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Concentration and market size: lower bound estimates for the Brazilian industry

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Abstract

The paper estimates the lower bound for market concentration taking as reference the framework advanced by Sutton (1991). Quantile regression methods were considered in the context of the Brazilian manufacturing industry in 2005 and separate estimates were obtained for exogenous and endogenous sunk cost industries. The evidence favoured a convergence of the concentration lower bound towards zero in exogenous sunk costs industries in line with previous empirical evidence for developed countries. In contrast, the magnitude was similar in the case of endogenous sunk cost industries what might reflect the low technological effort in that emerging economy

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1. Introduction

The recent empirical literature on Industrial Organization-IO increasingly relies on game-theoretical foundations. This tendency motivates a movement towards industry-specific studies and further highlights the disenchantment with inter-industry studies [see e.g. Schmalensee (1989)]. In contrast, the bounds approach advanced by Sutton (1991, 1998) explores robust relationships that hold across different sectors in a game-theoretic setting where different types of sunk costs may prevail. The referred theoretical framework has induced a handful of empirical studies as given by Sutton (1991), Lyons and Matraves (1996), Robinson and Chiang (1996) and Giorgetti (2000, 2003). A salient prediction implied by Sutton (1991) refers to the differential behaviour of the asymptotic concentration as market size increases depending on the nature of sunk costs. An implication of his framework would be that the referred lower bound would remain above zero in the case of industries with endogenous sunk costs (related to advertising and R&D) whereas it would converge to zero in the case of industries with exogenous sunk costs.

The evidence, despite difference in magnitudes and sectors´ definitions, appears to corroborate distinct patterns depending on the nature of sunk costs. Nevertheless, Giorgetti (2003) highlights the sensitivity of previous results to the presence of outliers and defend the use of robust methods of estimation. In the present paper, we undertake a similar approach by considering the estimation of concentration lower bounds for the Brazilian industry in 2005. The paper intends to contribute to the literature by considering a large developing country where traditional and dynamic industrial sectors co-exist and therefore provides further evidence on Sutton´s models that extrapolates the previously considered context of developed countries. That evidence can, in principle, be suggestive as the level of technological effort is typically low in the Brazilian economy[1] and therefore less discernible differences of the lower bound for concentration in accordance to the nature of sunk costs may emerge. Moreover, the paper focuses on a more accurate concentration measure similarly as Lyons and Matraves (1996) and in contrast with the remainder of the literature.
The paper is organized as follows. The second section briefly discusses the econometric approach and empirical implementation procedures. The third section discusses the data sources and detail variables´ construction procedures. The fourth section brings some final comments.

2. Estimation of Lower Bounds for Concentration

Previous studies for estimating the lower bound for concentration mostly relied on a maximum likelihood estimator referring to a Weibull specification. The sensitivity of such model to the presence of outliers had motivated Giorgetti (2003) to consider quantile regression-QR methods that provide a robust alternative for traditional estimators when the error distribution departs from normality Rather than considering a single central tendency that is assumed to be valid for the whole sample, QR allows for distinct effects of the explanatory variables depending on the portion of the conditional distribution of the dependent variable [see Buchinsky (1998) and Koenker (2005) for introductions on the topic]. The general econometric model takes the form that traces back to Sutton (1991):

$$\ln\left(\frac{HH}{1-HH}\right) = a + b\,\frac{1}{\ln(S/\sigma)} + \varepsilon \qquad (1)$$

[1] See e.g. Resende and Hasenclever (1998). A comprehensive discussion on the innovation survey used in this paper is considered by Kannebley Jr. et al (2005)

Where in the present application we consider the Hirschman-Herfindahl concentration index (HH = $\sum_{i=1}^{n} s_i^2$) in contrast with the majority of the previous studies that considered concentration ratios despite the associated shortcomings. As usual s_i stands for the market share of i-th firm in the industry taking as reference sales data. A second crucial choice pertains the market size (S) normalized by a minimum efficient scale measure (σ). For the former the aggregate sales of the industry are considered whereas for the latter the feasible proxy was the median sales figure of the sector.[2]

In the particular context of the present application, QR estimators can be obtained as the solution of the following problem, where 0 < θ < 1 stands for the θ-th regression quantile:

$$\min_{a,b}[\sum_{i\in\{i:\ln(\frac{HH_i}{1-HH_i})\geq a+\frac{b}{\ln(S_i/\sigma_i)}]} \theta \left| \ln(\frac{HH_i}{1-HH_i}) - (a + \frac{b}{\ln(S_i/\sigma_i)}) \right| +$$

$$\sum_{i\in\{i:\ln(\frac{HH_i}{1-HH_i})< a+\frac{b}{\ln(S_i/\sigma_i)}\}} (1-\theta) \left| \ln(\frac{HH_i}{1-HH_i}) - (a + \frac{b}{\ln(S_i/\sigma_i)}) \right|] \qquad (2)$$

The next essential aspect for empirical implementation of the analysis refers to the segmentation of the sample in terms of industries characterized by exogenous or endogenous sunk costs. Previous works by Lyons and Matraves (1996), Robinson and Chiang (1996) and Giorgetti (2000) considered a single cut-off point defined in terms of the advertising intensity-IA (advertising expenses/sales) and R&D intensity-IRD (R&D expenses/sales). The criterion thus defined 4 types of industries: type 1 (if IA and IRD ≤ 1%), 2A (if IA > 1% and IRD ≤ 1%), 2R (if IA ≤ 1% and IRD > 1%) and 2AR (if IA > 1% and IRD > 1%). Giorgetti (2003) considered a simplified criterion based on RA = (R&D+Advertising expenses)/sales by which exogenous sunk costs industries would be defined by RA ≤ 1% whereas endogenous sunk cost industries would require RA ≥ 4%. The elimination of the intermediate cases reflects the intention to avoid measurement errors. I adopt a similar procedure in the present paper as further discussed in the next section.

3. Empirical Anaysis

3.1-Data Construction

The paper relies on special tabulations from two different surveys carried out by the Instituto Brasileiro de Geografia e Estatística-IBGE for Brazil in 2005, namely the Pesquisa Industrial Annual (PIA) and the Pesquisa de Inovação Tecnológica (PINTEC). The tabulation for the PIA at the 4-digits level (CNAE4) for the manufacturing industry did not provide information on sectors with 1 or 2 firms due to confidentiality restrictions.

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[2] More sophisticated procedures where advanced in the literature as for example by Lyons (1980) that introduced a new measure minimum efficient scale-MES based on the firm's decision to set up a second plant, The new estimates were found to be in substantial agreement with those derived by the survivor technique. The adopted proxy for MES is inspired by Sutton (1991) and a similar procedure was implemented by Görg et al. (2000) and Görg and Strobl (2002).

The information for the PINTEC was available at the 3-digits level. We adopt the following cut-off points; exogenous sunk costs industries (RA ≤ 1%), endogenous sunk costs industries (RA ≥ 3%). This criterion respectively led to sub-samples with 114 and 37 industries. The basic variables upon which the transformed variables are the following:

. HH: Hirschman-Herfindahl concentration index for industries at the 4-digits level upon data from the PIA-IBGE. Net operating revenues represented sales

. S: market size as defined by total sales of the industry at the 4-digits level obtained from the PIA-IBGE

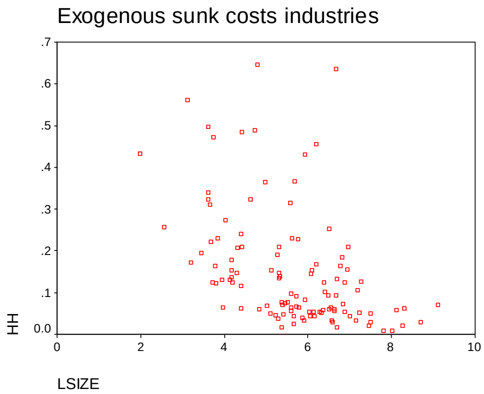
. Minimum efficient scale: median sales figure for the industry at the 4-digits level obtained from the PIA-IBGE

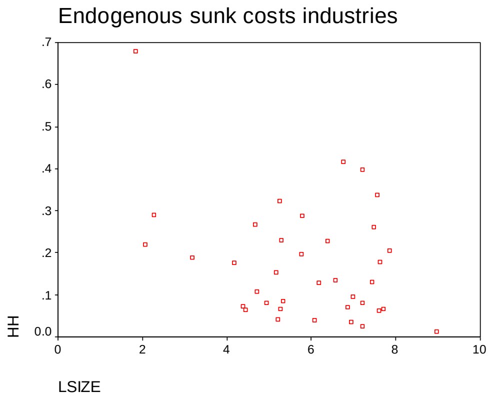
. R&D and advertising intensity as defined by (advertising plus R&D expenditures) divided by sales. The measure comprises both internal and external R&D and the firms from the PIA and PINTEC surveys were matched for the calculation of that measure and information was available at the 3-digits level. R&D data was obtained from the PINTEC survey whereas advertising and sales were obtained from the PIA survey.

A preliminary inspection of the data can obtained by considering scatter plots between concentration and market size for the exogenous and endogenous sunk costs industries as shown in figure 1. However, since the econometric analysis is later carried out with transformations of the concentration and (normalized) market size variable, the patterns of association are not immediately clear.

Figure 1

HH vs. $\ln(S/\sigma) \equiv$ LSIZE





3.2- Econometric Evidence

The estimations of the models were carried out with Stata SE 10.0 and the results are displayed in table 1. Given the focus on lower bounds, the analysis considered lower quantiles (5 % and 10% in the present application).

Table 1
Concentration lower bounds estimates-quantile regression

Industries with exogenous sunk costs (N = 114)	quantile 5%	quantile 10%
a parameter	-5.130	-4.932
	(0.000)	(0.000)
b parameter	9.657	9.264
	(0.000)	(0.000)
Asymptotic HH	0.006	0.007
	(0.076)	(0.029)
Industries with endogenous sunk costs (N = 37)		
a parameter	-4.642	-4.203
	(0.000)	(0.000)
b parameter	6.994	6.082
	(0.004)	(0.044)
Asymptotic HH	0.010	0.015
	(0.077)	(0.079)

Note: standard errors were obtained by bootstrap resampling procedures with 1000 replications and the corresponding p-values are displayed in parentheses. For the asymptotic concentration, we considered the delta method to generate the standard errors

The evidence mostly corroborates the predictions advanced by Sutton (1991). Direct comparisons with previous empirical studies are not straightforward given different sector definitions and a different measure of concentration. Nevertheless, previous evidence pinpointed asymptotic concentration levels for exogenous sunk costs industries that were close to zero as predicted, whereas larger values prevailed in endogenous sunk costs industries. In the present application, even if one considers a significance level higher than 5 % it appears to indicate a stronger convergence towards zero in the case of exogenous sunk costs industries. Interestingly, however, though one observes higher (asymptotic) concentration levels for endogenous sunk costs the differences are very small in the present case. The result is suggestive since the indicator for RAI reviews small magnitudes. In fact, if one considers the sub-sample of endogenous sunk costs industries a mean value of 0.047 and a coefficient of variation of 0.320 prevail. It appears that stronger contrasts between the two types of industries are more likely to prevail in countries where technological effort is more widespread across different industries.

4. Final Comments

The paper aimed at investigating the most salient prediction accruing from Sutton (1991) in the context of an emerging developing economy. Specifically, ideally one would expect an approximate convergence of the asymptotic concentration towards zero only in the case of exogenous sunk costs industries. In the present case, however, the difference between concentration bounds across the two types of industries are very small what might reflect the reduced magnitude of technological effort in that emerging economy. In other words, even though in the case of endogenous sunk costs industries that required a minimum RAI to be classified as such , the values are relatively low and therefore significant endogenous costs do not seem to prevail what may justify the similar results obtained for the two sub-groups of industries.

Avenues for future research require improved data sets. In particular, it would be interesting to consider other types of endogenous sunk costs that were not emphasized by Sutton. In fact, modern organizational practices like total quality management, just-in-time systems among others may constitute relevant sources of endogenous sunk costs beyond advertising and R&D expenses.

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