

DO SMALLER FIRMS GROW FASTER THAN LARGE ENTERPRISES? THE CASE OF CZECH TRANSPORTATION AND STORAGE INDUSTRY

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Resume

The study is focused on the relationship between firm growth and firm size. The aim of this study is to examine the growth-size relationship and test Gibrat's law validity in the Czech transportation and storage industry. To examine the relationship between firm size and firm growth, the linear auto-regression model is applied. The sales and sum of total assets are used as indicators of the firm size. The final sample contains data for more than 6,000 Czech firms in the period 2008-2017. The results have shown that Gibrat's law is not valid in the Czech transportation and storage industry. Smaller firms tend to grow faster than larger ones. Due to the limited scope of data, we were only able to verify the validity of Gibrat's law. The data used do not allow to examine the factors influencing the faster growth of small companies compared to large companies. It will be the subject of further research.

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1 Introduction

Transportation is a strategic sector of the European Union economy that influences the everyday lives of all the citizens of the European Union members. Transportation services provide significant macroeconomic contributions to national economies by, e.g. creating employment or national income. In the European Union, transportation creates around 11 million jobs [1-2]. Logistics and transportation sectors are the crucial industries for increasing the competitiveness of other sectors. At this time, all industries are dependent on logistics sectors [1, 3]. Many scholars are focused on the connection between transport and sustainability, for instance [4-7] and particularly sustainable transport, for example, [8-11]. If one wants to focus more and more on sustainable transport in the future, one also needs to know, as much as possible, about transport companies. One of the essential aspects is to understand companies' behaviour in terms of their growth and size.

One of the often mentioned advantages of the SMEs in the literature is their greater flexibility compared to large enterprises (e. g. [12-14]). This flexibility can contribute to firm growth [15]. On the other hand, large companies can benefit from economies of scales, which can create their competitive advantage over the small businesses [16].

An alternative view of the matter is provided

by the Gibrat's law. Gibrat[17] examined French manufacturing companies and revealed that company growth is a random effect independent of firm size. This idea is known as Gibrat's law or the law of proportionate effect. According to this law, firm growth is a random effect independent of the firm size. In other words, the probability of proportionate change in size is the same for all the firms in a given industry and is independent of the initial firm size [18-19]. Many researchers have followed Gibrat's work and are devoted to empirical testing the link between the firm growth and size. However, very few of them investigated the transportation and storage industry.

Are the smaller transport companies more flexible and do they grow faster compared to large transport companies? Or do large firms benefit from economies of scale and grow faster than small firms in the storage and transportation industry? Or does the Gibrat's law apply in this industry and the growth of companies is independent of their size?

The Czech Republic is one of the fastest growing economies among the Central and Eastern European countries and its location close to the major European Union economies, such as Germany, allows the Czech SMEs to integrate into regional European Union supply chains. In order to integrate into these regional supply chains, e.g. in the production of parts and components of some devices, cars or machines, well-developed and



efficient transport routes, transport networks, storage capacities and a general logistics system are required. Therefore, it is important to study this issue.

This paper aims to investigate the growth-size relationship and to test the Gibrat's law validity in the Czech transportation and storage industry. Knowledge of the situation in the industry and the advantages or disadvantages of the chosen size of the company carries important information for many users, shareholders and stakeholders. Knowledge of this information is essential for owners and top management of the companies in terms of strategic management, ensuring the sustainability of the company and planning its further development. They are also important for new competitors in terms of choosing the appropriate form and size of the company. Last but not the least, they are also useful for economic policy-makers in support of the small and medium-sized enterprises, which may be disadvantaged in some sectors where the company size and the benefits associated with it can create barriers to competition.

This paper is organized as follows: Section 1 deals with an introduction to the topic, an integral part of which is the aim and expected contribution of the paper. Section 2 contains a brief literature review. Section 3 describes the applied data and methodology and section 4 shows the empirical results, discusses the achieved results and compares these with the findings of previous studies. The last section, titled Conclusions and Limitations, focuses on the concise recapitulation of the main findings and provides limitations and suggestions for future research.

2 Literature review

The issue of influence of the company size on its growth and performance is given the great attention in the economic literature. The findings of previous studies, which dealt with the growth-size relationship and testing of the Gibrat's law, are not uniform.

The validity of the Gibrat's law was confirmed in the studies [20-27].

Some researchers' results on the size-growth link are mixed. No statistically significant relationship is, for instance, found only for a part of a sample; studies [28-31] should be mentioned.

A lot of papers rejected the validity of Gibrat's Law as well, e.g. [32-44].

The conclusions of these studies show that the relationship between the size and growth is not uniform but depends on many factors. One of them is the industry for which the relationship was tested. This fact is confirmed by [45]. Using the large sample of Swedish firms, they examined the size-growth relationship on an aggregate and sectoral level. They rejected the validity of the Gibrat's law on the aggregate level and concluded that the small firms grow faster

than larger counterparts. On the other hand, the results were mixed on the sectoral level. They showed that Gibrat's law is rather valid in mature industries with a high market concentration and a large share of group ownership.

However, one can conclude that most of the recent studies reject the validity of the Gibrat's law and confirm the tendency of a small firm to grow faster than the larger ones, e.g. [39-41, 43] and for the Czech Republic [46]. According to the economic theory, the various theoretical reasons for rejecting the validity of the Gibrat's law can be identified.

Attitude to innovation and flexibility could be the argument for the validity of the inverse relationship between firm size and growth. The smaller firms, which are usually also younger, could be more active and effective in the innovation process [40]. They are also more flexible and less risk-averse as compared to the larger firms [47]. These factors could be the driving force behind their higher growth. The passive and active learning models offer the other explanation of the different growth rate of small and large firms. According to these models, young firms accelerate their growth compared to larger and more experienced counterparts to achieve an efficient production scale [19].

Very few studies were focused on the transportation and storage industry. Authors found only a few studies: [1, 28, 48-50]. While papers [1, 48-50] rejected the validity of the Gibrat's law, [28] revealed no relationship between the firm size and firm growth. As the overview shows, the issue of the relationship between the size and growth of the company and testing the validity of Gibrat's law in the field of transportation and storage industry has received relatively little attention so far. No study addresses this issue for the Czech Republic either. Here is a space for research and this is the topic of this study. The Czech Republic is a small export-oriented economy with a convenient location in the middle of Europe. Well-developed and efficient transport routes, transport networks, storage capacities and logistics systems are very important and are a precondition for the competitiveness of Czech companies on the European market.

3 Data and methodology

Data for this analysis was taken from the Albertina Database [51] containing information for around three million firms in the Czech Republic. The data for transporting and storage companies were collected using the Statistical classification of economic activities NACE Rev. 2 (NACE) and the groups from H49 to H53 (H49 - Land transport and transport via pipelines, H50 - Water transport, H51 - Air transport, H52 - Warehousing and support activities for transportation, H53 - Postal and courier activities) from 2008 to 2017.

To analyse only the active firms, the firms that

had sales of less than 100,000CZK (~ € 4,055) per year in the investigated period (in prices of 2015) were excluded. Then, the sample was narrowed to include only established companies in the industry. Only data of such companies, which were at least five years in the industry in 2008, survived throughout the study period and did not change their main economic activity (using one-digit NACE) were selected. Development of start-up and ending companies is specific when the start-up companies tend to be smaller and their initial growth is very dynamic. On the contrary, firms in liquidation mostly report a decline or minimum activity regardless of size. The empirical studies confirm the fact that the Gibrat's law is more likely to be valid in mature industries [19, 45]

The final sample contained data of 6,388 firms and included 13,461 observations. An unbalanced panel was used that contained 10,058 observations of Land transport and transport via pipelines, 94 observations of Water transport, 106 observations of Air transport, 3,124 observations of Warehousing and support activities for transportation and 79 observations of Postal and courier activities.

For comparison, the validity of Gibrat's law was examined for the two firm size indicators - sales and total assets. According to [52], sales, total assets and the number of employees belong to among the most frequent indicators that are used for measuring firm size in research papers. Authors selected sales and total assets due to possible bias when comparing the findings of studies that used the number of employees as the firm size indicator (the total number of employees including part-time workers vs the recalculated number of the full-time employees). The sales indicator includes real

annual revenues from the sales of products, goods and services in thousands of CZK.

To verify the validity of the Gibrat's law, the approach from [45] was applied. They estimated the validity of Gibrat's law using the following model:

$$\ln S_{jt}^i = \alpha_{j0} + \alpha_{j1} \cdot \ln S_{j,t-1}^i + \theta_{jt} \cdot T_t + u_{jt}, \quad (1)$$

where S_{jt}^i the size of the i -th firm of the j -th industry at time t , $\theta_{jt} \cdot T_t$ is a vector of time specific fixed effects. To estimate the Gibrat's law validity, we modify the original model (equation 1) and use the following formula

$$\ln S_{jt}^i = \alpha_{j0} + \alpha_{j1} \cdot \ln S_{j,t-1}^i + \alpha_{j2} \cdot T_t + \alpha_{j3} \cdot NACE_j^i + \alpha_{j4k} \cdot T_t \cdot NACE_j^i + u_{jt}, \quad (2)$$

where S_{jt}^i is the size of the i -th firm at time t , $NACE_j^i$ is a dummy variable for the industry using the 5-digit NACE classification of the i -th firm, $\alpha_{j2} \cdot T_t$ is the vector of time-specific fixed effects, $\alpha_{j3} \cdot NACE_j^i$ is the vector of industry-specific fixed effects, $\alpha_{j4k} \cdot T_t \cdot NACE_j^i$ is a vector of time and industry-specific fixed effects. The values of parameter α_{j1} indicate whether Gibrat's law is valid or not. The Gibrat's law is valid if $\widehat{\alpha_{j1}}$ equals one. A value smaller than one implies that a small firm grows faster than a large one and the value greater than one indicates that the large firm grows faster than the small one.

Following [45], authors used the ordinary least squares (OLS) estimator to evaluate the model parameters. Because of heteroscedasticity and the problem of serial correlation, the OLS estimator was used with the cluster-robust standard errors. To

Table 1 Summary statistics (in thousands of CZK) - sales

Industry	Number of observations	Mean	Standard deviation
Transporting and storage (H)	13461	105979.5	264353.7
Land transport and transport via pipelines (H49)	10058	81108.18	184908.4
Water transport (H50)	94	54617.12	76989.12
Air transport (H51)	106	75414.88	97178.17
Warehousing and support activities for transportation (H52)	3124	174184.6	391925
Postal and courier activities (H53)	79	677512.9	937844.9

Table 2 Summary statistics (in thousands of CZK) - total assets

Industry	Number of observations	Mean	Standard deviation
Transporting and storage (H)	13461	70275.5	274814.5
Land transport and transport via pipelines (H49)	10058	63262.85	291344.5
Water transport (H50)	94	30538.94	40667.18
Air transport (H51)	106	39178.67	67446.17
Warehousing and support activities for transportation (H52)	3124	88770.73	209108.4
Postal and courier activities (H53)	79	320725.7	492594.5

confirm or reject the Gibrat's law, the null hypothesis $H_0 : (\widehat{\alpha}_1) = 1$ versus $H_1 : (\widehat{\alpha}_1) \neq 1$ using F-test was used.

The descriptive statistics are shown in Tables 1 and 2; calculations were performed based on [51].

4 Results and discussion

With use of Equation (2), the link between the firm growth and firm size for the transportation and storage industry was investigated. Equation (2) included time-specific fixed effects, industry-specific fixed effects and their interaction that enables to capture time and industry heterogeneity in growth rates. Model (1) included only time-specific fixed effects, model (2) contained time-specified fixed effects and industry-specific fixed effects (but without their combination) and model (3) included time-specified fixed effects, industry-specific fixed effects and their combination. The results for the firm size indicator "sales" are shown in Table 3; calculations were performed based on [51].

The key indicator for investigating the link between the firm size and firm growth is the value of the parameter $\widehat{\alpha}_1$. As noted above, if the value of $\widehat{\alpha}_1$ is equal to one, the validity of Gibrat's law is confirmed. For testing the null hypothesis $(\widehat{\alpha}_1 = 1)$, the F-test was used. For all the three models, there is a statistically significant relationship between firm size and firm growth (at the 1 percent level).

For comparison, the validity of Gibrat's law was examined for the firm size indicator "total assets". The findings of this computation are shown in Table 4. The results show that even in this case, the validity of the Gibrat's law was not confirmed. The null hypothesis $(\widehat{\alpha}_1 = 1)$ was here rejected at the 1 percent level of significance, as well. If one compares the results from Tables 3 and 4, one can find out that for both firm size indicators, the findings are the same. Therefore, the results are not affected by the selected size indicator. The estimated value of $\widehat{\alpha}_1 < 1$, which indicates that the small firms in the transportation and storage industry tend to grow faster than the large firms.

These results are consistent with the study

Table 3 The Gibrat's law validity estimation for the firm size indicator "sales" Transporting and storage

Industry	Model (1)	Model (2)	Model (3)
$\ln.S_{t-1} (\alpha_1)$	0.984*** (0.003)	0.981*** (0.003)	0.981*** (0.003)
T_t fixed effects	Yes	Yes	Yes
$NACE_j$ fixed effects	-	Yes	Yes
$T_t.NACE_j$ fixed effects	-	-	Yes
Constant	-0.012 (0.034)	0.046 (0.064)	0.103 (0.145)
R^2	0.942	0.943	0.943
N	13461	13461	13461
F-test	31.21	33.26	33.02
p-value	0.0000	0.0000	0.0000

Notes: ***significant at the 1 percent level, **significant at the 5 percent level, *significant at the 10 percent level, robust standard errors in brackets, F- test of $H_0 : \widehat{\alpha}_1 = 1$.

Table 4 The Gibrat's law validity estimation for the firm size indicator "total assets" Transporting and storage

Industry	Model (1)	Model (2)	Model (3)
$\ln.S_{t-1} (\alpha_1)$	0.989*** (0.003)	0.987*** (0.003)	0.987*** (0.003)
T_t fixed effects	Yes	Yes	Yes
$NACE_j$ fixed effects	-	Yes	Yes
$T_t.NACE_j$ fixed effects	-	-	Yes
Constant	0.069** (0.030)	0.171*** (0.036)	0.183* (0.101)
R^2	0.954	0.954	0.955
N	13461	13461	13461
F-test	14.81	17.18	16.04
p-value	0.0001	0.0000	0.0001

Notes: ***significant at the 1 percent level, **significant at the 5 percent level, *significant at the 10 percent level, robust standard errors in brackets, F- test of $H_0 : \widehat{\alpha}_1 = 1$.

Table 5 The Gibrat's law validity estimation for firm size indicator "sales"; Land transport and transport via pipelines

Industry	Model (1)	Model (2)	Model (3)
$\ln.S_{t-1} (\alpha_1)$	0.983*** (0.003)	0.980*** (0.004)	0.980*** (0.004)
T_t fixed effects	Yes	Yes	Yes
NACE _j fixed effects	-	Yes	Yes
T_t .NACE _j fixed effects	-	-	Yes
Constant	0.075 (0.067)	0.046 (0.064)	0.118 (0.145)
R ²	0.943	0.943	0.943
N	10058	10058	10058
F-test	23.30	28.41	28.34
p-value	0.0000	0.0000	0.0000

Notes: ***significant at the 1 percent level, **significant at the 5 percent level, *significant at the 10 percent level, robust standard errors in brackets, F- test of $H_0 : \widehat{\alpha}_1 = 1$.

Table 6 The Gibrat's law validity estimation for the firm size indicator "sales"; Warehousing and support activities for transportation

Industry	Model (1)	Model (2)	Model (3)
$\ln.S_{t-1} (\alpha_1)$	0.983*** (0.006)	0.983*** (0.006)	0.983*** (0.006)
T_t fixed effects	Yes	Yes	Yes
NACE _j fixed effects	-	Yes	Yes
T_t .NACE _j fixed effects	-	-	Yes
Constant	-0.057 (0.070)	-0.059 (0.056)	0.062 (0.063)
R ²	0.938	0.938	0.939
N	3124	3124	3124
F-test	8.46	7.14	6.93
p-value	0.0038	0.0078	0.0087

Notes: ***significant at the 1 percent level, **significant at the 5 percent level, *significant at the 10 percent level, robust standard errors in brackets, F- test of $H_0 : \widehat{\alpha}_1 = 1$.

results by Fiala and Hedija [46] that applied the same methodology and tested the validity of the Gibrat's law in the Czech Republic on the aggregate level. They concluded that the small firms tend to grow faster than the large counterparts. The results are also in line with conclusions of majority of previous studies that have dealt with transportation companies, for example, [1, 48-50]. Therefore, the smaller firms usually grow faster than their larger counterparts in this sector.

The results may be influenced to some extent by the fact that the analyzed transport and storage industry is highly inconsistent. The large firms dominated in some subsectors (for example, air transport). Other subsectors are mixed in terms of firm size. In addition, the optimal size to which companies could tend in individual subsectors may vary from a theoretical point of view. This fact is taken into account in the model applied by using industry-specific fixed effects. However, this may not be sufficient to capture and filter it out.

To get more robust results, the growth-size relationship was examined and the validity of the Gibrat's law in the two selected subsectors was tested, Land transport and transport via pipelines (H49) and Warehousing and support activities for transportation (H52). Within these subsectors, a sufficiently large sample of observations is available and they are thus suitable for applying the regression model.

In addition, in this case, to test validity of the Gibrat's law, equation (2) was used and the regression model parameters were estimated. Sales are used as the indicator of the firm size. The results are shown in Tables 5 and 6; Calculations based on [51].

As one can see in Tables 5 and 6, for both investigated sub-industries, there is a significant link between firm size and firm growth. Thus, the validity of the Gibrat's law for both sub-sectors was rejected. The conclusions are consistent with the findings for the whole industry. The estimated value of the coefficient $\widehat{\alpha}_1 < 1$, which shows that the small firms tend to grow

Table 7 The Gibrat's law validity estimation for the firm size indicator "total assets"; Land transport and transport via pipelines

Industry	Model (1)	Model (2)	Model (3)
$\ln.S_{t-1} (\alpha_1)$	0.991*** (0.003)	0.988*** (0.004)	0.988*** (0.004)
T_t fixed effects	Yes	Yes	Yes
NACE _j fixed effects	-	Yes	Yes
T_t .NACE _j fixed effects	-	-	Yes
Constant	0.062* (0.036)	0.173*** (0.042)	0.172* (0.101)
R ²	0.955	0.955	0.956
N	10058	10058	10058
F-test	7.25	10.02	9.37
p-value	0.0071	0.0016	0.0022

Notes: ***significant at the 1 percent level, **significant at the 5 percent level, *significant at the 10 percent level, robust standard errors in brackets, F- test of $H_0 : \widehat{\alpha_1} = 1$.

Table 8 The Gibrat's law validity estimation for the firm size indicator "total assets"; Warehousing and support activities for transportation

Industry	Model (1)	Model (2)	Model (3)
$\ln.S_{t-1} (\alpha_1)$	0.985*** (0.006)	0.983*** (0.006)	0.983*** (0.006)
T_t fixed effects	Yes	Yes	Yes
NACE _j fixed effects	-	Yes	Yes
T_t .NACE _j fixed effects	-	-	Yes
Constant	0.074 (0.056)	0.126* (0.069)	0.205*** (0.056)
R ²	0.948	0.948	0.949
N	3124	3124	3124
F-test	6.96	7.19	7.03
p-value	0.0085	0.0075	0.0082

Notes: ***significant at the 1 percent level, **significant at the 5 percent level, *significant at the 10 percent level, robust standard errors in brackets, F- test of $H_0 : \widehat{\alpha_1} = 1$.

faster than the large firms, even in these subsectors.

As with the analysis of the whole industry, authors also tested the growth size relationship using the total assets as a firm size indicator. The results are the same as for the sales and confirm the higher growth rate of small firms compared to large counterparts. The findings are presented in Tables 7 and Table 8 in the Appendix; Calculations based on [51].

5 Conclusions and limitations

The purpose of this paper was to examine the validity of the Gibrat's law for transportation and storage companies in the Czech Republic and to identify the size-growth link for the research period between 2008 and 2017.

It was found that the smaller firms grow faster as compared to larger ones in the Czech transportation

and storage industry. Thus, we rejected the validity of Gibrat's law for transportation and storage companies in the Czech Republic.

With regard to the size of a company, one can state that companies in this sector vary greatly in size. The small size of a company may not be a barrier to growth. The explanation for the faster growth of small companies may be their greater flexibility, better access to the innovation process or the effort to achieve an efficient volume of production quickly.

This study provides new insights into the size-growth relationship of the transportation and storage industry in the Czech Republic and brings interesting information for stakeholders and shareholders of firms in the transportation and storage industry. It shows that the small size of the company does not seem to be an obstacle to growth but on the contrary. It can mean competitive advantage.

Finally, the conclusions are consistent with results of majority of previous studies and show that the results are applicable to transportation and storage companies in the Czech Republic.

As already noted, this study extends the knowledge in the field of the relationship between firm size and firm growth in the transportation and storage industry. Authors are aware that there are some limitations in the used research design. The limited scope of the research sample allowed us to reliably verify the validity of Gibrat's law in only two subsectors. Thus, authors could not confirm whether the results for the whole sector were valid or for the individual sub-sectors

of the transportation and storage industry, as well. The data used did not allow a detailed analysis of the factors behind the faster growth of the small companies compared to the large companies in this sector. That will be the subject of the further research.

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