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TESTING OF GIBRAT'S LAW BY PANEL DATA ANALYSIS: THE CASE OF TURKEY

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Abstract

Gibrat's Law of Proportionate Effect is one of the matters of debate that continue to be relevant in the finance literature. Gibrat's Law argues that there is no relation between the size of the firms and their growth. In this study, it is aimed to test whether the Gibrat's Law is valid in the firms traded in the Borsa Istanbul (BIST) Basic Metal Industry. For this purpose, quarterly data of 12 firms regularly traded in the BISTfrom 2010 to 2015 are used. The relationships between the variables used in the study are tested by using panel data analysis. According to the findings obtained, Gibrat's Law is supported by some variables and it is also rejected by some variables. In other words, it has been reached to the conclusion that Gibrat's Law is partially valid in the BIST Basic Metal Industry sector.

Keywords:

Gibrat's Law;

Firm Size;

Growth;

Panel Data Analysis.

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1. Introduction

The firms come across rapidly changing economic conditions and therefore increasing competition. For this reason, in order to be able to continue functioning, they take financial decisions. Among these decisions, the growth strategies are very important (Baştürk and Ödül, 2008, 143). One of the first studies conducted on the growth of firms is the piece called "InégalitésÉconomiques" published by Robert Gibrat (1931). With this piece, Gibrat presented a model known as Law of Proportionate Effect. In the study he conducted, Gibrat asserts that the growths of the firms are independent of their size or the sector they are in. With this purpose, firstly, he classified the firms in the sectors they are in systematically. With this classification, he tested the relation between growth and size and he got results that support this law (Sutton, 1997, 40). With the presentation of this law, there have been many studies conducted. In many studies, it is observed that Gibrat's Law is rejected (Mansfield, 1962, Hymer and Pashigian, 1962, Droucopoulos, 1983, Hall, 1987, Wagner, 1992, Konings and Faggio, 2003, Cefis et al., 2004, Harris and Trainor, 2005, Vlachvei and Notta, 2008, Falk, 2008, Aslan, 2008, İskenderoğlu et al., 2008, Mukhopadhyay and Amirkhalkhali, 2010, Tunaer, 2010, Relander, 2011). None the less, in few studies, the validity of Gibrat's Law is accepted (Lotti et al., 1999, Stella et al., 2014).

In order to test the validity of Gibrat's Law in the study, the quarterly data of 12 firms traded in the BIST Basic Metal Industry from 2010 to 2015 are used. As it has become more and more important and it has shown growth since the construction sector has been growing in the framework of urban transformation, the Basic Metal Industry forms the sampling of the study. In the study, the values of total assets, real assets, equities, and sales have been used. The data are obtained from the balance sheets and income statements in Public Disclosure Platform (https://www.kap.org.tr/).

Some of the studies conducted in order to test the validity of the Gibrat's Law in the finance literature are tried to be summarized in Table 1.

Table 1.Studies Conducted to Test the Validity of Gibrat's Law

Author(s)	Year	Data and Series	Results
Mansfield	1962	U.S. manufacturing industry firms between 1916 and 1957.	Gibrat's Law is rejected
Hymer and Pashigian	1962	1000 largest U.S. manufacturing industry firms between 1946 and 1955.	Gibrat's Law is rejected
Droucopoulos	1983	The world's largest industrial firms are gathered as time periods1(1957-1977), time periods2(1967-1972), time periods3 (1972-1977)and time periods4(1967-1977).	Gibrat's Law is rejected
Hall	1987	U.S. manufacturing industries firms between 1972 and 1983.	Gibrat's Law is rejected
Wagner	1992	German manufacturing industry firms between 1978 and 1989.	Gibrat's Law is rejected
Wing and Yiu	1996	Shanghai manufacturing industry firms between 1989 and 1992.	Gibrat's Law is partial accepted
Lotti et al.	1999	Data set from the Italian National Institute for Social Security, new small firms, 1987-1993 mounthly period.	Gibrat's Law is accepted
Piergiovanni et al.	2002	Data set from the Italian National Institute for Social Security, new-born firms in five services business groups, 1989-1994 period.	Some business group reject the Gibrat's Law and some business group confirm the Gibrat's Law
Konings and Faggio	2003	Data for 834 firms in Poland, 233 firms in Estonia, 511 firms in Slovenia and 1548 firms in Bulgaria over the period 1993-1997 and data for 3776 firms in Romania between 1994 and 1997.	Gibrat's Law is rejected
Cefis et al.	2004	210 firms from a Pharmaceutical Industry database on the sample 1987-1998 period.	Gibrat's Law is rejected
Audretsch et al.	2004	1170 firm in the services industry firms between 1987 and 1991.	For the sample of large firms Gibrat's Law is accepted
Harris and Trainor	2005	U.K. manufacturing industryfirms between 1973 and 1998.	Gibrat's Law is rejected
Vlachvei and Notta	2008	178 Greek manufacturing and trading firms between 1995 and 2000.	Gibrat's Law is rejected
Falk	2008	European firms between 2000 and 2004.	Gibrat's Law is rejected
Aslan	2008	103 firms of the 500 largest firms in Turkey	Gibrat's Law is rejected

		between 1985 and 2004.	
Baştürk and Ödül	2008	30 manufacturing industry firms traded in the ISE between1993 and 2004.	Gibrat's Law is partial accepted
İskenderoğlu et al.	2008	Data from the largest 1000 firms determined by Istanbul Chamber of Industry between 1997 and 2006.	Gibrat's Law is rejected
Mukhopadhyay and Amirkhalkhali	2010	Fortune 500 largest industrial firms, 2000-2007 period.	Gibrat's Law is rejected
Tunaer	2010	Data from Turkish banking sector between 1988 and 2008.	Gibrat's Law is rejected
Akbulut	2012	Data for 152 firms traded in the ISE for 2007-2010.	For some variable Gibrat's Law is rejected but for some variable noting definite can be said
Stella et al.	2014	Ugandan manufacturing firms for the period 2001 to 2002.	Gibrat's Law is accepted
Dehghani et al.	2015	Iranian electronics industry firms between 1995 and 2011.	Gibrat's Law is rejected
Fiala and Hedija	2015	Czech Republic firms, 2007–2012period.	Gibrat's Law is rejected
Karadeniz et al.	2015	8 tourism firms traded in the ISE for 2002-2011.	Gibrat's Law is rejected
Hedija	2017	20073 Czech firms in the period 2008-2013.	Gibrat's Law is rejected

Resource: This table is prepared by means of above-mentioned resources.

In most of the studies conducted both nationally and internationally in order to test the validity the Gibrat's Law of Proportionate Effects with data, mostly from the industry sector, the Gibrat's Law is rejected. In other words, it has been set forth that there is a statistically significant relationship between growth and size.

2. Data and Methodology

In the study, 288 observations from quarterly data belonging to the period of 2010Q1 and 2015Q4 of 12 firms from the Basic Metal Industry the stocks of which are traded in the BIST constitute our samplings. With the data obtained from the quarter period balance sheets and

income statements of the companies shown in Table 2, the regression analysis is conducted in accordance with the panel data analysis.

Table 2. BIST Basic Metal Industry Sector Companies in the Analysis

Code	**Company Name**	**Code**	**Company Name**
BRSAN	Borusan Mannesmann	DMSAS	Demisas Casting
BURCE	Burçelik Machinery Factory	ERBOS	ErbosanErciyas Tube Industry
BURVA	Burçelik Valve	EREGL	Eregli Iron and Steel
COMDO	Componenta Casting	IZMDC	Izmir Iron and Steel
CELHA	Çelik Wire Rope	KRDMA, KRDMB, KRDMD	Kardemir Iron Steel Industry
CEMTS	Çemtaş Steel Machinery	SARKY	Sarkuysan Electrolytic Copper

When the studies conducted in the literature are considered, the variables used are seen as total assets, the number of employees, sales and equities. On the other hand, in our study, total assets (TA) is used as the dependent variable while real assets (RA), equities (EQ) and sales (S) are used as independent variables.

The regression model used in the study can be shown as;

$$\mathbf{TA_{it} = \beta_0 + \beta_1 RA_{1it} + \beta_2 EQ_{it} + \beta_3 S_{it} + \varepsilon_{it}}$$

The hypotheses created in order to test the validity of the Gibrat's Law are as below;

H_0: Gibrat's Law of Proportionate Effect is valid.

H_1: Gibrat's Law of Proportionate Effect is not valid.

3. Analysis and Empirical Results

The descriptive statistics belonging to the variables used in the panel regression model conducted in order to test whether the Gibrat's Law is valid in the firms from the Basic Metal Industry traded in BIST are summarized in Table 3.

Table 3.Descriptive Statistics

	TA	RA	EQ	S
Mean	19.70196	18.6185	18.92126	19.07392
Maximum	23.73616	23.08799	23.29378	23.20103
Minimum	15.82458	13.43941	14.20209	6.516193
Std. Dev.	1.957804	2.26915	2.024664	2.269706
Skewness	0.7788	0.5941	0.2856	0.000
Kurtosis	0.0591	0.2748	0.9815	0.000
N	288	288	288	288

When the data of skewness and kurtosis data are checked in order to determine if the series is distributed normally, it is seen that the values are within the acceptable limits. About the acceptable limits of aforementioned values, it is suggested that the skewness values must be between +1 and -1, the kurtosis value must be between +2 and -1 and also that the aforementioned values must be between +1 and -1 (Seçer, 2015, 25).

Table 4.Unit Root Test Analysis Results

TA	RA	EQ	S
-4.1752	-2.919	-4.7313	-9.687
0.0000	0.0018	0.0000	0.0000

In Table 4, the Levin, Lin and Chu unit root test results are shown. When the table is analyzed, the null hypothesis that suggests that for all variables, there is unit root in the series in the significance level of is 1% according to the applied unit root test results, is rejected. Namely, it is seen that the level values of all the variables are stable (Aydın, 2016, 119).

There are some tests developed to decide which one to use among fixed effects and random effects models. Among these tests, the important ones are Random Effects Test (Lagrange Multiplier Test), Likelihood Ratio and Hausman Test (YerdelenTatoğlu, 2005, 47).

Table 5. F Test Results

F Test	F(11, 261) = 1.42
Prob> F = 0.1656	

There are three approaches to the estimation of panel data model as pooled (classical model) regression, fixed effects and random effects. It is decided which one between pooled and fixed effects regression models will be used with F test (Yıldız et al., 2014, 198). In order to decide which one is the suitable model between the pooled model and fixed effects model, Chow (F test) is realized (Kaya and Canlı, 2013, 51). According to the results of the analysis conducted and shown in Table 5, the H0 hypothesis is rejected as Prob> F value is bigger than 0.05. In other words, the fixed effects model was not relevant and the pooled model was valid.

Table 6. Breusch and Pagan LagrangianMultipler Test for Random Effects Model

chi2(1) = 0.00
Prob> chi2 = 1.000

After the F test, also known as Chow Test, is conducted, the Breusch-Pagan test is conducted. This test is used in order to test the entity of individual heterogeneousness against the Random Effects Model. This way, it is found out whether the analysis is suitable for the least squares model (YedelenTatoğlu, 2016, 178). As it can be seen in the results of Table 6, as Prob> chi2 value is bigger than 0.05, the classical model is valid. According to the both analysis results, the pooled regression method is seen suitable without the need of Hausman test.

Table 7. Breusch-Pagan / Cook-Weisberg Test for Heteroscedasticity

chi2(1) = 0.17
Prob> chi2 = 0.6841

With the tests conducted, the model is determined and it is tested to see if there is heteroscedasticity which comes up as a statistic problem in the model and autocorrelation. The test results of Breusch-Pagan/Cook-Weisberg Test conducted to determine if there is a heteroscedasticity are shown in Table 7. When the test results are analyzed, as Prob> chi2 = 0.6841 value is bigger than 0.05, the H1 hypothesis is rejected, in other words, it is seen that there is no heteroscedasticity problem.

Table 8. Wooldridge Test for Autocorrelation

F	0.703
Probvalue	0.4197

For the autocorrelation problem encountered in terms of statistics, the Wooldridge test is conducted. As can be seen in Table 8, it has been determined that the Prob value is bigger than 0.05 which means there is no autocorrelation problem. In other words, this shows the rejection of the H1 hypothesis that suggests Wooldridge autocorrelation test is autocorrelation on the first order (Berke, 2009, 42).

Table 9. Model's Estimation Results

TA	**Coef.**	**Robust Std. Err.**	**T**	**P>|t|**
RA	0.1845057	0.032031	5.76	0.000*
EQ	0.2443954	0.027281	8.96	0.000*
S	0.0014985	0.001452	1.03	0.324
Cons.	-0.0082099	0.025608	-0.32	0.755

F(3, 11) = 118.37

Prob> F = 0.0000

R-squared = 0.4342

Root MSE = 0.06222

Note: * indicates significance at 1% level.

The regression results of the model are shown in Table 9. As the probability value (p=0.000) is less than 0.01 in the confidence interval of 99% of real assets variable, it is seen that there is a statistically significant relationship between real assets variable and total assets. This means one unit increase in real assets provides 0.185 unit positive contribution to the growth. As the

equities variable's probability (p=0.000) is smaller than 0.01, it is seen that it is statistically significant inside the created model. In another saying, one unit increase taking place in the equities variable increases the growth by 0.244 unit. On the other hand, it is seen that the probability value obtained for the sales variable (p=0,324) is not statistically significant inside the model.

4. Conclusion

In the framework of the study, when the quarterly data of 12 firms traded in the BIST Basic Metal Industry from 2010 to 2015, it is seen that some variables are statistically significant while some variables are not significant in explaining the model. According to the findings obtained, while the standpoint that suggests there is a relation between the size and the growth is partially rejected, it is also partially accepted. Hence, while H0 hypothesis cannot be rejected completely, The H1 also cannot be accepted fully. This result resembles some studies conducted by Akbulut (2012), Audretsch et al. (2004) and Piergiovanni et al. (2002). It is also seen there have been similar results obtained in the studies that analyzed the validity of Gibrat's Law in manufacturing industry sector.

In the studies that will be conducted after this, the analysis of firms operating in different sectors will be instructive for the researchers and investors in asserting for which kind of capital structure in firms the Gibrat's Law is valid.

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