UNIVERSIDADE FEDERAL
DO RIO DE JANEIRO

INSTITUTO DE ECONOMIA

Profits persistence in Brazil: a panel data study[i]

nº 446

Marcelo Resende[ii]

Julho de 2000

Textos para Discussão

UNIVERSIDADE FEDERAL DO RIO DE JANEIRO
INSTITUTO DE ECONOMIA

Profits persistence in Brazil: a panel data study[i]

nº 446

Marcelo Resende[ii]

Julho de 2000

[i] The author acknowledges research assistance from Marcos Lima and Cristina Hagler. Moreover, financial support from FUJB is gratefully acknowledged.

[ii] email: mresende@ie.ufrj.br

Ficha catalográfica

RESENDE, Marcelo

Profits Persistence in Brazil: a panel data study / Marcelo Resende. - Rio de Janeiro: UFRJ - Instituto de Economia, 2000.

15 p.; 21 cm. - (Texto para Discussão. IE/UFRJ; nº 446)

1. Lucros - Empresa Industrial - Brasil, 1986-98. I. Título. II. Série.

O Programa Editorial do IE/UFRJ (sucessor dos Programas Editoriais do IEI e da FEA/UFRJ), através das séries "TEXTOS PARA DISCUSSÃO", "TEXTOS DIDÁTICOS" e "DOCUMENTOS", publica artigos, ensaios, material de apoio aos cursos de graduação e pós-graduação e resultados de pesquisas produzidos por seu corpo docente.

Essas publicações, assim como mais informações, encontram-se disponíveis na livraria do Instituto de Economia, Av. Pasteur, 250 sala 4 (1º andar) – Praia Vermelha – CEP: 22290-240 / Caixa Postal 56028 – Telefone: 295-1447, ramal 224; Fax: 541-8148, a/c Elizabeth Queiroz.

Sumário

Abstract

The paper investigates the persistence of profits for industrial firms in Brazil during the period 1986-98. A simple theoretical framework justifies an autoregressive formulation for excess profits. A strong form of persistence can then be related to the presence of a unit root. Recently developed panel data unit root tests enable the consideration of short panels. The results thus obtained for three different forms of excess profitability mostly favour the presence of a unit root, indicating that despite a more competitive environment in the Brazilian economy one can still observe extremely persistent profits.

Resumo

O artigo investiga a persistência dos lucros para firmas industriais no Brasil ao longo do período 1986-98. Uma abordagem teórica simplificada justifica uma formulação autoregressiva para o excesso de lucros. Uma forma forte de persistência pode então ser relacionada à presença de uma raiz unitária. Testes para raiz unitária em painel recentemente desenvolvidos possibilitam a consideração de painéis curtos. Os resultados assim obtidos para três formas diferentes de excesso de lucratividade predominatemente favorecem a presença de uma raiz unitária, indicando que apesar do ambiente mais competitivo na economia brasileira pode-se ainda observar lucros extremamente persistentes.

1. Introduction

Traditional microeconomic theory usually sustains the notion that the so called abnormal profits could be diluted in the long run as a result of competitive pressures accruing from the entry of new firms. The empirical assessment of such mechanism has given rise to a broad empirical literature on profit persistence for developed countries [the works collected in MUELLER (1990) are representative]. Such efforts constitute attempts in dynamically characterizing the competitive process, and reveal a dissatisfaction with the static character of structure-conduct-performance models [see e.g. BROZEN (1971a,b)]. The referred empirical literature has addressed the profit persistence issue by means of econometric models with autoregressive dynamics justified upon a simple theoretical framework [see GEROSKI (1990)]. This class of models has not, however, been fully explored in terms of its diverse implications. In fact, one observes, in contrast with the macroeconomic literature, a slow dissemination of the use of time series techniques in the context of Industrial Organization – IO – that reflects to some extent the difficulties in obtaining long time series for microeconomic data [see BYERS & PEEL (1994)]. In this sense, the large growth of the macroeconomic literature on unit roots triggered by NELSON & PLOSSER (1982) did not have comparable impacts in the context of the IO literature despite the fact that persistence is also an important issue in the latter literature. Recent developments in the econometric testing of unit roots in the context of panel data [see LEVIN & LIN (1992, 1993) and IM, PESARAN & SHIN (1997)] provide the opportunity for formal testing of a strong form of persistence even with short-panels and constitute therefore a relevant additional tool kit for the profit persistence literature. In addition to this methodological motivation, we understand that the application to a developing country like Brazil can be especially illuminating. That economy experienced significant changes in the 90s associated with a trade liberalization process and with the price stabilization that followed the Real Plan in 1994. One can, in principle, characterize the recent period in Brazil as more competitive what provides an interesting setting for this type of investigation. The remainder of the paper is organized as follows. The second section presents a brief digression on time-series models in the context of profit persistence analysis and discusses the usefulness of panel data unit root tests in that context. The third section presents the empirical analysis by describing the data the construction and presenting the results obtained from the unit root tests. Finally, the fourth section brings some concluding remarks.

2. Profit persistence and econometric analysis

2.1. Basic theoretical framework

It is possible to construct simple theoretical frameworks that provide foundations for empirical analyses of profit persistence. An influential example is given by GEROSKI (1990) who motivates a simple autoregressive empirical model with a simplified theoretical model. The basic steps can be summarized as follows. Let $\rho(t) \equiv \pi(t) - \pi p(t)$ denote firm's excess profits at period t, where $\pi(t)$ and $\pi p(t)$ represent firm's profitability at period t and the long-run competitive rate-of-return respectively. We can consider two general classes of factors determining changes in $\rho(t)$. First there are systematic factors (say "entry" $E(t)$) and a set of other factors orthogonal to the first class that can be generically referred as "luck" $\mu(t)$ that would be an i.i.d. normally distributed process with zero mean and variance δ_μ^2. Next the author conceives a simple expression relating changes in excess profitability to the two classes of explanatory factors:

$$\Delta\rho(t) = \theta_0 + \gamma_0 \; E(t) + \gamma_1 \; \rho(t-1) + \mu(t) \qquad (1)$$

where $\Delta\rho(t) \equiv \rho(t) - \rho(t-1)$.

A difficulty associated with the previous expression refers to the existence of non-observable components in $E(t)$, including, for example, potential entry. The latent variable character of this formulation requires then a link that expresses $E(t)$ in terms of observable factors, a possibility is given as follows:

$$E(t) = \phi[\rho(t-1) - \rho^*] + \varepsilon(t) \qquad (2)$$

where ρ^* denotes the equilibrium value of $\rho(t)$ which does not induce further entry movements and $\phi > 0$ stands for a speed parameter indicating the attractiveness of entry. Even when $\rho(t-1) = \rho^*$ one can observe an exogenous flow of entry or exit given by $\varepsilon(t)$ which it is assumed to be a normally distributed process with zero mean and variance σ_ε^2. By combining expressions (1) and (2) we can obtain expression (3) which only involves observable variables

$$\rho(t) = \alpha + \lambda\rho(t-1) + v(t) \qquad (3)$$

where $\alpha \equiv (\theta_0 - \gamma_0\phi\rho^*)$, $\lambda \equiv (\gamma_0\phi + \gamma_1 + 1)$ and $v(t) \sim N(0, \delta_v^2 = \gamma_0\,\delta_\varepsilon^2 + \delta_\mu^2)$.

It is possible then to obtain a simple autoregressive formulation upon the aforementioned author's approach, where λ would indicate the degree of persistence. A formal testing of the extreme persistence involved in the case of $\lambda = 1$ would not had been possible before the advent of panel data unit root tests which allow for short time periods. It is worth mentioning that a similar panel autoregressive analogue to expression (3) could be readily obtained (with double subscripts). In fact, if one conceives firm specific dependencies in expressions (1) and (2) that would be indeed the case.

2.2. Panel data unit roots

It is well known that traditional unit root tests possess low power against near unit root alternatives [see e.g. DIEBOLD & NERLOVE (1990)]. The development of panel data unit root tests addresses this aspect and additionally allows considering data sets with a short time dimension. Early treatments appear in QUAH (1994). The most disseminated results were developed by LEVIN & LIN (1993, 1994) and IM, PESARAN & SHIN (1997) and surveys on the topic appear in BANERJEE (1999) and MADDALA & WU (1999). The range of applications which is still restrict and does not comprise IO studies. Examples of applications include BERNARD & JONES (1996) in the context of productivity convergence, CULVER & PAPELL (1997) on inflation and PAPELL (1997) on purchasing power parity.

Levin and Lin - LL - consider unit root testing for different models with different degrees of heterogeneity across time and units. The main result obtained referred to simple Gaussian limiting distributions in contrast with functionals of Brownian motion obtained in the traditional literature. One representative specification (model 5 of LL (1992)) for a generic variable y is given by:

$$\Delta y_{i,t} = \alpha_i + \beta y_{i,t-1} + \varepsilon_{i,t} \quad i = 1,\dots,N \;\; t = 1,\dots,T$$

with the null hypothesis H_0: $\alpha_i = \beta_i = 0 \;\forall i$. The alternative hypothesis is given by $H_1 = \beta_i = \beta < 0 \;\forall i$. The referred test can be carried by means of the t statistic obtained upon a within-group estimator for panel. It can be shown that under the null of a unit root $\sqrt{1.25}\, t_\beta + \sqrt{1.875N} \Rightarrow N(0,1)$. In the event of serially correlated errors, one can consider augmented regressions and examine the ADF statistic which will possess the same limiting distribution. Further extensions pertaining serial correlation and heterocedasticity appear in LEVIN & LIN (1993). The various tests developed by LEVIN & LIN possess some important limitations. The main limitation refers to a common parameter β across different units. This assumption will be too restrictive in the context of the alternative hypothesis. IM, PESARAN & SHIN - IPS - (1997), provide a panel data unit root test that relaxes such assumption. Considering the model given in expression but with parameter β varying across units as given below:

$$\Delta y_{i,t} = \alpha_i + \beta_i y_{i,t-1} + \varepsilon_{i,t} \quad i = 1,\dots,N \;\; t = 1,\dots,T$$

IPS propose test where H_0: $\beta_i = 0 \;\forall i$ and H_1: $\exists\, i$ s.t. $\beta_i < 0$. One therefore relaxes the strong homogeneity assumption embodied in the LL tests. The simplest test proposed by IPS, the so called t-bar statistic is defined as the average of the individual Dickey-Fuller (DF) or augmented Dickey-Fuller (ADF), say τ_i statistics:

$$\bar{t} = \frac{1}{N}\sum_{i=1}^{N} \tau_i, \quad \textit{where} \quad \tau_i = \frac{\beta_i}{\sigma_{\beta_i}}$$

where $(\sqrt{N}\;(\bar{t} - E(\tau_i|\beta_i = 0)/(\mathrm{Var}(\tau_i|\beta_i = 0)^{1/2}) \sim N(0,1)$

The means $E(\tau_i|\beta_i = 0)$ and variances $\mathrm{Var}(\tau_i|\beta_i = 0)$ were obtained by IPS by means of Monte Carlo simulations for the same degree of augmenting in the different time series (in the present application 2 and 3). In the present application we will consider the t-bar test for different excess profitability measures. The t-bar test for a model with a deterministic trend will also be considered to assess persistence though this formulation is not directly implied from the previous presentation.

3. Empirical Analysis

3.1. Data Sources

The main data source is the data bank on the 1000 largest firms in Brazil which is generated in an annual basis and comprises balance sheets and results accounts. This data bank is organized by the Centre of Entrepreneurial Studies and Finance - Getulio Vargas Foundation - Brazil. It was possible to obtain annual data for the period 1986-98, for which we considered the largest possible (balanced) panel of industrial firms. Three profit rates definitions were considered: profit before taxes divided by total assets (GPTA), profit after taxes divided by total assets (NPTA) and operating profits divided by total assets (OPTA). In order to empirically implement the analysis outlined in the previous section, one generates sample means of the profit rates under the different definitions. For the sake of empirical implementation the profitability deviations are constructed upon the period sample mean given generically by $\bar{\pi} \equiv \sum_{i=1}^{N} \frac{\pi_i}{N}$ for all t. Similar profitability deviations were constructed, for example, by JENNY & WEBER (1990), ODAGIRI & YAMAWAKI (1990) and SCHWALBACH & MAHMOOD (1990) among others.

3.2. Empirical Results

Table 1 shows the trade liberalization process in Brazil which started in 1990 in terms of a declining trend in the nominal tariffs. This change coupled with the price stabilization following the Real plan in 1994 would in principle signal a more competitive environment.

Table 1
Nominal tariffs (%) for selected industry sectors in Brazil

Sector	Sep/89	Dec/90	Feb/91	Jan/92	Oct/92	Jul/93
Steel	15.2	14.3	10.1	8.1	6.5	5.5
Other metal work	34.0	34.8	27.6	23.4	19.9	16.3
Machines and tractors	38.7	37.1	28.4	24.5	20.2	19.1
Electrical material	41.2	44.1	35.2	29.8	23.5	18.8
Electronic equipment	39.4	40.6	35.2	28.8	24.3	20.7
Vehicles, trucks and buses	65.0	78.7	58.7	48.8	39.0	34.0
Other vehicles and parts	38.0	37.4	29.9	25.4	20.8	17.9
Wood and furnishing	25.8	25.4	16.4	11.1	9.8	9.5
Cellulose, paper and printing	24.3	23.6	13.4	10.9	9.5	9.3
Rubber industry	47.6	46.6	34.8	28.5	20.6	14.9
Various chemical products	25.5	21.1	16.2	13.7	11.3	10.9
Pharmaceutical and perfumery industry	34.4	31.5	20.8	16.9	13.8	12.8
Plastic articles	39.5	39.0	31.2	26.0	19.2	16.8
Textile industry	52.5	31.3	30.4	24.5	20.3	14.4
Clothing	75.0	51.1	48.3	38.8	29.3	20.0
Leather and footwear	35.8	29.6	24.8	20.5	16.0	14.2
Coffee industry	28.9	28.9	20.0	15.6	14.4	12.2
Drinks and other food products	43.5	43.5	36.9	30.4	20.5	16.3
Sample mean	31.6	30.0	23.3	19.2	15.4	13.2

Note sample means were computed over all sectors not only for the selected that are reported in the table. Source: KUME (1998).

The results obtained in the panel data unit root testing for three measures of profitability are presented next in tables 2 and 3.

Table 2
Panel data unit roots results (t-bar test without time trend)

Variable	Test Statistic (lag 2)	p-value	Test Statistic (lag 3)	p-value
GPTA	-0.464	0.321	1.719	0.957
NPTA	-0.042	0.483	0.915	0.820
OPTA	-6.761	0.000	-4.204	0.000

Table 3
Panel data unit roots results (t-bar test with time trend)

Variable	Test Statistic (lag 2)	p-value	Test Statistic (lag 3)	p-value
GPTA	-0.295	0.384	-0.350	0.363
NPTA	-1.177	0.120	-2.295	0.011
OPTA	-0.403	0.343	-3.038	0.001

When one considers the t-bar statistic for the model without time trend the results favour the existence of a unit root, except in the case of the OPTA variable.

When we focus the analysis in the model with time trend, as indicated by table 3, we reject the null hypothesis of unit root for NPTA and OPTA for augmenting lags of 3, but in any case the overall evidence appears to favour the existence of a unit root and therefore an extreme form of persistence in profitability despite an apparently more competitive environment in Brazil.

4. Final comments

The paper investigated a strong form of non-stationarity referring to the existence of unit root in the autoregressive process associated with excess profitability in Brazil. This simple formulation can be theoretically motivated and recent developed panel data unit root tests can provide formal testing of persistence in the context of short panels. Despite the fact that a large proportion of the studied years could be labelled as "competitive" the evidence indicated that an extreme level of persistence associated with the presence of a unit root in excess profitability cannot be discarded. This somewhat unexpected result emphasizes the importance of consolidating competition and anti-trust policies in Brazil which are still not mature. A relevant extension, currently under investigation, refers to the use of quarterly data for the post-liberalization period. This robustness check will be useful despite the more restricted character of this alternative data source which possesses a smaller number of firms and only those that are unquoted.

REFERENCES

BANERJEE, A. Panel Data Unit Roots and Cointegration: an Overview, Oxford, *Bulletin of Economics and Statistics*, Special Issue, pp. 607-29, 1999.

BERNARD, A. & JONES, C. Productivity Growth Across Industries and Countries, *Review of Economics and Statistics*, 78, 135-146, 1996.

BROZEN, Y., The Antitrust Task Force Desconcentration Recommendation, *Journal of Law and Economics*, 14, pp. 279-92, 1971a.

BROZEN, Y. Bain's Concentration and Rates of Return Revisited, *Journal of Law and Economics*, 14, pp. 351-69, 1971b.

BYERS, J. D. & PEEL, D. A. Linear and Non-Linear Models of Economic Time-Series: an Introduction with Applications to industrial economics, *in*: J. Cable (ed.), *Current Issues in Industrial Economics*. MacMillan, London, 1994

CUBBIN, J. & GEROSKI, P. A. The Convergence of Profits in the Long-Run: Inter-Firm and Inter-Industry Comparisons, *Journal of Industrial Economics*, 35, pp. 427-42, 1987.

CUBBIN, J. & GEROSKI, P. A. The Persistence of Profits in the United Kingdom, *in*: D.C. Mueller (ed.), *The Dynamics of Company Profits*. Cambridge University Press, Cambridge, 147-167, 1990.

CULVER, S. E. & PAPELL, D. H. Is There a Unit Root in the Inflation Rate? Evidence from Sequential Break and Panel Data Models, *Journal of Applied Econometrics*, 12, pp. 435-444, 1997.

DIEBOLD, F. X. & NERLOVE, M. Unit Roots in Economic Time Series: a Selected Survey, *in*: Fomby, T. & Rhodes, E. (eds.), *Advances in Econometrics: Cointegration, Spurious Regressions and Unit Roots*. JAI Press, Greenwich, 1990.

GEROSKI, P.A. Modeling Persistent Profitability, *in*: D. C. Mueller (ed.), *The Dynamics of Company Profits*. Cambridge University Press, Cambridge, 15-34, 1990.

IM, K. S., PESARAN, M. H. & SHIN, Y. Testing for Unit Roots in Heterogeneous Panels, Department of Applied Economics, University of Cambridge, mimeo, 1997.

JENNY, F. Y. & WEBER, A. P. The Persistence of Profits in France, *in*: D.C. Mueller (ed.), *The Dynamics of Company Profits*. Cambridge University Press, Cambridge, 123-128, 1990.

KARLSSON, S. & LÖTHGREN. On the Power and Interpretation of Panel Data Unit Root Tests, *Economics Letters*, 66, pp. 249-55, 2000.

MADDALA, G. S. & WU, S. A Comparative Study of Unit Root Tests with Panel Data and a new Simple Test, *Oxford Bulletin of Economics and Statistics*, Special Issue, 631-52, 1999.

ODAGIRI, H. & YAMAWAKI, H. The Persistence of Profits in Japan, *in*: D. C. Mueller (ed.), *The Dynamics of Company Profits*. Cambridge University Press, Cambridge, 129-146, 1990.

PAPELL, D. H. Searching for Stationarity: Purchasing Power Parity under the Current Float, *Journal of International Economics*, 43, 313-332, 1997.

PESARAN, M. H., SMITH, R. & IM, K. S. Dynamic Linear Models for Heterogeneous Panels, *in*: L. Matyas and P. Sevestre (eds.), *Econometrics of Panel Data: Handbook of Theory and Applications*. Kluwer Academic Publishers, Boston, 1995.

QUAH, D. Exploiting Cross-Section Variates for Unit Root Inference in Dynamic Data, *Economics Letters*, 44, pp. 9-19, 1994.

SCHWALBACH, J. & MAHMOOD, T. The Persistence of Corporate Profits in the Federal Republic of Germany, *in*: D. C. Mueller (ed.), *The Dynamics of Company Profits*. Cambridge University Press, Cambridge, 105-121, 1990.