# Firm Dynamics of International Joint Ventures in Shanghai's Manufacturing Sector: Testing the Validity of Gibrat's Law

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**Abstract**

*How joint ventures (JVs) grow over time has important implications on government JV policies and enterprises' decisions in JV formation. This paper studies JVs in the manufacturing industries of Shanghai by analyzing the empirical relationship between the size of JVs with their growth over time. Whether Gibrat's Law can describe the dynamic behavior of JVs is tested by using the panel data of four Shanghai industries from 1989 to 1992. Two empirical results are obtained: (1) Small JVs are better in creating jobs than large JVs. (2) In terms of output growth, both small and large JVs follows a simple stochastic growth process which is more or less dictated by the Gibrat's Law.*

## Introduction

The rapid increases of joint venture (JV) activities in the seventies and eighties have developed an industry of studying JVs for the past two decades. Although numerous features of JVs have already been studied, little research has been done to understand the dynamics of JVs over time. For example, what determines the growth and the size distributions of JVs over time?

Studies in international business show that firm size is one of the important factors that determines foreign direct investment (FDI) and exporting behaviour. Researchers have focused on the static relationship between firm size and FDI or exporting behaviour: (1) Firm size is found to be positively related to FDI, i.e., the bigger the firm, the more likely will it have foreign direct investment (Horst 1972; Caves 1974; Buckley and Casson 1976; Buckley and Pearce 1979; Lipsey, Kravis and O'Connor 1983; Terpstra and Yu 1988). (2) In addition, numerous researchers have studied the relationship between firm size and exporting behaviour (a good literature review is presented in Calof 1994). They conclude that firm size is generally found to be positively related to firms' propensity to export (Bonaccorsi 1992; Calof 1994). However, how the size of JVs affects their growth over time has not been fully understood. This paper attempts to study the empirical relationship of firm dynamics, especially the growth, of JVs with their size. Does firm size affect the growth of JVs? If so, how does it affect the growth?

It is well known that the size distributions of companies are highly skewed; Log-normal distribution is commonly used to approximate the size distribution of firms. Schmalensee (1989, p. 994) terms

this regularity as a stylized fact. Early studies of firm's growth rates in the United States, e.g., Hymer and Pashigian (1962) and Mansfield (1962), generally supported Gibrat's Law of Proportionate Growth. This Law predicts that each firm faces the same distribution of growth possibilities, and each firm's actual growth is determined by random sampling from that distribution (Scherer and Ross 1990, p. 141; Wagner 1992). In other words, firm growth is *independent* of firm size. However, recent studies by Evans (1987a, 1987b), Storey et al. (1987) have found that Gibrat's Law is rejected for small firm sector because growth and size are negatively correlated, even allowing for the exiting of slow growth firms. Tschoegl and Yu (1990) also test the applicability of Gibrat's Law in the liquor brand market and their results reject Gibrat's Law as well. The purpose of this paper is to investigate whether firm growth is related to firm size by testing whether Gibrat's Law is valid for manufacturing JVs in Shanghai from 1989 to 1992.

Why is Gibrat's Law important? It has implications for industrial policies. For any developing countries which focus on economic development, a balanced economic growth and rapid industrialization are always their top priority. If Gibrat's Law holds, i.e., firm growth is independent of firm size, firm size is not a concern in designing policy program to promote business development. However, if Gibrat's Law does not hold, the government can possibly use policy to exploit the situation so as to achieve its development targets. For example, suppose the empirical results unambiguously point to a faster growth rate of smaller firms, the government should provide incentives to encourage the birth and growth of small firms (Wagner 1992). In most of developing countries, unemployment caused by rapid urbanization, surplus labor in rural sector, etc., is the most difficult problem faced by their governments. Encouraging the birth and development of small firms can help solving the unemployment problem gradually if small firms grow faster and create more jobs.

The purpose of this paper is to investigate whether Gibrat's Law is valid for JVs. There are at least two reasons that motivate an empirical study in this area. The first reason is related to developing countries' policy of attracting foreign direct investment. In attracting foreign direct investment, besides the objective of technology transfer, job creation is undoubtedly an important target. Large and well-connected multinationals are usually favoured by most developing countries because they can provide better technology and more capital to developing countries in joint venture cooperation. In addition, there is a misconception that large multinationals can always create more jobs in developing countries because their joint ventures are usually of large scale. However, job creation ability is dependent on their growth over time. If empirical results suggest that small joint ventures can grow faster than their larger counterparts, the governments should not ignore the better job creation ability of these small joint ventures. Moreover, developing countries should also consider the contribution of small international joint ventures to their economic development and be more receptive to small- and medium-sized firms in developed countries which are interested in investing in them.

The second reason stems from a theoretical argument. Gibrat's law may provide an alternative view on the growth of JVs. For more than thirty years of study, H.A. Simon (1991), a Nobel Prize winner, suggests that the present theories provide little to explain the phenomenon of firm growth. In addition, he also finds that efficiency (economies and diseconomies of scale) has little to explain firm growth which is produced mainly by a simple stochastic growth mechanism, for example, Gibrat's Law (Ijiri and Simon 1977). This hypothesis receives support from people who view firm growth as a statistical phenomenon resulting from the cumulative effects of the chance operation of a large number of forces each operating independently (Storey 1990). As a result, firm growth is independent of firm size. If this hypothesis is true, chance and luck are the determinants of the successes of firms. For example, a firm can grow rapidly simply because it has a successive run of good luck; or, a lucky chief executive officer choice may affect growth favourably for a decade or more (Scherer & Ross 1990, p. 141-145).

We are going to test the relevance of Gibrat's law to JVs in Shanghai, one of the major industrial city in the People's Republic of China (PRC). Two questions are studied in this paper. First, do small JVs perform better in creating jobs than their large coun-

terpart? Since the opening up of her economy in 1978, PRC has been one of the hottest choices for foreign direct investment. No country had more equity joint venture formation than China during the 1980s (Beamish 1993). Despite China's success in attracting JVs, little research has been done to understand how China's JV policy is related to her development objectives. Without a doubt, one of China's objectives of forming JVs is technology transfer. However, solving the unemployment problem and absorbing surplus labor in the loss-making state sector and rural areas are also very important for China. If a newly formed JV can stably grow and continuously create jobs over time, it is definitely beneficial to the Chinese economy in the long run. In addition, a government policy of setting up ten small JVs each employing one hundred workers can subsequently generate more jobs than a policy of forming one large JV employing one thousand workers in the long run. That creates a positive argument for forming more small JVs. In addition, negotiating a large JV project, which may involve several government bodies, i.e., ministries in the central government, provincial and regional governments, usually takes much longer time and much more efforts than negotiating small JV projects. In most cases, the provincial or regional governments of China can make final decisions in approving smaller JV projects so that a lot of time and efforts can be saved. If the government wants to decrease the unemployment rate, should the Chinese government pursue a policy of attracting only large multinationals or other medium- and small-sized overseas enterprises? Our empirical study can shed some light on answering this question.

Second, does the output of JVs follow a simple stochastic growth process which is independent of firm size? The better performance of small JVs is also documented by Tomlinson (1970) who finds that among the British JVs in India and Pakistan, 56% of smaller JVs operated by small parent firms provides high returns on investment (ROIs) but only 7% of those JVs involved large firms provides high ROIs. Newbould, Buckley and Thurwell (1978) and D'Souza & McDougall (1989) also conclude that smaller firms, on average, can perform better with their foreign direct investment. Although small firms usually have a higher failure rate, there is no solid evidence that a large JV is more stable than a small JV. The stability of JVs in China depends on factors which can affect both large and small JVs in China and regardless of their size, most of JVs in China are observed to be stable (Beamish 1993). According to Beamish (1993), investors from Hong Kong and Taiwan are the majority of foreign partners of JVs in China. A lot of these JVs are of smaller scale than the JVs formed with western investors. These small JVs formed with Hong Kong and Taiwanese investors (they are all ethnic Chinese) face less practical problems like communication and cultural differences than western investors. These favourable factors possessed by these JVs may account for their stability. Since the implementation of economic reform in 1978, small JVs have been making substantial progress and contribution which may have been overlooked by researchers. Testing Gibrat's Law may provide an alternative explanation.

**Data**

The data set which is supplied by the Shanghai Economic Commission includes the input-output information of manufacturing enterprises. This data set contains enterprise's net industrial output values (value-added, measured at current prices in Chinese yuan), gross industrial output values, original values of fixed assets (in Chinese yuan), net values of fixed assets, types of ownership.

Shanghai, a metropolitan city of thirteen million people is chosen because it has been one of the important commercial and industrial cities before and after 1949. According to different issues of Shanghai's Statistical Yearbooks, the city's share in the national industrial output is very high which had an average of 15 percent from 1949 to 1979 and about 7 percent in the post-reform period although Shanghai accounts for only one percent of the national population.

Among all Shanghai's manufacturing industries, two labor or less skill intensive industries (textile, clothing) and two capital or skill intensive industries (machinery and equipment, electronics and telecommunication equipment) are considered in our study. This panel data set covers 64 joint ventures: 25 in textile, 13 in clothing, 13 in machinery and equipment, and 13 in electronics and telecommunication

equipment. This data set tracks these firms from 1989 to 1992.

**Methodology**

We assume the model of firm growth to be

$$S(i, t) = S^{\beta}(i, t-1) \exp[\mu(i, t)] \quad (1)$$

where S (i, t) is the size of firm i in period t; $\beta$ is a growth parameter; and $\mu$ (i, t) is firm i's draw from the common distribution growth rates. We further assume that

$$\mu(i, t) \sim N(\alpha, \sigma^2)$$

Therefore,

$$\mu(i, t) = \alpha + \varepsilon(i, t) \text{ where } E[\varepsilon(i, t)] = 0$$

Taking logarithm of equation (1), we have the following cross-sectional relationship:

$$\log S(i, t) = \beta \log S(i, t-1) + \alpha + \varepsilon(i, t) \quad (2)$$

Gibrat's Law is equivalent to the following three null hypotheses (Tschoegl and Yu 1990):

**Hypothesis 1 (H1)**: $\beta=1$.

**Hypothesis 2 (H2,** absence of serial correlation): Cov [$\varepsilon$ (i, t), $\varepsilon$ (i, t-1)]=0.

**Hypothesis 3 (H3,** homoscedasticity): $E[\varepsilon^2(i, t)] = \sigma^2(t)$

When firms accept these three null hypotheses simultaneously, these firms are growing according to Gibrat's Law. To derive a model of estimation, equation (2) is re-arranged to take into account the possibility of first order serial correlation in growth rate (H3). This is done to avoid bias due to serial correlations in the presence of lagged dependent variables (Chesher, 1979). The following model is obtained:

$$\log S(i, t) = \alpha + \beta \log S(i, t-1) + ru(i, t-1) + \varepsilon(i, t) \quad (3)$$

where r is the serial correlation coefficient; u (i, t) = ru (i, t-1) + $\varepsilon$ (i,t); and $\varepsilon$ (i, t) is the standard stochastic error term. Re-write equation (3) in terms of lagged dependent variable, we have

$$\log S(i, t) = b_0 + b_1 \log S(i, t-1) + b_2 \log S(i, t-2) + \varepsilon(i, t) \quad (4)$$

where $b_0 = (1-r)\alpha$, $b_1 = \beta + r$, $\beta_2 = -\beta r$. The inclusion of log S (i, t-1) and log S (i, t-2) may cause the possibility of high multicollinearity. To reduce the numerical problems caused by multicollinearity, we add and subtract $\beta r \log S(i,t-1)$ from the right hand side of equation (4). Re-arranging terms results in the following equation:

$$\log S(i, t) = b_0 + b_3 \log S(i, t-1) + b_2 \log S(i, t-2) - \log S(i, t-1)] + \varepsilon(i, t) \quad (5)$$

Now $b_3 = \beta + r - \beta r$ ($b_1$ is easily recovered by $b_3 - b_2 = b_1$), and $b_2$ still equals $-\beta r$. Although, mathematically, equation (5) is identical to equation (4), equation (5) has a much lower correlation between its first two explanatory variables. Because of the limited number of JVs in each industry, we pool all four industries together in the estimation and testing. Therefore, an additional set of dummy variables is added to equation (5) in order to capture the effects caused by different industries.

$$\log S(i, t) = b_3 \log S(i, t-1) + b_2 \log S(i, t-2) - \log S(i, t-1)] + \sum_{j=1}^{4} a(j) D(i, j) + \varepsilon(i, t) \quad (6)$$

where D (i,j) represents firm i belonging to industry j and j = 1,..,4. $b_0$ is deleted in estimation so as to avoid its perfect collinearity with the four dummy variables. We test Gibrat's Law (H1, H2 and H3) using equation (6). $\beta$ and r are recovered by solving the following equation

$$\beta = [b_1 + \sqrt{b_1^2 + 4b_2}]/2, \quad r = [b_1 - \sqrt{b_1^2 + 4b_2}]/2$$

If we subtract log S (i, t-1) from both sides of equation (2), we have

$$\log S(i, t) - \log S(i, t-1) = g(i, t) = (b - 1) \log S(i, t-1) + \alpha + \varepsilon(i, t)$$

where g(i, t) is simply the growth rate of firm i in period t. Obviously, if H1 does not hold, the growth rate, g (i, t), is not independent of firm size S (i, t - 1). Firms started with larger size can always grow faster (slower) than firms started with smaller size as long as $\beta > (<) 1$. There are different implications resulted from the rejection of H1. If $\beta>1$, concentration will increase more rapidly than the case of $\beta=1$. Large firms can quickly dominate the market. However, if $\beta<1$, concentration may not decrease over time despite the fact that small firms grow faster than large firms. Whether concentration decreases or not depends on another parameter, $\rho^2$, which is the squared correlation coefficient between log S (i, t) and log S(i, t-1) (Tschoegl and Yu 1990). It can be easily shown that the ratio of variances of log S (i, t) and log S (i, t-1) follows:

$$\frac{\text{var [log S (i, t)]}}{\text{var [log S (i, t - 1)]}} = \frac{\beta^2}{\rho^2}$$

the ratio of $\beta^2/\rho^2$ can be estimated by the sample estimate of $\beta^2/R^2$ where $R^2$ is the coefficient of determination of equation (2). Obviously, if $\beta<1$, dispersion will decrease only if $R^2 > \beta^2$.

Firm size is commonly measured by its employment, e.g., the U.S. Small Business Administration classifies firms that employ less than five hundred workers as small firms, or by its output. In testing Gibrat's Law, we adopt both definitions of firm size. In order to test hypothesis H3 (presence of heteroscedasticity), Breusch and Pagan (1979) and Godfrey (1978) test for heteroscedasticity is used. The estimation and testing are done by SHAZAM 6.2[1].

## Empirical Results

The results of empirical tests are reported in Table 1a, 1b and 2. Since the acceptance of Gibrat's Law required that hypothesis H1, H2 and H3 hold simultaneously, only JVs during certain periods of time can clearly accept all three hypotheses: In Table 2, the Breusch-Pagan-Godfrey tests show that all JVs are free of heteroscedasticity, i.e., hypothesis H3 is accepted. In Table 1a, only the JVs in 1992 accept hypothesis H1 and H2 when the firm size is measured by employment. Therefore, the JVs in 1992 fully accept Gibrat's Law. However, on average, the JVs reject either hypothesis H1 or hypothesis H2 more often. The rejection is especially strong in 1991. Since estimated $\beta$ are all less than 1, it suggests that small JVs grow faster and create more jobs.

However, when firm size is measured by output, all JVs nearly accept both hypothesis H1 and H2 for all periods except that the output of JVs in 1992 rejects H2 (Table 1b). This result indicates that output growth of joint ventures is more likely to follow Gibrat's Law, i.e., in terms of firm growth, large JVs do not have any advantage over any small JVs and all JVs' output simply follows a simple stochastic growth model. Nevertheless, all statistically significant $\beta$ estimates are less than one, as shown in Table 1a, suggesting that small firms do grow faster than their larger counterparts and the jobs created by these small JVs are more permanent because they are still expanding rapidly in terms of output and employment. Combining these two results, there is a positive argument for promoting small JVs since they do help in solving the unemployment problem in China.

According to our empirical results, the Chinese economy can have more dynamic gains by forming ten small JVs each employing one hundred workers than by creating a large JV employing one thousand workers. The result that small firms grow faster has important implications for the economic development policy of China. One major problem that has been bothering the Chinese government is how to stop the heavy losses made by giant state-owned enterprises (SOEs). Such heavy losses are basically the reason for persistent budget deficits of the central government. To finance these deficits, the government has to resort to printing money which creates inflation. One solution to stop this nightmare is to close these loss-making SOEs. However, letting these loss-making SOEs go bankrupt will create mass unemployment which may cause instability to the society. Judging from their job creation ability, small firms may help in restructuring the economy by reallocating workers from the loss-making SOEs to them. Moreover, the presence of more small firms can also increase the competition in the market. Consequently, the Chinese government may need a long term and well planned small business policy to pro-

**Table 1a.**
**Results of testing Gibrat's Law (ß=1 and r=0) on manufacturing joint ventures in Shanghai (size measured by employment)**

| | 1991-92 | 1991 | 1992 |
|---|---|---|---|
| β and r[1] | (6.519*) | (9.255**) | (2.321) |
| β | 0.949** | 0.919* | 0.973 |
| (β=1) | (7.664) | (5.651) | (2.278) |
| r | 0.124 | 0.304** | 0.112 |
| (r=0) | (1.765) | (11.27) | (1.315) |
| $R^2$ | 0.957 | 0.945 | 0.979 |
| Firm no. | | 64 | |

Notes: 1. Joint test of ß=1 and r=0. The values in parentheses are the F statistics of the corresponding restrictions. '*' implies $p < 0.05$ and '**' implies $p < 0.01$.

**Table 1b.**
**Results of testing Gibrat's Law (ß=1 and r=0) on manufacturing joint ventures in Shanghai (size measured by output)**

| | 1991-92 | 1991 | 1992 |
|---|---|---|---|
| β and r[1] | (1.855) | (0.110) | (3.494) |
| β | 1.030 | 1.000 | 1.065 |
| (β=1) | (0.409) | (0.000) | (1.194) |
| r | -0.192 | -0.046 | -0.352* |
| (r=0) | (3.700) | (0.177) | (4.001) |
| $R^2$ | 0.815 | 0.855 | 0.804 |
| Firm no. | | 64 | |

Notes: 1. Joint test of β=1 and r=0. The values in parentheses are the F statistics of the corresponding restrictions. '*' implies $p < 0.05$.

**Table 2.**
**Results of Breusch-Pagan-Godfrey test for Hypothesis H3**

| Period | measured by employment | measured by output |
|---|---|---|
| 1991-92 | 7.338 | 8.893 |
| 1991 | 6.410 | 3.941 |
| 1992 | 5.301 | 8.943 |

Notes: The reported values are the Breusch-Pagan-Godfrey test statistics (Chi-square statistics) of the case in which firm size is measured by the their employment and output.

mote the birth and development of small firms.

## Conclusion

This short paper studies the empirical relationship between the size of JVs and their growth over time by testing whether Gibrat's Law can adequately describe the dynamic behaviour of the JVs. The panel data set used in this empirical study includes four industries in Shanghai from 1989 to 1992. Our empirical results obtained are as follows: (1) Small JVs are better in creating jobs than their large counterparts. (2) In terms of output growth, small JVs are similar to large JVs that both types of firms follows a simple stochastic growth process which is more or less dictated by Gibrat's Law. Based on this result, the economies of developing countries (at least, the Chinese economy) can reap more dynamic benefits by creating more small JVs than large JVs as small JVs create more jobs over time and help solving their unemployment problems.

## Suggestions for Future Research

Since our basic goal of this paper is to present a first report of the growth of Chinese joint ventures which have been developing rapidly for the past ten years, there are at least two directions for further research in small firm effect on the dynamics of JVs: (1) Studies should be undertaken to check the validity of this small firm effect that smaller JVs can grow faster than larger ones across different countries. (2) If this small firm effect does exist, one should examine which factors cause it and how this small firm effect works theoretically.

**Endnotes**

1. In Evans (1987b) an empirical issue called sample selection bias appears: All firms are present at the beginning of the sample period but some firms exit before the end of sample period. It creates an issue of sample censoring. In our panel data set, this issue is not present because the early exited firms are not considered.

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