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Working Paper

Comparative analysis of economic efficiency of Polish and German listed companies

Institute of Economic Research Working Papers, No. 44/2014

Provided in Cooperation with:

Institute of Economic Research (IER), Toruń (Poland)

Suggested Citation: Sajnog, Artur (2014) : Comparative analysis of economic efficiency of Polish and German listed companies, Institute of Economic Research Working Papers, No. 44/2014, Institute of Economic Research (IER), Toruń

This Version is available at:

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Institute of Economic Research Working Papers

No. 44/2014

**Comparative analysis of economic efficiency of
Polish and German listed companies**

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The paper submitted to

**VIIIth INTERNATIONAL CONFERENCE ON APPLIED
ECONOMICS
CONTEMPORARY ISSUES IN ECONOMY
under the title
MARKET OR GOVERNMENT?**

Institute of Economic Research and Polish Economic Society Branch
in Toruń

18-19 June 18-19, 2015, Toruń, Poland

Toruń, Poland 2014

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Comparative analysis of economic efficiency of Polish and German listed companies

JEL Classification: G32

Keywords: *efficiency, measure of efficiency, DEA, Polish and German joint-stock companies*

Abstract: The main subject of theoretical-empirical study presented in this paper is economic efficiency of companies listed on the Polish and German capital market¹. The discussed research problem was investigated in the form of a comparative analysis and realized in two parts. The discussion presented in the first part depicts mainly theoretical reflections on the essence and assessment measures of companies' economic efficiency. The second part presents the results of a comparative empirical research on economic efficiency of the companies listed on the Warsaw Stock Exchange and included in the WIG30 index as well as the companies listed on the Frankfurt Stock Exchange, which belong to the DAX index. The research period comprises years between 2004-2013. A comparative analysis of economic efficiency of the companies was conducted using a traditional ratio analysis and the nonparametric DEA method. The results of the empirical research confirm that German companies achieved significantly higher values of basic economic categories in the analysed decade, financial results in particular; however, their generated profits did not reflect in higher values of profitability ratios. Polish companies performed much better as they also showed higher efficiency from the DEA's point of view.

Introduction

Conducting a comparative research on the problems of economic efficiency of the companies listed on the European stock exchanges is a natural consequence of adopted and realized micro- and macroeconomic

¹ The publication is co-financed from the funds of donations for the projects fostering the development of young scientists and doctoral students.

objectives of the EU economic development. One of them is the growth of economic efficiency of public limited companies. It translates into the economic growth of national economies and improvement of life of societies.

The problem also concerns the companies listed on the Polish trading floor compared to the companies listed in stock exchange indexes in developed countries including Germany. While analyzing data from the International Monetary Fund which concern economic growth, it must be noted that in the recent years the Polish economy has achieved, and according to the forecast, it will still achieve much higher values of the real GDP than the German economy².

Economic efficiency plays a leading role in shaping of the investment potential of public limited companies listed on the capital market in a given country. The potential is diversified and it seems that German companies, which function in a developed market, will have a high development level of production factors, in particular, much higher values of wealth and capital in comparison with Polish enterprises. On the other hand, it seems likely that they do not exploit production and service reserves significantly, which may result in a lower level of economic efficiency in German listed companies as compared to Polish entities.

The main aim of the study is to determine the level and character of spatial diversification of economic efficiency in the companies listed on the Warsaw Stock Exchange and Frankfurter Wertpapierbörse. In order to achieve this objective a specific research hypothesis was formulated and it stated that in economic practice there are significant differences in the level of economic efficiency of the analysed Polish and German public limited companies, and they mainly concern return on total assets.

Methodology of the research

The conducted empirical research refers to the companies listed on the Warsaw Stock Exchange and included in the WIG30 index as well as the companies listed on the Frankfurt Stock Exchange (germ. Frankfurter

² According to the IMF data, the real GDP in 2013 amounted to 1.6 in Poland, whereas in Germany 0.5. Moreover, the IMF forecasts show that between 2014-2015 the economic growth rate will respectively amount to: for Poland 3.1 and 3.3, and for Germany 1.7 and 1.6.

Wertpapierbörse – FWB)³, which belong to the DAX index. The analysis comprised financial statements of 60 companies classified for both indexes on 20.11.2014. In order to meet the objective of the study the author decided to concentrate on a ten-year research period i.e. years between 2004-2013. Empirical data was obtained from the EMIS (Emerging Markets Information Services) database, stock market bulletins, Polish and German stock exchanges' websites as well as the websites of the analysed companies.

The analysed research problem is realised in two parts. Discussion in the first part includes the assessment of the companies' efficiency based on a traditional ratio analysis using accounting measures. It was assumed that two analytical dimensions can be included in the applied system of the efficiency assessment. These are the following:

a) an absolute dimension i.e. accounting balance sheet and result categories, and

b) a relative dimension (return ratios)⁴.

The other dimension of company's efficiency assessment allows to use standard formulas of return on sales ratio (ROS), return on equity ratio (ROE) as well as return on total assets ratio (ROTA), which are respectively a relation between net profit to return on sales, equity and total assets. For the sake of comparison of stream data with balance sheet data while constructing last two ratios, a methodical solution that was used, accepted a balance sheet value of equity and total assets as an average state in a given period:

$$ROE_n = \frac{EAT_n}{\bar{E}}, \quad ROTA_n = \frac{EAT_n}{\bar{A}},$$

where:

EAT_n – net profit in a given financial year,

\bar{E} – average accounting value of equity in a given financial year,

\bar{A} – average accounting value of total assets in a given financial year.

Additionally, measures of descriptive statistics i.e. classical and positioning measures of location and diversification were also used in the empirical research.

³ Frankfurter Wertpapierbörse (FWB) is the largest of seven stock exchanges in Germany and one of the most important financial centres in the world securities market. The organization of public trading is controlled by Deutsche Börse AG.

⁴ It is worth noting that return, similarly to efficiency, is classified in absolute or relative values. Compare Bednarski, 2003, p. 59; Bednarski, 2007, p. 96.

The second part of the research describes the application of the DEA (Data Envelopment Analysis)⁵ method which enables to calculate economic efficiency measures in a synthetic way. The efficiency ratio measured by this method can be described as a quotient of the weighted sum of inputs (see Dyckhoff & Allen, pp. 411-436):

$$e = (\sum_{r=1}^s \mu_r \times Y_r) / (\sum_{i=1}^m v_i \times X_i),$$

where:

e – measure of efficiency,

s – number of outputs,

m – number of inputs,

μ_r – weights describing significance of individual outputs,

v_i – weights describing significance of individual inputs.

It is stated in the literature that the DEA method is one of the most efficient ways of efficiency assessment in various economic entities (compare Cummins et al., 2010, p. 1526; Kao, 2014, p. 117; Lim et al., 2014, p. 361; Sahoo et al., 2014, pp. 921-922). It shows a number of attractive statistical features, including among others:

1) it enables to analyse companies' activity which is characterized by a huge amount of inputs and outputs,

2) it is not necessary to apply rank order scaling of inputs and outputs, thanks to which a subjective researcher's impact on the results is eliminated,

3) it allows to consider various inputs and outputs included in diverse units, not only the monetary ones,

4) it is not necessary to check functional dependence between inputs and outputs (no need for determining a production function),

5) volume of inputs possible to minimize, or outputs possible to achieve with certain inputs are evaluated,

⁵ In the Polish literature the DEA method is known as the frontier analysis method or data envelopment analysis. It must be stressed that there are numerous publications in which the DEA method was applied to assess the efficiency of various entities e.g. power houses, hospitals, insurance companies, colleges, farms, joint-stock companies, industry sectors; or to evaluate efficiency of investment on the capital market. This method is most commonly used in the banking sector. Compare Halkos & Tzeremes, 2013, pp. 1658-1668; Fiordelisi et al., 2011, pp. 1315-1326; Chortareas et al., 2013, pp. 1223-1231; Rogowski, 1996, pp. 4-48; Feruś, 2006; Hülsmann & Peters, 2007.

6) it enables to discover extreme values that can be overlooked while using other methods because of the effect of data averaging (compare Rogowski, 1996, pp. 4-48).

Depending on the purpose of the analysis and assumed research assumptions, the DEA method offers an opportunity to calculate three forms of efficiency measures i.e. input-oriented efficiency, output-oriented efficiency, and efficiency without orientation. Moreover, there is the possibility to estimate efficiency measures in three categories: constant economies of scale, changeable economies of scale, and non-growing economies of scale (see Banker et al., 1984, pp. 92-1078; Färe et al., 1985; Kleine, 2002, p. 210).

Table 1. Inputs and outputs in the DEA model

Variants	Inputs	Outputs
Variant I	E, TA	$ROTA, ROE$
Variant II	$E, TA, \Delta E, \Delta TA, D/E$	

Mark: E – equity; TA – total assets (total capital), ΔE – dynamics of equity, ΔTA – dynamics of total assets (total capital), D/E – debt-equity ratio, $ROTA$ – return on total assets, ROE – return on equity.

Source: autor's own study.

For the need of the study a variant oriented toward inputs with steady economies of scale was applied. The choice of this model was dictated by the main research objective of the study that focused the analysis of factors determining economic efficiency on minimization of inputs. Classical measures of return (equity and total assets) in entities were accepted as outputs whereas as inputs⁶ the author accepted:

- a) in the first variant – only accounting values of total assets and equity,
- b) in the second variant – accounting values of total assets and equity, ratios of their dynamics and ratios of capital structure, measured by a relation of debt to equity (debt-equity ratio) (see Table 1).

⁶ What must be stressed here is the contractual character of the notions „inputs” and „outputs”. As far as connection of the term „output” with returns is justified in this study, the term „inputs”, which usually refers to costs, is used only to perform the role of customary terminology used in the terminology of DEA method.

The essence and measures of company efficiency

The concept of „efficiency” is one of the most popular notions in economics and science of management as well as in general economic practice. However, it is often interpreted and understood ambiguously and used in diverse ways in management practice.

According to an encyclopedic definition, efficiency is perceived as a relation of outcomes to outlays (see *Wielka Encyklopedia PWN*, 2002, p. 53). The notion of efficiency often relates to a rule of rational management, taking a form of two variants: effective (maximization of outcome) and economical (minimization of outlay) (see Matwiejczuk, 2000, p. 27).

In the discussion on actions oriented toward obtaining new outcomes some attention must be paid to an attribute of their efficiency, combining effectiveness with efficiency, expediency and cost-effectiveness. Moreover, in the literature efficiency is often linked with such notions as: productivity, profitability, rationality or even purposefulness. In such a context it may be understood as not only an outlay-outcome relation, but also as an ability to adjust promptly to changes, to implement a strategy and to accomplish objectives, or as a tool for assessment of efficiency and effectiveness of actions (see Skrzypek, 1999, pp. 11-12).

The evolutionary development of defining efficiency is presented by M. Holstein-Beck who lists six categories composing a comprehension of content and range of the notion of efficiency. They include:

- 1) productivity (in a techno-economic dimension by H.Emerson),
- 2) competence (in an organizational-bureaucratic dimension by M. Weber),
- 3) effectiveness (in a praxeological dimension by T. Kotarbiński),
- 4) functionality (in a humanistic dimension by R. Beckhard),
- 5) communication (in a personality dimension by D.J. Lawless), and
- 6) morality (in a behavioral dimension by K. Obuchowski).

However, in the light of the record of the organisation and management theory, it is assumed that efficiency is a primary category in relation to the above-mentioned notions (see Skrzypek, 2007, p. 214).

Taking the diversity and the inconsistency of defining the category of efficiency into consideration it must be pointed that there are two key approaches: purposeful and systemic, which significantly differ (compare Bielski, 2002, p. 109). The first one focuses on a degree of achieving set objectives and is identified with a notion of *effectiveness* (efficacy, purposefulness), the latter one focuses on a degree of using resources,

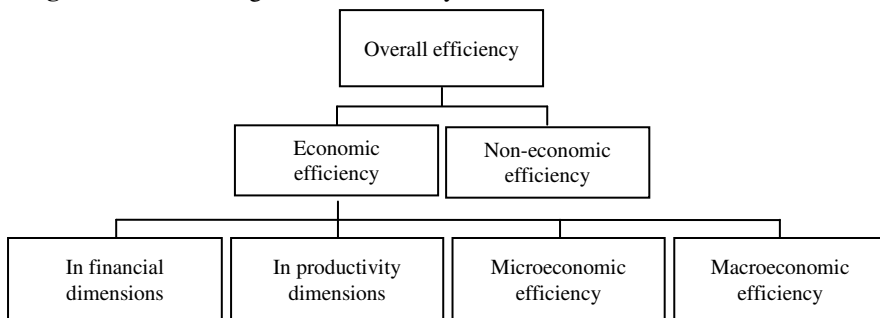
which is described as *efficiency* (productivity, efficacy, cost effectiveness). As proof of the existence of differences in perceptions of these two approaches one can quote a statement saying that „effectiveness relates to doing things in a right way, whereas efficiency relates to doing the right things” (see Clark, 2005, p. 5). Being more precise, effectiveness is identified with cost effectiveness in the theory of competent activities. In economic reality, a desired condition is „a combination of effectiveness and efficiency with cost-effectiveness. Since it can happen that one can act efficiently but uneconomically and also one can do harm or act for benefit efficiently and economically” (see Niedzielski, 2011, p. 20).

Contemporary management of organisation also requires including a criteria of social righteousness (social effectiveness) (compare Nowosielski, 2008) as well as value for a client to the assessment of management competence. Simultaneously, what must be pointed out is a need for exclusion of allocative efficiency (allocation of resources according to customer preferences), or price efficiency (low prices while obtaining outlays and/or high prices while selling products) (compare Szydło, 2008; Szymańska, 2010).

The presented variety of approaches proves that scientific research on various aspects of efficiency must definitely be further conducted and discussed.

The subject of particular interest that is presented in the study is economic efficiency that derives from a rule of rational management and is defined as a difference between outcomes and outlays incurred in order to obtain these outcomes. It can be observed in financial and/or productivity dimensions and concern a single enterprise and/or the whole economy (see Diagram 1).

Diagram 1. Basic categories of efficiency



Source: autor's own study.

The foreign literature also presents the notion of overall efficiency that comprises technical efficiency and allocative efficiency (compare Aparicio et al., 2015, p. 882). It is also pointed out that there are a lot of studies on economic efficiency in technical and productive dimensions, whereas too little attention is paid to efficiency in a financial dimension, mainly when assessment of profits, costs etc. is concerned (compare Silva, 2014, pp. 108-112).

A very interesting approach to a modern perception of economic efficiency is the one presented by E. A. Helfert. The author points out that a basic economic objective of rational management is administration of selected resources at a strategic level in a way that in the long run an economic value will be created, ensuring not only covering but also a good return of incurred outlays without exceeding a level of risk accepted by owners (see Helfert, 2004, p. 427).

Economic efficiency is a category used, first of all, as a criterion of assessment of activity of the whole company as well as its specific areas. The importance of this category results from the fact that it prejudices the essence of enterprise as an economic entity, conditioning its functioning and determining its development (see Osbert-Pociecha, 2007, pp. 337-349). It concerns an ability to enhance a company's market position and improve its financial results. Moreover, acting in line with economic efficiency while taking decisions in enterprises is compatible with maximization of benefits for owners (see Wrzosek, 2005, p. 459).

The measurement of economic efficiency is an extremely complex and difficult problem of theory and practice of the assessment of enterprises' functioning and development. They result from diverse objectives, forms and conditions of enterprise functioning, adverse expectations of stakeholders and changing concepts and practice of management.

In economic theory and practice an efficiency relation refers mainly to analysing outcomes with set outlays or using outlays in order to obtain assumed outcomes.

Efficiency understood as mutual relations between outlays and outcomes can be presented on the basis of three basic formulas:

- 1) efficiency as a difference between outcomes and outlays (profitability),
- 2) efficiency as a quotient of outcomes to incurred outlays (cost effectiveness), and
- 3) efficiency as a quotient of difference between outcomes and outlays to incurred outlays (rate of return).

When outlays and outcomes can be presented in measurable units, their collation enables to obtain the efficiency ratio that allows to make assessment in comparison with, e.g., a set base level, plan or efficiency of other units. Measures of efficiency are based on three approaches (see Szymańska, 2009, p. 159):

a) ratio – constructing relations between various volumes (based on return, cost-effectiveness, productivity ratios),

b) parametric – determining technical dependence between outlays and production, showing a maximum amount of product that can be obtained at a specific level of outlays – e.g. SFA (Stochastic Frontier Approach) method, TFA (Thick Frontier Approach) method, DFA (Distribution Free Approach) method, and

c) nonparametric – using a procedure of linear programming – DEA method (Data Envelopment Analysis), FDH method (Free Disposal Hull) (see Charnes et al., 1978, pp. 429-444).

In spite of the fact that while assessing enterprises' efficiency a dynamic growth of interest in DEA and SFA methods (compare Lampe & Hilgers, 2015, pp. 1, 12) is observed, it must be stressed that ratio analysis still remains a relatively simple method of insight into economic operations and results of functioning of economic entities, as it concentrates on constructing relations between these volumes (compare Sierpińska & Jachna, 2014, pp. 144-145). It is very important, however, that these values are correctly estimated and interpreted, which is conducted on the basis of comparing obtained results with accepted reference bases. The literature presents a number of ratios used in assessment of economic efficiency of enterprises, which allow to conduct an analysis in a very broad range. These ratios include accounting, financial or market ratios that can be expressed in an absolute or relative dimension (see Table 2).

Undoubtedly, the efficiency measures that are most often analysed are return ratios, mainly because of their role and importance in assessment of financial situation formulated by creditors, owners and the State Treasury. Their application to management practice in enterprises faces certain constraints connected with, among others, accounting policy, focus on the past, disregarding risk and capital cost and structure. Measures of profitability and efficiency based on cash flow as a rule eliminate imperfections of accounting ratios concerning using various accounting rules, however, they have some disadvantages. Most of them were created in consulting companies which advertised them aggressively, creating temporal fads, moreover, they are very often used only to measure short-

term achievements (see Dudycz, 2005, pp. 163-169). Market valuation, on the other hand, considered the most objective, is dependent on the situation in capital market, speculative operations, or established policy of stock market investors.

Table 2. Examples of accounting, financial and market ratios used in assessment of economic efficiency of enterprises

		Symbol	Designation
		Accounting ratios	Absolute
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization		
NOPAT	Net Operating Profit After Tax		
EPS	Earnings Per Share		
Relative	ROI		Return on Investment
	ROA		Return on Assets
	ROS		Return on Sales
	ROE		Return on Equity
	DFL		Degree of Financial Leverage
	DOL		Degree of Operational Leverage
Financial ratios	Absolute	FCF	Free Cash Flow
		FCFE	Free Cash Flow to Equity
		GCF	Global Cash Flow
		DCF	Discounted Cash Flow
		NPV	Net Present Value
		CVA	Cash Value Added
	Relative	IRR	Internal Rate of Return
		CFROI	Cash Flow Return on Investment
		WACC	Weighted Average Cost of Capital
Market ratios	Absolute	EVA	Economic Value Added
		EVC	Economic Value Creation
		MVA	Market Value Added
		SVA	Shareholder Value Added
	Relative	TSR	Total Shareholder Return
		VCI	Value Creation Index

Source: autor's own study based on Jaki (2012, pp. 150-154).

The weaknesses of efficiency assessment measures presented above seem, nonetheless, natural, especially in the light of inability to create an overall system of measurements of achievements and financial efficiency of

enterprises, which could reflect their diversity and multiplicity as well as complexity of mechanisms shaping such efficiency.

Based on the empirical studies conducted on the basis of German concerns, it can be stated that only one third used market measures in the assessment of efficiency. Although nearly three quarters formulated their action objectives as value maximization, numerous enterprises used traditional profitability measures in financial controlling, taking accounting profit into account (compare Pellens et al., 1997, pp. 1933-1939). On the basis of the analysis of the biggest German public limited companies (from DAX index) it shows that in the majority of cases (more than 90%) relative measures of enterprise value were used and they were calculated on the grounds of the accounting profit (see Fischer & Wenzel, 2005, p. 25). Similar conclusions were drawn by other authors as well (see Hermann et al., 1999, pp. 399-406).

Empirical research results

The results of the conducted empirical research confirm the diversity of shaping of basic economic categories in Polish and German public limited companies in the period between 2004-2013. It is proved by calculated average values of equity and total assets as well as sales revenue (see Table 3).

Table 3. Average values of equity and total assets as well as sales revenue of companies included in WIG30 and DAX indexes between 2004-2013 (in million EURO*)

Specification	Index	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total assets	WIG30	4,4	4,7	5,5	6,7	6,6	6,9	7,6	7,5	8,2	8,5
	DAX	120,9	131,8	147,7	178,9	187,6	152,6	167,5	179,5	177,7	161,4
Equity	WIG30	1,0	1,1	1,4	1,8	1,6	1,8	2,1	2,1	2,3	2,4
	DAX	11,8	13,7	15,1	16,0	14,4	15,3	17,6	18,5	19,7	19,8
Sales revenue	WIG30	0,8	1,0	1,5	1,7	2,1	1,7	2,1	2,4	2,5	2,2
	DAX	31,1	32,8	36,3	35,5	36,6	33,3	37,7	40,9	44,4	43,3

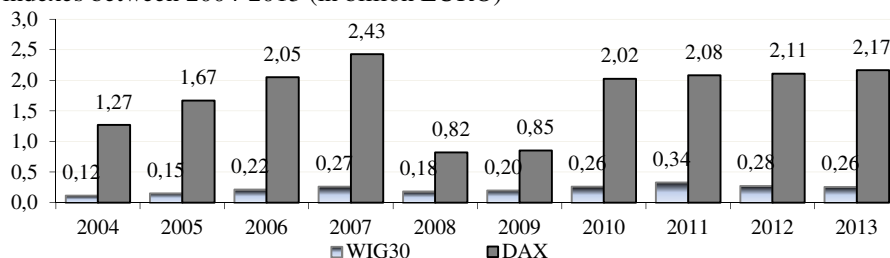
* To calculate balance sheet data from companies listed in WIG30 an average NBP exchange rate on balance sheet date was used, whereas to calculate items of profit and loss account the used value was an arithmetic average of NBP exchange rates binding on the last day of specific months in a given year.

Source: autor's own study based on EMIS database, <http://www.boerse-frankfurt.de> and websites of analysed companies.

The figures presented in table 3 show unanimously that in the analysed decade companies included in WIG30 index achieved much lower values of equity and total assets as well as sales revenue than companies from DAX index. Differences in the value of total assets amounted to about 150 billion Euros on average, equity to about 15 billion Euros, whereas sales revenue to about 35 billion Euros. The biggest positive changes in values of these economic categories were observed between 2004-2007. A subsequent two-year period reflects some kind of market collapse that is described as crisis situation (compare Dach, 2011, pp. 33-36), whereas years between 2010-2013 show a relative growth of values of selected items of balance sheet and profit and loss account.

What should be underlined here is shaping of accounting measures of economic efficiency in absolute terms i.e. financial results of examined companies. The analysis of financial statements between 2004-2013 pointed at a certain regularity connected with a significant dominance of German companies over Polish enterprises (see Figure 1).

Figure 1. Average values of financial results of companies from WIG30 and DAX indexes between 2004-2013 (in billion EURO)



Source: autor's own study based on EMIS database, <http://www.boerse-frankfurt.de> and websites of analysed companies.

Moreover, three similar research subperiods were noted (between 2004-2007, 2008-2009 and 2010-2013), in which analysed measures showed diverse tendencies. What should be stressed here are more radical changes in values of financial results of companies from DAX index contrary to companies from WIG30 index, in particular in 2008 and 2010, in comparison with the previous year. What is also worth noting are differences in a reverse trend of economic efficiency that was observed in the last three years. When German companies showed an increase of economic efficiency, the Polish ones noted a decline in the average values of financial results.

While analyzing calculated measures of descriptive statistics it must be stressed that in German companies a more considerable diversification of financial results values was observed in the analysed decade than in companies from WIG30. It is also confirmed by values of standard deviations as well as minimum and maximum values in each analysed research period (see Table 4). In particular this situation was visible between 2011-2012, when differences between minimum and maximum achieved financial results amounted to a dozen billion Euros.

Table 4. Summary statistics of financial results values in companies included in WIG30 and DAX indexes between 2004-2013 (in billion Euros)

Specification	Index	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Standard deviation	WIG30	0,15	0,19	0,27	0,34	0,31	0,28	0,30	0,56	0,31	0,32
	DAX	1,28	1,76	1,77	2,17	1,98	2,36	1,82	3,23	4,42	2,61
Minimum	WIG30	-0,06	0,00	-0,02	0,00	-0,44	-0,15	0,01	-0,25	-0,11	-0,04
	DAX	-0,37	-0,31	-0,27	-0,37	-3,84	-4,54	0,32	-2,22	-5,26	-2,76
Maximum	WIG30	0,47	0,63	0,91	1,05	0,95	0,87	1,14	2,75	1,17	1,21
	DAX	4,63	7,41	7,02	7,97	5,73	8,40	6,84	15,41	21,72	9,07
Median	WIG30	0,06	0,05	0,10	0,11	0,10	0,08	0,15	0,17	0,18	0,12
	DAX	0,68	1,07	1,66	1,92	0,90	0,50	1,22	1,10	1,22	1,26

Source: autor's own study based on EMIS database, <http://www.boerse-frankfurt.de> and websites of analysed companies.

Based on the above-mentioned economic efficiency measurement conducted on accounting result categories in absolute terms it can be claimed that German companies achieved higher efficiency than the Polish enterprises. Presented in table 5 results of empirical research confirm, however, that economic efficiency of Polish companies measured in relative terms, in majority of cases is definitely higher than in German companies. It is also indicated by calculated average values of return on sales, equity and total assets ratios. Moreover, in companies from WIG30 index a bigger diversification of efficiency measures, especially one expressed by return on sales ratios, was observed.

It must be noted that in companies from WIG30 in each analysed year calculated average values of return on sales ratios were a dozen or several dozen percentage points higher than in companies from DAX index (see Figure 2). What is more, average values of return on total assets and equity ratios of the Polish companies, except four cases, exceeded measures of

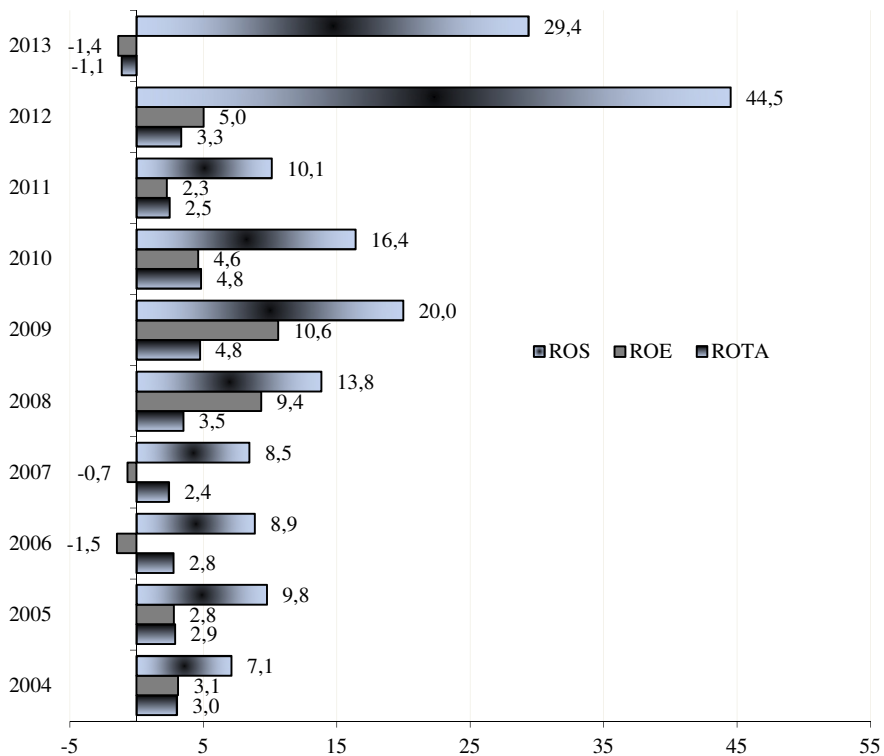
companies from the German stock market by a few percentage points. It confirms significant disproportions between average values of ROS, ROE and ROTA ratios in companies included in WIG30 and DAX indexes between 2004-2013.

Table 5. Summary statistics of return on sales (ROS), return on total assets (ROTA) and return on equity (ROE) in companies included in WIG30 and DAX indexes between 2004-2013 (in %)

Ratios	Specification	Index	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
ROS	Mean	WIG30	12,4	16,0	16,6	17,9	17,2	20,5	23,6	17,9	50,7	39,1
		DAX	5,3	6,3	7,8	9,5	3,4	0,5	7,2	7,8	6,1	9,7
	Standard deviation	WIG30	14,9	12,5	15,1	14,3	30,7	30,6	28,9	23,4	184,4	114,4
		DAX	5,3	5,8	7,3	11,6	17,3	14,6	5,2	8,8	7,6	19,3
	Minimum	WIG30	-27,7	0,6	-6,5	0,5	-57,3	-14,5	1,3	-60,0	0,2	-12,2
		DAX	-5,3	-4,6	-3,4	-4,8	-72,3	-63,2	1,9	-3,0	-11,6	-5,1
	Maximum	WIG30	36,5	37,7	45,7	45,6	136,3	159,2	149,5	79,7	989,6	616,1
		DAX	18,4	26,2	36,1	51,7	42,1	24,1	20,3	38,0	30,1	100,0
	Median	WIG30	9,0	11,5	12,5	14,3	13,0	17,1	16,6	16,4	12,6	16,6
		DAX	4,7	5,5	6,2	6,6	4,4	2,7	5,3	6,0	5,7	5,8
ROE	Mean	WIG30	16,8	17,1	16,4	18,0	18,0	14,8	18,7	15,3	14,9	12,7
		DAX	13,7	14,3	17,9	18,7	8,6	4,2	14,0	13,0	9,8	14,0
	Standard deviation	WIG30	18,3	13,3	13,0	10,2	31,4	16,0	22,8	15,9	14,8	12,7
		DAX	10,9	8,2	9,3	11,7	26,1	14,8	6,4	11,6	18,3	35,0
	Minimum	WIG30	-16,6	0,9	-19,2	0,9	-38,9	-13,1	3,7	-28,6	-15,1	-5,4
		DAX	-9,7	-5,4	-4,9	-7,2	-93,5	-36,5	3,1	-14,7	-74,3	-48,1
	Maximum	WIG30	79,1	58,1	48,0	45,0	150,9	74,3	127,5	60,6	74,0	58,2
		DAX	43,9	29,0	43,4	56,5	74,0	29,3	27,2	37,4	32,2	184,2
	Median	WIG30	16,1	15,0	16,3	16,5	12,3	12,9	12,9	13,8	13,0	11,4
		DAX	11,9	12,8	16,7	16,4	9,6	7,4	13,7	12,6	13,3	12,1
ROTA	Mean	WIG30	7,1	7,1	8,0	7,9	6,6	6,1	9,1	6,9	7,0	5,7
		DAX	4,0	4,2	5,3	5,5	3,1	1,3	4,2	4,4	3,7	6,8
	Standard deviation	WIG30	5,5	7,1	9,6	7,8	10,9	7,8	14,1	10,8	11,3	7,7
		DAX	4,7	4,3	5,3	6,4	9,6	4,2	3,2	5,0	4,5	19,4
	Minimum	WIG30	-0,1	0,6	-5,7	0,3	-13,3	-6,8	0,7	-20,1	-10,3	-2,6
		DAX	-3,4	-3,0	-2,5	-3,4	-35,2	-10,7	0,1	-3,0	-11,4	-3,8
	Maximum	WIG30	16,3	23,0	28,9	30,5	41,2	30,4	74,7	46,4	58,8	38,2
		DAX	18,8	18,0	20,7	30,4	30,4	12,8	13,7	20,6	11,3	108,0
	Median	WIG30	6,1	3,6	5,5	6,9	4,1	4,7	5,3	4,7	4,9	4,6
		DAX	2,6	3,1	3,9	3,9	2,8	1,0	3,6	4,1	4,0	4,0

Source: autor's own study based on EMIS database, <http://www.boerse-frankfurt.de> and websites of analysed companies.

Figure 2. Variations in average values of return on sales, return on total assets and return on equity in companies included in WIG30 and DAX indexes between 2004-2013 (in pp)



Source: autor's own study based on EMIS database, <http://www.boerse-frankfurt.de> and websites of analysed companies.

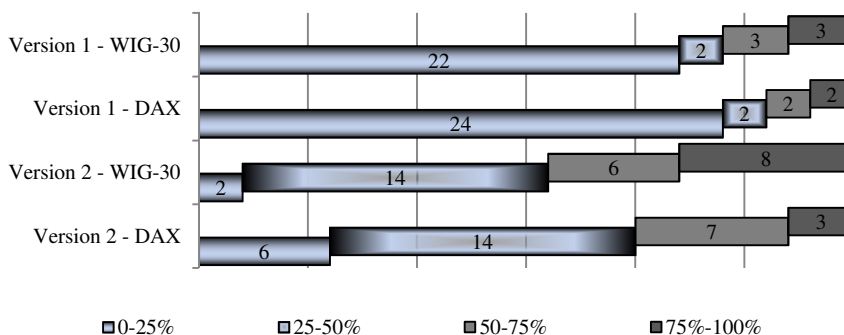
Special attention should be drawn to deviations between the analysed enterprises between 2008-2009, when the WIG30 companies, despite a market collapse, noted an increasingly higher return on sales and insignificant declines in return on total assets. In the DAX companies, on the contrary, observed declines in profitability ratios amounted to over 50 percentage points. Presented results confirm the hypotheses assumed at that

time that effects of insolvency of American institutions immediately reached Europe, Germany in particular (see Romanie, 2008).

What is also worth stressing is the situation in the last analysed period when German companies significantly improved their economic efficiency in every analysed area, and especially the one measured by means of return on equity ratio. As a result of a positive process the efficiency of the companies from DAX index in 2013 turned out to be higher than in the Polish stock market companies.

The results of the analysis of efficiency measures calculated by means of DEA Frontier software⁷ for 10 examined periods (between 2004-2013)⁸ showed that according to the first version of the model, the majority of WIG30 and DAX companies were characterized by efficiency lower than 25%⁹, whereas in the second version at the level between 25-50% (see Figure 3). Significant differences between Polish and German entities, in favour of the first group, were apparent in relation to DEA measures that confirm a high efficiency (75-100%).

Figure 3. Structure of analysed companies included in WIG30 and DAX indexes by their efficiency between 2004-2013



Source: autor's own study based on EMIS database, <http://www.boerse-frankfurt.de> and websites of analysed companies.

⁷ Free version available on the website within the study: Cook, W.D. & Zhu, J., 2008, *Data Envelopment Analysis: Modeling Operational Processes and Measuring Productivity*.

⁸ Specific efficiency measures were calculated on the basis of mean values of specific inputs and outputs for the period between 2004-2013.

⁹ Taking into consideration the constraints of the DEA method (positive values of inputs and outputs), negative values of specific inputs and outputs were replaced by a zero value. Compare Feruś (2006, p. 50).

The detailed analysis of the examined entities from WIG30 index proved that according to the second variant the higher efficiency was observed in seven public limited companies: CCC, CYFROWY POLSAT, KGHM, LPP, PZU, SYNTHOS and TVN (see Table 6).

Table 6. Average values of efficiency measures (DEA) in the analysed companies included in WIG30 and DAX indexes between 2004-2013

WIG30	DEA measures		DAX	DEA measures	
	Version 1	Version 2		Version 1	Version 2
<i>ALIOR</i>	4,2%	14,5%	<i>ADIDAS</i>	25,7%	38,9%
<i>ASSECO POLAND</i>	7,5%	42,0%	<i>ALLIANZ</i>	1,4%	28,0%
<i>AZOTY</i>	7,6%	40,9%	<i>BASF</i>	5,8%	50,6%
<i>BOGDANKA</i>	12,5%	64,7%	<i>BAYER</i>	5,1%	36,3%
<i>BORYSZEW</i>	29,6%	29,6%	<i>BEIERSDORF</i>	100,0%	100,0%
<i>BZ WBK</i>	3,0%	41,0%	<i>BMW</i>	3,5%	34,5%
<i>CCC</i>	100,0%	100,0%	<i>COMMERZBANK</i>	0,9%	7,4%
<i>CYFROWY POLSAT</i>	51,0%	100,0%	<i>CONTINENTAL</i>	13,4%	29,4%
<i>ENEA</i>	1,0%	24,5%	<i>DAIMLER</i>	1,6%	25,6%
<i>ENERGA</i>	1,6%	26,0%	<i>DEUTSCHE BANK</i>	1,2%	21,1%
<i>EUROCASH</i>	78,5%	96,6%	<i>DEUTSCHE BÖRSE</i>	56,7%	67,6%
<i>GTC</i>	3,0%	34,1%	<i>DEUTSCHE LUFTHANSA</i>	11,0%	29,3%
<i>HANDLOWY</i>	1,9%	31,5%	<i>DEUTSCHE POST</i>	9,0%	41,0%
<i>ING</i>	2,7%	33,9%	<i>DEUTSCHE TELEKOM</i>	0,6%	10,0%
<i>JSW</i>	2,0%	33,8%	<i>E.ON</i>	1,7%	29,9%
<i>KERNEL</i>	51,0%	67,4%	<i>FRESENIUS</i>	16,1%	28,5%
<i>KGHM</i>	4,8%	100,0%	<i>FRESENIUS MEDICAL CARE</i>	13,1%	34,6%
<i>LOTOS</i>	1,8%	26,6%	<i>HEIDELBERGCEMENT</i>	6,7%	23,8%
<i>LPP</i>	50,0%	100,0%	<i>HENKEL</i>	16,8%	48,5%
<i>MBANK</i>	2,2%	25,3%	<i>INFINEON TECHNOLOGIES</i>	0,0%	0,0%
<i>ORANGE</i>	0,7%	30,9%	<i>K+S</i>	100,0%	100,0%
<i>PEKAO</i>	4,3%	64,0%	<i>LANXESS</i>	51,4%	51,4%
<i>PGE</i>	1,4%	58,6%	<i>LINDE</i>	11,1%	44,8%
<i>PGNIG</i>	2,3%	47,7%	<i>MERCK</i>	24,3%	66,0%
<i>PKN ORLEN</i>	2,5%	51,9%	<i>MÜNCHENER RÜCK</i>	3,9%	46,5%
<i>PKO BP</i>	4,7%	71,6%	<i>RWE</i>	11,0%	74,7%
<i>PZU</i>	6,5%	100,0%	<i>SAP</i>	43,6%	100,0%
<i>SYNTHOS</i>	100,0%	100,0%	<i>SIEMENS</i>	4,2%	59,4%
<i>TAURON</i>	2,0%	36,8%	<i>THYSSENKRUPP</i>	0,3%	0,9%
<i>TVN</i>	66,7%	100,0%	<i>VOLKSWAGEN</i>	2,7%	55,3%

Source: autor's own study based on EMIS database, <http://www.boerse-frankfurt.de> and websites of analysed companies.

In these cases efficiency measures were at the level of 100%. A similarly high efficiency from DEA's point of view (nearly 100%) was noted in EUROCASH. On the other hand, the lowest degree of efficient usage of capital outlays was noted in ALIOR.

While conducting a thorough analysis of the entities from DAX index it must be stated that there were only two cases (K+S and SAP) in which one hundred per cent efficiency was achieved in the examined period. The lowest efficiency from DEA's point of view (below 10%) was observed in three enterprises: COMMERZBANK, INFINEON TECHNOLOGIES and THYSSENKRUPP.

Conclusions

On the basis of conducted empirical research it cannot be unequivocally stated that the Polish public limited companies, contrary to the German enterprises, were characterized by higher economic efficiency. It is a fact that the companies included in DAX index achieved definitely higher values of basic economic categories, financial results in particular, accounting measures of efficiency in absolute terms. On the other hand, generated profits did not translate into higher values of return ratios which make up accounting dimension of economic efficiency in relative terms. On these grounds the companies from WIG30 looked much better, both in relation to return on sales, total assets or equity. Similarly, however, less radical conclusions can be drawn on the basis of efficiency analysis by means of DEA measures. On the basis of this nonparametric approach, it must be stressed that German companies achieved, on average, lower efficiency ratios in relation to the companies from the Polish stock market.

The assumed research hypothesis can be considered empirically confirmed. However, the conclusions from the above-mentioned analysis cannot be generalised, but the results can be a significant contribution to further scientific research.

What can be undoubtedly stated is the fact that problems presented in the study which concerned a choice of forms, methods and tools of economic efficiency assessment in enterprises determine obtained results and thus, further conclusions and taking specific investment decisions. However, conducting a multi-factor and multi-dimensional analysis of

company efficiency while using various approaches and accounting, financial and market measures, is indispensable to create assessment that will enable enterprises to develop and implement a system of efficient and effective management.

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