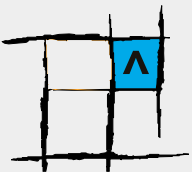




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in the Brazilian Manufacturing Sectors**



**Macroeconomic Environment and Market Power
In the Brazilian Manufacturing Sector**

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Recently industrial organization studies have moved their focus of research from the relationship between market power and industrial concentration to the robustness of results supporting evidence of market power with respect to macroeconomic performance. The importance of the macroeconomic environment in building up and toning down market power in different manufacturing sectors with diverse degrees of competition has received increased attention in the areas of macroeconomics and industrial organization.

This work examines data from the Brazilian manufacturing sector to check for evidence of market power, and then analyzes macroeconomic factors that help building these results up. The empirical evidence corroborates the hypothesis of presence of market power in the period analyzed, and shows that margins are strongly correlated to income distribution indicators.

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1) Introduction

The degree of competitiveness of industrial sectors may be assessed by the extent to which producer prices diverge from their respective marginal costs of production. The appropriate methodology to test the hypothesis of equality between prices and marginal cost depends on the type of data available. Accounting data at the individual firm level are required to develop a bottom-up approach for analyzing sector performance. However, aggregate data on output and labor can be used to perform the analysis based on unit costs of production as measured by total factor productivity (TFP).

TFP improvements as a measure of reductions in the real cost of production ("real cost reduction"), may or not be correlated with movements of inputs. Exploring this correlation is the basis of the methodology used here to assess the degree of competitiveness of the Brazilian manufacturing sectors. To do that, this work uses information from the Brazilian Census Bureau (IBGE) and the Brazilian Applied Economic Research Government Agency (IPEA) to compile a panel data of variables of the Brazilian industry, which includes manufacturing sector aggregate data on output, labor, capital, and indicators of both industrial concentration and capacity utilization. We proceed, then, to estimate the TFP for the manufacturing sector, and to check if there is any departure from the joint hypothesis of competition+constant-returns-to-scale by examining the "independence" of TFP with respect to the selected set of exogenous variables. We also test the impact of short-term variables such as government and macroeconomic policy characteristics on market power.

Section II, below, describes the methodology used in this work. Section III discusses the data and results, and Section IV gives the conclusion.

II Methodology

This work follows the approach proposed by Hall (1988) who shows that measured total factor productivity, based on the assumption of perfect competition, is pro-cyclical in the presence of market power. The hypotheses being tested jointly are of the existence of competition and constant returns to scale. The inconsistency between competition

and increasing returns makes it appropriate to test the two hypotheses together.

The departing point is Solow's (1957) aggregate production function¹, $Q = \Theta F(K, N)$, where K and N represent the inputs capital and labor, and Θ is an index of Hicks-neutral technical progress. Under the assumptions of competition and constant returns to scale, Solow establishes the relationship

$$(1) \Delta q_t - \alpha_t \Delta n_t = \theta_t,$$

where Δq is the rate of growth of the output/capital ratio ($\Delta \log[Q/K]$), α is the factor share earned by labor (equals to wN/pQ), Δn is the rate of growth of the labor/capital ratio ($\Delta \log[N/K]$), and θ is the rate of Hicks-neutral technical progress ($\Delta \log \Theta$). The growth of productivity expressed in the left-hand side of the equation has been called in the literature "total factor productivity" - the word total used to underline the contrast between this measure and the ones that relate just one input to the output. Because there is no reason to think that the rate of growth is constant over time, it is natural to represent it as having both an "average deterministic tendency" θ_t and a stochastic term μ_t :

$$(2) \Delta q_t - \alpha_t \Delta n_t = \theta_t + \mu_t.$$

The next step assumes that Δz_t is an exogenous variable able to cause movements in manufacturing inputs and output, but uncorrelated to the disturbance μ_t . Aggregate demand variables such as current and lagged real GNP growth are examples of "instruments" fit to do the job. If the variable Δz_t is chosen as one that does not affect the right-hand side of (2), (i.e., it does not cause productivity shifts), then it is not correlated with the right-hand side either. Hall states that, "under competition and constant returns to scale, the Solow residual is uncorrelated with all variables known neither to be causes of productivity shifts nor to be caused by productivity shifts." The joint hypothesis of competition and constant returns is rejected if an exogenous variable turns out to be correlated with the Solow residual.

¹ What follows draws heavily from Hall (1988).

Assuming that both the capital stock varies over time and there is technical progress, the measure of marginal cost changes to include the cost of change in the capital stock ΔK , $r\Delta K$:

$$(3) \quad x = \frac{w\Delta N + r\Delta K}{\Delta Q - \theta Q}.$$

Denoting $\mu = p/x$ as the markup ratio, equation (2) can be rewritten as

$$(4) \quad \Delta q_t - \mu_t \alpha_t \Delta n_t = \theta_t + u_t.$$

Rearranging equation (4) to express the Solow residual under market power:

$$(5) \quad \Delta q_t - \alpha_t \Delta n_t = (\mu_t - 1) \alpha_t \Delta n_t + \theta_t + \mu_t.$$

Equation (5) allows for the following interpretation: the covariance of an instrumental variable with the Solow residual will differ from zero to the extent that the markup ratio μ_t departs from one. The statement of the covariance of the residual with an instrumental variable Δz is written as equation (6) below:

$$(6) \quad \text{cov}[\Delta q - \alpha \Delta n, \Delta z] = \text{cov}[(\mu - 1) \alpha \Delta n, \Delta z].$$

Hall (1988) explores this relationship by assuming that both the weighed employment growth $\alpha \Delta n$ and the markup $(\mu_t - 1)$ ratio vary linearly with the instrument Δz :

$$(7) \quad \mu_t - 1 = a + b \Delta z_t,$$

Assuming also that the instrument is distributed around zero mean with variance σ^2 and has first and third moments equal to zero, the expression for the covariance is

$$(9) \quad \text{cov}(\Delta q - \alpha \Delta n, \Delta z) = (bc + ad) \sigma^2.$$

Equation (9) has the following interpretation: the covariance of the Solow residual with the instrument will

be close to zero under competition ($\mu_t=1$) and positive under market power ($\mu_t>1$).

III Data and Results

The data for the analysis is from three sources: Brazilian Census Bureau (IBGE), the Brazilian Applied Economic Research Government Agency (IPEA), and the Brazilian Central Bank (BACEN). The manufacturing data utilized are for twenty-two two-digit major industrial groups for the years 1986-1995 on gross revenue sales, payroll bill, sector aggregate cost of intermediary goods, and an accounting measure of capital. The economic data are gross domestic product growth rates (GDPGR), two indices of income distribution, GINI and THEIL, manufacturing product growth rate (MPGR), and wholesale price index (WSHPI). Constructed variables are total factor productivity (TFP), price-cost margin (PCMG), and payroll bill/revenue sales (PAYSHA).

Table I displays the summary statistics of these variables. It is important to bear in mind that some are time series variables: GDPGR, MPGR, WSHPI, GINI, and THEIL, and others are panel data variables: TFP, MPGR, PCMG, and PAYSHA. These latter variables have statistics computed over cross-section and time series observations.

The first question addressed here refers to the possibility that total factor productivity (TFP) in the Brazilian manufacturing sector is uncorrelated with an instrument (exogenous) variable that affects both output and employment in the sense discussed in Section I. Hall (1988) tests this hypothesis for the U.S. economy based on the argument used to develop equation (6) above. He does this by employing a "regression version" of the covariance test he proposed in equation (6), and chooses two instrumental (exogenous) variables to perform it: the rate of growth of military expenditure and the rate of change of crude oil world price. His results show a significant rejection of the hypothesis of absence of market power in the second regression, which uses crude oil world price as instrumental variable. Table II reproduces the two equations estimated by Hall, and presents a fixed effects panel data equation estimated here for the Brazilian manufacturing two-digit major groups using gross domestic

product growth rates as exogenous variable.² We find a significant rejection of the hypothesis of absence of market power in the Brazilian industry as well.

TABLE I SUMMARY STATISTICS

	PCMG	PAYSHA	TFP	WHSPI
Min:	0.10008	0.01323	-9.92550	0.00830
Mean:	0.47007	0.06863	3.91006	0.44553
Median:	0.45727	0.06818	1.28860	0.35816
Max:	0.85678	0.16851	66.17100	1.15469
Std Dev.:	0.13112	0.02846	12.98880	0.37276

	GDPGR	MPGR	GINI	THEIL
Min:	-4.30000	-8.20000	0.58000	0.70000
Mean:	2.70000	1.80000	0.60556	0.76556
Median:	3.50000	1.90000	0.60000	0.77000
Max:	7.50000	11.70000	0.64000	0.89000
Std Dev.:	3.47834	5.84841	0.01711	0.05158

TABLE II TOTAL FACTOR PRODUCTIVITY AND INSTRUMENTAL VARIABLE ΔZ (HALL'S NOTATION)

A) U.S. ECONOMY, ΔZ = RATE OF GROWTH OF MILITARY EXPENDITURE (RGME), TIME SERIES 1953-1984 (HALL 1988)

	Value	Std. Error	t value
CONST.	0.021	0.004	5.25
RGME	0.094	0.064	1.4687

B) U.S. ECONOMY, ΔZ = RATE OF CHANGE OF THE WORLD PRICE OF CRUDE OIL (CWPCO), TIME SERIES 1953-1984 (HALL 1988)

	Value	Std. Error	t value
CONST.	0.029	0.005	5.8
CWPCO	0.110	0.042	2.619

C) BRAZILIAN MAJOR INDUSTRIAL GROUPS, ΔZ = GROSS DOMESTIC PRODUCT GROWTH RATES PANEL DATA WITH FIXED EFFECTS SECTOR DUMMY VARIABLES, 1986-1995

	Value	Std. Error	t value
GDPGR	0.2931	0.0514	5.7042

Besides the evidence of market power in the Brazilian manufacturing sector shown in regression C in Table II, the second question of interest is whether there is also evidence that the macroeconomic environment prevailing in most of the period analyzed (1986-1995), characterized by very high and variable inflation as well as wage

² This choice of instrumental variable follows the lead of Domowitz, Hubbard, and Petersen [1988], who argue that gross product is a good instrument so long as no individual industry is large relative to the economy.

indexation, affects the behavior of price-margin ratios. The main reason that this might be the case was the generalized indexation system in place in Brazil, which had different degrees of speed in contract inflation adjustments, and allowed for almost instantaneous "margin recovery" on the part of industrial producers in contrast with the much slower pace of "income periodic recovery" observed for wage earners.

Table III below presents a summary of macroeconomic aggregate indicators in the period analyzed here revealing the extreme volatility of all of them.

TABLE III BRAZILIAN AGGREGATE MACROECONOMIC INDICATORS

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
ARIR %	-0,4	-8,8	7,3	43,4	-29,2	-12,4	30,2	7,1	24,8	35,7
GDPGR %	7,5	3,5	-0,1	3,2	-4,3	1	-0,5	4,9	5,9	4,2
MPGR %	11,7	1	-2,6	2,9	-8,2	0,3	-4,2	7	6,7	1,9
CPI %	65,2	415,9	1037,7	1783,0	1476,7	480,2	1157,8	2708,4	909,7	14,8

ARIR = ANNUAL REAL INTEREST RATE; GDPGR = GROSS DOMESTIC PRODUCT GROWTH RATE; MPGR = MANUFACTURING PRODUCT GROWTH RATE; CPI = CONSUMER PRICE INDEX. SOURCE: BACEN

Figure 1 depicts the high volatility of price-cost margins across "industry major group"-year observations, in contrast with a much more stable pattern recorded for payroll/sales observations.

FIGURE 1 PAYROLL/SALES AND PRICE-COST MARGINS, "INDUSTRY MAJOR GROUP"-YEAR OBSERVATIONS (196)

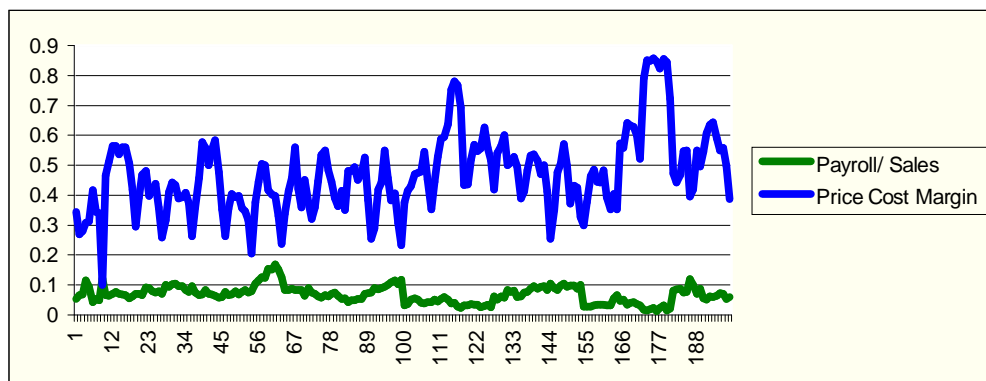


Table IV below presents regression results that show a very strong relationship between manufacturing margins and selected economy indicators: wholesale price index (regression A), the GINI (regression B), and the THEIL (regression C).

Regression A in Table IV presents evidence of a positive correlation between price-cost margin and the wholesale price index, which lends credit to the idea that industrial producers in Brazil were able to defend well their margins in the volatile macroeconomic environment existent in the period analyzed.

Brazilian manufacturing firms had a very unique "experiment" with respect to pricing decisions in the years 1986-1995, which were years of both high and variable inflation with the exception of the last one. GDP cycles notwithstanding, this economic environment rendered, most of the time, non-effective the standard analytical pattern employed in Industrial Organization regarding firm price decisions, namely Cournot versus collusive behavior. The indexation system in place in Brazil triggered a dynamics of purchase power recovery of prices and wages (given past inflation) that had the latter adjusted at a much slower pace than the former, and allowed firms extreme flexibility in pushing down the market any input cost increases by setting product prices at a higher level with no constraints. For consumers, the problem of extracting *signal* - relative price of products, from *inflationary noise* was nearly impossible.

Regressions B and C in Table IV show that price margins are positively correlated with both the GINI and the THEIL indices. Although there were, of course, other mechanisms related to the performance of income distribution indicators in those years, this is still a remarkable result.

**TABLE IV PRICE-COST MARGIN (PCMG), PRICE INDEX
AND INCOME DISTRIBUTION INDICATORS**

A) PRICE-COST MARGIN (PCMG) VERSUS WHOLESAL PRICE INDEX (WSHPI),
PANEL DATA WITH FIXED EFFECTS SECTOR DUMMY VARIABLES

	Value	Std. Error	t value
WSHPI	0.1532	0.0152	10.1063

B) PRICE-COST MARGIN (PCMG) VERSUS GINI COEFFICIENT (GINI),
PANEL DATA WITH FIXED EFFECTS SECTOR DUMMY VARIABLES

	Value	Std. Error	t value
GINI	0.5190	0.0403	12.8787

C) PRICE-COST MARGIN (PCMG) VERSUS THEIL COEFFICIENT (THEIL),
PANEL DATA WITH FIXED EFFECTS SECTOR DUMMY VARIABLES

	Value	Std. Error	t value
THEIL	0.4174	0.0289	14.4290

IV CONCLUSION

This work examines data from the Brazilian manufacturing sector to check for evidence of market power, and then analyzes macroeconomic factors that help building these results up. The empirical evidence corroborates the hypothesis of presence of market power in the period analyzed, and shows that margins are strongly correlated to income distribution indicators.

This suggests that a useful area for further research would be to extend this analysis to subsectors of the manufacturing sector.

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