EFFECTS OF ENTRY DETERRENT STRATEGIES ON SIZE DISTRIBUTION OF FIRMS IN THE INDIAN MANUFACTURING

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Abstract

This paper intends to study the relationship between firm size and growth, effects of entry deterrent strategies (EDS) on firms' size distribution (FSD) and determining factors of inequality of firm sizes. One approach is the 'Law of Proportionate Effect' (LPE) hypothesis by Gibrat (1931), implicitly suggests that increasing concentration and resulting lognormal distribution are due purely to random process. Another approach we propose is due to systematic processes whereby strategic entry deterrents such as advertising expenditure, intangibles, R & D expenditure and excess capacity are expected to have positive impact on inequality of firm sizes. In practice, though the prevalence of lognormal distributions of firm size indicates that there are stochastic forces at work, such stochastic processes operate along with more systematic influences on concentration. Hence, we propose to study systematic effects such as entry deterrent strategies may be seen as either accelerating or decelerating the stochastic process and it is to these systematic influences on inequality of firm size that we direct our analysis on in this paper. The empirical analysis of the present study is for 8 sectors over 1990-2007 using Centre for Monitoring Indian Economy (CMIE) – PROWESS data base.

We reject Gibrat's LPE in explaining FSD. While we reject LPE we have all justification as we have estimated and contemplated the Law. We have found more reasoning in EDS explaining FSD than LPE. Any positive real number in economics is ought to have lognormal distribution and FSD converges to lognormal distribution irrespective of LPE. As a matter of fact, our concern should be not of having zero skewness rather, we should learn to see how skewed the distribution is to the right and determinants of these variances and skewnesses within the lognormal distribution framework. We model inequality as a function of EDS and other control and policy variables referring to Bloch (1981) and estimated results in various models show strong and statistically significant relationship between inequality of firm size and EDS. Intangibles, R & D expenditure, excess capacity and mean firm size are statistically significant and inequality increasing. Number of firms operating and export openness are statistically significant and inequality decreasing. We presume that the analysis has some use to concerned competition policies.

Keywords: Firm's Size Distribution, Law of Proportionate Effect, Entry Deterrent Strategies, Skewness, Kurtosis, State of Competition

1.1 Introduction

This paper intends to study the relationship between firm size and growth, effects of entry deterrent strategies (EDS[1]) on firms' size distribution (FSD[2]) and determining factors of

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[1] See Bain, J. S. (1950, 1954, 1956); Cassels (1937); Caves & Porter (1977, 1980); Comanor & Wilson (1979); Dixit (1980); Stigler (1964); Hilke (1984); Wenders (1971); Liberman (1987); Mani (1992);

inequality of firm sizes. Given the initial firm size distribution, an increased variance in the firms' sizes leads to greater spread of firm sizes over time. Spread of firm sizes imply that there is a tendency of an increase in market concentration and hence movement towards anti-competitive markets. Hence, defined strategic entry deterrents such as advertising expenditure, intangibles, R & D expenditure and excess capacity are being anti-competitive, are expected to have positive impact on variance in the firms' sizes. Another approach to changes in concentration is to regard these as an outcome of a random or stochastic process. According to simplest version of the 'Law of Proportionate Effect' (LPE) hypothesis by Gibrat[3] (1931), concentration levels emerge as a result of a random process whereby firms face certain probability distribution of growth rates which is independent of the firm's initial size. Over a period of time, some firms experience high growth rates several periods in succession while others shamble with low growth rates. Since growth rate is proportional, the large firms experience more absolute growth than smaller firms and inequality in firm size will tend to increase over time. The distribution of firm size becomes positively skewed and, over time, will approach the lognormal distribution. It is empirically observed that many industries do have lognormal distribution of firm size i.e. basically a few large firms and a much bigger number of small ones[4], which gives the stochastic approach to explaining changes in concentration much of its appeal.

LPE implicitly suggests that increasing concentration is an upshot of purely random process. Hence laissez-faire policy of no intervention in the competitive process will hardly preserve competitive market structures. In practice, though the prevalence of lognormal distributions of firm size indicates that there are stochastic forces at work, such

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Maashan & Shanan (1986); Schmalensee (1978, 1981, 1983); Sen, A (1997); Spence (1977, 1979, 1980); Bloch, H (1980); Kumar (1990), Hay (1976).

[2] See Coad, A (2008); Baldwin & Gorecki (1991); Baumol (1962); Balakrishnan & Babu (2003); Simon (1964); Hymer & Pashigan (1962); Pagano & Schivardi (2003).

[3] Since original article by Gibrat (1931) is in French language, we refer Sutton (1997) and Mansfield (1962) for interpretation of Gibrat's Law.

[4] One of the interesting issues on the literature on competitive behavior of markets is that of the '**missing middle**'. The extent to which a market over time gets dominated by 'middle sized' firms defined as those with an average sales share. The presumption is that in non-competitive markets middle sized firms tend to disappear because of either takeover by larger firms or loss of market share. In any case, a missing middle indicates a segmented, possibly non-competitive market [For details see Pant and Pattanayak (2005), Das, Sandwip & Pant, Manoj (2006)].

stochastic processes operate along with more systematic influences on concentration.[5] Hence, systematic and deliberate effects such as entry deterrent strategies may be seen as either accelerating or decelerating the stochastic process and it is to these systematic influences on the level of concentration, inequality of firm size and market structure that we direct our analysis on in this paper.

1.2 Genesis of Firm size distribution (FSD) and LPE[6]

In Chamberlin (1933), the theoretical model of monopolistic competition has all firms of equal size even though each operates at a scale too small to achieve minimum average cost. The general problem may be viewed as one of the likelihood of mixing together efficient and inefficient firms in the same industry. In Chamberlin's monopolistic competition model, all firms are of inefficient size and the inequality is zero. In long run equilibrium with perfect competition and a single minimum average cost output level, the inequality of firm size is also zero. The inequality of firm size is higher in an intermediate case where efficient and inefficient size firms are mixed together in equal proportions. Given this possibility and also given dual nature of EDS and their credibility to deter entry, we find it difficult to determine the direction of the effects of entry deterrent strategies on the inequality of firm size. Hence entry deterrent strategies may have both positive as well as negative effects on inequality of firm sizes (Bloch, 1981).

Given the initial firm size distribution, an increased variance in firm growth rates leads to a greater spread of firm sizes over time (Sutton, 2002). Therefore, we expect a positive relationship between industry growth rates and inequality of firm size. In a stochastic firm growth model for which the LPE holds:

$\Rightarrow$ Firm growth follows a random process and is independent of initial size.

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5 For example, if larger firms have cost advantages over smaller ones then this will operate at the same time as the stochastic process and the movement towards increased concentration will take place faster than if firms of all sizes had the same costs. In this case, therefore, the distribution of growth rates is not independent of firm size; instead, large firms have better chance of growing fast. This is inconsistent with the simplest kind of stochastic process outlined above, but does not indicate that no random forces are at work.

6 See Table 1.1 for brief review of literature (All the Tables are in Appendix).

⇒ The resulting distribution of firms' size is lognormal.[7]

⇒ There will be an increasing industrial concentration since both large and small firms have the same chance of growing by a given proportion during any period.

⇒ The inequality of firm size proxied to be variance in market shares[8] is independent of the mean size of firms in an industry.

It is true that stochastic forces can operate on the size distribution of firms in conjunction with cost and competition conditions. And, if the magnitude of cost differences or the levels of competition affect the probability of survival of high cost firms (small firms or entrants), the Law does not hold. In this case, the probability of a given proportionate change in a firm's size is not independent of the initial firm size. Thus, finding the effects of cost and competition variables on the inequality of firm sizes is evidence that the Law does not hold, regardless of the relationship between average firm size and the inequality of firm size. However, even if Gibrat's Law does not hold, the variance and /or skewness of the firm size distribution might not shrink over time (Hart & Oulton, 1996), and one then observes that the firm size converges to a lognormal distribution. Unfortunately, economic theory does not say too much on the evolution of the skewness of the firm size distribution. Rather, the error terms of concerned equation are often assumed to be normal, although there are some exceptions (Huber & Pfaffermayr, 2007).

From an economic point of view, the analysis of the evolution of the shape of the firm size distribution forms the means to describe the evolution of market structure over time. Under an increasing variance or skewness of the distribution of the firm size, markets tend to concentrate [9] and large firms gain dominance over time (Bloch, 1981; Clarke,

[7] Of course, a firm size distribution skewed to the right implies only that Gibrat's Law cannot be rejected. However, one cannot a priori exclude that the skewness is the result of turbulence, namely of the presence of new-born firms in the right tail of the distribution.

[8] The inequality measure used depends on relative firm size rather than absolute firm size and market share is a relative firm size.

[9] Clarke (1985) shows that the Herfindahl concentration index can be written as $H = \frac{1}{N}\left(\frac{\sigma_{yt}^2}{\mu_{yt}^2} - 1\right)$.

Hence, at constant mean a decrease in variance implies a reduction in the concentration.

1985; Sutton, 1992). Economic policy, specifically competition policy, is exactly interested in this issue.

Several theoretical models explain the evolution of how firms update their beliefs about their true efficiency and successful firms adjust their size accordingly and grow (Jovanovic, 1982; Ericson & Pakes, 1995). In contrast, firms finding out that they are not efficient enough shrink and eventually exit (Huber & Pfaffermayr, 2007). These models imply that the firms' growth rates decrease in size at given age of surviving firms[10] (Evans, 1987). However, entry and exit are reality and are continuous and several new firms enter at any point in time; several firms do exit. There are firms graduating from young to grow old but, there are equally good number firms enter and exit at any point in time so that the lognormal distribution is prevalent all the time. As a matter of fact, our concern should be not of having zero skewness, rather we should learn to see how skewed the distribution is to the right within the lognormal distribution framework.

1.3 Testing Law of Proportionate Effect

The LPE framework postulates that the growth of firms is a random process; while there may be a large number of systematic factors affecting growth, collectively they exercise only a limited influence on firm's proportionate growth. To test the LPE, the first order autoregressive log liner model AR (1) has been adopted (Hart & Prais, 1952; Dasguta, 1985; Yadav, 2007). The formal derivation of this model is given below.

Let $S_{i\,t}$ be the size of i^{th} firm at time't', $S_{i\,t+1}$ be the size of i^{th} firm at time'$t+1$' and let α be the constant growth rate, which is common to all firms, then we have:

$$S_{i\,t+1} / S_{i\,t} = \alpha \qquad (1)$$

[10] Also, the variance of the firm size distribution is higher for young firms, but it declines for a given age cohort according to these models. This leads to smaller changes in the size of the firms as they grow older. Over time, the probability of a financial constraint decreases as the entrepreneurs running the successful surviving firms accumulate wealth and creditors learn about successful firms.

The second element in the growth equation (equation 2) is a systematic tendency for the growth of a firm to be related to initial size (i.e.,) $S_{i\,t}^{\beta-1}$ and the third element is a random term e^{Uit} which enter the growth equation multiplicatively.

Thus, the growth equation is given by:

$$S_{i\,t+1} / S_{i\,t} = \alpha\, S_{i\,t}^{\beta-1}\, e^{Uit} \qquad (2)$$

The effect of the initial size on growth is determined by the value of β (equation (2)). For β=1, the exponent of $S_{i\,t}$ is zero and so initial size has no effect on future growth (thus, LPE holds). For β>1, the initially large firms grow at a faster rate than small ones and for β<1, the initially small firms grow at a faster rate than larger ones. Thus, β can be termed as the LPE determining parameter.

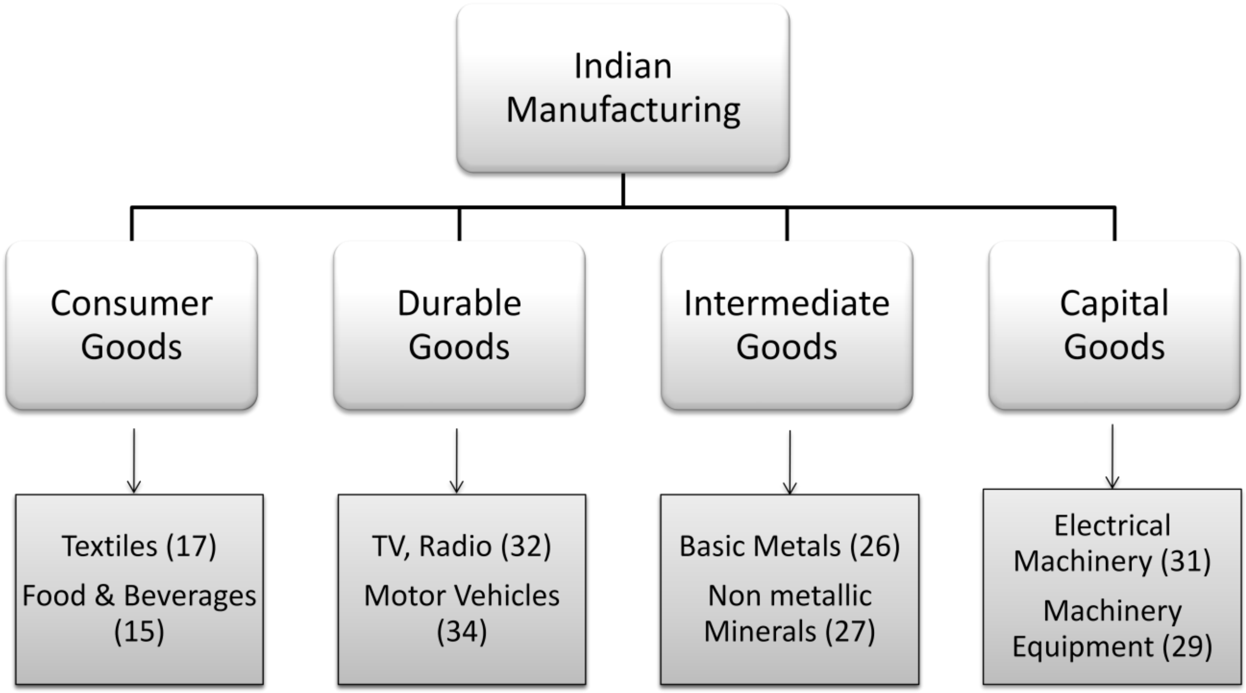
Taking natural logarithms on both sides of equation (2), we have,

$$\ln S_{i\,t+1} = \ln \alpha + \beta \ln S_{i\,t} + U_{i\,t} \qquad (3)$$

This model (3) is the specified model to test the LPE in the Indian context. This model has been estimated using ordinary least squares (OLS) technique for measuring firm size – total sales in the industry. It has been estimated using both ordinary least squares and panel regression analysis, for 18 years from 1990 to 2007 across selected sectors in the Indian manufacturing.

1.4 Industry Sample and Data Source

We have chosen 8 sectors from Indian manufacturing broadly classifying them into 4 groups and have chosen 2 sectors each for a group as follow:



Note: Within parenthesis are NIC codes of selected sectors.

The empirical analysis of the present study is for the period 1990-2007 using Centre for Monitoring Indian Economy (CMIE) – PROWESS data base. Prowess is a database of large and medium Indian firms. It contains detailed information on over 23,000 firms. These comprise all companies traded on India's major stock exchanges and several others including the central public sector enterprises. The database covers most of the organized industrial activities, banking, organized financial and other services sectors in India. The companies covered in Prowess account for 75 per cent of all corporate taxes and over 95 per cent of excise duty collected by the Government of India. Prowess provides detailed information on each company. This includes a normalized database of the financials covering 1,500 data items and ratios per company.

1.5 Results and Analysis: LPE

The estimated results of ordinary least squares (OLS) are shown in Table 1.2 and in Table 1.3 we have shown panel regression results. Based on Hausman specification test (chi-square statistic with one degrees of freedom is 11.94 which is statistically significant at 1%), we reject the null hypothesis in favor of random effects and hence we have statistically chosen fixed effects model for interpretations. The estimated values of the LPE determining parameter β were significantly less than unity in both OLS and fixed effects models and these results imply that the initially small size firms are having higher growth as compared to large size firms for Indian manufacturing during the study period. Thus, our findings show that the LPE does not hold for the Indian manufacturing operating during 1990 to 2007. Since the LPE does not hold, it can be asserted that there is an optimum size of the firm and there are limits to firm size. It can also be concluded that the rate of growth of a firm in one period has influence on its growth in subsequent periods.

The basic idea of our work is to look if, over a period of time, the empirical distribution of firm sizes converges towards a lognormal distribution, under the hypothesis that this represents the limit distribution (Lotti & Santarelli, 2001). Accordingly, in order to test statistically the conformity of the logarithm of the empirical distribution to the normal distribution, we have computed some tests of normality. First of all, we have estimated the Skewness and Kurtosis statistics, which represent very good descriptive and inferential indexes for measuring normality. The Skewness and the Kurtosis indexes are the third and the fourth standardized moments of the distribution. In particular, the literature refers to the Skewness index as:

$$\sqrt{\beta_1} = \frac{E(X-\mu)^3}{\sigma^3}$$

and to the Kurtosis index as:

$$\beta_2 = \frac{E(X-\mu)^4}{\sigma^4}$$

where μ and σ are the mean and the standard deviation of the distribution under examination. Since for a normal distribution they are equal to 0 and 3 respectively, a natural way to evaluate the non-normality of a distribution is to look at the difference of such empirical moments from those values. Aimed at evaluating the pattern of convergence to a normal distribution, we have computed different tests for normality. First, we have used a simple test based on the Skewness and Kurtosis indexes (Lotti &

Santarelli, 2001), which allow to test statistically the null hypothesis : $H_0 : \sqrt{\beta_1} = 0$ and $H_0 : \beta_2 = 3$.

The Skewness index measures the degree of symmetry of a distribution: if $\sqrt{\beta_1} > 0$ it's skewed to the right, while $\sqrt{\beta_1} < 0$ corresponds to skewness to the left. Looking at Table 1.4, one can note that for Indian manufacturing the FSD does not tend to become symmetric over time, with different patterns of divergence and is still skewed to the right.

The Kurtosis index represents a measure of the curvature: distributions with $\beta_2 > 3$ show thicker tails than the normal distribution and tend to exhibit higher peaks in the center of the distribution, whereas distributions with $\beta_2 < 3$ tend to have lighter tails and to have broader peaks than the normal. For Indian manufacturing (see Table 1.5), the Kurtosis index does not show any convergence towards the normal distribution.

The results suggest a strong departure from normality of the FSD for Indian manufacturing during the entire study period. It is interesting to note that though, LPE does not hold in terms of zero effects of initial size on firm growth, the FSD ends up with lognormal distribution. It is here that we depart our focus on systematic factors affecting FSD than random process itself.

Having noticed the invalidity of LPE, we understood that the whole analysis did not indicate that no random forces are at work. We believe that there are some systematic forces either directly affecting the FSD or accelerating/decelerating the stochastic process leading to lognormal distribution.

1.6 Entry deterrent strategies as systematic forces affecting FSD[11]

[11] In the recent literature, the theory of 'Competitive Heterogeneity' has been widely used to mean inter-firm performance differences which is due to inter-firm differences in 'resources & capabilities' as proclaimed by Resource-Based-View (RBV) economists (See Hoopes, D et al (2003)). Madhok, A et al (2010) looks at competitive heterogeneity in terms of 'Comparative Firm Advantage' (CFA) wherein he clearly distinguishes between ability based and willingness based Isolating Mechanisms both simultaneously operating to determine inter-firm performance differences. However, Madhok's approach

It becomes too partial to assume that firms' normal functioning[12] without EDS will result in LPE. We believe that there is more reasoning in terms of EDS in the study of FSD beyond LPE and possible lognormal distribution of firm sizes. Firms often strategically take recourse to various entry deterrent methods to prevent entry of firms into an industry to earn excess profits, to gain market shares, to grow big, to control the markets and etc. The very fact of usage of deterrent methods by firms to deter entry will alter FSD over a period of time and it eventually results in lognormal distribution independent of LPE. Also these EDS are cost and competition variables and hence finding their statistical significance on the inequality of firm sizes will be strong evidence that the Law (LPE) doesn't hold.

The model below is similar to the one used by Harry Bloch (1981) in his seminal work '*Determinants of variance in market shares in Canadian Manufacturing*'. He states that commonly used measures of industrial concentration can be expressed as functions of the number of firms in an industry and a measure of firm size inequality. Prior to Harry Bloch, studies of the causes of industrial concentration have emphasized factors affecting the number of firms in an industry. He extended the study of causes of concentration by examining factors which affect the variance in market shares as a measure of firm size inequality. We further extend the model to explain EDS as factors causing inequality of firm size along with other systematic factors. Here we also take note of the results obtained from Gibrat's LPE estimation so that model is justified on logical ground.

Model: Size Distribution Model

A $\quad$ $\boldsymbol{Z = f\,(N, S, EDS, G)}$

Where,

complements the RBV approach and hence still be part of resources and capabilities explanations. Our approach of Entry Deterrent Strategies (EDS) determining the competitive heterogeneity is again a part of both RBV and CFA approaches as these EDSs are nothing but resources and capabilities of firms to deter new comers, and also new comers' resources and capabilities to enter despite EDS are a straight forward explanations of pre and post-entry industry dynamisms which ultimately explains the competitive heterogeneity.

[12] In the literature, we have identified a dichotomous nature of firm behavior with respect to normal competitive behavior and anti-competitive behavior. The differences are ambiguous as there are no conventional rules set to identify what constitutes a normal competitive behavior and what doesn't constitute an anti-competitive behavior (See Bishop & Walker (2010) for details).

Z	=	Variance in market shares
N	=	Number of firms
S	=	Mean firm size
G	=	Growth of firms' output sales
EDS	=	Set of strategic entry deterrents such as excess capacity proxied to be inventories, product differentiation proxied to be intangibles, advertising expenditure, R&D expenditure
O_{it}	=	Export openness
D_1	=	1 from 1990 – 1995 0 otherwise
D_2	=	1 from 2000 – 2007 0 otherwise
ε_{it}	=	Random disturbance.

A multiplicative functional form is used in estimating the relationship, such that

$$Z = \beta_1 N^{\beta 2} S^{\beta 3} e^{(\beta 4G+\beta 5EDS+\beta 6O+\varepsilon)}$$

The relationship in equation is multiplicative because the influence of each of the independent variables can be expected to depend on the values of other independent variables. Another reason for the multiplicative form is that it allows use of ordinary least squares regression on a log linear version of equation. The scale of a variable determines whether it is introduced directly or exponentially into equation. The variables in the exponent are proportions. The proportional variables are introduced exponentially so that a given change in the proportion has a constant impact on the logarithm of market share variance. Also, these variables take zero or negative values which would make the logarithm of the variable undefined in the log linear estimating equation.

1.7 Results and Analysis: Size Distribution Model

We have shown all the results in Table 1.6. Our regression analysis allows for each independent variable in each model in recursive fashion.

In model 1 we have shown panel regression results of size distribution model wherein we have modeled firm size inequality solely as a function of EDS. Without control variables the model shows statistical significance with advertising and inventories. Advertising expenditure having negative and inventories having positive relation indicate the former having possible inequality decreasing and the latter having possible inequality increasing effects.

In model 2, we have introduced number of firms operating as an additional independent variable. Here it is interesting to note that only R&D is statistically significant among all the EDS and it has inequality increasing effect. Number of firms operating is negative and statistically significant. As expected more the number of firms operating in the industry, less is the inequality with 1% statistical significance. This is due to the fact that more firms do mean greater spread of market shares which eventually reduces the inequality.

In model 3, we have introduced mean firm size as an additional variable to model 2. Here R&D and inventories are statistically significant and both have inequality increasing effects. Number of firms operating is negative and statistically significant and mean firm size is positive and statistically significant. Growing mean firm size indicates the growing difference between large and small firms' market shares. Hence bigger mean firm size, as expected, is positively related to inequality with 5% statistical significance.

As a matter of fact we also wanted to check whether growth as a variable has any effect on inequality. The intension is to examine whether LPE of Gibrat with some assumptions relaxed is valid at least partially. When we had checked for LPE alone independently, both in time series and panel regression set ups (See Tables 1.2 and 1.3), it did not confirm the validity and hence we had rejected LPE. In model 4, we have introduced growth as an additional variable to model 3. Now R&D, intangibles and inventories have shown statistical significance and established positive relation. All the EDS except advertising have shown inequality increasing effects. Number of firms and mean firm size are as expected negative and positive with 1% and 10% statistical significance respectively. To confirm its strong invalidity of LPE, we have noticed that growth variable is far from statistical significance.

In model 5 we have export openness[13] as an additional explanatory variable. Results are similar to model 4. R&D, intangibles and inventories have shown statistical significance and established positive relation; number of firms and mean firm size are statistically significant negative and positive respectively; growth variable is not statistically significant. It is imperative to note that export openness is statistically significant (1%) and inequality decreasing. With perfectly elastic foreign market demand and also domestic economy's viability to export, market scope and scale has widened and each firm gets to export the excess production. Firms in closed economy oligopoly model may have had more inequality of firm sizes possibly due to market power of bigger firms to foreclose the domestic market. Now open economy oligopoly model with exports have shown market disciplining effects having established negative and statistically significant relation with inequality of firm sizes which is possibly due to viable export options to perfectly elastic foreign market (Agarwal & Barua, 2004, 2002, 1994, 1993).

In models 6, 7 and 8 we have introduced dummy 1 (liberalization dummy) alone, dummy 2 (WTO dummy) alone and dummy 1 & dummy 2 together respectively to model 4 i.e., without export openness. The intension is to check whether effects of liberalization and WTO tariff reductions either together or in independent set ups have any impact on inequality of firm size without having to control for exports. In model 6 industry dynamics with respect firm size inequality remains same as in model 4 except for mean firm size going statistically insignificant. Dummy 1, though statistically insignificant, has inequality decreasing effect. Model 7 shows similar results in comparison to model 4, but dummy 2 though statistically insignificant, has inequality decreasing effect. In model 8, we have used both dummy 1 and dummy 2 as independent variables and the results are similar to model 6 and both dummy 1 and dummy 2 are statistically insignificant, but have inequality decreasing effects. Few interesting things to note here are when dummy 1 is used in model 6, mean firm size had turned out to be statistically insignificant;

[13] See Siddarthan & Pandit (1992); Siddarthan & Dasgupta 1983; Katrak (1980); Balakrishnan et al (2000, 2002)

whereas when dummy 2 is used in model 7, mean firm size had positive and statistically significant effects that too its level of statistical significance had improved over model 4 from 10% to 5%; when both dummy 1 and dummy 2 are used in model 8, mean firm size had again turned out to be statistically insignificant. Dummy 1 effect as a control variable has larger impact on mean firm size than dummy 2. While entry liberalization effects (Dummy 1) nullify the effects of mean firm size, WTO effects don't. Mean firm size doesn't matter in explaining inequality of firm size as long as the entry restrictions are removed and it matters when WTO tariff reductions are announced due to the fact that bigger firm or least cost per unit firm or more efficient firm tends to export more. We test for the support of this argument in models 9, 10, and 11.

In model 9, we have introduced exports and dummy 1 as open economy variables to model 4. R&D, intangibles, inventories and mean firm size are statistically significant and all have inequality increasing effects. Also number of firms and export openness are statistically significant and have inequality decreasing effects. Dummy 1 is negative but statistically insignificant. In comparison to model 6, where we had model 9 minus exports, mean firm size was not statistically significant, whereas in model 9, it is positive and turning out to be statistically significant at 5%. Export openness as an open economy variable has more impact than liberalization dummy and hence when it comes to exports, mean firm size matters due to the fact that bigger firm tends to export more. Though export openness has inequality reducing impact, mean firm size shows inequality increasing effect which is mainly due to the fact that strength of the impact is more with export openness (statistical significance at 1%) than mean firm size effects (statistical significance at 5%).

In model 10 we have replaced dummy 1 with dummy 2 into model 9. Results show that industry dynamics remain the same as in model 9 as it is evident that R&D, intangibles, inventories and mean firm size are statistically significant and positively related and number of firms and export openness are statistically significant and negatively related. Dummy 2 is negative but statistically insignificant. In comparison to model 7 and 9, one can easily notice that mean firm size has shown more strength in terms of statistical significance. This could be due to the fact that both WTO tariff reduction dummy and export openness are sequential and have negative effects on inequality. As we had observed in model 7, with dummy 2 alone that mean firm size had statistically significant relation; it is positive and statistically significant in model 10 along with export openness. Though with exports inequality decreases, these effects are disturbed with bigger firms tending to export more and hence making mean firm size a statistically significant variable. It is also interesting to note that mean firm size has stronger impact with exports (1%) and dummy 2 than exports and dummy 1 (5%).

Model 11 in a way is a complete model allowing for all the control and policy variables along with EDS. Results are similar to models 9 and 10 with R&D, intangibles, inventories and mean firm size are being statistically significant and positively related; number of firms and export openness are being statistically significant and negatively related; both dummy 1 and dummy 2 are statistically insignificant. Once again dummy 1 effects bring down the level of statistical significance of mean firm size from 1% to 5% compared to model 10.

The most important thing which we observe is the fact that from model 4 to model 11 i.e., from the model in which we had started using growth as additional independent variable, it is consistently far from statistical significance. This approves the invalidity of LPE as an approach to explain the cause of FSD and FSD resulting in log-normal distribution.

1.8 Conclusion

Rejecting Gibrat's Law of Proportionate Effect (LPE) in explaining firms' size distribution (FSD) is first step we have persuaded as it was necessary to establish strong relation between entry deterrent strategies (EDS) and FSD. While we reject LPE we have all justification and economic logic as we ourselves have estimated and contemplated the LPE. We have found a lot of reasoning in EDS explaining FSD than LPE. Any positive real number in economics is ought to have lognormal distribution and FSD converges to lognormal distribution irrespective of LPE. As a matter of fact, our concern should be not of having zero skewness. Rather we should learn to see how skewed the distribution is to the right and determinants of these variances and skewnesses within the lognormal distribution framework. As a second step, we model variance of firm size (inequality) as a function of EDS and other control and policy variables referring to previous studies and estimated results in various models show strong and statistically significant relationship between variance of firm size and EDS. Results in all the models have been interesting and we presume that the analysis has some use to concerned competition policies.

Appendix

Table 1.1: Brief Literature Review

STUDY	DATA	RESULTS
Mansfield, 1962	About 1,000 US firms in steel, petroleum and tires over 1916-57.	Gibrat's law fails to hold in about 50% of cases: smaller firms grow faster.
Brusco - Giovannetti - Malagoli, 1979	1,250 Italian firms in ceramics, mechanical and textiles over 1966-77.	Gibrat's law fails to hold in most cases when only survived firms are included: smaller firms grow faster.
Kumar, 1985	1,747 UK quoted firms in manufacture and services over 1960-76.	The relationship between size and growth was negative for the 1960-65 and 1972-76, but it was non-significant for the period of 1966-71. Overall, Gibrat's Law not valid. Small firms grow faster.
Hall, 1987	1,778 US manufact. firms over 1972-79 and 1976-83 (only incumbents)	Smaller firms grow faster.
Evans, 1987a and 1987b	42,339 US manufacturing firms, subdivided in 100 sectors.	Smaller firms grow faster in 89 industries out of 100.
Contini - Revelli, 1989	1,170 Italian firms over 1980-86 (only incumbents).	Moderate evidence that smaller firms grow faster.
Dunne – Roberts - Samuelson, 1989	219,754 US manufacturing plants over 1967-82 (only entrants).	Smaller firms grow faster.
Wagner, 1992	About 7,000 West German manufact. plants over 1978-89; (only incumbents).	Gibrat's law fails to hold, but no evidence that smaller firms grow faster.
Dunne - Hughes, 1994	2,149 UK companies over 1980-85 (only incumbents).	Smaller firms grow faster.
Mata, 1994	3,308 Portuguese manufacturing firms over 1983-87 (only entrants).	Smaller firms grow faster.
Hart - Oulton, 1996	87,109 UK companies over 1989-93 (only incumbents).	Smaller firms grow faster.
Harhoff – Stahl - Woywode, 1998,	10,902 West German firms over 1989-94 (only incumbents).	Smaller firms grow faster.
Audretsch et al. ,(1999)	1,570 Italian manufacturing firms from 19 industries over 1987-93	In most industries, the Gibrat's Law does not apply for new firms. The relationship between firm growth and start-up size is statistically significant.
Das (1995)	206 Indian firms in Computer hardware industry over 1983-88	The relationship between firm size and growth was negative, and age has a strong positive impact on growth.

Note: This Table is a compilation from previous studies.

Table 1.2: Time series OLS results:

Industry	Intercept	$Ln\ S_t$	Adjusted R sq	N
Textiles	1.32** 2.78	0.87*** 18.22	0.95	18
Food & Beverages	2.02** 2.61	0.81*** 11.04	0.87	18
TV & Radio	2.24** 2.12	0.76*** 6.75	0.72	18

Motor Vehicles	1.91* 1.85	0.82*** 8.14	0.79	18
Basic Metals	0.73 1.53	0.94*** 21.38	0.96	18
Non-Metallic Minerals	0.70* 1.97	0.94*** 26.5	0.97	18
Electrical Equipment	0.44 0.96	0.96*** 20.18	0.95	18
Machinery Equipment	1.69* 1.96	0.84*** 10.04	0.85	18

Note: ***, **, * are significant at 1, 5, and 10 % respectively.

Table 1.3: Panel results:

Dep Var	**Ln S_{t+1}**
Intercept	1.45*** 5.37
S_t	0.86*** 32.24
F	1039.71 0
F(ui=0)	1.85 0.08
corr(ui,Xb)	0.56
sigma_u	0.08
sigma_e	0.208
rho	0.131
Hausman	11.94 0.0005
R Sq	within = 0.88 between = 0.99 overall = 0.92
Model	FE
N	144

Note: ***, **, * are significant at 1, 5, and 10 % respectively.

Table 1.4: Skewness

Skewness								
Industry	Textiles	Food & Beverages	TV & Radio	Motor Vehicles	Basic Metals	Non-Metallic Min	Electrical Equipment	Machinery Equipment
1990	5.36	4.35	3.45	4.84	9.84	82.90	2.96	9.58
1991	3.89	4.48	3.63	5.97	10.95	80.25	3.26	9.90
1992	4.26	4.10	3.31	6.49	11.78	84.31	3.50	10.44
1993	4.60	4.46	4.58	6.53	12.17	85.52	3.27	11.14
1994	4.76	7.47	4.88	6.89	13.52	84.97	4.04	11.48
1995	5.70	8.41	4.11	7.61	14.21	86.63	4.43	11.14
1996	5.70	8.15	4.61	7.69	13.22	94.16	4.84	11.79
1997	5.03	5.80	4.31	7.90	12.43	99.37	4.68	11.74
1998	5.48	5.29	4.37	7.89	12.60	107.73	5.03	12.21
1999	5.40	6.30	4.43	8.08	13.98	108.07	4.97	13.12
2000	5.31	5.32	4.03	9.02	14.59	126.77	4.45	12.57
2001	5.09	7.53	3.50	8.53	13.20	129.51	3.79	12.40
2002	3.59	5.37	3.89	8.27	12.55	118.65	4.30	13.47
2003	4.67	4.59	5.18	8.48	12.47	124.72	4.88	13.64
2004	4.49	7.36	4.73	8.67	12.19	107.15	4.91	14.03
2005	5.20	7.47	5.02	8.72	11.71	112.38	5.09	13.63
2006	4.78	5.68	4.70	8.24	11.18	105.11	4.90	13.34
2007	4.41	9.96	5.15	7.61	9.78	78.89	4.58	11.78

Note: All the test statistic are statistically significant at 1%.

Table 1.5: Kurtosis

Kurtosis								
Industry	Textiles	Food & Beverages	TV & Radio	Motor Vehicles	Basic Metals	Non-Metallic Min	Electrical Equipment	Machinery Equipment
1990	35.93	24.24	12.68	25.79	101.40	82.90	11.03	104.30
1991	17.88	26.15	13.45	40.14	125.87	80.25	14.60	113.84
1992	22.40	21.08	10.60	47.04	147.08	84.31	16.92	127.88
1993	26.90	24.23	23.42	46.58	158.65	85.52	13.07	146.58
1994	27.84	79.44	26.97	51.57	196.80	84.97	19.87	156.48
1995	39.61	98.37	16.78	62.76	218.34	86.63	23.42	151.94
1996	40.97	94.55	22.24	63.13	192.66	94.16	29.16	170.21
1997	31.44	42.47	18.92	66.92	169.05	99.37	27.46	167.00
1998	38.19	35.54	19.56	66.39	176.19	107.73	28.77	176.86
1999	40.62	58.46	20.31	70.60	218.22	108.07	30.38	199.63
2000	36.06	35.80	17.25	89.14	237.58	126.77	23.68	188.17
2001	34.89	85.75	12.37	80.65	198.10	129.51	16.11	182.75
2002	15.06	37.25	15.80	74.81	178.44	118.65	22.65	208.29
2003	28.76	26.48	30.25	79.24	177.66	124.72	26.94	215.32
2004	24.41	76.70	24.65	84.39	171.28	107.15	26.57	225.59
2005	33.28	78.87	27.20	86.31	161.13	112.38	28.89	216.20
2006	26.95	43.63	24.18	77.41	146.37	105.11	26.69	203.95
2007	22.72	128.82	31.50	67.20	113.85	78.89	23.21	158.52

Note: All the test statistic are statistically significant at 1%.

Table 1.6: Inequality in FSD and EDS

Dep Var	Ln Variance in Market Shares									(144 Observations)
Model	1	2	3	4	5	6	7	8	9	10	11
Constant	-0.34	3.19***	2.65***	2.56***	1.86***	2.79***	2.43***	2.61***	2.05***	1.78***	1.92***
	-0.97	7.37	5.52	6.03	3.82	4.97	5.54	4.42	3.35	3.58	3.03
Advertising	-24.51**	3.27	2.54	4.37	-5.46	3.75	4.6	4.13	-5.87	-5.04	-5.36
	-2.44	0.39	0.31	0.53	-0.62	0.45	0.56	0.5	-0.66	-0.57	-0.6
R & D	9.77	22.74***	18.55**	16.54**	14.33*	16.73**	15.08*	15.34*	14.51*	13.2*	13.41*
	1.00	2.88	2.40	2.17	1.91	2.19	1.95	1.97	1.93	1.74	1.75
Intagibles	0.93	0.45	0.98	4.45*	4.41*	4.69*	4.91*	5.05*	4.60*	4.79*	4.90*
	0.36	0.24	0.51	1.72	1.75	1.79	1.88	1.91	1.80	1.87	1.90
Inventory	1.82***	0.59	1.20***	1.11**	1.16***	1.14**	0.97**	1.01**	1.18***	1.04**	1.07**
	3.85	1.49	2.65	2.50	2.66	2.54	2.09	2.13	2.69	2.29	2.31
No. of Firms		-0.66***	-0.68***	-0.65***	-0.53***	-0.68***	-0.65***	-0.67***	-0.56***	-0.53***	-0.55***
		-9.54	-10.02	-9.75	-6.76	-8.51	-9.7	-8.3	-6.12	-6.75	-6.03
Mean firm size			0.11**	0.08*	0.14***	0.06	0.11**	0.09	0.13**	0.17***	0.15**
			2.45	1.77	2.89	1.17	2.06	1.5	2.25	2.97	2.35
Growth				0.09	0.04	0.12	0.06	0.09	0.07	0.02	0.04
				0.70	0.35	0.86	0.48	0.61	0.5	0.18	0.3
Export Open					-2.01***				-1.99***	-1.96***	-1.95***
					-2.7				-2.67	-2.63	-2.6
Dummy 1						-0.04		-0.02	-0.03		-0.02
						0.53		-0.45	-0.52		-0.37
Dummy 2							-0.05	-0.04		-0.04	-0.04
							-1.06	-0.96		-0.88	-0.8
Wald chi2(7)	32.31	143.99	157.04								
	0	0	0								
F				22.45	21.51	19.6	19.8	17.51	19.04	19.17	17.15
				0	0	0	0	0	0	0	0
F(ui=0)				78.27	78.4	74.04	78.25	73.73	72.64	78.29	72.36
				0	0	0	0	0	0	0	0
corr(ui,Xb)	0 (assumed)	0 (assumed)	0 (assumed)	0.156	0.44	0.118	0.068	0.049	0.403	0.354	0.334
sigma_u	0.863	0.512	0.598	1.013	0.935	1.02	1.041	1.044	0.94	0.958	0.96
sigma_e	0.232	0.178	0.176	0.176	0.172	0.177	0.176	0.177	0.173	0.172	0.173
rho	0.932	0.892	0.919	0.97	0.966	0.97	0.971	0.971	0.967	0.968	0.968
Hausman	0.89	5.78	0.1	1456	1467	863.48	1393.14	869.01	814.66	1411.72	817.45
	0.92	0.32	0.99	0	0	0	0	0	0	0	0
R sq											
within	0.19	0.52	0.53	0.54	0.57	0.55	0.55	0.55	0.57	0.57	0.57
between	0.34	0.68	0.77	0.25	0.51	0.23	0.19	0.18	0.47	0.42	0.4
overall	0.25	0.62	0.7	0.26	0.47	0.24	0.2	0.2	0.45	0.4	0.39
Model Type	RE	RE	RE	FE	FE	FE	FE	FE	FE	FE	FE

Note: ***, **, * are significant at 1, 5, and 10 % respectively.

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