to capture the effect of scale we include the output proxy ('total revenue', in logarithm) among the regressors of (5)–(6).

number of (estimated) fully efficient scores and small variation in other scores — when the DEA was applied to each industry or time separately.

Definitions and descriptive statistics of major variables are presented in Table 1. The monetary values are measured in *Ukrainian Hrivna (UAH)* — the legal medium of exchange in Ukraine (official and street exchange rate were almost the same over the period, slightly fluctuating around 5.33UAH per 1 USD). We could have translated it into US Dollars, but it is not necessary, since one of the advantages of the Farrell-type efficiency measure, and its DEA estimate, is satisfaction of commensurability property (i.e., independence from units of measurement up to scalar transformation).

The sample consists of companies in seven business sectors or industries: Chemical, Construction, Engineering, Metallurgy, Services, Transport and Food industries. We used companies' annual financial statements to extract information on firm's cost structure and net sales, ownership structure and information on business sector in which company operates.[9] Data cov-

[8] The companies with 100% shares owned by state are formerly fully state owned and were incorporated and listed in order to transfer (partially or fully) company's shares to private sector through the stock exchange.

[9] For the foreign-ownership variable of a firm we use the sum of shares of foreign owners that have at least 5% share-stake in a firm, since for owners of less then 5% share stake information is not available in the data bases we had.

ers enterprises of quite a different size: on average the annual *total revenue* of a company in the sample is about 293 million UAH and varies in the interval from about 0.03 mln to 5094 mln of UAH. On average, both state and foreign organizations own about 17% of the ownership rights in the enterprises for our sample. The distribution is quite skewed to right, as suggested by the median relative to the mean, which is however typical for income-type data. In terms of firm's average total revenue, the leading industry in the sample is Metallurgy, followed by the Chemical industry and closed by Services and Transportation industries.

To our knowledge, there is no corporate governance index (estimated by some rating agencies) available for Ukrainian companies in our data set. Thus, one of the biggest challenges of data collection was to obtain some reasonable proxies that would mimic the state of corporate governance quality at the enterprises. The best source we had for this was the two databases provided by the Ukrainian State Commission for Securities and Stock Market (hereafter, Commission). We have also interviewed experts of Financial Markets International/USAID Corporate Governance Project in Ukraine on possible indicators for corporate governance quality. We also used experience of rating agencies (e.g. Standard and Poor's, 2002) and generally accepted corporate governance principles (Higgs, 2003; Sarbanes Oxley Act, 2002; OECD, 1999) to extract at least those indicators of corporate governance quality that are available at firm's financial statements and from databases of the Commission.

One of the Commission's databases documents all complaints from individuals and organizations to the Commission against the issuers of securities. The other database contains information on all check-ups made by the Commission based on those complaints and results of these check-ups, thus documenting whether those complaints were reasonable or not. Among the violations found by the Commission there are violations of shareholders' rights, nondisclosure of statements, violation of proper conduct of register, etc. We assume that the presence of at least two *complaints* against an enterprise submitted to Commission indicates about possible failures in this company's corporate governance system, since it was unable to answer the demands of its stakeholders (this is coded in variable No_Comp). The variable No_Vio represents whether those complaints were determined (by the Commission) to be a violation of the stakeholders rights or not. Intuitively, if the value of an indicator is 1 then the respective corporate governance characteristic is satisfactory and if otherwise (zero) then it is not satisfactory.

Finally, we have also used companies' annual financial statements to extract information on such indicator of corporate governance quality as *publication of financial statements in the press*, including timeliness (Publ), which we hope will mimic the state of transparency level of the companies. Table 2 presents descriptive statistics for such indicators.

Estimation results

First stage of the analysis: DEA

Upon using DEA to estimate efficiency scores for each firm via (2) with T estimated as in (3), we use the kernel density estimator to obtain the estimates of the true density of true efficiency scores. To account for the issue of bounded support we use the Schuster (1985)–Silverman (1986) reflection method, with Gaussian kernel and bandwidth chosen via method proposed by Sheather and Jones (1991).

Visualization of the estimated density for all the firms in Fig. 1 (doted curve) gives clear indication that there are some outliers present in the sample. There could be many reasons for why these firms happened to be so different from others. First of all, some of these outliers could be firms that follow totally different distribution of efficiency. Alternatively, some of them could follow the same distribution but had 'bad luck' (e.g., bankruptcy, strike, etc) at the time of data record to appear far in the tail of the distribution. Also it might be that there is an error in recording information for some of them (e.g., not all revenue accounted for or extra digits typed for costs or revenue, etc). Although such outliers do not disturb the estimation of the frontier they still may cause difficulties for convergence in numerical maximization of the empirical likelihood function. As a result, we choose to trim the 10% tail of the distribution (16 observations out of 158) and, at the second stage, to work with this trimmed sample from now on.

The estimated density of distribution of efficiency scores obtained from the trimmed sample is also visualized in Figure 1, with a solid curve. In order to test significance of the impact of trimming, we compare the two samples using a version of Li (1996) test (adapted to DEA context by Simar and Zelenyuk (2004)). The resulting bootstrap P-value is 0.825 (for the null hypoth-

Table 2 Indicators of corporate governance quality

Name	Description of variable	Mean
Publ	= 1 if company's annual financial statements where published in the press, 0 otherwise.	0.766
No_Comp	= 1 if there were less than two complaints to the Commission against the enterprise during last three years, 0 otherwise.	0.886
No_Vio	= 1 if there was no violation of corporate governance legislation found by the Commission check-ups, 0 otherwise.	0.949

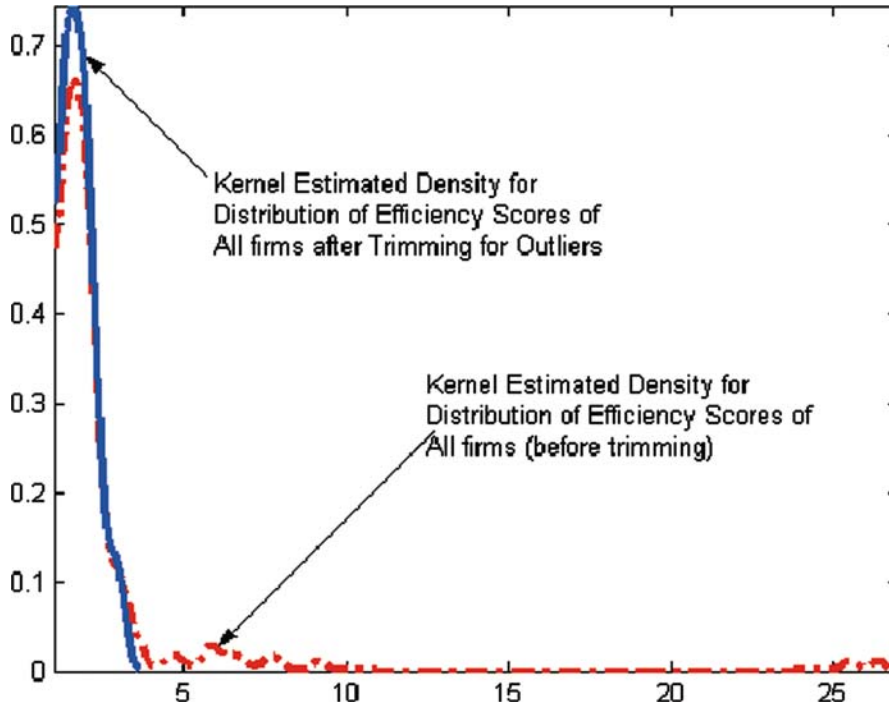

Fig. 1 Kernel estimated density for distribution of efficiency scores for all firms: before and after trimming 10% of 'outliers' in the right tail

esis that the underlying distributions are equal), thus encouraging us that crucial information about the underlying distribution is likely to remain in the sample after such trimming.

Table 3 gives summary of results for estimation at the first stage (DEA). In particular, using Simar and Zelenyuk (2003) approach we obtain bootstrap-based (bias-corrected) estimates and confidence intervals for the weighted and non-(or equally weighted) group efficiencies, median and standard deviation of efficiency scores for each *industry* and over all firms in the population that our sample represents. The weights of aggregation were obtained using Färe and Zelenyuk (2003) approach, which for our case are just the observed revenue shares.

First thing to note from Table 3, is that the bias-corrected statistics of interest are larger than those based on the original DEA estimates: the estimated bias is about −30% on average. Also note that, for the entire sample, the mean is very close to the median — this is mainly a result of using the trimmed sample for outliers in efficiency. (The difference however remains for some industries.) Another interesting observation is that the Färe–Zelenyuk weighted (by observed revenue) industry efficiency scores are smaller, about 10% or more, than the (equally-weighted) sample means for all industries except for the Metallurgical industry. This suggests that the larger firms (having larger weight in aggregation) are typically more efficient, which is a manifestation of apparent economies of scale present in all industries. (Metallurgy is a 'small' exception perhaps because all firms are already quite large relative to firms in other industries, and might have exhausted all the economies of scale). The champion of such economies of scale in our sample is the Services industry, where the difference is about 35%, which is

Table 3 Estimation results from the first stage: DEA with Bootstrap

Statistics	Groups	Original	Bootstrap	Estimation of	Est. 95%	Conf. Interval
		DEA estimates	Stn. dev.	Bias-correct. eff. score	Lower bound	Upper bound
Weighted (by observed revenue) group efficiency	Chemistry	1.476	0.173	1.669	1.271	1.907
	Construction	1.888	0.242	2.267	1.692	2.599
	Engineering	2.050	0.373	2.534	1.649	3.002
	Metallurgy	1.529	0.149	1.784	1.443	2.032
	Services	1.589	0.187	1.883	1.437	2.128
	Transport	1.776	0.302	2.105	1.316	2.498
	Food	1.329	0.114	1.543	1.254	1.647
	All	*1.579*	*0.135*	*1.849*	*1.537*	*2.053*
Mean (non-weighted) group efficiency	Chemistry	1.580	0.171	1.856	1.461	2.086
	Construction	2.036	0.270	2.492	1.897	2.827
	Engineering	2.191	0.361	2.731	1.960	3.159
	Metallurgy	1.474	0.129	1.721	1.412	1.905
	Services	1.826	0.255	2.235	1.630	2.544
	Transport	1.858	0.245	2.269	1.703	2.571
	Food	1.444	0.128	1.694	1.395	1.853
	All	*1.780*	*0.194*	*2.152*	*1.776*	*2.358*
Median	Chemistry	1.571	0.198	1.872	1.371	2.112
	Construction	1.957	0.284	2.387	1.680	2.699
	Engineering	2.045	0.373	2.513	1.739	2.931
	Metallurgy	1.488	0.155	1.794	1.442	1.976
	Services	1.871	0.283	2.366	1.737	2.724
	Transport	1.788	0.266	2.185	1.499	2.492
	Food	1.395	0.128	1.661	1.332	1.790
	All	*1.743*	*0.197*	*2.142*	*1.725*	*2.358*
Standard deviation	Chemistry	0.343	0.098	0.451	0.259	0.618
	Construction	0.446	0.124	0.571	0.284	0.774
	Engineering	0.509	0.164	0.666	0.323	0.925
	Metallurgy	0.306	0.087	0.401	0.243	0.549
	Services	0.555	0.170	0.761	0.359	0.992
	Transport	0.500	0.156	0.665	0.343	0.888
	Food	0.367	0.129	0.508	0.246	0.690
	All	*0.509*	*0.126*	*0.664*	*0.413*	*0.813*

Notes: Estimation is according to Simar and Zelenyuk (2003) group-wise heterogeneous sub-sampling approach, with 2000 bootstrap replications both for estimation of bias correction and for confidence intervals. Sub-sample size for each group $l(l = 1, \ldots, 7)$ is determined as $m_l = n_l^{0.7}$, but results are robust to neighboring sizes.

quite natural for a transitional economies where the Services industry is only being at early development stage (see Blanchard (1997) for more discussion on this).

Results presented in Table 3 also suggest that, among the industries, there are apparent differences in point estimates for all presented statistics, especially in averages and medians of efficiency. Bootstrap-estimated confidence intervals, however, are quite wide and suggest that only a few of these differences are significant (e.g., Food industry vs. Construction or Engineering, since their confidence intervals do not overlap). This claim is also supported by using the RD-statistics (see Simar and Zelenyuk 2003 for details), which we however do not present here for the sake of space. The relatively large confidence intervals suggest about large variability of the mean efficiency which may be due to the fact that the technical efficiency (or/and its mean) might be influenced by some particular factors, other than the statistical noise and the industry specifics. We will try to analyze this in the next subsection.

Analysis of determinants of efficiencies: Truncated regression

Table 4 presents results of regression analysis for model (5)–(6). For the sake of robustness of our claims, we have tried four specifications. The first specification

Table 4 Results of truncated regression analysis using model (5)–(6)

Regressors	Estimated coefficients for regression (5)–(6)			
	Spec. 1	Spec. 2	Spec. 3	Spec. 4
Publ	−0.085	–	–	–
No_comp	−0.178	−0.223	–	–
No_vio	−0.559***	−0.597***	−0.615***	−0.617***
Foreign	0.091***	0.092**	0.087***	0.100***
State	0.100***	0.103***	0.095***	0.108***
Foreign*State	0.011	0.018	0.019	–
log(Y)	−0.123***	−0.135***	−0.138***	−0.137***
Chemistry industry	4.230***	4.419***	4.311***	4.308***
Construction industry	4.766***	4.968***	4.811***	4.783***
Engineering industry	4.970***	5.172***	5.048***	5.035***
Metallurgy industry	4.080***	4.261***	4.206***	4.250***
Services industry	4.279***	4.473***	4.325***	4.298***
Transport industry	4.776***	5.024***	4.872***	4.840***
Food industry	4.014***	4.224***	4.074***	4.040***
Year dummy	0.227**	0.212**	0.243***	0.235***
σ_ε^2	0.213***	0.219***	0.223***	0.224***

Notes: (i) The regressand is the bootstrap-biased-corrected DEA estimate of the unobserved *inefficiency score* of firm *j*. (ii) *, **, *** — significance from zero at 10%, 5%, 1% level, according to bootstrap confidence intervals. (iii) Estimation according to Algorithm 2 of Simar and Wilson (2003), with 2000 bootstrap replication both for bias correction and for confidence intervals of the estimated regression coefficients

includes 15 regressors: three CG-indicators (Publ, No_comp, No_vio) described above, three measures of ownership-structure (Foreign, State and Foreign*State), variable for capturing scale effect (log(Y)), year-dummy and seven industry-dummies for capturing industry specific differences (regulation, etc) influencing efficiency. State and Foreign variables are measured in logs of percentages. For this model, according to bootstrap confidence intervals, such regressors as Publ, No_comp and Foreign*State turned out to be insignificant even at 10%. We therefore also re-estimated the same model but without some or all of these regressors, and they were persistently insignificant. A good sign is that all the specifications have produced quantitatively similar results, and therefore unanimously suggest the same qualitative conclusions summarized below.

First of all, coefficients for every industry-dummy and the year-dummy turned out to be significant in all specifications, strengthening the evidence that, as expected, there are certain industry and annual specifics (unobserved by us) that impact efficiency levels of generating revenues from major investments.

Such corporate governance quality indicator as Publ (publication of annual financial statements in the press, on time) — an indicator of transparency — has expected sign but statistically insignificant from zero, and we dropped it from other specifications. Another corporate governance indicator, No_Comp (no complaints against the company from its stakeholders to the Commission), has a negative sign as expected, however the coefficient is also not significant in both specifications it was present. The fact that the coefficient for the variable No_Comp is insignificant may suggest that the presence of complaints against a company (to the Commission) *per se* does not have strong relationship to efficiency of that company. An exception would be the case when the complaint was found to be 'reasonable' by the Commission — as we next see for the variable No_Vio (no violation of corporate governance legislation found by the Commission check-ups). Indeed, the coefficient for indicator No_Vio is found to be negative and significant at 1% level for all the specifications. This implies that companies for which State Commission for Securities and Stock Market found a violation of corporate governance related laws have tendency to be less efficient. Such conclusion is well expected from the theory: companies violating the corporate governance principles (such as inappropriate treatment of shareholder rights, poor disclosure of information about its activity, improper conduct of register, etc) may bring upon themselves serious conflicts among shareholders and managers, and consequently result in a substantial loss in efficiency of resource utilization. In particular, this loss in efficiency may be incurred from a

company's mismanagement like asset stripping, transfer pricing etc., which is quite a common occurrence in FSU countries (see Stiglitz, 1999, p. 13, 14, 20).[10]

Confirming previous studies on corporate governance in Ukraine (e.g., Akimova and Schwodianer, 2004) we found significant ownership effects on performance. Noteworthy, we found that the state-ownership is positively associated with firm's inefficiency, thus confirming previous findings by Andreeva (2003), Melnichenko (2002) for Ukraine, and Brown and Earle (2000) for Russia. This essentially explains the corporate governance problem of state ownership, which is often characterized by underutilization of resources (e.g., see Blanchard (1997) for theoretical discussions of this phenomenon).

Somewhat surprisingly, coefficients for foreign ownership are positive and significant in all specifications, thus rejecting our expectation that foreign firms tend to be more efficient than local firms, which was based on numerous evidence from other FDI empirical literature (e.g., see Akimova and Schwödiauer (2004), Yudaeva et al (2000) as well as recent paper by Javorcik (2004)). This might be due to the fact that, for average efficiency level, it might not matter whether the firm is foreign or not, but whether it is exercising proper corporate governance practices. Such an unexpected phenomenon could also arise due to the fact that foreign investors may be oriented on long-term goals investing more than others in company's capital and personnel, while neglecting short-term benefits which we predominantly capture. Another possible explanation is that much of the foreign capital is in fact former local capital that was out-flowed into offshore zones for tax or money-laundering purposes, and then in-flowed back as foreign direct investment (FDI). As a result, *de jure*, our data might indicate the presence of a large 'foreign' share at a company, but, *de facto*, the company can still be essentially local.

Finally, the interaction between the state and foreign ownership jointly present at one enterprise have not given evidence, in our analysis, about positive or negative influence on the efficiency level of such an enterprise, as suggested by the insignificant coefficients of variable Foreign*State in all specifications.

The scale effect has also been found negatively associated with inefficiency for all specifications. This gives another support to our earlier finding that the larger firms tended to be more efficient than the smaller ones, for most of industries, which we obtained while comparing weighted and non-weighted group efficiencies (see Table 3).

Overall, our results and conclusions are quite robust: all the specifications have produced quantitatively similar results, and therefore unanimously suggest the same qualitative conclusions.

Conclusions and policy recommendations

In this study, we find empirical support for our main hypothesis that there is a *positive* relationship between the levels of corporate governance quality across firms and the relative efficiency levels of these firms. This gives another empirical support for Leibenstein's idea that the major source of X-efficiency is motivation at each level of management/ownership. This is also a support of the argument of Stiglitz (1999), that establishment and enforcement of proper corporate governance principles shall significantly enhance development of individual corporations and economies as a whole — at least due to increasing of efficiency of resource utilization.

We also find negative association between the share of the state ownership in a firm and this firm's efficiency which supports previous findings by other researchers (Brown and Earle, 2000; Andreeva, 2003; Melnychenko, 2002).

Remarkably, we found that the relationship between the share of the foreign ownership at a firm and this firm's inefficiency level is positive and significant, implying that actually foreign firms are not more but less efficient than local firms, at least in our sample. Together with other findings mentioned above, this may suggest that it does not matter what the origin of the firm is but whether this firm is exercising good corporate governance practices or not.

[10] We also tried our models with two more potential Corporate Government indicators. One was on attendance of general shareholder meeting of a company, but it almost coincided with variable No_Vio (except for two observations) and we had to omit it for the sake of convergence of numerical optimization of the likelihood function. The other was on dummy representing existence of website of the company (1 if present, 0 otherwise). This variable might mimic some transparency of the company. When this variable was included in regression — it was never significant although had expected sign (negative), while other coefficients were similar as in other models. Sometimes, however, maximization of the likelihood routine had to quit (many times when this variable was included to Model 1 and a few times when in was included to Model 2), exceeding more than 10000 iterations. We suspect that this was because the models were 'overloaded' with dummy-variables relative to the sample size. Details are available upon request.

Our measurement was not perfect. Possible improvements of this study are to use larger data sets and more corporate governance indicators that would enable using group-wise heterogeneous or/and non-parametric extensions of Simar and Wilson (2003) truncated regression with iterated bootstrap approach.

Overall, the empirical evidence we found is consistent with various economic and management theories suggesting that the quality level of corporate governance at an enterprise must be positively correlated with efficiency of such an enterprise. Importantly, this conclusion is found for a transitional country, where the ethics of capitalism is far from being fully inoculated into the culture and mentality — for a country where such issues as transparency have often being viewed as a nuisance rather than as a way to success. We hope that our study will contribute at least a bit to increase in beliefs that good corporate governance is beneficial for enterprise performance in transitional countries as well. More generally, we also hope our results would be provocative for more studies in this area, with better methods and better data, and that altogether these studies will stimulate dissemination of high standards of corporate governance practices.

Appendix: Estimates and confidence intervals for regressions summarized in Table 4

Table A1 Estimated confidence intervals for Model 1

Model 1	Est. Coeff.	Bounds of the Bootstrap Est. confidence intervals					
		Lower 5%	Upper 5%	Lower 1%	Upper 1%	lower 10%	Upper 10%
Publ	−0.085	−0.306	0.129	−0.378	0.189	−0.270	0.089
No_comp	−0.178	−0.479	0.092	−0.571	0.194	−0.427	0.049
No_vio,	−0.559	−0.904	−0.224	−1.019	−0.108	−0.858	−0.271
Foreign	0.091	0.029	0.153	0.013	0.175	0.038	0.143
State	0.100	0.039	0.165	0.021	0.184	0.050	0.153
Foreign.*State	0.011	−0.026	0.052	−0.040	0.061	−0.020	0.045
log(Y)	−0.123	−0.182	−0.070	−0.195	−0.051	−0.173	−0.078
Chemistry	4.230	3.184	5.385	2.845	5.589	3.342	5.182
Construction	4.766	3.793	5.829	3.476	6.062	3.979	5.621
Engineering	4.970	3.956	6.058	3.582	6.342	4.135	5.882
Metalurgy	4.080	2.965	5.280	2.619	5.684	3.123	5.104
Services	4.279	3.393	5.222	3.079	5.422	3.558	5.061
Transport	4.776	3.697	5.956	3.305	6.261	3.866	5.771
Food	4.014	3.030	5.070	2.706	5.315	3.171	4.900
Year	0.227	0.037	0.421	−0.025	0.484	0.068	0.391
σ_ε^2	0.213	0.177	0.289	0.157	0.301	0.187	0.283

Table A2 Estimated confidence intervals for Model 2

Model 2	Est. Coeff.	Bounds of the Bootstrap Est. Confidence intervals					
		Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
No_comp	−0.223	−0.508	0.058	−0.596	0.158	−0.471	0.014
No_vio,	−0.597	−0.978	−0.252	−1.093	−0.126	−0.919	−0.316
Foreign	0.092	0.029	0.154	0.003	0.174	0.039	0.143
State	0.103	0.038	0.164	0.010	0.182	0.048	0.154
Foreign.*State	0.018	−0.017	0.058	−0.033	0.069	−0.013	0.052
log(Y)	−0.135	−0.192	−0.078	−0.212	−0.060	−0.183	−0.089
Chemistry	4.419	3.268	5.528	2.957	5.892	3.456	5.363
Construction	4.968	3.958	5.997	3.652	6.339	4.118	5.843
Engineering	5.172	4.114	6.231	3.759	6.642	4.279	6.096
Metalurgy	4.261	3.079	5.436	2.748	5.756	3.270	5.265
Services	4.473	3.553	5.429	3.291	5.702	3.713	5.232
Transport	5.024	3.894	6.192	3.525	6.513	4.055	6.010
Food	4.224	3.152	5.291	2.831	5.584	3.345	5.103
Year	0.212	0.032	0.397	−0.027	0.472	0.060	0.371
σ_ε^2	0.219	0.177	0.295	0.153	0.308	0.189	0.288

Table A3 Estimated confidence intervals for Model 3

Model 3	Est. Coeff.	Bounds of the Bootstrap Est. confidence intervals					
		Lower 5%	Upper 5%	Lower 1%	Upper 1%	lower 10%	Upper 10%
No_vio,	−0.615	−1.012	−0.235	−1.135	−0.124	−0.949	−0.302
Foreign	0.087	0.026	0.156	0.006	0.173	0.037	0.143
State	0.095	0.034	0.158	0.014	0.174	0.044	0.150
Foreign.*State	0.019	−0.020	0.056	−0.032	0.068	−0.015	0.050
log(Y)	−0.138	−0.194	−0.080	−0.218	−0.066	−0.187	−0.090
Chemistry	4.311	3.171	5.495	2.836	5.786	3.354	5.288
Construction	4.811	3.818	5.827	3.541	6.241	3.978	5.704
Engineering	5.048	4.007	6.140	3.661	6.530	4.170	5.985
Metalurgy	4.206	3.000	5.419	2.705	5.747	3.238	5.218
Services	4.325	3.445	5.255	3.146	5.592	3.566	5.103
Transport	4.872	3.727	6.027	3.398	6.437	3.913	5.848
Food	4.074	3.008	5.107	2.700	5.484	3.175	4.955
Year	0.243	0.064	0.423	0.012	0.483	0.097	0.396
σ_ε^2	0.223	0.180	0.302	0.155	0.317	0.193	0.294

Table A4 Estimated confidence intervals for Model 4

Model 4	Est. Coeff.	Bounds of the Bootstrap Est. Confidence Intervals					
		Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
No_vio,	−0.617	−0.990	−0.258	−1.093	−0.115	−0.931	−0.317
Foreign	0.100	0.043	0.161	0.023	0.177	0.052	0.150
State	0.108	0.054	0.167	0.037	0.189	0.062	0.157
log(Y)	−0.137	−0.196	−0.079	−0.215	−0.063	−0.186	−0.088
Chemistry	4.308	3.135	5.451	2.894	5.770	3.302	5.273
Construction	4.783	3.770	5.783	3.494	6.018	3.920	5.644
Engineering	5.035	3.968	6.133	3.658	6.403	4.103	5.964
Metalurgy	4.250	3.073	5.473	2.688	5.820	3.237	5.267
Services	4.298	3.370	5.217	3.137	5.443	3.510	5.065
Transport	4.840	3.684	6.029	3.438	6.322	3.869	5.801
Food	4.040	2.991	5.060	2.685	5.406	3.139	4.906
Year	0.235	0.061	0.419	0.009	0.458	0.082	0.390
σ_ε^2	0.224	0.184	0.299	0.163	0.313	0.194	0.293

Acknowledgements We also would like to thank Tom Coupé, Jarmila Curtiss, Antony W. Dnes, David Epstein, Roy Gardner, Natalia Konstandina, Kent Lewis, Alexej Lissitsa, Andrew Masiuk and Iryna Zheka for providing valuable comments. We also acknowledge informational support from Oksana Vasilenko (Analyst FMI) and Ann Wallace (Project Manager FMI/USAID Corporate Governance Project in Ukraine). Finally, we would like to thank two anonymous *referees* for very valuable comments and critiques that helped substantially improve the paper. Research support from the "Interuniversity Attraction Pole", Phase V (No.P5/24) from the Belgian Government (Belgian Science Policy) is acknowledged. Only the authors are responsible for the views expressed and mistakes made.

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