TESTING GIBRAT'S LAW ON CROATIAN FREIGHT TRANSPORT AND LOGISTICS FIRMS

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Abstract

Gibrat's law states that growth rate of the firm is independent of firm's size. This paper tests Gibrat's law on the panel data of Croatian freight transport and logistics firms during the period from 2006 to 2015. The data from Bureau van Dijk's Amadeus database is used to test the Law. The sample includes 565 firms. The aim of the paper is to analyze whether the growth of the freight transport and logistics firms in Croatia depends of its size. The number of employees and sales of the firm are used as independent variables, while yearly sales growth is taken as the depended variable. In analysis is also included the age of the firm in order to control for variable other than the size that affect the growth rate of the firm. Using econometric model (fixed effects estimator) we find that there is statistically significant proportional connection between size of the firms and their respective growth rates, moreover the results shows the growth in number of employees has a positive impact on the growth rate while the growth in sales and age of the firm have negative impact on the growth rate. It means larger and older firms have slower growth rate. That is why the Gibrat's law is rejected in case of Croatian freight transport and logistics firms.

Key words: Gibrat's law, freight transport & logistics, panel data, fixed effects

1. INTRODUCTION

Logistics is one of the tools that play a key role in the change and improvement of the economy. Logistics and transport industry provides significant macroeconomic contributions to national economy by creating employment, and creating national income and foreign investment inflow. On the microeconomic level, logistics industry is a key industry in increasing the competitive power of firms. Moreover, the logistics and transport industry has an important mission in revitalizing and improvement of the competitiveness of other industries. Today, all industries are dependent on logistics sector (Sezer & Abasis, 2017). Considering the significant role of the

logistics and transportation firms in generating employment and innovations with which they contribute to their local economies, firm growth rates represent an important field of interest for researchers and growth support policy makers. One of the significant contribution to the firm growth theory was the one introduced by Robert Gibrat (1931) known as the Law of Proportionate Effects or commonly used Gibrat's law (hereinafter: the Law) where he states that the growth rate of a given firm is independent of its size at the beginning of the examined period.

Many authors who are introduced in the Section 2 have tested the Law on diverse industries, in different countries using different models and the results were similar when it comes to the industry. The focus was mostly dedicated to the manufacturing industry while later papers included service sector in their analysis. The differences between distribution of firms' sizes between manufacturing and service industry vary as well as the different structure of ownership relationship within firms in 1930s when compared to 21th century (Host & Zaninović, 2017).

There is evident a considerable number of studies showing the relationship between size and growth of firms in the developed nations i.e. Italy, UK., US, Spain etc. However, the researchers have come across only a few studies that had analysed the growth pattern of firms in developing countries (Aggarwal & Chander, 2008). The Law brings interesting connotations for determining the intensity of industry concentration and the significance attributed to testing its validity is quite understandable (Vuković et al, 2014).

The aim of this paper is to analyse whether the results of testing the Law on Croatian freight transport and logistics firms show the independents of the growth and firm size. The analysis was based on the panel data of 565 Croatian freight transport and logistics firms during the period from 2006 to 2015. It is important to emphasize that the time span of 10 years includes also the period before and after the EU accession which for sure had its impact on examined industry considering the dictated macroeconomic policies of the largest countries and integration by itself.

The paper is divided into the 6 sections. After the Introduction, section 2 gives the review of the relevant literature covering the Gibrat's law. The methodology of the research is explained in section 3. Section 4 presents the description of the data and descriptive statistics while the results and discussion are contained in section 5. Finally, section 6 concludes and gives suggestion for the potential further development of the analysis.

2. LITERATURE REVIEW

A common interpretation of the Gibrat's law presented in numerous paper is that a firm's growth rate and its size are independent of each other. In other words, the Law states that small firms grow at the same rate as large firms. As mentioned above in the introduction, the considerable literature has rejected the Law, but various papers have found that the Law is valid for certain subsamples or time periods. Hence, the question is not whether Gibrat's law is valid, but rather when and in which industry it is valid. The main research question of this paper is whether the Law is valid for the Croatian freight transport and logistics firms. Robert Gibrat stated that "the

distribution of firm's size which can be measured by sales and number of employees of firms, could be well approximated with a lognormal distribution, and the reason could be the nature of the firm's growth process, that is multiplicative and independent of the size" (Gonzalez-Val, Lanaspa & Sanz, 2010).

Earlier studies based on small subsamples of well-established and large firms tended to confirm the Law, because of the market structure which was mainly controlled by a smaller number of firms. This means that the earlier studies were showing faster growth of large firms than smaller ones (Teurel & Carrioza, 2008). The Law continued to receive more attention in the theoretical and empirical literature during 1960s and 1970s, but Sutton (1997) made a great contribution in understanding the Law clearer when stated that it is important to distinguish between absolute and relative growth of the firm and therefore the Law states only that the relative growth is independent of the firm's size. Furthermore, in his work Gibrat's Legacy he stated that the reason for incompatible results lies in the systematic differences in the sample selection, for example in the case of manufacturing sector, the findings mostly show that the Law in not valid whilst it is valid in the case of the service sector (Nassar, Almsafirb & Al-Mahrouqc, 2014). Another important fact is that the papers were mainly focused on testing the particular industry, while ignoring the attributes of a given country or region. What is specific for Croatia freight and logistics firms is that firms which are operating in Croatia mostly have their own logistic networks for their needs therefore integrated logistic service specialist suppliers are not numerous. It is still a young and growing field of business in Croatia.

After more than 70 years of Gibrat's seminal book, Bottazi et al. (2009) returned to the study of the French manufacturing sector. They examinated which properties of firm size distributions and growth dynamics characterize the aggregate dynamics and if they are, at the same time, robust under disaggregation, hence they analysed the size distribution, Gibrat's law, the growth rates distribution, and growth rate autocorrelation at both aggregate and disaggregate levels. The results rejected the Law, by showing that the growth process is independent of firm's size.

Audretch et al. (2004) examined whether Gibrat's law can be rejected for the services as it was for the manufacturing industry. His research was based on a large sample of Dutch firms from service industry. His findings showed that for the Dutch services industry, Gibrat's law was generally valid. Almus & Nerlinger (2000) tested the Law on the sample of West German manufacturing firms where they subdivided them into young firms which are technologically intensive and non-technologically intensive as well as in distinct size classes. The results showed the Law was rejected for both, technologically intensive and non-technologically intensive in all periods examined but there was no significant difference between both firm groups. This confirmed the thesis that smaller firms have larger growth potential than larger ones.

Goddard et al. (2002) and Oliveira & Fortunato (2003, 2006) used panel data analysis to test if Gibrat's law holds for Japanese and Portuguese manufacturing firms and the results were not supportive, hence the Law was rejected. In the case of Turkish companies, the results were two-fold, Gibrat's law did not hold in the case of cement, plastic and pipe, textile, medicine and chemical, steel iron, automobile and other industries because results showed that firm size and firm growth were not independent of each other. In the case of food, electrical machinery, electronics and transportation

firms the Law was valid as the relationship between firm size and firm growth was independent. It important to emphasize that by using different approach, considering cross sectional correlation, the results were quite opposite because the Law was rejected in all industries except ceramics and electronics (Aslan, 2008). Calvo (2006) analysed whether small, young, and innovating firms have experienced a greater employment growth than other Spanish firms over the period from 1990 to 2000. The study was based on a sample of 1272 manufacturing firms in which only 967 of the firms survived for the entire ten-year period. In the case of Spanish young and innovative firms, the Law failed to hold since the results showed that old firms grow less than young ones, and innovating activity (both process and product) is a strong positive factor in the firm's survival and its employment growth. Moreover, it is possible that firm, as it grows, loses flexibility and organizational efficiency which can lead to the more difficult growth for large firms than to the small ones (Kwangmin & Jinhoo, 2010).

A significant number of empirical papers spanning an extensive range of countries, and including both small and as well large firms, resulted in a peculiar result; growth rates (of surviving firms) tend to systematically decrease with increasing firm size. The transport and logistics market in Croatia is quite young and in the process of growing. As far as we know, this is this first time that an analysis of the Law is tested on specifically freight transport and logistics firms. The conclusion of the analysis is that a considerable number of researches showed that small firms indeed grow faster than large firms. This is supported both by both theoretical and empirical evidence.

3. DATA AND DESCRIPTIVE STATISTICS

In paper is used panel data available from Bureau van Dijk's Amadeus. The sample consists of 565 firms involved in the freight transport and logistics industry (Division 52 according to Nace Rev. 2) during 2006 to 2015 period. More specifically, division 52 consists of two groups and six classes and includes warehousing and support activities for transportation, such as operating of transport infrastructure, the activities of transport agencies and cargo handling. Group 52.1 includes operation of storage and warehouse facilities for all kind of goods while group 52.2 includes support activities for transportation (land, water and air transportation). Last class (52.29) of the group 52.2 is very broad and includes: forwarding of freight, arranging or organizing of transport operations by rail, road, sea or air, organization of group and individual consignments (including pickup and delivery of goods and grouping of consignments), issue and procurement of transport documents and waybills, activities of customs agents, activities of sea-freight forwarders and air-cargo agents, brokerage for ship and aircraft space, goods-handling operations, e.g. temporary crating for the sole purpose of protecting the goods during transit, uncarting, sampling, weighing of goods (NACE, 2008, p. 241).

In order to test the Law, three variables were used; sales, measured in thousands of euros, number of employees and age of the firm. Original sample consisted of 735 firms, but we eliminated all observations that had at least one missing value for any

of the three aforementioned variables during observed period (roughly 23% of the firms). As a robust check, it is tested the model that will be explained in the next section on the original sample and the results were not significantly different.

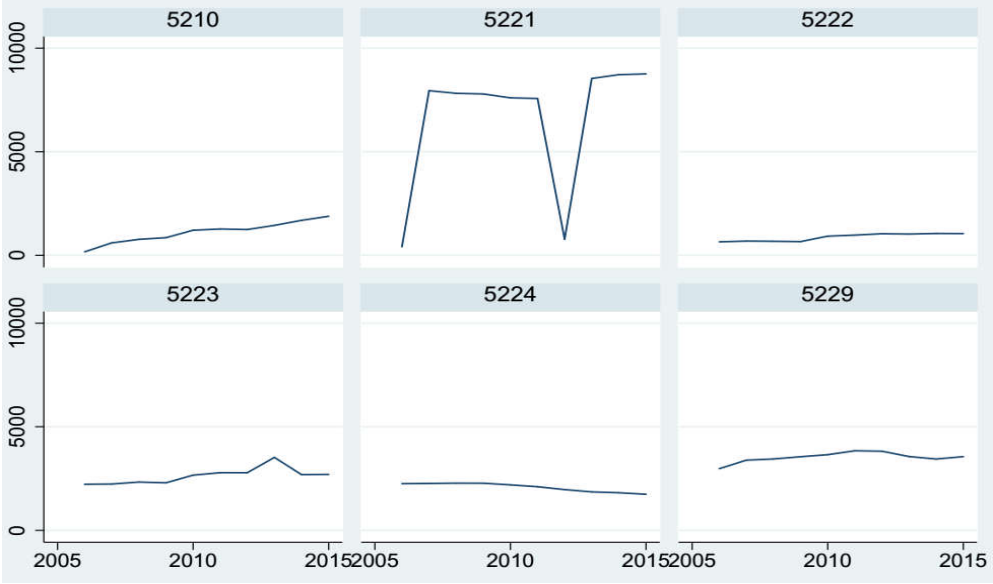
Figure 1. Aggregate sales across industry classes

Source: Authors' calculations

Figure 1 presents aggregate sales across industry classes, where can be seen positive trend of sales in division 5210 and 5223 e.g. air transport, which is quite obvious considering the trend in the world where air transport mark positive trend. Moreover, according to the International Air Transport Association (IATA, 2017) the global air freight markets are showing that the demand, measured in freight ton kilometers (FTKs) grew by 3.8% in 2016 compared to 2015. Furthermore, the industry's average growth rate was 2.0% over the last five years. The trend regarding other two variables, 5222 and 5224 is relatively stagnant throughout the period, while the trend in 5221 shows significant decrease in the period after 2010, when the economic crises in Croatia was at its peak.

Unlike the trend in aggregate sales, Figure 2, number of employees shows the stagnant trend in 4 out of 6 observed industries. The only industry where is evident oscillating trend is land transport, where, as in the previous figure can be seen significant drop in the period during 2011 and 2012.

Figure 2. Aggregate number of employees across industry classes



Source: Authors' calculations

Table 1 contains descriptive statistics for division 52 in general, as well as for each of the particular classes within division. It can be noted that group 5229, other supporting industries makes the most important share in the division 52 while air transport makes the smallest share in division. The most employed persons are in air transport industry while other supporting industries have the smallest number of employees. When considering the average amount of sales, air transport with more than 12 million euros on average has the dominant position, while the land transport with 500 000 euros on average, the last position in observed sample. The highest standard deviation can be noted in land transport sales, as well as the coefficient of variation, while the lowest standard deviation is present in water transport sales, but coefficient of variation shows that standard deviation is 3 times higher than average.

Table 1. Descriptive statistics of the three main variables across industry classes

Division /Class	No. of firms	Variables	Obs.	Mean	Std. Dev.	Min	Max
52	565	employment	3,447	48.75	335.5	1	7455
		sales	3,447	2530	11593	0.0185	201598
		age	3,447	13.65	10.73	0	70
5210 – warehousing & storage	48	employment	231	48.24	149.0	1	919
		sales	231	4689	12936	0.980	100887
		age	231	13.32	8.414	0	32
5221 – land transport	86	employment	459	143.7	871.2	1	7455
		sales	459	500	25177	0.0185	201598
		age	459	14.31	10.07	0	69
5222 – water transport	57	employment	352	24.87	49.72	1	278
		sales	352	1748	4413	0.226	28397
		age	352	16.21	13.44	0	70
5223 – air		employment	119	220.3	276.5	1	878

transport	19	sales	119	12040	24528	6.409	147344
		age	119	15.94	12.14	0	53
5224 – cargo handling	19	employment	121	171.4	258.1	1	983
		sales	121	4556	6779	2.927	26689
		age	121	27.92	24.41	0	70
5229 – other supporting industries	336	employment	2,165	16.27	49.42	1	609
		sales	2,165	1267	3854	0.136	47060
		age	2,165	12.20	8.309	0	69

Source: Authors' calculations

4. METODOLOGHY

The most simplest way to test the Law is the one that includes regression with two variables, dependent (y_{it}), that is the growth of the firm, usually proxied by the change in sales between years, in time period *t* and independent variable ($x_{i,t-1}$), that is, the size of the firm in time period *t-1* (proxied by the level of sales). Practically, this means estimating the following equation:

$$lny_{it} = \beta_0 + \beta_1 \ln x_{i,t-1} + \varepsilon_{it} \qquad [1]$$

We emphasize that we did logarithmic transformation of the variables in order to be able to interpret the β_1 as the elasticity, although this is not technically required. If β_1 is around 0, then the Law holds, while if β_1 is significantly different than 0, the Law doesn't hold. We used [1] as the backbone of our econometric model, although we expanded it with two variables that affect the growth of the firm, namely number of employees (other proxy for the size of the firm) and the age of the firm, that can be proxy for competitiveness of the firm.

If we were to use approach model in aforementioned process of econometric modelling, the basic econometric model could be the following:

$$growth_{it} = \beta_0 + \beta_1 sales_{it} + \beta_2 empl_{it} + \beta_3 age_{it} + a_i + \lambda_t + u_{it} \qquad [2]$$

Equation 2 presents our econometric model. Growth of the firm is calculated as the difference in the log of sales between *t* and *t-1* period. Sales and employment are log-transformed while the age is in absolute terms. Individual effect is denoted with a_i, aggregate time (yearly) effects are denoted with λ_t, while u_{it} is a stochastic error term.

In order to estimate it, we first employed both fixed effects (FE) estimator and random effects (RE) estimator, although even before using them, we suspected that FE will be more suited to our data, since it is plausible to assume that idiosyncratic component (a_i) will be correlated with the regressors. Hausman test (results of the test are contained in Table 2) confirmed that RE is not consistent and that we should stick with the FE.

Table 2. Results of the Hausman test

	(b)	(B)	(b-B)
	FE	RE	Difference
L1. lnsales	-0.552	-0.317	-0.235
L1. lnempl	0.0416	0.243	-0.201
L1.age	-0.0201	0.00335	-0.0235
year			
2008	-0.0298	-0.0509	0.0211
2009	-0.116	-0.174	0.0580
2010	-0.108	-0.154	0.0454
2011	-0.0424	-0.0916	0.0492
2012	-0.0711	-0.182	0.111
2013	-0.0720	-0.200	0.128
2014	-0.0515	-0.212	0.161
chi2(10)	474.2		
Prob>chi2	0		

Source: Authors' calculations

5. RESULTS AND DISCUSSION

Results of the estimation of Equation 2, shown in Table 3, clearly indicate that the Law doesn't hold for the division 52 as well as for each of the particular classes within division. Moreover, results indicate that smaller firms grow faster (this is noticeable from the sign of the coefficient lagged log of sales, which is negative). If the size of the firm grows by 1%, the growth of the firm will be lower by 0. 5% on average. Regarding the variable number of employees, the coefficient is only significant for the support activities in the air transportation, higher the number of employees (by 1%), higher the growth of the firm (by 0.2%). Coefficient for the age of the firm is mildly negative and significant for the division 52. This indicates that performance gets worse with age due to organizational rigidities that are possibly developed throughout the years etc.

Generally, we can see that the explicative power of the model (R-squared) is quite high, given the sample limitations and relatively low number of variables that are included in the model, it varies from 30 to 46%.

Table 3. Results of the estimation of Equation 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	52	5210	5221	5222	5223	5224	5229
VARIABLES	growth	growth	growth	growth	growth	growth	growth
L.lnsales	-0.552***	-0.671***	-0.462***	-0.563***	-0.543***	-0.505**	-0.574***
	(0.0462)	(0.185)	(0.0555)	(0.130)	(0.106)	(0.203)	(0.0637)
L.lnempl	0.0416	0.0323	0.0557	0.228*	0.00437	0.124	0.0441
	(0.0340)	(0.0736)	(0.156)	(0.115)	(0.0305)	(0.149)	(0.0421)
L.age	-0.0201***	0.000480	-0.0385	-0.0442**	0.0296	-0.0128	-0.0169*

	(0.00754)	(0.0153)	(0.0239)	(0.0183)	(0.0215)	(0.0217)	(0.00987)
2008.year	-0.0298	-0.0166	-0.121	0.0800	0.176	-0.0665	-0.0411
	(0.0473)	(0.156)	(0.187)	(0.0715)	(0.140)	(0.0729)	(0.0602)
2009.year	-0.116***	0.00942	0.162	-0.162	0.0823	-0.247*	-0.156***
	(0.0432)	(0.117)	(0.195)	(0.0973)	(0.148)	(0.118)	(0.0556)
2010.year	-0.108***	0.0555	-0.0393	-0.0802	-0.152	-0.246	-0.127**
	(0.0400)	(0.120)	(0.101)	(0.123)	(0.154)	(0.145)	(0.0558)
2011.year	-0.0424	-0.0236	0.176	-0.0380	0.187	-0.224*	-0.0849
	(0.0415)	(0.127)	(0.115)	(0.0965)	(0.140)	(0.126)	(0.0575)
2012.year	-0.0711**	-0.0946	0.0654	-0.134	-0.0387	-0.301**	-0.0753*
	(0.0330)	(0.149)	(0.0904)	(0.108)	(0.144)	(0.136)	(0.0442)
2013.year	-0.0720**	0.0666	-0.0689	-0.0822	-0.00135	-0.233*	-0.0822
	(0.0363)	(0.105)	(0.0975)	(0.0695)	(0.107)	(0.129)	(0.0512)
2014.year	-0.0515	0.0636	-0.138	-0.00692	-0.0935	-0.178	-0.0433
	(0.0403)	(0.110)	(0.124)	(0.0769)	(0.176)	(0.232)	(0.0553)
2015.year	-	-	-	-	-	-	-
Constant	3.405***	4.122***	3.135***	3.591***	3.757***	3.777**	3.308***
	(0.275)	(1.248)	(0.439)	(0.674)	(1.035)	(1.714)	(0.360)
Observations	2,830	178	365	288	99	102	1,798
R-squared	0.330	0.383	0.306	0.466	0.441	0.342	0.335
Number of id	513	43	74	54	19	16	307

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations

6. CONCLUSION

Since Gibrats's original formulation, the Law has been intensively tested. In the earlier researches, it was mainly focused on manufacturing industry and later on, on service industry. The results of testing vary across different countries, subsamples and market structures. In this paper is used panel data analysis to test the validity of the Law focused specifically on the Croatian freight transport and logistics firms. The aim was to analyse whether the holds in case of Croatian freight transport and logistics firms, namely if the growth is independent of the firm's size. The analysis was based on the panel data of 565 Croatian freight transport and logistics firms (division 52, Nace Rev. 2) during the period from 2006 to 2015. To test the Law, three variables were used; sales, measured in thousands of euros, number of employees and age of the firm. The results of the estimation showed that the Law doesn't hold in the case of Croatian freight transport and logistics firms, namely for division 52 as well as for each of the particular classes within division. Furthermore, results indicate that in our case smaller firms grow faster than larger ones. The analysis showed the same results in most of the empirical works dedicated to service sector. Hence Gibrat's law was rejected for Croatian freight transport and logistics industry as the growth rates have been found to be associated with firm size. As for the future research, there should contain more variables that best describe the structural relations between classes within the group.

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