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Firm growth dynamics in Iranian insurance industry

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Abstract

Traditional approach to the firm size and its growth rate is based on comparative statics analysis and it does not really deal with the dynamics of growth. This paper takes a dynamic approach to investigate the relationship between firm size and its growth rate for Iranian insurance firms during 2003-2009. The study applies two ways to verify the validity of Gibrat's law in Iranian insurance industry. First way is to consider the independence of two important attributes of firms including firm size and growth rates. The second way is based on panel regression estimation. The results of the study reject the validity of Gibrat's law and indicate the fact that small firms grow faster than their larger counterparts.

Key words: Firm size distribution, firm growth, panel regression, insurance firms
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1. Introduction

Traditional theoretical work into the size and growth of firms is based on comparative statics framework, and it does not really deal with the dynamic of growth. According to traditional theory Firms are at their 'optimal size' and if they are not at that size, it is assumed that they will grow instantaneously to reach it. In this way, firm growth is treated as an appendage to the optimal size theory[1]. Many economists believe that the theory is not satisfactory and the notion of 'optimal size' has been rejected by many studies.

Growing dissatisfaction with the static approach on firm size has led to the ascendancy of new themes in theoretical work and emphasis on the prevalence of uncertainty, change and bounded rationality in economy. Uncertainty and bounded rationality are important foundations for the analysis of firm growth in modern economies, because growth inevitably involves expansion into new areas. In addition, firm is changing through growth. An important theme is Path-dependency. According to the theme what a firm did in the past determine what it can do in future. Thus a firm's growth opportunities are constrained by its current activities. In addition, it is necessary to recognize the existence of great heterogeneity among firms[2].

Regularity that has emerged from research on the growth of firms is known as Gibrat's law[3]. The law provides a better description of industrial development than any other alternative theory. Three theoretical foundations of Gibrat's law are as follows. First, Gibrat's law emphasizes heterogeneity among firms that comes from the variance of the growth shocks. Second, the stochastic nature of Gibrat's law refers to the inherent uncertainties in a market-based economy. Third, Gibrat's law accommodates the principle of path dependency by the fact that a current firm size is viewed as the mere amalgamation of all previous growth shocks.

This study applies both panel regression analysis and Chi square ($\chi 2$) for testing independence in Iranian insurance industry. The methodology of the study is mainly based on the studies of Audretsch *et al* (2004), and Johansson (2004) [4].

Nowadays many policy makers advise supporting small and medium Size firms to boost job creation and economic growth. But the effectiveness of such policies can be examined by testing the validity of Gibrat's law. Rejection of Gibrat's law in favor of small firms implies that any policy to support small firms has significant effect on job creation and economic growth.

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1. For more details refer to John Lipczynski et al., (2005), page 272.
2. For more details refer to Alex Coad. (2009), page 5.
3. Audretsch et al., (2004)
4. The model which was used by Audretsch et al, is like; $Logxt=\alpha+\beta Logxt-1+\epsilon$

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Empirical Literature

Gibrat's work is the first study to explain in stochastic terms the systematically skewed pattern of firm size distribution within an industry. In this section a comprehensive literature review on Gibrat's law is not provided. Instead, we introduce an overview of the essential results.

Hart and Prais (1956) studied selected UK companies during 1885 - 1950. Firms were grouped into 3 small, medium and large classes. The study concluded that distribution of growth rates (defined as final size divided by original size) in 3 groups is quite equal. The study supported Gibrat's Law.

Hymer and Pashigian (1962) examined thousand largest U.S. manufacturing firms in 1946. Firms were ranked by size into quartiles in ten industries. Growth rate was measured by assets between 1946 and 1955. The mean and standard deviation for the size classes were compared. The mean growth rate was not related to the size of the firm while the standard deviation of the distribution of growth rates was inversely related to the size of the firms. According to the finding of the study Gibrat's Law tends to fail.

Wagner (1992) examined 7000 firms of Germany manufacturing sector from 1978 to 1989. He used a first order auto-regressive process for different periods of time and found positive autocorrelation between growth rates. He rejected Gibrat's law.

Dunne and Hughes (1994) examined over 2000 U.K. companies. A probit model was estimated for survival on growth. The study considered growth for the periods 1975-1980 and 1980-1985. The logarithm of size at the end of the period was regressed on the logarithm of size at the beginning of the period. The study concluded that smaller companies grow faster than larger ones. The validity of Gibrat's Law was rejected by the study.

Machado and Mata (2000) examined all firms operating in 155 industries in Portuguese manufacturing sector in 1983 (18,552 firms) and 1991 (26,515 firms). The study used the Box-Cox quintiles regression model to analyze the firm size distribution. The model was estimated by Generalized Least Squares (GLS) and normality test was performed on the standardized estimated residuals. The prediction of log-normal distribution implied by Gibrat's law was rejected by the study.

Becchetti and Trovato (2002) examined a sample of Italian firms over the period 1995-1997. Firms were divided into three groups; small, medium and large. Multivariate regression model was applied in which the dependent variable represented changes in size and each regressor represented a different factor that is expected to affect firm growth. Gibrat's Law was not rejected for large firms, whereas it was rejected for small and medium sized firms.

Piergiovanni, Santarelli, Klomp and Thurik (2003) studied 9051 newborn firms in five Italian hospitality industries between 1989 and 1994. Firm size was measured in terms of employment. The study divided firms into several size

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classes and examined whether firm growth rates are equally distributed across these classes. Firms were ranked in order of size and divided into quartiles. Similarly firm growth rates were also divided into quartiles. If the observed frequencies of the resulting 16 cells in the cross tables of firm size and growth rates are equal, Gibrat's law would be supported. Chi square statistic used to test whether or not growth rates and firm size are independent. In 3 out of 5 sub groups Gibrat's law was rejected.

Fotopoulos and Louri (2004) examined 2,640 Greek manufacturing firms operating in both 1992 and 1997. The study used information on employment, age and share of foreign ownership. Non - parametric kernel density estimation was applied. Results of the study show firm growth is not random, because both firm size and age have a negative effect on growth.

Audretsch, Klomp, Santarelli and Thurik (2004) examined 1,170 firms in five Dutch hospitality industries between 1987 and 1991. Size was measured in terms of sales. The study divided the observed firm sizes into several size classes and then examined whether firm growth rates are equally distributed across these classes. Firms were ranked in order of size and divided into quartiles in each sub-sector, similarly, firm growth rates were also divided into quartiles; if the observed frequencies of the resulting 16 cells in the cross tables of firm size and growth rates are equal, Gibrat's Law would not be rejected. Chi square statistic used to test whether or not growth rates and firm size are independent. According to the results of the study Gibrat's Law is rejected in 4 out of the 5 sub-sectors for the sample.

Johansson (2004) examined Swedish IT industry for the period 1993-1998. Firm size measured in terms of employment. Conclusions of the study are based on Panel regression. The results of the study did not support Gibrat's Law. The results show that firm growth decreases with firm size as well as with firm age.

Feizpour. M.A, Mahmoudi. V. and Soltani.E, (2010) studied the validity of Gibrat's law in manufacturing firms in Iran during 1995-98. The study used transition matrices to examine Gibrat's law. The results of the study indicated that Gibrat's Law is rejected for manufacturing firms in Iran over the period of time. The study confirms the fact that size is an important variable in the growth of Iranian manufacturing firms.

2. Data and Methodology

Different indicators of firm size may be used for empirical investigation. Employment and total sales are the most commonly used indicators. This is in part because data on these indicators is among the easiest to obtain. In the majority of cases, it will make insignificant difference which indicator is taken, as they give similar results. Total annual premium is chosen as a measure of firm size in the study. Thus the data used in the study consists of annual premiums of all Iranian insurance firms in the industry during 2003 – 2009. The

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data were obtained from Iranian central insurance company and it is reported in table (1).

Table 1. Annual premium (billion IRR)

	Insurance Company (Firm)	2003	2004	2005	2006	2007	2008	2009
1	Iran	6873.3	9180.3	11361.7	13477.7	15955.7	19231.1	21341.3
2	Asia	2843.0	3400.5	3707.0	4655.0	5198.6	5726.5	5567.6
3	Alborz	937.8	1224.4	1475.1	1975.0	2458.4	2785.2	3071.1
4	Dana	1711.6	1578.7	2023.6	2119.1	2717.7	2654.0	2936.1
5	Moalem	15.6	23.8	28.2	46.6	221.1	781.9	1863.0
6	Parsian	181.0	1410.0	1761.5	1489.6	2419.1	2995.3	3242.3
7	Tosea	4.6	6.2	6.6	24.5	69.2	212.0	786.8
8	Razi	15.4	88.2	167.3	279.7	614.5	863.1	860.2
9	Karafarin	42.6	155.2	321.1	522.3	849.9	1076.6	1319.0
10	Sina	14.4	109.8	262.7	402.8	876.1	910.8	1172.6
11	Mellat	8.5	74.9	224.2	1076.8	1296.7	1496.2	1664.8
12	Day	0.0	0.0	61.6	173.5	436.1	600.8	652.3
13	Saman	0.0	0.0	15.1	107.7	245.6	405.0	476.2
14	Novin	0.0	0.0	0.3	86.0	164.4	357.8	771.0
15	Pasargad	0.0	0.0	0.0	0.7	99.3	252.6	474.0
16	Mihan	0.0	0.0	0.0	0.0	0.0	0.3	22.2
	Total	12648	17252	21416	26437	33622	40349	46221

Source: Iranian statistical yearbook of insurance industry (2003-2009).

Until 2003 insurance market was dominated by four top firms. The four firms controlled over 97.8 percent of total market. Other firms grew fastly during the period of time and their market share reached to 28.8 percent in 2009. The structure of the industry is highly concentrated but industrial concentration had a decreasing trend during the period of time. The structure of the market is reported in table (2).

Table 2. Iranian insurance market total premiums and distribution

	Premiums in billion IRR		Percentage share of primiums	
Insurance firms	2003	2009	2003	2009
Four top firms	12366	33222.3	97.8%	71.9%
other firms	282.1	12998.2	2.2%	28.1%
Total	12648.1	46220.5	100%	100%

Source: Author's calculations based on statistical yearbooks of insurance industry

The Iranian insurance market size had a dramatic growth during the period of time. While the market size was about 12366 billion IRR in 2003, it reached to 33222.3 billion IRR in 2009.

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From an empirical view point, the validity of Gibrat 's Law can be tested in two different ways: either by using a sample of firms continuously active during a given period (balanced panel analysis), or by using population of firms in a period of time and testing the Law. Both approaches have some shortcomings. Considering only incumbent surviving firms is by definition equivalent to considering only a sub-sample of the firms' population and to neglecting entries and failures which is an important element of industrial dynamics. This approach can be appropriate only under the assumption that the equations' residuals are not correlated with unobservable characteristics concerning the decision to enter or exit the market. In fact the approach tries to estimate the parameters of panel regression thus the approach is known as parametric approach. Accordingly, if Gibrat's Law is not a feature of the best incumbent firms, but a general pattern of industrial dynamics, it should be tested over the entire population of firms in a period of time. In fact the approach tests the null hypothesis that the two attributes (firm size and growth rate) are independent of each other. The study applies both approaches to examine Gibrat's law in Iranian insurance industry during 2003-2009.

3. Gibrat's Model

About eight decades after the seminal publication of Gibrat (1931), Gibrat's law has been received a huge amount of attention in the empirical studies up to now. Many observations demonstrate that the firm size distribution is positively skewed. Thus examining the firm size distribution is a useful point of entry for research into the dynamics of growth in the selected industry. Gibrat (1931) considered the size of French firms in terms of employees and concluded that the lognormal distribution was a valid heuristic. Many other empirical studies examined the firm size distribution to verify the validity of Gibrat's law.

In order to introduce Gibrat's model we define y_t to be the size of a firm at time t, and let u_t be random variable representing an idiosyncratic, multiplicative growth shock over the period t – 1 to t. So we have

$$y_t - y_{t-1} = u_t y_{t-1}$$

This can be developed to obtain

$$y_t = (1 + u_t)y_{t-1} = y_0(1 + u_1)(1 + u_2) \dots \dots (1 + u_t)$$

Logarithms can be taken in order to approximate log $(1+u_t)$ by u_t

$$\log(y_t) \approx \log(y_0) + u_1 + u_2 + \cdots + u_t = \log(y_0) + \sum_{i=1}^{t} u_i$$

In the limit, as t tends to become very large, the log (y_0) term will become insignificant, and we obtain

$$\log(y_t) \approx \sum_{i=1}^{t} u_i$$

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Hence, a firm's size at time t can be explained purely by its idiosyncratic history of multiplicative shocks. If we further assume that all firms of an industry are independent entities with normally distributed growth rates, then this stochastic process leads to the emergence of a lognormal firm size distribution[1]. As mentioned before the validity of Gibrat 's Law can be tested in two different ways: either by using a sample of firms continuously active during a given period (balanced panel analysis), or by using a population of firms and testing the independency of two attributes including size and growth. In the next section both approaches are applied to verify the validity of Gibrat's law in Iranian insurance industry.

Chi square (χ^2) for testing independence

The approach applies the χ^2 test for independence to investigate the difference in frequency when observations are classified by growth rate after classification by firm size. Based on 16 incumbent firms in 2009, firms are divided into 4 size classes. In each size class observations on average growth rate are classified into 4 classes. Average growth rates are calculated for each size class for the period of 2003-2009. The hypothesis to be tested is that the two attributes (firm size and growth rate) are independent of each other. Table (3) reports the average growth rates for each size class.

Table 3. Observed Frequency of firm size / growth rate

Average growth rate (g) Firm Size (y) (billion Rial)	$g \leq 0.20$	$0.20 < g \leq 0.40$	$0.40 < g \leq 0.60$	$g > 0.60$	Total
$y \leq 1000$	0	0	1	6	n_{1o}=7
$1000 < y \leq 2000$	0	0	1	3	N_{2o}=4
$2000 < y \leq 5000$	1	1	1	0	N_{3o}=3
$y > 5000$	1	1	0	0	n_{4o}=2
Total	n_{o1}=2	n_{o2}=2	n_{o3}=3	n_{o4}=9	N=16

Source: Author's calculations

Firm size is measured in terms of total annual premium. As mentioned Chi square (χ^2) test is used to test whether or not growth rates and firm sizes are independent.

The test statistic is:

$$\chi^2 = \sum_{i=1}^{p}\sum_{j=1}^{q} \frac{\left(n_{ij} - \left({}^{n_{io}n_{oj}}/_{N}\right)\right)^2}{{}^{n_{io}n_{oj}}/_{N}}$$

Which follows a χ^2 distribution with $(p-1)(q-1)$ degrees of freedom. If calculated χ^2 exceeds the critical value then the null hypothesis that the two

[1]. For more details refer to Alex Coad. (2009), page 19.

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attributes (firm size and growth rate) are independent of each other is rejected. The calculated χ^2 is 14.35 and the critical value at 0.05 significance level ($\chi^2_{(9\,,\,0.05)}$) is 16.92. As the calculated χ^2 does not exceed the critical value of χ^2 the null hypothesis that the two attributes (firm size and growth rate) are independent of each other is not rejected. Thus the result of χ^2 test indicates the fact that firm sizes and growth rates are not independent attributes. The conclusion rejects Gibrat's law in the Iranian insurance industry.

4. Panel Regression

Empirical investigation to verify the validity of Gibrat's law in the selected industry can be relied on panel regression estimation. The parameters of the following equation are estimated by panel data obtained from Iranian insurance industry:

$$\log(y_{it}) = \alpha_i + \beta \log\left(y_{\mathrm{i,(t-1)}}\right) + \mathrm{u_{it}}$$

Where firm's size is represented by y_t, α is a constant term (industry-wide growth trend) and u_t is a residual error. Research into Gibrat's law focuses on the coefficient β. If β takes the value of unity, then firm growth is independent of size. Smaller firms grow faster than their larger counterparts, if β is smaller than one. Also, if β is larger than one, then larger firms grow relatively rapidly and there is a tendency to concentration and monopoly.

The equation can be transformed into the following equation.

$$\log(y_{it}) - \log\left(y_{\mathrm{i,(t-1)}}\right) = \alpha_i + (\beta - 1)\log\left(y_{\mathrm{i,(t-1)}}\right) + \mathrm{u_{it}}$$

The right hand of the above equation indicates the growth rate of firm size. If g_t represent the growth rate the following equation is obtained.

$$\mathrm{g_{it}} = \alpha_i + (\beta - 1)\log\left(y_{\mathrm{i,(t-1)}}\right) + \mathrm{u_{it}}$$

The final model can be estimated by a variety of methods. To choose estimation method firstly it is necessary to test for heterogeneity or pooling test. The test examines whether or not the intercepts take on a common value, say α. The test is also known as Chow test. An important advantage of panel data models is that we can allow for heterogeneity among subjects, generally through subject-specific parameters[1]. The null hypothesis of homogeneity can be expressed as:

$\mathbf{H_0: \alpha_1 = \alpha_2 = \cdots = \alpha_n = \alpha}$

This is an exact test in the sense that it does not require large sample sizes yet does require normality of the responses. Studies have shown that the F-test is not sensitive to deviations from normality. The result of Chow test for Iranian insurance firms for the period of time is reported in table (4).

1. For more details refer to Edward W. Frees (2004), page 39.

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Table 4. Chow test results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.888463	(10,54)	0.5496
Cross-section Chi-square	10.052971	10	0.4359

Source: Author's calculations

The results of Chow test indicate the fact that the null hypothesis of homogeneity cannot be rejected. Thus we can apply pooled least square method of estimation. The results of estimation are reported in table (5).

Table 5. Pooled least square estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	1.227399	0.091719	13.38214	0.0000
$Y_{i,(t-1)}$	-0.134318	0.014280	-9.406282	0.0000

Source: Author's calculations

The estimated coefficient for $Y_{i,\,(t-1)}$ is -0.134 which is equivalent to $\beta = 0.866$. The estimated β is less than one so we can say that Gibrat's law is not valid in the industry because smaller firms grow faster than their larger counterparts.

5. Conclusions and Recommendations

The paper examines the validity of Gibrat's law in Iranian insurance industry for the period of 2003-2009. Two popular approaches including examination of independency of firm attributes (including firm size and growth rate) and panel regression have been applied to test Gibrat's law in the Iranian insurance industry. Results show firm size and growth rate are not independent attributes in the industry. The result indicates that Gibrat's law is rejected in the industry. Panel regression method also supported the results obtained by the first approach. In fact the results strongly demonstrate that Gibrat's law is not valid in the industry. Thus firm size is an important determinant of firm growth rate over time. In panel regression analysis estimated beta is less than one which indicates small firms grow faster than their larger counterparts. The results imply that small firms can create more jobs and boost economic growth. According to the findings, an effective policy to boost economic growth is reduction of entry barriers for new small firms. Such policies also can lead the industry to more competitive environment because smaller firms get more market share.

Data source:

Data are collected from the statistical yearbook of insurance industry, published by Iranian central insurance Press.

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