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Measurement Of Cost Factors: Evidence From Trading Companies

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ABSTRACT

The paper attempts to emphasize the importance of measuring the factors and opportunities for sustainable long-term growth of the company's value in the interests of its owners and investors. This implies the need to use mathematical and statistical methods and models to measure the quantitative and qualitative economic interrelationships of gross profit as the main indicator of the cash flow and the factors of its growth, in particular, based on panel data. The study results in a methodological approach to assessing the growth factors of a trading company value based on models of panel data analysis. The authors propose to construct a combined regression model, a model for analyzing panel data with fixed effects, models for analyzing panel data with random effects in the Gretl software in order to reveal the interrelationships of gross profit and growth factors on the basis of specific economic data. The study confirmed the hypothesis of a cause-and-effect link between the gross profit of retail stores and their location in the absence of random effects. The empirical estimates of the models' parameters of the panel data analysis implemented in the Gretl software and presented in the paper will help to determine the bottlenecks in the territorial location of the trading company's stores in terms of the influence of the growth factors of gross profit. Therefore, in the future, researchers can develop more conceptual marketing activities to attract buyers taking into account the territorial features of sales in the city.

Keywords**:** company value, profit, model with fixed effects, random effects model, Hausman test

1 INTRODUCTION

The company's value is the main criterion for assessing the effectiveness of the company's operation both from the point of view of owners and managers and potential investors and the state. Research papers emphasize that owners are increasingly interested in trends, opportunities for sustainable long-term growth in the value of the property they own [1, 2]. The world practice shows that the most competitive are those enterprises where the criterion for evaluating the effectiveness of decision making is the further increase in the cost of business [3], current value of future revenues which are expected to be received through use and possible further sale of the property.

Depending on the cost factors that are the main variables in the algorithms, the evaluation methods are divided into methods of income, comparative and cost approaches [2, 4, 5, 6]. The methods of the income approach link the value of the valuation object and the magnitude of future cash flows. In other words, the income approach determines the current value of future cash income which is expected to be received through use and possible further sale of the property. In this case, the calculation can be carried out through projected cash flows or other performance indicators, such as profit and dividends [4, 7, 8]. Undoubtedly, the more is the income brought by the object of valuation, the greater is its market value [9,10]. Therefore, the purpose of the research is to identify, differentiate and evaluate the company's cost factors directly associated with measuring the factors of the company's gross profit as the main indicator of cash flow. Owing to the modern specifics of the trade

industry (limited own working capital), the company's gross profit depends more on debt to suppliers and the number of shop visitors. Due to the use of panel data, it is possible to take into account and analyze individual territorial differences between the districts of the city, which cannot be done within the framework of standard regression models. In the study, we tested the hypothesis of a cause-and-effect link between the gross profit of retail stores and their location in order to justify ways to increase the cash flow and, ultimately, the market value of the trading company.

2 METHODS

The target of research of the growth factors of gross profit (Y) was the trading company with six retail stores selling household chemical goods and cosmetics located in different districts of the city. To test the hypothesis formulated in the study, a sample of 48 observations on gross profit, debt to suppliers (X1, thousand rubles), average number of visitors per quarter (X2, thousand people) from Q1 2012 to Q4 2016 was used. Exploiting these data, a combined regression model, a panel data model with fixed effects, a panel data analysis model with random effects in the Gretl software are constructed. The quality characteristics of these models are analyzed using the Chow test and the Hausman test.

3 RESULTS

The resulting combined model, shown in Figure 1, looks like this:

$$Y = -14{,}375 + 0{,}357X_1 + 4{,}687X_2 + e, R^2 = 0{,}9440 \qquad (1)$$

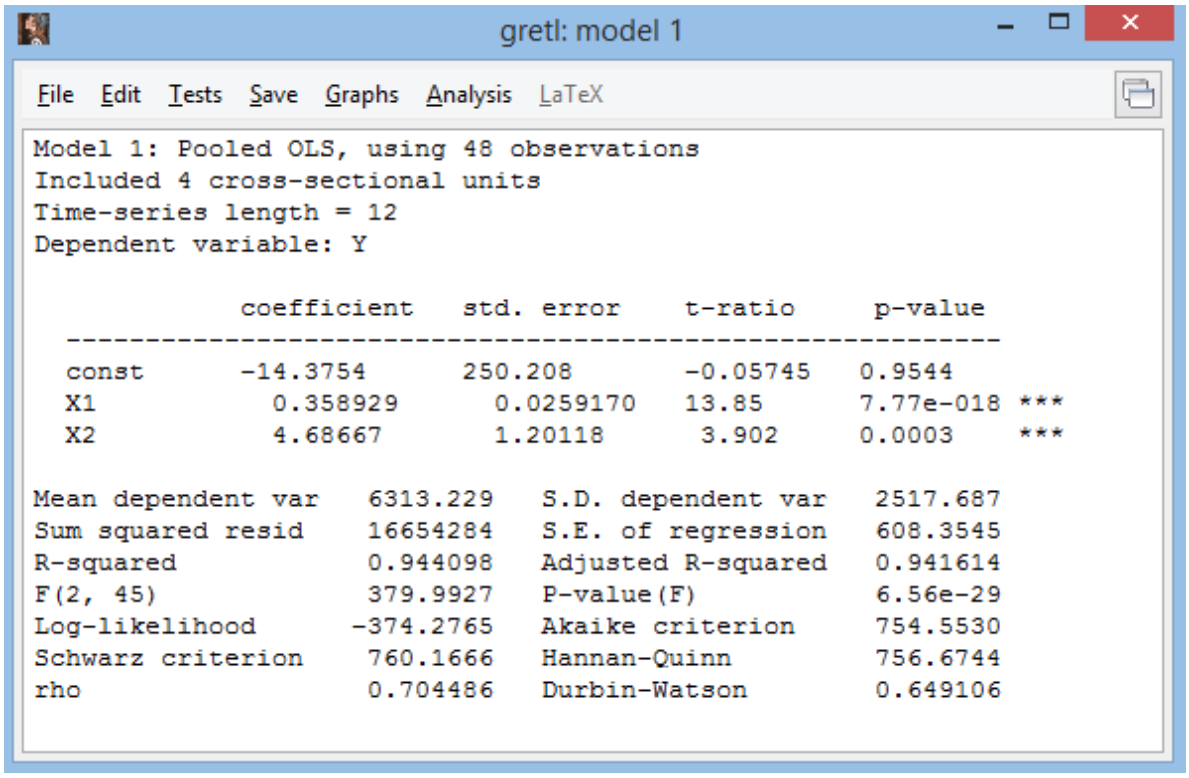
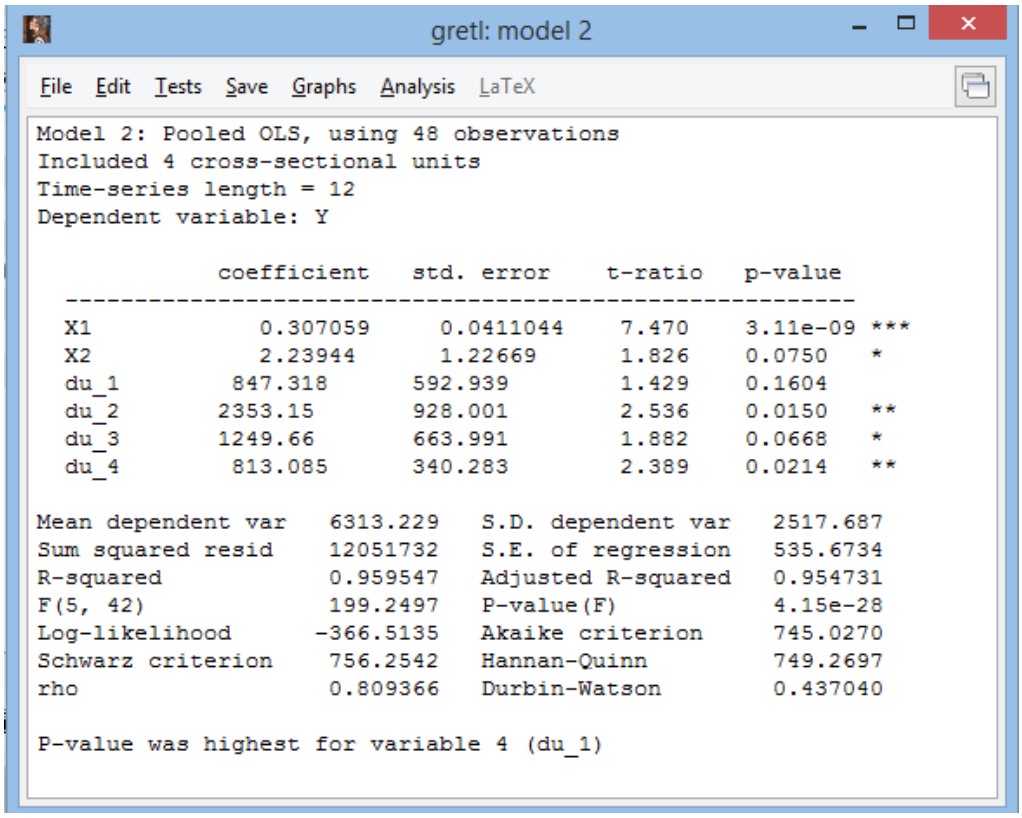


Figure 1. OLS estimation of the combined regression model

As can be seen from Fig. 1, the model (1) is statistically significant for the Fisher test (*P-value (F)* <0.01), the regression coefficients are statistically significant in the Student's test (*P-value (t)* <0.01), which confirms the influence of factors X1 and X2 on profit. To determine the difference in the influence of factors X1 and X2 depending on the city's district on the gross profit of stores, we will study the heterogeneity of gross profit and, to do this, we construct a model for analyzing panel data with fixed effects (Fig. 2).

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Model 2: Pooled OLS, using 48 observations
Included 4 cross-sectional units
Time-series length = 12
Dependent variable: Y

             coefficient   std. error    t-ratio   p-value
  ---------------------------------------------------------
  X1            0.307059     0.0411044    7.470    3.11e-09 ***
  X2            2.23944      1.22669      1.826    0.0750   *
  du_1        847.318      592.939        1.429    0.1604
  du_2       2353.15       928.001        2.536    0.0150   **
  du_3       1249.66       663.991        1.882    0.0668   *
  du_4        813.085      340.283        2.389    0.0214   **

Mean dependent var   6313.229   S.D. dependent var   2517.687
Sum squared resid    12051732   S.E. of regression   535.6734
R-squared            0.959547   Adjusted R-squared   0.954731
F(5, 42)             199.2497   P-value(F)           4.15e-28
Log-likelihood      -366.5135   Akaike criterion     745.0270
Schwarz criterion    756.2542   Hannan-Quinn         749.2697
rho                  0.809366   Durbin-Watson        0.437040

P-value was highest for variable 4 (du_1)
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Fig. 2. OLS estimations of the panel data analysis model with fixed effects

The resulting regression model for analyzing panel data with fixed effects has the form:

$$Y = 847{,}318du_1 + 2353{,}15du_2 + 1249{,}66du_3 + 813{,}085du_4 + 0{,}307X_1 + 2{,}239X_2 + e,$$
$$R^2 = 0{,}9596 \qquad (2)$$

where du_1 - the dummy variable “District № 1”;

du_2 - dummy variable “District № 2”;

du_3 - dummy variable “District № 3”,

du_4 - dummy variable “District № 4”;

Model (2) is statistically significant for the Fisher test (P-value (F) <0.01), the coefficient of regression at factor X1 with a probability of 99% is statistically significant for the Student’s test (P-value (t) <0.01), the coefficient regression at factor X2 with a 90% probability is statistically significant in the Student’s test (P-value (t) <0.1), statistically significant coefficients for the dummy variables du_2, du_3, du_4 indicate the presence of heterogeneity (difference) in the gross profit in stores between districts №2, №3, №4, due to the influence of factors X1, X2. The statistically insignificant coefficient for the dummy variable du_1 (P-value (t)> 0.1) shows that the regressors X1, X2 do not affect the individual difference in gross profit in the store in district №1. This suggests that it is necessary to increase the effectiveness of marketing activities to attract buyers in districts Nos. 3 and 4.

To choose between the combined regression model (1) and the regression model of panel data analysis with fixed effects (2), we will test the null hypothesis about the absence of individual effects (that is, the best quality of the combined model from the point of view of the X1, X2 influence on profit). To test the null hypothesis, the Chow test is used, which is based on comparing the errors of model (1) and model (2), and the one with a smaller error is chosen. The observed value of the F-criterion is determined:

$$F = \frac{(SS_R - SS_{UR})/(N-1)}{SS_{UR}/(NT - N - K)}$$

where SS_R - the sum of the squares of the residuals (errors) in the constrained model (combined model 1); SS_{UR} - the sum of squares of the residuals in the model without constraints (model of analysis of panel data with fixed effects 2);

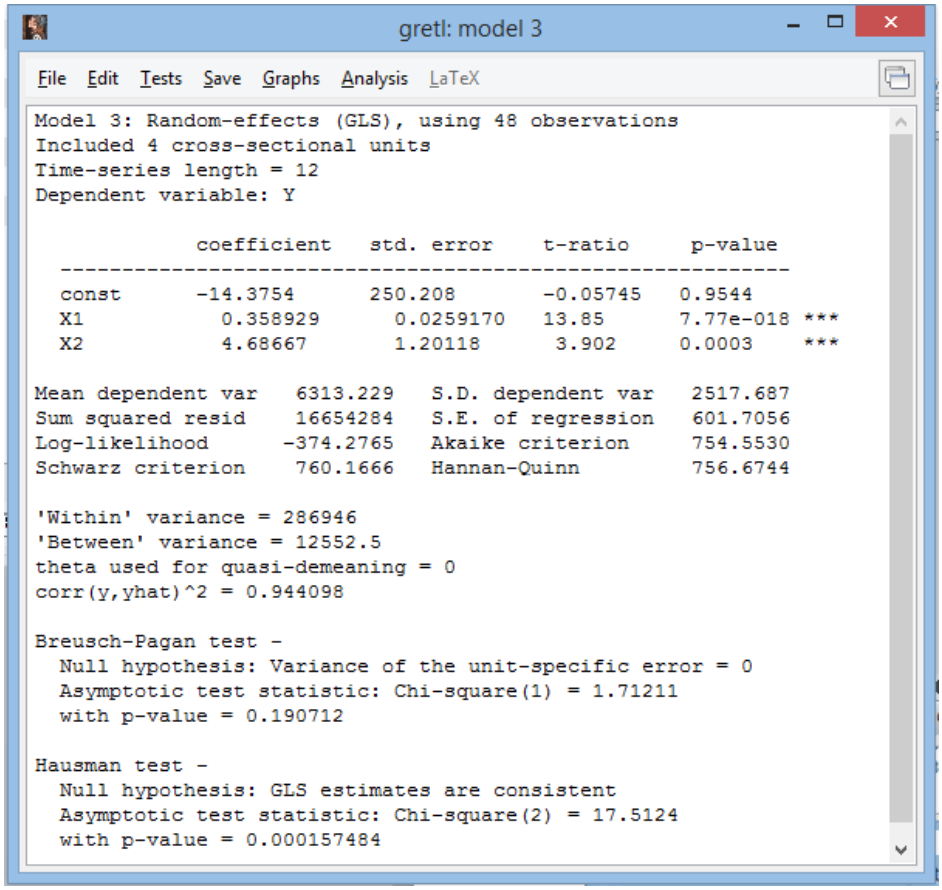
N - number of spatial objects (panels);

T - length of time series in each panel;

K - the number of regressors in the models.

Let us define the critical value: F (0,05; 3; 42) = 2,827; 5,347> 2,827. Hence, the null hypothesis about the absence of fixed individual effects should be rejected. However, it is necessary to find out whether the territorial differences in the influence of X1 and X2 are random.

To test the hypothesis of the random nature of the individual effects (differences) of gross profit in stores around the city districts, that is, the lack of correlation between the heterogeneity of gross profit in the context of the city districts and factors X1, X2, we construct the third of the models proposed above - the model for analyzing panel data with random effects estimated by the available generalized least-squares method (GLS-estimations) (Fig. 3).



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gretl: model 3
File  Edit  Tests  Save  Graphs  Analysis  LaTeX

Model 3: Random-effects (GLS), using 48 observations
Included 4 cross-sectional units
Time-series length = 12
Dependent variable: Y

             coefficient   std. error    t-ratio     p-value
  ---------------------------------------------------------
  const      -14.3754      250.208       -0.05745    0.9544
  X1           0.358929      0.0259170   13.85       7.77e-018 ***
  X2           4.68667       1.20118      3.902      0.0003    ***

Mean dependent var   6313.229   S.D. dependent var   2517.687
Sum squared resid    16654284   S.E. of regression   601.7056
Log-likelihood      -374.2765   Akaike criterion     754.5530
Schwarz criterion    760.1666   Hannan-Quinn         756.6744

'Within' variance = 286946
'Between' variance = 12552.5
theta used for quasi-demeaning = 0
corr(y,yhat)^2 = 0.944098

Breusch-Pagan test -
  Null hypothesis: Variance of the unit-specific error = 0
  Asymptotic test statistic: Chi-square(1) = 1.71211
  with p-value = 0.190712

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(2) = 17.5124
  with p-value = 0.000157484
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Fig. 3. GLS - estimations of the panel data analysis model with random effects

The obtained model for analyzing panel data with random effects has the form:

$$Y = -14{,}375 + 0{,}359X_1 + 4{,}687X_2 + e \qquad (3)$$

Its regression coefficients are statistically significant.

To choose between random and fixed effects, we test the null hypothesis that there is no correlation between individual effects and regressors X1, X2 (the presence of random effects). To test the null hypothesis, the Hausman test is used. The observed value of the Q_H statistics is determined:

$$Q_H = (\hat{\beta}_{\text{int}} - \hat{\beta}_{FGLS})' \left[\hat{V}(\hat{\beta}_{\text{int}}) - V(\hat{\beta}_{FGLS}) \right]^{-1} (\hat{\beta}_{\text{int}} - \hat{\beta}_{FGLS})$$

where $\hat{\beta}\,\text{int}$ - the intragroup estimate;

$\hat{\beta}_{FGLS}$ - estimation of the available generalized least squares method.

The Q_H-statistic was 17.5124, the p-value (Q_H) = 0.000157484 <0.01. Hence, it is possible to reject the null hypothesis and make a choice in favor of a fixed effects model (2), reflecting the heterogeneity of the net profit of stores in the context of the city districts due to the influence of factors X1 and X2.

4 DISCUSSION

Certainly, it is obvious that mathematical and statistical methods and models should be used to measure the quantitative and qualitative economic interrelationships of gross profit and growth factors on the basis of specific economic data, namely, panel data [11,12]. Their advantages enable to build more flexible and meaningful models and get answers to questions that are not available within the models based on spatial data. Panel data provide the researcher with a large number of observations, increasing the number of degrees of freedom and reducing the dependence between the explanatory variables, and, consequently, the standard errors of the estimates [13]. Another significant advantage of the panel data models is that they make it possible to trace the individual evolution of the characteristics of all sampling objects in the context of the territories. The combined model is the ordinary linear regression model. The combined model is obtained if you collect all the data in one large regression with N*T observations (N - the number of spatial objects (panels), and T - the length of the time series in each panel). The combined model does not consider the panel structure of the data. In the fixed effects model, the effect of heterogeneity is modeled between observing objects with location parameter that is constant with respect to time, but specific for each object of observation. This is exactly a model with dummy variables, it is necessary to identify the territorial differences in the influence of factors. The term “fixed effects” means that the constant in the regression equation may differ between the objects of observation. In the random effects model, the effect of heterogeneity of observing objects is simulated by introducing a mi effect that is invariant in time but is specific for each object of observation, which is assumed to be independent of the regressors. It is obvious that heterogeneuos and various factors of the gross profit of the trading company penetrate into its activities, and, therefore, they have to be necessarily taken into consideration in econometric models. Models of panel data analysis provide a diversity of options to account for heterogeneity.

5 SUMMARY

According to the combined model (1), without taking into account the differences in the influence of factors in the context of districts, the increase in debt to suppliers by 1,000 rubles leads to an increase in gross profit by 0.359 thousand rubles on average; an increase in the number of visitors by 1 thousand people leads to an increase in gross profit by 4, 687 thousand rubles on average. The combined model does not take into account territorial differences, but serves only to reflect the cause-effect relationship. We make a choice in favor of the model of panel data analysis with fixed effects (2). According to this model, an increase in debt to suppliers by 1 thousand rubles leads to an increase in gross profit by 0.307 thousand rubles on average; an increase in the number of visitors by 1 thousand people leads to an increase in gross profit by 2, 239 thousand rubles on average. At the same time, the greatest positive difference in gross profit under the influence of factors X1, X2 from the average gross profit for all stores is observed in the stores of district No. 2 (du_2 = 2353.15), and the smallest in the store of district No. 4 (du_4 = 813,085).

6 CONCLUSIONS

Thus, we have confirmed the hypothesis that there is a cause-and-effect link between the gross profit of retail stores and their location, and the quantitative impact of such factors as indebtedness to suppliers and the number of shop visitors on gross profit is also proved and revealed. Therefore, in future studies it seems necessary to develop a set of special marketing measures to attract buyers in the districts No.3, No.4.

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