Panel data analysis applied in financial performance assessment

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ABSTRACT

This paper aims to present the use of panel data analysis in order to assess the state and dynamics of financial performance of the companies listed on the Bucharest Stock Exchange under the influence of determinant factors. Financial performance may be assessed by means of return on equity – ROE. Its main determinant factors suggested by literature are return on assets - ROA and own or financial leverage (FL). This paper provides a theoretical background and applied panel data analysis of two case studies that use fixed and random-effects models (investigating the influence of ROE of previous period on ROE for the current period). The selection of one of the two types of models is based on the results obtained by applying the Hausman test. The study includes Romanian companies listed on Bucharest Stock Exchange (BSE) during 2006-2015 and uses balanced samples. The authors used SAS 9.2 for data processing.

Keywords: panel data analysis, financial performance, return on equity, return on assets, financial leverage

JEL Classification: C23, C58, G31, M41

INTRODUCTION

Repeated recording of the same population requires a cross-sectional analysis of the influence of factor variables on resultative variables. The development of econometric modeling techniques, advanced statistical methods and computer applications of data processing contributed to the appearance of panel data analysis.

First applications of this type of data are mainly found in longitudinal studies of sociological problems (Lazarsfeld, 1948). The increase of interest for studying events at the macroeconomic level and high availability of data for specific samples have significantly contributed to further use of panel data analysis in the research of macroeconomic indicators dynamics (Gujarati, 2004). In microeconomics, main lines of research investigated features and behavior of companies, labor force and consumers (Sevestre, 2002). The use of this type of data has been recently noted in accounting (Jager, 2008; Jaba *et al.*, 2013; Jaba *et al.*, 2016a).

Seen as a business project that occurs over time and is subject to multiple risks (de La Bruslerie, 2006), the company and the analysis of its performance are extremely important to its shareholders. Shareholders ground their decisions to put the available funds into company's assets on performance criteria (Penman, 2007). Assessment of company performance based on the degree of shareholders' equity reflects the return on equity (Fabozzi and Peterson, 2003).

The return on shareholders' equity, namely, the total own equity may be assesed using a performance indicator known in literature under the name of *return on equity* (*ROE*) (Bragg, 2002). Return on equity may vary from one company to another (during the same period) depending on a set of features specific to financial leverage or efficiency of capital goods (de La Bruslerie, 2006). Additionally, return on equity may vary from one period to another (for the same company) depending on the economic context in which the company operates (Jaba *et al*., 2016a). The occurrence of such differences between companies or financial periods requires the use of panel data analysis to assess over time the effects of determinant factors on return on equity.

In this chapter, we aim to provide a theoretical presentation of panel data analysis in the field of finance and accounting and its practical use in the assessment of the influence of determinant factors on return on equity. The applicative part includes two case studies of Romanian companies listed on Bucharest Stock Exchange during 2006-2015. In the analysis of panel data, the selection the two types of models is based on the results obtained after applying the Hausman test. Data were processes using SAS 9.2. In the case studies, main results obtained by applying panel data analysis measuring the influence of determinant factors on return on equity aim to produce the descriptive statistics of the analyzed variables, values of the Hausman test and choose one of the two suggested models (fixed effects or random effects, estimate parameters of regression models (in case of fixed- effects models, the estimation of fixed effects of time and between companies).

The results suggest that economic performance of companies listed on Bucharest Stock Exchange expressed as return on equity varies both between companies and from one financial period to another depending on return on assets and on own and financial leverage.(*FL*).

1. THE PRINCIPLES OF PANEL DATA ANALYSIS

In specialized literature, panel data also appear under the name of *pooled data* or *longitudinal data* (Gujarati, 2004). *A panel dataset* is a set of *cross-section data* Y_{nt} ($n = 1,...,N$ and $t = 1,...,T$) obtained by means of statistical observation performed periodically in a defined time interval T of variables characteristic for a group of N individuals (Baltagi, 2005). Panel dataset involves a variability of observations for the same individuals over time leading to recording of $N \cdot T$ observations (Guiso *et al.*, 2002). From the perspective of this representation, statistical observation shows a variation of individual features contributing to the increase of variability of observations and accuracy of estimation (Sevestre, 2002).

1.1. Features of panel data analysis

Panel data is the outcome of a successive recording of the same individuals in a selected sample for a specific period of time. Even if in the observed sample the criterion for random selection may be very restrictive, eventual correlations may be made among indicators describing individuals over time.

By the size of the sample, panel data may be: *balanced* (individuals are observed over equal periods of time) or *unbalanced* (individuals are observed over different periods of time). By the selection method of individuals, panel data set may be classified into: *continuous* (individuals selected in the sample remain unchanged during recording observations) or *rotative* (a series of individuals are observed during a number of specified periods, then these may be eliminated from the sample being replaced by other individuals for whom new observations will be recorded)

In what regards the structure of analyzed data, panel data analysis will consider for N indiiduals, K variables for T different moments. For statistical observation, we may identify three perspectives for panel data analysis: individual n, time t and variable Y. Based on these notations, Y_{nt} is the observed variable Y for individual n at moment t (Sevestre, 2002). If individuals remain constant, chronological series are obtained and if the period is constant, there will be a sequential series of individuals included in the sample. Depending on the purpose of analysis, panel data set may have more than two dimensions (temporal and individual) by including other factors that will be used to structure the analyzed sample (N individuals over T period for C groups).

Some authors argue that in order to make recordings of the panel type, the time variation is not a key criterion if the variation of recorded observations may be explained by at least one dimension (*N* individuals observed by *C* criteria) (Guiso *et al.*, 2002).

As shown above, panel data set is characterized by double dimensional representation, *temporal and transverse,* conferring them a significant advantage compared to other types of data (Sevestre, 2002).

Temporal dimension enables us to observe individual's evolution over time depending on studied variables. This dimension determines statistical recording of data of each observed statistical unit as time series. For this dimension, the breakdown of total variability in each recorded observation should mainly consider the number periods used in the study. For this case, total variance may be broken down as follows (Sevestre, 2002):

Total variance = Intertemporal variance + Intratemporal variance, or

$$\sum_{n=1}^{N}\sum_{t=1}^{T}(y_{nt} - y_{..})^2 = N\sum_{t=1}^{T}(y_{.t} - y_{..})^2 + \sum_{n=1}^{N}\sum_{t=1}^{T}(y_{nt} - y_{.t})^2 \quad (1)$$

Transversal dimension (individual) allows to observe the variance of features from one individual to another irrespective of period of time *t* for which observations have been recorded and total variance may be decomposed, as follows (Sevestre, 2002):

Total variance = Inter-individual variance + Intra-individual variance, or

$$\sum_{n=1}^{N}\sum_{t=1}^{T}(y_{nt} - y_{..})^2 = T\sum_{n=1}^{N}(y_{n.} - y_{..})^2 + \sum_{n=1}^{N}\sum_{t=1}^{T}(y_{nt} - y_{n.})^2 \quad (2)$$

By active combining of the two dimensions, total variance of recorded observations may be decomposed, as follows (Sevestre, 2002):

Total variance = Inter-individual variance + Inter-temporal variance + Intra-individual-temporal variance, or

$$\sum_{n=1}^{N}\sum_{t=1}^{T}(y_{nt} - y_{..})^2 = N\sum_{t=1}^{T}(y_{.t} - y_{..})^2 + T\sum_{n=1}^{N}(y_{n.} - y_{..})^2 + \sum_{n=1}^{N}\sum_{t=1}^{T}(y_{nt} - y_{n.} - y_{.t} - y_{..})^2 \quad (3)$$

Main difference between the last breakdown and the first two lies in simultaneous consideration of intra-temporal and intra-individual differences. The breakdown method of total variance as in the last model is the main advantage of studying individuals' behavior from the perspective of the individual and the temporal dimensions (Jaba *et al.*, 2013).

1.2. Models of panel data analysis

To analyze panel data, we start from a series of data recorded for N individuals observed for a T period of time. For these data, the following general model may be written used for the analysis of a resultative variable (Y) by determinant factors (X_k):

$$y_{nt} = b_{0nt} + \sum_{k=1}^{K} b_{knt} x_{knt} + w_{nt} \tag{4}$$

$n = 1,...,N$ and $t = 1,...,T$, where y_{nt} represents values of dependent variable, x_{knt}, values K for dependant variable, b_{0nt}, a constant and w_{nt}, the error component (Sevestre, 2005).

Coefficients b_{0nt} and b_{knt}, $k = 1,...,K$ varies in time and between individuals. As the behavior of individuals may change in time that regards dependent variables of the studied sample, we may observe in the studied sample the absence of recorded data homogeneity.

As the number of coefficients ($NT(K + 1)$) is higher to the total number of observations (NT), it is difficult to estimate the model using traditional methods. In this case, contrasts between coefficients should be used by defining two canonic models: *fixed effects models* (individual or temporal) and *composed error models* (random effects)

Fixed effects models

In case of fixed effects models, it is assumed that the influence of considered factor variables (x_{knt}) on the dependent variable (y_{nt}) is identical for all individuals during the entire analyzed period ($b_{knt} = b_k$). In this case, the constant b_{0nt} may be broken down as follows:

$$b_{0nt} = b_0 + a_n + d_t \tag{5}$$

where, b_{0nt} is the constant of the regression model, b_0, a constant a_n indicates unobservable differences between individuals and d_t temporal differences that may appear in individuals.

Based on this breakdown, the regression model may be written as follows (Sevestre, 2002):

$$y_{nt} = b_0 + a_n + d_t + \sum_{k=1}^{K} b_k x_{knt} + w_{nt} \tag{6}$$

To estimate parameters of the fixed effects model we may consider the individual and temporal specificity by introducing specific effects also called fixed effects in individuals and periods that represent coefficients to be estimated. In case of a model for a specific period, two companies that have the same observable features should have the same values for the resultative variables:

$$E(y_{nt} / x_{1nt},...,x_{Knt}) = b_0 + a_n + d_t + \sum_{k=1}^{K} b_k x_{knt} \quad (7)$$

We may observe in this model that if there is a difference in companies stable in time, it may be emphasized by means of the coefficient a_n. By analogy, the coefficient d_t measures the effect of temporal variation of company features.

Random effect models

In this case, the random character of specific effects differentiates composed effect models from fixed effects models. Generally, composed effect models may be written as (Sevestre, 2002):

$$y_{nt} = b_{0nt} + \sum_{k=1}^{K} b_k x_{knt} + \varepsilon_{nt} \quad (8)$$

and,

$$\varepsilon_{nt} = u_n + v_t + w_{nt} \quad (9)$$

where, the specific individual (u_n) and temporal (v_t) effects are random, with zero mean and variance σ_u^2 and σ_v^2. The model may be easily broken down , the error factor being made up of three elements: a component that does not present autocorrelation (w_{nt}) neither individually nor temporally, a component as an individual specific effect (u_n) and a component as a temporal specific effect (v_t), not correlated between them or with themselves (Jaba *et al.*,2016b) .

Depending on these features, the conditional mean of values y_{nt} are:

$$E(y_{nt} / x_{1nt},...,x_{Knt}) = b_0 + \sum_{k=1}^{K} b_k x_{knt} \quad (10)$$

In case of random effect model, individual effects u_n express unobservable personal features and they are uncorrelated with dependent observable variables.

To choose one of the two types of models (with fixed or random effects), *F* test and *Hausman* tests are used (Jaba *et al.*, 2016a).

1.3. Advantages and limitations of panel data analysis use

The use of panel data brings some advantages (Baltagi, 2005): control over *individual heterogeneity* as panel data are mainly oriented towards individuals observed over time; combining time series with cross-section observations enables panel data *to provide additional information about them, limit collinearity of selected variables, to provide more degrees of freedom by independent values that may vary even more the efficiency in analysis*; panel data *are more indicated in the study of adjustment and variation dynamics*; panel data enable *to identify and measure the effects that cannot be identified by simple use of cross-section analysis or time series*; using panel data *complex models associated to reality may be built and tested more easily*, unlike the use of *cross-section* data or time series, panel data *enable the reduction or elimination of difficulties related to data aggregation* (biais).

Also, using panel data analysis contributes to improved accuracy in estimating regression models parameters, better analysis of an event by including individual and time dimensions into the model, simplified statistical inference process (compliance with classical hypotheses of regression analysis not being needed) (Hsiao, 2003).

In case of panel data, their analysis may be limited by a series of factors related to data selection and collection, distortion measurement errors, sample selection, time series for short periods, cross-sectional dependence of factors (Baltagi, 2005). Building and collecting panel-type data attracts with it a set of problems typical for sampling: representativeness, non-responses, inexact responses or outliers, frequency of data collection, set reference period (Baltagi, 2005).

Distortion measurement errors are another limitation of panel data use. It appears if there are erroneous recordings of responses needed to build a data base (Sevestre, 2002). In terms of problems generated by the selection of individuals included in the sample, there are some limitations caused by the censorship of some individuals leading to related data, appearance of non-responses, the omission of individuals associated data, decrease of the ability to record data for consecutive periods (Baltagi, 2005). In most cases, panel data regarding macroeconomics cover short periods of time recorded for each individual and do not allow to make long-term forecasts (Baltagi, 2005). Another problem occurs when panel data are used for long time series to analyze macroeconomic events. In this case, the use of panel data does not consider eventual cross-sectional dependencies that may appear among factors (Baltagi, 2005).

2. ANALYSIS OF THE COMPANY PERFORMANCE BASED ON RETURN ON EQUITY (*ROE*)

Understanding the economic performance of a company and assessment of its ability to continue its operation are important for its main suppliers of capital, namely, for its current shareholders, potential investors and creditors (Robu *et al.*, 2012). For this purpose, the first and second categories of stakeholders are interested in obtaining benefits as dividends in exchange for equity made available to the company (Penman, 2007). Measurement of equity provided by the shareholders and their analysis of company performance is made by means of return on equity (*ROE*). *ROE* is calculated as a ratio between net income (after paying fees and taxes to the state) and own equity (*EQ*; and $EQ = TA - L$; where *TA* = Total assets, and *L* = Total debt). The use of net income in the calculation of return on equity is justified as it is used as a basis for paying dividends to shareholders proportional to the amount of equity made available to the company (Bragg, 2002).

For the company, net income is obtained by adding the operating income and financial income. The operational or main activity is used to obtain operating income as a difference between operating revenue and expenses. Operating income is based on company's assets used to obtain future economic benefits. Therefore, the efficiency of using company's assets may be assessed by means of return on assets (*ROA*) calculated as a ratio between operating income and operating assets (Fabozzi and Peterson, 2003).

Financial income is a difference between revenue and financial expenses (not related to operational activity). Financial revenue is usually the interest receivable or favorable foreign exchange differences related to assets or debts of the company (de La Bruslerie, 2006). Financial expenses are usually interest payable for borrowed equity from creditors to finance operations and favorable foreign exchange differences related to monetary and non-monetary assets of the company (de La Bruslerie, 2006).

The calculation of net income if the company uses external funding (for example, medium and long term bank loans for which annually an interest *D* will be paid, calculated as a percentage *d%* of the amount of loans) and the tax rate is *p%* (from gross income), may be made as follows (Penman, 2007):

$$NI = IBT - Tx \qquad (11)$$

where:

$$IBT = OI + NOI \qquad (12)$$

$$Tx = p\% \cdot IBT \qquad (13)$$

$$OI = OR - OE \qquad (14)$$

$$NOI = NOR - NOE \quad (15)$$

where,

NI = Net income; IBT = Income before taxes; Tx = Taxes; OI = Operating income; OR = Operating revenues; OE = operating expenses; NOI = Non-operating income; NOR = Non-operating revenues; NOE = Non-operating expenses.

Starting from the equation (11) and considering hypothetically that the company records in its financial operation only expenses and no revenue (*NOR = 0*) and the tax rate is *p* is 0%, Net income is calculated as follows (Penman, 2007):

$$NI = OI - NOE \quad (16)$$

where,

$$NOE = Interest\ expenses = D = d\% \cdot Debts \quad (17)$$

Calculated this way, *NI* is used to calculate the return on equity:

$$ROE = (NI / EQ) \cdot 100 \quad (18)$$

i.e.

$$ROE = (NI / EQ) \cdot 100 = [(OI - D)/EQ] \cdot 100 \quad (19)$$

By breaking down the equation *(3.9)*, we get:

$$ROE = (OI/EQ - D/EQ) \cdot 100 \quad (20)$$

The (20) equation is multiplied by *(TA/TA)* and is written as:

$$ROE = [(OI/EQ) \cdot (TA/TA) - (D/EQ) \cdot (TA/TA)] \cdot 100 \quad (21)$$

or

$$ROE = [(OI/TA) \cdot (TA/EQ) - (D/EQ) \cdot (TA/TA)] \cdot 100 \quad (22)$$

Also, the (22) equation is multiplied by *(L/L)*, and written as:

$$ROE = [(OI/TA) \cdot (TA/EQ) \cdot (L/L) - (D/EQ) \cdot (TA/TA) \cdot (L/L)] \cdot 100 \quad (23)$$

or:

$$ROE = [(OI/TA) \cdot (EQ + L)/EQ) - (D/L) \cdot (L/EQ)] \cdot 100 \quad (24)$$

but

$$ROA = OI/TA \quad (25)$$

and,

$$FL = L/EQ \quad (26)$$

Where, *FL* is an indicator of financial structure and indicates company's degree of external financing (*FL* > 1) or own funds (*FL* < 1).

Starting from the equations (25) and (26), the equation (24) may be rewritten as follows:

$$ROE = [ROA \cdot (1 + FL) - d \cdot FL] \cdot 100 \quad (27)$$

i.e.

$$ROE = (ROA + ROA \cdot FL - d \cdot FL) \cdot 100 \quad (28)$$

or

$$ROE = [ROA + (ROA - d) \cdot FL] \cdot 100 \quad (29)$$

If $p > 0\%$,

$$ROE = [ROA + (ROA - d) \cdot FL \cdot (1-p)] \cdot 100 \quad (30)$$

Based on equations (29) and (30), if *d* and *p* are not known*, ROE* is a function of *ROA* and FL, thus: *ROE = f (ROA; FL)*, the return on equity depends both on operational return and the financial leverage (*FL*) having a direct impact on the cost of borrowed equity (*d*).

3. CASE STUDIES ON THE USE OF PANEL DATA ANALYSIS

Financial performance of a company may be assessed using *ROE*. This indicator is used to assess the degree to which the equity made available by shareholders (total own equity) may be remunerated based on net income of the company as the main source for dividend payment (Penman, 2007).

Return on equity may vary in time (depending on the business context in which the company operates) and also from one company to another (depending on operational and financial policies used by the management) (Jaba *et al.*, 2016a). For simultaneous analysis of *ROE* variations between companies and over time under the influence of determinant factors (*ROA* and *FL*), panel data analysis should be used. Using this type of analysis, we may assess the variation of return on equity (*ROE*) over time and the significant differences that may exist among companies.

3.1. Results and discussions about the use of fixed effects models

In case of panel analysis of *ROE variation* under the influence of determinant factors, the study suggests the following fixed effects model:

$$ROE = \beta_0 + \alpha_n + \delta_t + \beta_1 ROA + \beta_2 FL + \varepsilon_{nt} \quad (31)$$

where, β_0 is a constant, β_1 and β_2 are regression model parameters, α_n are cross-sectional fixed effects (inter-individual), δ_t are temporal fixed effects and ε_{nt} is the error random variable.

The target population aimed by the study includes all companies listed on BSE on the regulated market between 2006 and 2015, where 85 companies had been listed on BSE under the regulated market section by the end of 2015. A balanced sample of 58 companies was extracted from this population. Data were collected from *Thomson Financial* database by means of *Datastream Advanced 4.0* using the source code assigned to each variable included in the model: [WC08301] for *ROE*; [WC01250]/ [WC02999] for *ROA* and [WC08231] for *FL*.

Descriptive statistics for each analyzed variable of the selected sample are shown in *Table 1*.

Descriptive statistics

Table 1

Variable	Mean	Median	Std Deviation
ROE	0.032	0.040	0.099
ROA	0.036	0.033	0.057
FL	0.787	0.471	0.795

The results from *Table 1* show in the means of companies listed on BSE we may see reduces values of *ROE*, 3.2% that indicates a low return on equity (for 100 units invested by shareholders, they will receive 3.2 units as dividends) Even though *ROA* is positive (3.6%), low value of *ROE* may be explained by the fact that the obtained operating income does not cover the cost of indebtedness. High degree of indebtedness of companies listed on BSE, (*FL* = 0.787) also brings a high cost of borrowed equity expressed by interest payable that have a direct impact on net income in the sense of its diminishing.

For the analyzed sample, the source code in SAS 9.2 used to perform the panel data analysis in case of fixed effects models is as follows:

```
PROC TSCSREG DATA = WORK.DATABASE
;
      MODEL ROE=   ROA FL /

      FIXTWO
      ;
      ID Firm      Year
      ;
RUN; QUIT;
```

Main results obtained in SAS 9.2 refer to a set of statistics related to the estimated model (*Table 2*), test the fixed effects model using F test (*Table 3*), test the model using the Hausman test (Table 4.4) and estimate fixed effects model (*Table A.1* from Appendix).

Fit statistics for the model with fixed effects (cross and time fixed effects)

Table 2

Fit Statistics			
SSE	1.4560	**DFE**	510
MSE	0.0029	**Root MSE**	0.0534
R-Square	0.7416		

(SSE = Sum of squares due to errors; DFE = degrees of freedom for the error: the numbers of the observations in the data set minus the numbers of the parameters; MSE = Mean sum of squares due to errors).

Based on the value of R^2, it may be noted that 74.16% of *ROE* variation is explained by the influence of *ROA* and *FL* in case of cross and time fixed effects model.

Testing fixed effects model using F test

Table 3

F Test for No Fixed Effects			
Num DF	**Den DF**	**F Value**	**Pr > F**
66	510	3.78	<.0001

The value of F test calculated as a ratio between mean of squares due to the model (MST) and mean of squares due to the error is of 3.78. This model indicates that fixed effects model explains in a significant proportion the variation of *ROE* under the influence of factors.

Testing the fixed effects model using the Hausman test

Table 4

Hausman Test for Random Effects		
DF	**m Value**	**Pr > m**
2	7.06	0.0294

Table 4 completes *Table 3* that shows the result after applying the Hausman test (H_0: the model shows the random effects; H_1: the model does not show the random effects). Hausman specification test (H) is used for testing the consistency of the estimated parameters; in the case of fixed effects, on the null hypothesis (H_0), the parameters of the model are consistent but inefficient, and on the alternative hypothesis (H_1) the parameters of the model are consistent and possibly efficient (Jaba *et al.*, 2016b) . Based on the obtained results, we may state that the estimated model does not show random but only cross and time fixed effects.

For the fixed effects model, the estimations of the regression model are presented in *Table A.1* in the appendix. The table shows that *ROA* and *FL* have a significant influence on *ROE*: an increase of 100% of *ROA* (operational efficiency) duet o an increase of *ROE* by 128.13% and an increase of degree of indebtedness by one unit (its doubling) causes a reduction of *ROE* by 3.64% due to interest payable for borrowed equity and that contribute to the reduction of net income. Also, *Table A.1* shows a set of significant cross-sectional and time differences.

We may underline that in the analysis, the last company in the sample is set as a reference unit for the estimation of individual differences.

Table A.1 shows that there is a set of significant differences related to the level of *ROE*, between the companies number 58 (reference) and companies under the following numbers: 22, 24, 27, 32 and 41. These companies have higher values of *ROE* than the value estimated for company 58 (reference) with estimated values of cross differences.

In what regards time fixed effects, we may observe that for a company from the sample, the value of *ROE* estimated for the third year (2008) of the studied period is lower (by 2,131%) than the *ROE* estimated for the last year (2015), for which *ROE* is 1.90% (*Intercept*). Except year 2008, there are no significant differences of *ROE* of the calculated value in the studied sample during 2006-2015.

3.2. Results and discussions on the use of random effects models.

In case of panel analysis of *ROE* variation under the determinant factors, the study suggests the following random effects model:

$$ROE = \beta_0 + \beta_1 ROA + \beta_2 FL + u_n + v_t + w_{nt} \qquad (32)$$

where, β_0 is a constant, β_1 and β_2 are regression models parameters, u_n, individual random effects (zero mean and variance σ_u^2), v_t, temporal random effects (zero mean and variance σ_v^2), w_{nt} is the error component without autocorrelation neither in the individual, nor in the temporal dimensions.

The same target population is included in this case study. It contains all Romanian companies listed on BSE, on the regulated market, 85 companies during 2006-2015. In case of random effects model, randomly a reduced number of companies is chosen, the sample includes only 3 companies observed over a period of 10 years. It is important that the 3 companies are representative as they are included in the BET index of BSE. In this case, the source of data is *Thomson Financial* database, using *Datastream Advanced 4.0*, using the source code assigned to each variable included in the model: [WC08301] for *ROE*; [WC01250]/ [WC02999] for *ROA* and [WC08231] for *FL*.

Descriptive statistics for the analyzed variables of the selected sample are shown in *Table 5*.

Descriptive statistics

Table 5

Variable	Mean	Median	Std Deviation
ROE	0.119	0.120	0.044
ROA	0.098	0.103	0.035
FL	0.332	0.339	0.217

The results of *Table 5* show that in the means of companies listed on BSE and that are included in the calculation of the BET index we may note positive *ROE*, of 11.9% indicating a high degree of return on equity (for

100 units invested by shareholders, they will get 11.9 units as dividends). Compared to *ROE*, *ROA* is positive (9.8%) but lower: for 100 units of assets used in operation, the resulting benefits are of 9.8 units. The degree of indebtedness is reduced (*FL* = 0,332) for companies listed on BSE included in the calculation of ET causing a low cost of borrowed equity.

For the studied sample, the source code in SAS 9.2 used in the panel data analysis, in case of random effects models, is as follows:

```
PROC TSCSREG DATA = WORK.DATABASE
;
      MODEL ROE=   ROA FL /

      PARKS RHO     RANTWO
      ;
      ID Firm      Year
      ;
RUN; QUIT;
```

Main results obtained in SAS 9.2 include a set of statistics related to the estimated model (*Table 6*), a breakdown of the total variance (*Table 7*), model testing using the Hausman test (*Table 8*), estimation of the random effects model (*Table 9*) and the estimation of parameters related to individual random effects (*Table 10*).

Fit statistics for the model with random effects

Table 6

Fit Statistics			
SSE	20.4569	**DFE**	27
MSE	0.7577	**Root MSE**	0.8704
R-Square	0.8648		

(SSE = Sum of squares due to errors; DFE = degrees of freedom for the error: the numbers of the observations in the data set minus the numbers of the parameters; MSE = Mean sum of squares due to errors).

Based on the value of R^2, we may note that 86.48% of *ROE* variance is explained by the influence of *ROA* and *FL* in case of random effects models.

Table 7. Total variance breakdown

Variance Component Estimates	
Variance Component for Cross Sections	0.000106
Variance Component for Time Series	0
Variance Component for Error	0.00029

Results shown in *Table 7* indicates the presence of individual random effects (associated variance > 0), as well as the absence of temporal random effects (associated variance = 0).

Testing random effects model using the Hausman test

Table 8

Hausman Test for Random Effects		
DF	m Value	Pr > m
2	2.27	0.3213

The results obtained by applying the Hausman test (H_0: the model shows random effects; H_1: the model does not show random effects) indicates that the estimated model shows random effects

Parameter estimates for the random effects model

Table 9

Parameter Estimates					
Variable	DF	Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.01914	0.0138	-1.38	0.1776
ROA	1	1.118663	0.1136	9.84	<.0001
FL	1	0.095449	0.0165	5.78	<.0001

Based on the results shown in *Table 9*, we may observe that *ROA* and *FL* have a significant influence on *ROE*: an increase by 100% of *ROA* (operational efficiency) produces an increase of *ROE* by 111.86% and an increase of the degree of indebtedness by one unit (it doubling) causes an increase of *ROE* by 9.54%. This may be mainly explained in case of high-performance companies that generate profit from operations that may be used to cover the cost of borrowed equity, enough profit remaining to be distributed to shareholders. Also, a high degree of indebtedness reflecting borrowed funds that are invested to obtain future business benefits (profitable investments) significantly contribute to the increase of return on equity.

Table 10. Estimations of parameters related to individual random effects

First Order Autoregressive Parameter Estimates	
Firm	**Rho**
Firm 1 (OMV PETROM S.A.)	0.285824
Firm 2 (S.N.G.N. ROMGAZ S.A.)	0.506226
Firm 3 (SNTGN TRANSGAZ SA MEDIAS)	0.051735

Table 10 s shows the parameters of individual random effects for the 3 companies included in the sample. Based on this, we may state that for each company, *ROE* increases from one period to another with an estimated value *Rho* (ex: on the average, first company *ROE* increases year by year by 28.58%, second company *ROE* by 50.62% and third company *ROE* by 5.17%).

CONCLUSIONS

Economic performance of a company assessed by means of return on equity may vary from one company to another (over the same fiscal year) depending on a set of features specific to the use of capital goods and financial leverage and from one period to another (for the same company) based on the context in which the company operates. The analysis and estimation of such differences among companies and fiscal years may be made using panel data analysis to assess over time the effects of the determinant factors on return on equity.

This chapter presented main theoretical and methodological aspects related to the panel data analysis and fixed and random effects models, main concepts of economic performance, methods of their assessment using *ROE* and the influence of main determinant factors and the final part included two case studies in SAS 9.2 of panel analysis of *ROE* under the influence of *ROA* and *FL* by applying the two types of suggested models.

Main results obtained by applying the panel data analysis investigating the influence of determinant factors on return on equity include: descriptive statistics of studied variables, values of the Hausman test and choosing one of the models (fixed or random effects), estimating the parameters of regression models (and in case of fixed and random effects models, their estimation).

Based on the obtained results, we may note that financial performance of listed companies varies among companies and in dynamics from one fiscal year to another depending on the return on assets (*ROA*) and own or foreign financial leverage (*FL*). Methodologically, panel analysis of return on equity may be used to assess company performance both in terms of structure and in dynamics.

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Appendix

Parameters estimates for the fixed effects model

Tabel A.1

Parameter Estimates						
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Label**
CS1	1	0.037537	0.0239	1.57	0.1176	Cross Sectional Effect 1
CS2	1	-0.008	0.0241	-0.33	0.7400	Cross Sectional Effect 2
CS3	1	0.014383	0.0244	0.59	0.5560	Cross Sectional Effect 3
CS4	1	0.027985	0.0241	1.16	0.2452	Cross Sectional Effect 4
CS5	1	0.011817	0.0245	0.48	0.6302	Cross Sectional Effect 5
CS6	1	0.001743	0.0239	0.07	0.9419	Cross Sectional Effect 6
CS7	1	-0.00909	0.0260	-0.35	0.7265	Cross Sectional Effect 7
CS8	1	0.019953	0.0240	0.83	0.4070	Cross Sectional Effect 8
CS9	1	-0.0066	0.0239	-0.28	0.7825	Cross Sectional Effect 9
CS10	1	-0.03287	0.0239	-1.37	0.1700	Cross Sectional Effect 10
CS11	1	0.015327	0.0243	0.63	0.5283	Cross Sectional Effect 11
CS12	1	-0.00789	0.0242	-0.33	0.7445	Cross Sectional Effect 12
CS13	1	0.008234	0.0244	0.34	0.7356	Cross Sectional Effect 13
CS14	1	0.025827	0.0255	1.01	0.3124	Cross Sectional Effect 14
CS15	1	0.012734	0.0244	0.52	0.6021	Cross Sectional Effect 15

Parameter Estimates						
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Label**
CS16	1	0.027802	0.0244	1.14	0.2559	Cross Sectional Effect 16
CS17	1	0.013646	0.0241	0.57	0.5712	Cross Sectional Effect 17
CS18	1	-0.01355	0.0255	-0.53	0.5954	Cross Sectional Effect 18
CS19	1	0.003471	0.0247	0.14	0.8884	Cross Sectional Effect 19
CS20	1	0.005969	0.0240	0.25	0.8036	Cross Sectional Effect 20
CS21	1	-0.00674	0.0247	-0.27	0.7847	Cross Sectional Effect 21
CS22	1	0.053597	0.0252	2.12	0.0341	Cross Sectional Effect 22
CS23	1	0.0089	0.0248	0.36	0.7200	Cross Sectional Effect 23
CS24	1	0.049292	0.0245	2.01	0.0449	Cross Sectional Effect 24
CS25	1	0.022734	0.0241	0.94	0.3453	Cross Sectional Effect 25
CS26	1	-0.00396	0.0262	-0.15	0.8802	Cross Sectional Effect 26
CS27	1	0.121601	0.0261	4.65	<.0001	Cross Sectional Effect 27
CS28	1	-0.01162	0.0248	-0.47	0.6402	Cross Sectional Effect 28
CS29	1	-0.01032	0.0245	-0.42	0.6742	Cross Sectional Effect 29
CS30	1	-0.02769	0.0240	-1.15	0.2487	Cross Sectional Effect 30
CS31	1	-0.00109	0.0243	-0.04	0.9642	Cross Sectional Effect 31
CS32	1	0.154169	0.0250	6.17	<.0001	Cross Sectional Effect 32
CS33	1	0.024016	0.0239	1.00	0.3158	Cross Sectional Effect 33
CS34	1	0.049645	0.0260	1.91	0.0571	Cross Sectional Effect 34
CS35	1	0.008588	0.0242	0.36	0.7223	Cross Sectional Effect 35
CS36	1	0.032076	0.0242	1.32	0.1858	Cross Sectional Effect 36
CS37	1	0.02045	0.0246	0.83	0.4059	Cross Sectional Effect 37
CS38	1	0.017362	0.0242	0.72	0.4737	Cross Sectional Effect 38
CS39	1	-0.0118	0.0258	-0.46	0.6474	Cross Sectional Effect 39
CS40	1	-0.01746	0.0239	-0.73	0.4655	Cross Sectional Effect 40
CS41	1	0.15365	0.0259	5.92	<.0001	Cross Sectional Effect 41
CS42	1	-0.03606	0.0239	-1.51	0.1325	Cross Sectional Effect 42
CS43	1	0.004022	0.0241	0.17	0.8677	Cross Sectional Effect 43
CS44	1	0.020563	0.0241	0.85	0.3948	Cross Sectional Effect 44
CS45	1	0.005232	0.0243	0.22	0.8298	Cross Sectional Effect 45
CS46	1	0.01494	0.0239	0.62	0.5325	Cross Sectional Effect 46
CS47	1	-0.00942	0.0240	-0.39	0.6951	Cross Sectional Effect 47
CS48	1	0.012479	0.0241	0.52	0.6053	Cross Sectional Effect 48
CS49	1	0.018871	0.0241	0.78	0.4340	Cross Sectional Effect 49
CS50	1	0.009932	0.0247	0.40	0.6882	Cross Sectional Effect 50
CS51	1	-0.02127	0.0250	-0.85	0.3956	Cross Sectional Effect 51
CS52	1	-0.00861	0.0241	-0.36	0.7216	Cross Sectional Effect 52
CS53	1	-0.00363	0.0243	-0.15	0.8811	Cross Sectional Effect 53
CS54	1	0.006331	0.0242	0.26	0.7939	Cross Sectional Effect 54
CS55	1	0.003847	0.0243	0.16	0.8744	Cross Sectional Effect 55
CS56	1	-0.00714	0.0246	-0.29	0.7713	Cross Sectional Effect 56
CS57	1	0.027594	0.0241	1.14	0.2532	Cross Sectional Effect 57
TS1	1	0.016132	0.0100	1.61	0.1080	Time Series Effect 1
TS2	1	-0.00658	0.00997	-0.66	0.5098	Time Series Effect 2
TS3	1	-0.02131	0.00995	-2.14	0.0326	Time Series Effect 3
TS4	1	-0.01521	0.00993	-1.53	0.1262	Time Series Effect 4
TS5	1	-0.01592	0.00998	-1.60	0.1113	Time Series Effect 5
TS6	1	-0.00835	0.00993	-0.84	0.4011	Time Series Effect 6
TS7	1	0.002133	0.0101	0.21	0.8321	Time Series Effect 7
TS8	1	0.001671	0.0101	0.17	0.8681	Time Series Effect 8
TS9	1	-0.00017	0.0100	-0.02	0.9862	Time Series Effect 9
Intercept	1	0.005223	0.0190	0.27	0.7836	Intercept
ROA	1	1.281315	0.0587	21.84	<.0001	
FL	1	-0.03638	0.00494	-7.36	<.0001	

(Significant values for a level of 0.05)