Does Gibrat's Law Hold for Retailing?

Evidence from Sweden

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ABSTRACT. Gibrat’s Law predicts that firm growth is a purely random effect and therefore should be independent of firm size. The purpose of this paper is to test Gibrat’s law within the retail industry, using a novel data-set comprising all Swedish limited liability companies active at some point between 1998 and 2004. Very few studies have previously investigated whether Gibrat’s Law seems to hold for retailing, and they are based on highly aggregated data. Our results indicate that Gibrat´s Law can be rejected for a large majority of five-digit retail industries in Sweden, since small retail firms tend to grow faster than large ones.

***JEL* Classifications**: L11; L25; L81

Keywords: firm dynamics; firm size; firm growth; retail industry

1. Introduction

In 1931, after observing that the size distribution of French manufacturing establishments closely resembled the lognormal distribution, Robert Gibrat suggested a law of proportionate effect. Gibrat's Law predicts that firm growth is a purely random effect, independent of firm size (Gibrat, 1931). The law has received great interest in the literature, as attested by two authoritative surveys in the Journal of Economic Literature (Sutton, 1997; Caves, 1998) as well as by Geroski (1995) and Lotti et al. (2003).

Recent studies tend to reject the hypothesis that growth is independent of firm size. Instead, it seems that small firms grow faster than large ones (Hall, 1987; Evans, 1987a, 1987b; Dunne et al., 1989; Dunne and Hughes, 1994; Audretsch et al., 1999; and Calvo, 2006).

However, some researchers (Mowery, 1983; Hart and Oulton, 1996; Cefis and Orsenigo, 2001; Becchetti and Trovato, 2002; Lotti et al., 2003; and Geroski and Gugler, 2004) still argue that Gibrat's Law holds for firms over a certain size, i.e, for those larger than the industry minimum efficient scale (MES) of production. Other studies that could not reject at least a weak version of the law are Bottazzi et al. (2005), Droucoupoulos

(1983), Hardwick and Adams (2002), and Audretsch et al. (2004).

As noted by Coad (2009, p. 25), most empirical studies of Gibrat's Law have focused exclusively on the manufacturing sector. But growth might differ across industries (Wilson and Morris, 2000; Audretsch et al., 2004). Since the manufacturing industry is capital intense, characterized by scale economies and high sunk costs, small manufacturing firms might need to grow faster than large ones in order to survive. But in industries such as retailing, where scale economies, sunk costs, and capital intensity are not as essential for firm growth, small firms might not need to grow faster than larger ones to survive (Petrunia, 2008). Thus, Gibrat's Law might hold in retail industries.

An increasing number of studies have investigated the relationship between size and growth of service firms (Variyam and Kraybill, 1992; Johnson et al., 1999; Wilson and Morris, 2000; Audretsch et al., 2004; Nunes and Serrasquieiro, 2009). In most cases the results seem to be qualitatively similar to those obtained for manufacturing. However, very few studies provide analysis particularly as to whether Gibrat's law holds for the retail industry.[1] Notable exceptions are Singh and Whittington (1975), Dunne and Hughes (1994), Hart and Oulton (1999), and Petrunia (2008). However, the results are ambiguous, being based on highly aggregated data, and not focused on differences within the retail industry.

Using a data set consisting of all limited liability firms in 5-digit retail-industries in Sweden during the period 1998-2004, we tested Gibrat's Law. Our data-set makes it possible to focus on variations in the size-growth relationship *within* the retail industry, at the least aggregated level possible.

With all retail firms included in the sample, Gibrat's law can be rejected for 81.2% of retail industries when firm size is measured by employment, and for 60.9% when measured by revenue. With only surviving firms included in the sample, the law is rejected in 62.9% and 61.9% of cases, respectively. Finally, with only firms exceeding industry minimum efficient scale (MES) included, it can be rejected in 83.6% and 60.9% of cases, respectively.

[1] This does not mean that there has not been any analysis conducted, but rather that the retail industry has been included as a sub-sample within the service industry or within all firms.

Gibrat's Law is thus rejected for a majority of the five-digit retail industries in Sweden. In general, small firms seem to grow faster than large ones, confirming evidence from other industries. However, Gibrat's Law holds more often when only firms that survived during the study period are included. Hence, small retail firms seem to have higher growth rates, but also lower survival rates, than large firms.

The next section reviews previous empirical studies that investigated whether Gibrat's law holds for the retail industry, followed by the data and the econometric model in section 3. The results are presented in section 4, while section 5 summarizes and draws conclusions.

2. Previous empirical studies of Gibrat's Law for retailing

While many studies have tested Gibrat's Law for manufacturing (Coad, 2009), few have tested it for the retailing. Table 1 summarizes the previous studies that did focus at least part of their analysis on retailing.

Singh and Whittington (1975) used firm growth data for almost 2,000 listed firms in 21 industry groups (including retailing) in the United Kingdom during the period 1948-1960. Gibrat's Law seemed to hold for retailing, though the results overall provided some support for a positive relationship between firm size and firm growth.

[Table 1 about here]

Dunne and Hughes (1994) used data on 1,172 firms in the United Kingdom during the period 1975-1980 and 1,696 firms during 1980-1985. They separated the data into 19 industries (including retailing), arguing that (p. 125): *"if some industries are characterised by a fast overall growth in their market, and a smaller average size of company, then an analysis for all industries taken together may produce an apparently negative relationship between size and growth even though within each industry a positive relationship, or no relationship, may exist."* Using data on 127 retail firms, they found that small retail firms seemed to grow faster than large ones during 1975-1980. On the other hand, they could not reject Gibrat's Law for 161 retail firms during 1980-1985.

Hart and Oulton (1999) argue that previous studies testing Gibrat's Law suffered from two major drawbacks. First, the data in most studies had been truncated, excluding the smallest firms. Second, previous studies had mostly focused on the relationship between firm size and growth in manufacturing. To deal with these problems, they used data (from the OneSource database of UK company accounts) on 28,445 firms in 46 industries, including 3,426 in two two-digit retail industries (SIC-80 codes 64 and 65). Small firms seemed to grow faster than larger ones in one of the retail industries (SIC-80 code 65), but not in the other.

Finally, Petrunia (2008) investigated whether Gibrat’s Law seemed to hold for the retail and manufacturing industries in Canada during 1986-1995. The law was always rejected for the aggregated retail industry, as small retail firms had a higher growth rate than large ones. When the sample was separated into 22 two-digit manufacturing industries and 6 two-digit retail industries, Gibrat’s Law could still be rejected for all retail industries when only incumbents were analyzed, and for most of them even when new entrants were included.

Results from previous empirical studies are thus ambiguous. Furthermore, the studies are often based on small samples, and always performed at a high industry aggregation level. In order to facilitate comparisons with previous studies, our study (Daunfeldt et al., 2010) is summarized on the bottom row of Table 1. We use a data-set that consists of 18,141 firms during the period 1998-2004. The richness of the data makes it possible to perform the analysis at the least aggregated (5-digit) industry-level. We find that Gibrat's Law can be rejected both for the aggregate retail industry and for a majority of the 5-digit retail industries. The results thus confirm previous findings from other industries that small firms tend to grow faster than large ones.

3. Data and Empirical Method

3.1 Data

All limited liability firms in Sweden are legally required to submit an annual report to the Swedish patent and registration office (PRV). The data used in this study was collected from MM (Market Manager) Partner, now merged with PAR, a Swedish consulting firm that gathers economic information from PRV, used mainly by Swedish commercial decision-makers. The data covers all Swedish limited liability companies in the retail industry that were active at some point during 1998-2004, 18,141 firms in total, and 94,954 observations - including all variables found in the annual reports, e.g., revenues, profits, number of employees, salaries, fixed costs, and liquidity.

We set out to test whether Gibrat's Law could be rejected for 5-digit retail industries in Sweden during the period 1998-2004.

Only annual data on firm size and industry classification are needed to perform such an analysis. Many indicators have been used to measure firm size in the literature (Delmar, 1997). Employment and revenue are the most commonly used indicators of firm size, so we employed them in this paper. In the data, retail firms are classified into industries according to the European Union's NACE-standard, a classification based on firm activity commonly employed by Statistics Sweden (SCB). The comprehensive data-set thus makes it possible to estimate whether Gibrat's law holds for firms active in five-digit NACE-industries.

Descriptive statistics of the variables included in the empirical analysis are given in Table 2. The variables are further discussed in the next section.

[Table 2 about here]

3.2 Empirical Model

To test Gibrat’s law for sectors within the Swedish retail industry, the following equation is estimated using ordinary least-squares:

$$\ln S_{it}^{j} = \alpha_{jo} + \alpha_{j1} \ln S_{it-1}^{j} + \varphi_{t}^{j} + \varepsilon_{it}^{j} \tag{1}$$

where S_{it}^{j} is the size of firm *i* in industry *j* (*j*=1,2,...,69) in period *t* (*t*=1998,...,2004), and φ_{t}^{j} is a vector of time-specific fixed effects included to capture time-variant heterogeneity in growth rates. Size is measured as either the number of employees or the revenue of the firm. Gibrat's law is found to hold if α_{j1} is equal to one, whereas an estimated parameter that is smaller than one implies that smaller firms grow faster than large firms, and vice versa.

4. Results

We first estimated Equation (1) for the retail industry as a whole using three model specifications. Model I was estimated on the full sample, consisting of both surviving firms and firms that exited during the study period.[2] However, including all firms might obscure the relationship between size and growth, since smaller firms have higher exit rates than larger firms (Lotti et

[2] In Mansfield's (1962) renditions, the regressions testing the law took a form where the growth rate, not the logged size of the firm was included as the dependent variable. In Model I, a growth rate of -100% was attributed to firms that made exit. Using Equation (1) a similar operation is not possible, as this would entail assigning the size 0 to firms that made exit. As the log of 0 is impossible, we instead delete firms when they exit.

al., 2003). We therefore estimated Model II using only firms that survived the study period. Finally, Model III included only firms above the MES of the industry, defined as the median plant-size measured as number of employees. These three models correspond to Mansfield's (1962) three renditions of Gibrat's law.

The results are presented in Table 3.

[Table 3 about here]

The results indicate that $\alpha_1 < 1$, irrespective of whether we use number of employees or revenues as our firm size variable, and irrespective of whether all firms, only continuing firms, or only firms above industry minimum efficient scale are included in the sample. Thus small retail firms tend to grow faster than large ones, so that firm growth is dependent on firm size, supporting a large majority of previous studies on the relationship between firm size and firm growth more generally.

The fact that Gibrat's Law does not seem to hold even when only firms above the industry MES are studied is less expected, and contradicts many previous studies (e.g., Mowery, 1983; Hart and Oulton, 1996; Cefis and Orsenigo, 2001; Becchetti and Trovato, 2002; Lotti et al, 2003; Geroski and Gugler, 2004).

However, differences in industry context could mean that Gibrat's law is rejected for some industries, but not for others (Audretsch and Elston, 2010). Hence, aggregating all retail firms might obfuscate relationships that would show up in less aggregated analysis. Equation (1) is therefore also estimated separately for each five-digit retail industry *j* (*j*=1,2,...,69) during the period 1998-2004.

Figures 1, 2, and 3 illustrate the 5-digit results from Table 3. Only industries with at least 30 valid observations are included in the sample.

[Figure 1 about here]

Gibrat’s Law can be rejected, applying the conventional 5% significance level, for 56 of 69 retail industries in Sweden (81.2%), measuring firm size by employment (Figure 1). Gibrat’s Law holds more often when revenues is used to measure firm size, but can still be rejected in 42 of 69 industries (60.9%). The estimated parameter is $\alpha_{j1} < 1$ in all cases when the law is rejected, indicating that small retail firms in general grow faster than large ones.

Figure 2 shows the corresponding numbers when only firms that survived during the study period are included. With firm size measured by employment, Gibrat's Law can be rejected for 40 out of 63 industries (62.9%); measured by revenue, it can be rejected in 39 out of 63 cases (61.9%). Thus, Gibrat’s law is rejected less often when only surviving firms are included, implying that small retail firms tend to have faster growth than large ones, but also higher exit rates. The results differ little whether employment or revenue is used as measure of size.

[Figure 2 about here]

Previous studies have suggested that Gibrat’s law should be rejected less often when only firms larger than industry minimum efficient scale of production are included, for two reasons. First, small firms need to grow faster than large firms to reach a certain MES. Second, small firms may simply grow faster because of regression to the mean, i.e., above average growth rates tend to be followed by results closer to the average.[3]

[Figure 3 about here]

[3] A well known example is that superior performance for sport rookies in a likely to be followed by poorer performance due to regression alone (Gilovich, 1991).

However, this does not appear to be the case for the Swedish retail industry (Figure 3). On the contrary, Gibrat's Law can be rejected at least as often when only firms over minimum efficient scale are included (56 out of 67 cases, or 83.6% with firm size by employment, and 42 out of 69 cases, or 60.9% measured by revenue). Thus, the negative relationship between firm size and firm growth is still present even when the smallest firms within each 5-digit retail industry are excluded. Nunes and Serrasqueiro (2009) presented similar findings for Portuguese companies in the service sector, finding a negative relationship between firm growth and firm size irrespective of whether small, medium or large companies were analyzed.

To summarize, Gibrat's Law is rejected for a large majority of retail industries when all firms are included in the sample and employment is used to measure firm size. Gibrat's Law is rejected less often when revenue is used to measure size, so the choice of size-measure influence the results. The results are very similar when only firms above industry minimum efficient scale are included, despite the fact that many studies have suggested that Gibrat's Law should hold more often in this case. However, when only firms that survived the study period are included, Gibrat's law seems to hold more often, suggesting that firms that exited during the study period were often small and characterized by high initial growth.

When Gibrat's law is rejected the estimated coefficient α_{j1} is statistically larger than one in 0% of cases when using data on all firms, regardless of the choice of size-measure, in only 2.5% (employment) and 5.1% (revenue) when using only surviving firms, and again in 0% of cases regardless of size-measure when using only firms above industry MES. This clearly suggests that small retail firms in general grow faster than large ones.

To analyze whether there is a similar pattern at more aggregated industry level, Equation (1) was also estimated on the 3-digit and 4-digit level (Table 3).

[Table 3 about here]

Gibrat's Law can be rejected for all 3-digit retail industries in four out of six specifications. In the remaining two, it can be rejected for six of seven 3-digit industries.[4] Gibrat's law could also be rejected in 71%-93% of cases when the analysed at the 4-digit level. It seems that a less aggregated analysis means that

[4] The estimation results for all 3-digit retail industries are presented in Tables A1 and A2 in the Appendix. Repair of personal and household goods (527) is the only 3-digit retail industry for which Gibrat's Law could not be rejected.

Gibrat's Law holds more often. An aggregated analysis might thus wipe out effects that would show up otherwise. The estimated parameter is smaller than one in almost all cases, suggesting again that small firms in general grow faster than large ones.

5. Summary and Conclusions

Gibrat's Law is probably one of the most investigated areas of firm growth. For example, Gibrat's Law has received "a huge amount of attention in the empirical industrial organization literature" Coad (2009, p. 39). Many studies have used micro-level firm data to test Gibrat's Law, concluding that smaller firms grow faster than large ones (see overview by Lotti et al., 2003). However, previous empirical studies on firm growth have almost excessively focused on manufacturing firms (Audretsch et al., 2004; Coad., 2009). More recent studies have also analysed firm growth in the service sector, but the results have been qualitatively similar.

We tested Gibrat's Law on the retail industry using a comprehensive data-set including all limited liability firms in the Swedish retail industry during the period 1998-2004. Very few studies have previously investigated the relationship between firm size and firm growth in retailing, and they have all been based on highly aggregated data. Our data-set made it possible to test whether Gibrat's Law could be rejected for 5-digit retail industries.

It has been argued that there might be industry differences in the extent to which Gibrat's Law holds (Petrunia, 2008). Manufacturing firms, for example, are active in industries characterized by scale economies, sunk costs, and high capital intensity, suggesting that small manufacturing firms need to grow faster than small retail firms in order to survive. Thus, Gibrat's Law might be more likely to hold in retailing. However, we found that Gibrat's Law could be rejected for a large majority of the five-digit retail industries in Sweden. In accordance with previous studies, small firms tend to grow faster than large ones.

This result might be due simply to regression to the mean, i.e., that large firms grow slower because above average growth-rates tend to be followed by results closer to the average. However, we found that Gibrat's Law could be rejected as often when only firms above industry minimum efficient scale were included. Thus, the negative relationship between firm size and firm growth was still present when the smallest firms within each 5-digit retail industry were excluded.

Gibrat’s Law could be rejected less often when only firms that survived during the study period were included. This suggests that small young retail firms may be characterized by high growth rates but also lower survival rates.

Even though we found that Gibrat’s Law could be rejected in most cases, it still seems to hold in 16-39% of the studied industries when analysed at 5-digit level. This contradicts our results at higher levels of aggregation (reported in Table 2), and also contradicts most other recent empirical studies on the relationship between firm size and firm growth. Aggregate analysis can thus give misleading results on the relationship between firm growth and firm size. Future studies should therefore investigate more carefully under what circumstances Gibrat's Law seems to hold. This is important since intra-industry differences regarding Gibrat’s Law might depend on barriers to growth or barriers to survival.

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Table 1. Summary of previous empirical studies on whether Gibrat's Law seems to hold for retailing

Study	Country	Period	Firms	Industry level	Reject Gibrats law?
Singh and Whittington (1975)	UK	1948-1960	NA[a]	2-digit	No
Dunne and Hughes (1994)	UK	1975-1980,	127	2-digit	Yes
		1980-1985	161		No
Hart and Oulton (1999)	UK	1989-1993	3426	2-digit	Yes (SIC-code 65)
					No (SIC-code 64)
Petrunia (2008)	Canada	1986-1995	48487	2-digit	Yes[b]
Daunfeldt et al. (2010)	*Sweden*	*1998-2004*	*18141*	*5-digit*	*Yes*[b]

Note: [a] NA=Not Available. [b] In most cases. Petrunia are less likely to reject Gibrat's law when new entrants are studied, whereas Daunfeldt et al. (2010) could not reject Gibrat's law in between 20% and 41% of the studied industries.

Table 2: Means and standard deviations of size-variables

	N	Min	Max	Mean	Standard dev.
Employees	94,954	1	13,452	9.2	149.0
Revenue (1'000s of SEK)	94,381	1	33,083,000	19862.14	387844.6

Table 3. Summary of estimation results (Eq.1) at the 3, 4 and 5-digit industry-classification levels. Number of retail industries with α=1, α<1, and α>1 by model and degree of aggregation, with size measured by employment and revenue.

	Firm size measured by employment			Firm size measured by revenue		
Model 1: All firms	a_1=1	a_1<1	a_1>1	a_1=1	a_1<1	a_1>1
3-digit	0	7	0	1	6	0
4-digit	2	27	0	7	22	0
5-digit	13	56	0	27	42	0
Model 2: Surviving firms	a_1=1	a_1<1	a_1>1	a_1=1	a_1<1	a_1>1
3-digit	1	6	0	0	7	0
4-digit	9	20	0	8	20	1
5-digit	23	39	1	24	37	2
Model 3: Firms above MES	a_1=1	a_1<1	a_1>1	a_1=1	a_1<1	a_1>1
3-digit	0	7	0	0	7	0
4-digit	2	27	0	5	24	0
5-digit	11	56	0	27	42	0

MES = Minimum efficient scale

Figure 1. Results from industry-specific regressions testing Gibrat's Law for *all* firms in 5-digit retail industries, 1998-2004(Model I). Number of 5-digit retail industries with α=1, α<1, and α>1, with firm size measured by employment and revenue.

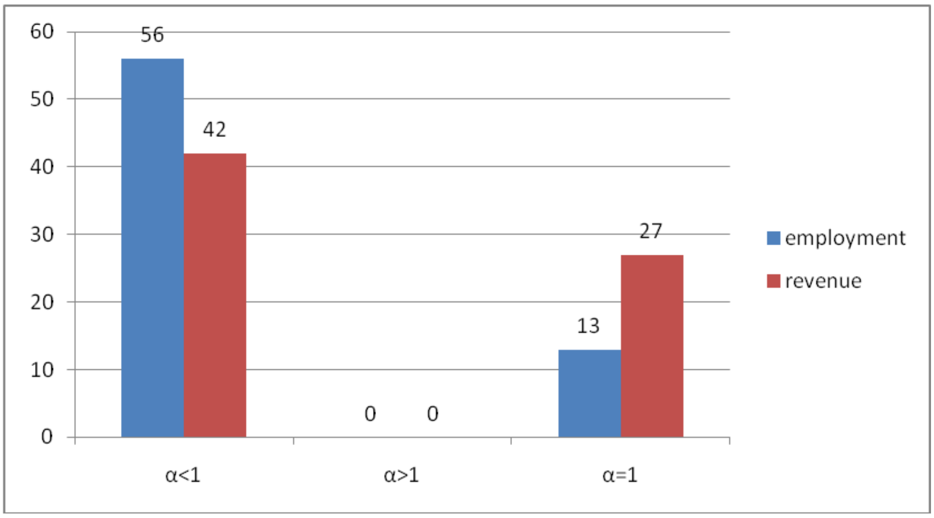


Figure 2. Results from industry-specific regressions testing Gibrat's Law for *surviving* firms in 5-digit retail industries, 1998-2004 (Model II). Number of 5-digit retail industries with α=1, α<1, and α>1, with firm size measured by employment and revenue.

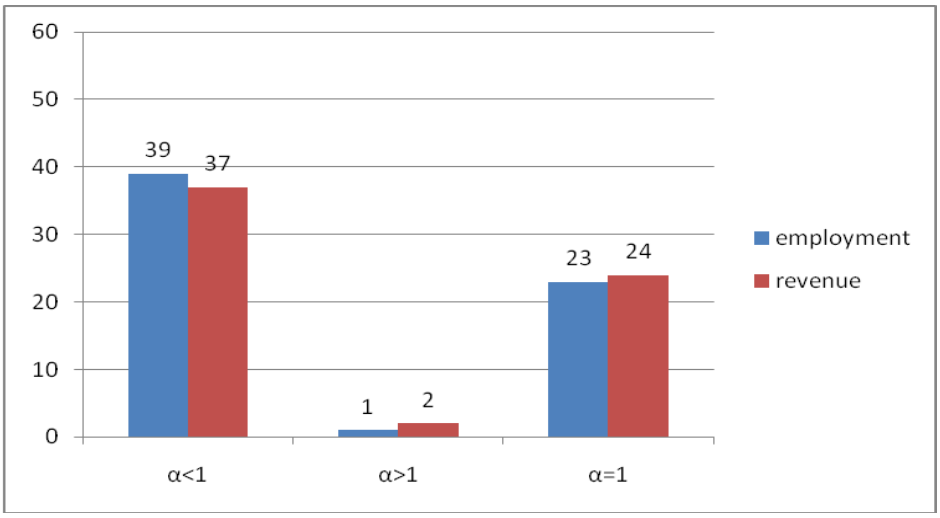
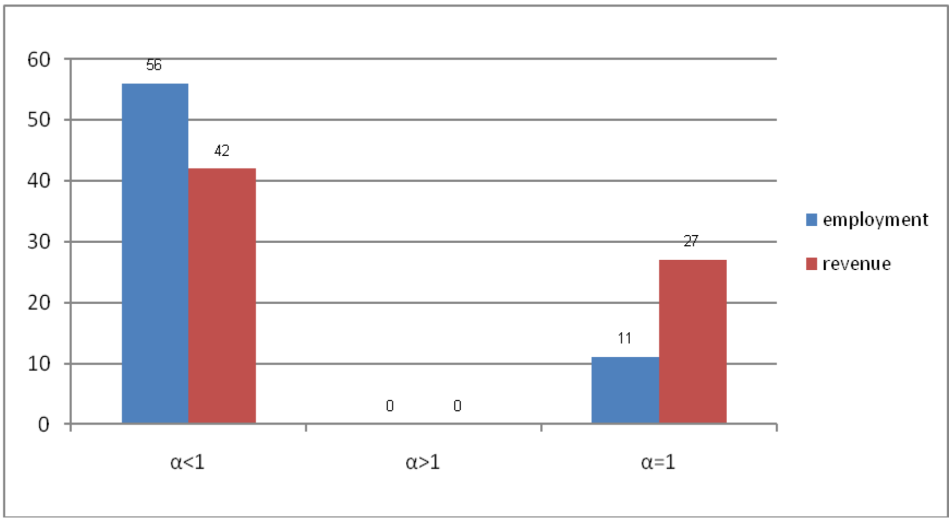


Figure 3. Results from industry-specific regressions testing Gibrat's Law for all firms larger than industry MES in 5-digit retail industries, 1998-2004 (Model III). Number of 5-digit retail industries with α=1, α<1, and α>1, with firm size measured by employment and revenue.



APPENDIX

Table A1. Estimation results (Eq.1) for each 3-digit retail industry with firm size measured by employment

	All firms		Surviving firms		Above MES	
3-digit retail industry	α	t-value	α	t-value	α	t-value
521 Retail sale in non-specialized stores	0,97	-12,34	0,98	-6,28	0,92	-20,17
522 Food, beverages, tobacco	0,93	-14,09	0,96	-8,36	0,88	-20,57
523 Pharmaceuticals, medical goods, cosmetics, toilet articles	0,97	-3,39	0,98	-2,36	0,96	-4,47
524 Other retail sale of new goods in specialized stores	0,96	-30,45	0,97	-20,28	0,92	-50,44
525 Second-hand goods	0,93	-4,59	0,93	-3,71	0,94	-4,14
526 Retail sale not in stores	0,98	-4,30	0,99	-2,32	0,96	-5,45
527 Repair of personal and household goods	0,98	-3,81	0,99	-1,47	0,95	-7,39

Table A2. Estimation results (Eq.1) for each 3-digit retail industry with firm size measured by revenue

	All firms		Surviving firms		Above MES	
3-digit retail industry	α	t-value	α	t-value	α	t-value
521 Retail sale in non-specialized stores	0,96	-13,24	0,97	-12,34	0,91	-19,91
522 Food, beverages, tobacco	0,91	-14,47	0,90	-14,09	0,87	-19,50
523 Pharmaceuticals, medical goods, cosmetics, toilet articles	0,95	-4,45	0,97	-3,39	0,96	-4,66
524 Other retail sale of new goods in specialized stores	0,96	-26,36	0,97	-30,45	0,94	-36,60
525 Second-hand goods	0,92	-5,02	0,92	-4,59	0,92	-4,41
526 Retail sale not in stores	0,97	-3,64	0,98	-4,30	0,96	-4,92
527 Repair of personal and household goods	0,99	-1,58	1,01	-3,81	0,98	-3,11