Firm Performance in an Extremely Turbulent Environment: Year, Industry and Firm Effects

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Abstract

Performance varies. The simple statement hides many intricacies of strategic management. Because performance varies among individual firms, researchers can explore factors that differentiate these firms and explain why some firms are consistently outperforming others. Because performance varies among industries, researchers can explore structural characteristics of activity branches accounting for increased performance as well as mediocre, below average performance. Because performance varies with time, researchers can explore environmental and internal dynamic elements that drive strategic decision-making. In reality, measuring and analyzing performance is a very complicated issue when performance varies simultaneously from firm to firm, from industry to industry and from year to year. The theoretical discussion behind this question is the relative importance of the industrial organization derived approach to strategy versus the resource-based view. This paper analyzes the composition of performance variance in a turbulent environment, typical of emerging economies. An empirical study of Brazilian firms during 1998 to 2001 is made. Results demonstrate that firm effects are still dominant, with year and industry effects being much smaller than anticipated in this type of environment.

Introduction

If a researcher looks at a population of firms during a span of time, he will, most probably, observe a distribution of results that resembles a bell shape. Few firms will have sustained, above normal, returns - the empirical definition of competitive advantage (BARNEY, 2002) - and few will have persistent below normal returns, which would lead them to be selected out by market forces.

Understanding performance is crucial for business strategy as a field of research. After all, a successful strategy is to be measured in terms of economic performance. Theories developed in the business strategy field should be able to explain differences in performance and predict the impact of significant decisions on performance.

Neoclassical economic theory has originally focused on the aggregate result of industries as a primary explanation of heterogeneity and tended to downplay the individual differences among firms. Although recognizing that firms are not all the same, the interpretation implicitly accepted by most economists is that these differences are also determined by the context and so the unit of analysis is best selected as the industry and not the individual firms (NELSON, 1991). The field of strategy has taken the opposite approach. It is founded on the assumption that the individual positions and actions generate relevant differences and so, the most convenient unit of analysis is the firm not the industry (RUMELT, 1991). The issue of heterogeneity and homogeneity is what determines the choice of unit of analysis in a field of research (KLEIN; DANSEREAU; HALL, 1994). The economic approach assumes the heterogeneity among industries as more important while the strategy field sees the heterogeneity among individual firms as more relevant.

This debate has broadened into the strategy field itself, especially through the stream originated from the paradigm of industrial organization that originated the SCP model (where the structure of the industry determines conduct or strategy, which, in turn, determines

performance), which was the basis for Michael Porter's positioning concepts (PORTER, 1981). In this view, industry really matters when it comes to defining firm performance levels.

> *« ...At the broadest level, firm success is a function of two areas: the attractiveness of the industry in which the firm competes and its relative position in that industry. Firm profitability can be decomposed into an industry effect and a positioning effect. Some firm successes come almost wholly from the industry in which they compete; most of their rivals are successful too! ... »* (PORTER, 1991, p. 100)

On the other hand, an emphasis on internal resources can be traced to the first classics such as Barnard (1938), Selznick (1957), and Penrose (1959). The resource-based view of strategy focuses specifically on the individual firm differences as a basis for the development of the strategy (BARNEY, 1991, 2001; CONNER, 1991; PETERAF, 1993; WERNERFELT, 1984, 1995). Researchers in this stream share an interest in pondering the inner growth engines or "the black box" of the firm, and argue that a firm's continued success is chiefly a function of its internal and unique competitive resources (HOSKISSON, 1999). Wernerfelt (1995) uses a sports analogy to illustrate that the resource-based-view is not contrary but complementary to the more traditional, environment-based generic strategies. Sports have a body of generalized strategic knowledge that is not dependent on the opponent: in soccer one should avoid crossing the ball in front of his own goal and in chess it is usually wise to develop bishops and knights before Rooks and Queen, for example. When the opponent is defined, however, another body of strategic thinking is called upon. In soccer, teams with tall players can force plays that exploit this characteristic, in chess, a player with great experience in the French defense will use it against an opponent that dislikes the semi-closed positions that arise.

Despite the importance of the issue, it has received scant empirical attention, probably reflecting the scarcity of reliable data and the statistical difficulties it presents (McGAHAN; PORTER, 1997). Rumelt (1991) presented the most influential study, building on the approach of Schmalensee (1985). McGahan and Porter (1997, 2002) further extended the work of Rumelt (1991) taking a larger set of data and a more sophisticated statistical approach.

The objective of the present paper is twofold. First, it reviews the status of research to date focusing on the common findings and on the conclusions that can be drawn from it, rather than focusing on the differences and on the defense of opposite theoretical positions. It demonstrates that, although seen by some as contradictory (MAURI; MICHAELS, 1998), the findings for the manufacturing group of industries can be reconciled. Firm idiosyncratic effects represent the largest component of performance variance. Industry effects are also significant, but much smaller. Year effects have been found to be absent or very small. These common findings suggest the IO and resource-based approaches have to be taken as complementary to explain performance. Second, it contributes to the debate exploring the analysis of performance in an extremely turbulent environment. Competition outside the US, especially in emerging economies, faces different, and, sometimes, much more turbulent, environments. Since all previous research was done with US data, would results hold for these more turbulent and ever changing environments? One intriguing finding in previous research has been the very small, sometimes absent, year effects. This has not been deeply explored in the literature and was usually dealt with a simple remark that year effects were absent or significant, but small. A turbulent environment, by definition, would allow one to expect these year effects to be larger. Turbulence is also likely to affect the different industries unequally causing higher transient industry effects, measured by the interaction year-industry. Turbulence is also likely to affect individual firms differently, so a larger part of performance would be left unexplained. An analysis of performance of Brazilian firms during the period

1998 to 2001, a known period of extreme domestic and international turbulence, was performed. Findings indicated surprisingly no year effects; even smaller industry effects than previous studies in less turbulent environments and confirmed the preponderance of firm effects. The paper also explores the idea of using the coefficients of firm effects as an objective measure of sustainable competitive advantage, that could be useful in future studies.

Antecedents

Prior Research on Performance

Schmalensee (1985) published a seminal paper using data from the Federal Trade Commission (FTC), year of 1975, analyzing the results of 1,775 business units, operated by 456 corporations in 242 industries. The ratio of operational income to total assets was used as a measure of performance, with an average of 13.6% and a standard deviation of 18.7%. Market share was used as an attempt to capture business unit specific factors that could affect profitability. Market share had been previously identified to have a positive and highly significant impact on business profitability (RAVENSCRAFT, 1983). Schmalensee (1985) analyzed data using analysis of variance and variance components techniques reaching the following basic conclusions:

- There is no significant influence in the results associated with the fact of a business unit being part of a larger corporation.
- The industrial sector in which a business unit operates has a significant influence in its results, and this influence explains 19 – 20% of the total variance in the results.
- Market share effects explain a negligible portion of the variance of business units' results.
- Around 80% of the variance in the results is not explained by the above factors.

The fact that the influence of the industrial sector was clearly identified and statistically significant was seen, in Schmalensee´s opinion, as a justification of the classical approach with focus at industry level. One of the important points of the research resided, however, in what was not found rather than what was unveiled. Recognizing that the model could not explain 80% of the variance of business profitability, the author mentions: *"While industry differences matter, they are clearly not all that matters"* (SCHAMALENSEE, 1985, p. 350).

Rumelt (1991) extended considerably the original work of Schmalensee (1985) using the same FTC database, but including data from four years instead of only one. He used the results of 1974 to 1977 instead of only 1975. In total, 1774 business units, belonging to 457 corporations, operating in 242 industries were analyzed reaching 6932 observations for the four years. He also used an extended sample, called in the paper sample B, with 10,866 observations by adding smaller business units that had been excluded by Schmalensee´s size criterion. The same accounting measure, the ratio of operating profit to total assets was used. The average rate of return on sample A was 13.9% with a standard deviation of 16.7% and 13.2% and 20.3% for sample B respectively. Having four years of results made it possible to identify a portion of the total variance associated with the individual business unit, since there were four observations for each business unit. It also became possible to calculate the variance associated with the interaction year and industry separating fixed and transient industry influences. Finally, the proposed model was able to explain more than 63% of the variance. Rumelt (1991) used the variance components technique as the main statistical tool, using nested ANOVA to complement the analysis. The main findings of Rumelt´s work can be summarized as follows:

- Confirming the finding of Schmalensee (1985), no significant effect due to the business unit belonging to a larger corporation, could be identified.

- The industrial sector had a significant influence and explained around 16.2% of total variance. Approximately half of that was associated with fixed effects and the other half with transient ones, related to the interaction industry x year.
- Persistent factors, associated with each individual business unit accounted for 46.4% of the total variance. This indicates that market share as used in Schmalensee´s work was a poor proxy for business unit specific effects. This portion of the total variance could not be isolated in Schmalensee´s work and was included in the 80% unexplained variance. In Rumelt´s analysis only 36.9% of the variance was left unexplained.

The analysis of sample B provided similar results, with industry accounting for 9.4% of the total variance, corporation effect could explain 1.6% of total variance, and the business unit was still the most important component with 44.2%. The unexplained variance was higher, reaching 44.8%.

Although these two papers provided consistent findings, with no contradictions from the statistical perspective, they have been used to support different views. Schmalensee´s work was used to support the strategic analysis based on industry (MONTGOMERY; PORTER, 1991) while Rumelt´s results were used to question this view since he found a somewhat smaller and partially transient industry influence and a large, significant influence of permanent factors associated with the business unit itself. This emphasized the importance of the resource-based approach (ROQUEBERT; PHILLIPS; WESTFALL, 1996). Rumelt (1991, p.182) clearly states in his conclusions to the paper, that the most important sources of rents in the US manufacturing businesses are due to resources or positions that are specific to particular business units rather than related to corporations or industry membership. As a logical implication, theoretical or statistical work seeking to explain the dispersion of business-unit profit rates must use the business unit as unit of analysis.

Roquebert, Phillips and Westfall (1996) published a similar research using a more recent and broader database, the COMPUSTAT. The data covered the period of 1985 to 1991, and the analysis was done on 16,596 observations. The different database merits further discussion. COMPUSTAT database is broader in scope, including 746 manufacturing industries while the FTC only 260, almost 3000 corporations versus fewer than 500 in the FTC, and less restrictive including smaller corporations with fewer business units. The concept of business unit is also different. McGahan and Porter (1997) prefer to call it business segment instead of business unit since its definition may encompass more than one business unit. Firms are forced to release information on performance about business segments that account for 10% or more of total sales, so some business segment can consist of more than one business unit in its strict definition. Having made this observation, this paper will continue to use the business unit term for clarity. The analysis was based on components of variance technique estimated by the maximum likelihood method. Findings were very similar to the two previous studies with one notable exception, the corporate effect. They found a significant corporate effect explaining 17.9% of the total variance while the two previous works had not identified significant effects. Industry accounted for 12.5% of the total variance (2.3% of that through the year-industry interaction, so transient) and the business unit accounted for the largest variance component with 37.1%. The model was able to explain 68.0% of total variance leaving 32% unexplained. The issue of corporate effect seemed to be quite sensitive to sample, increasing as the number of business units per corporation decreased. This seemed to be in the same direction of Rumelt´s (1991) findings with sample B where he found a small corporate effect. Other authors also treated the issue of corporate effect more extensively and we refer to them for further explanations since the issue is not so relevant for this research (See BOWMAN; HELFAT, 2001; BRUSH; BROMILEY, 1997; BRUSH; BROMILEY; HENDRICKX, 1999; CHANG; SINGH, 2000).

McGahan and Porter (1997) published a broad work based on COMPUSTAT data from 1981 to 1994. The data used consisted of 72,742 observations with and average of 5196 business units per year through the 14 years analyzed, a substantially larger figure than previous studies. The research, however, did not cover only manufacturing, but also other broad economic sectors like Mining and Agriculture, Retailing, Transport, Services, Lodging and Entertainment. The method of analysis was similar to Rumelt (1991), using the components of variance as the main technique followed by nested ANOVA. The main difference introduced in the method was the allowance for serial correlation in the error term attempting to cover for any influence of a shock in the previous year. While the approach is quite interesting and maybe even necessary when treating long time series of results, it is unclear how much this treatment improved the results of the model. This is certainly an area to be explored further in future work. Much of the discussion on the results was done using the aggregate figures of all broad economic sectors making the point that industry mattered more than previous studies were indicating, but when the results of the manufacturing group of industrial sectors were analyzed, the findings were, again, consistent with the previous studies:

- The largest variance component was associated with the business unit and amounted 35.45% of the total. The length of the time series considered could be one of the reasons for a smaller figure than previous studies, since only factors that were permanent throughout the whole length of the period were considered.
- The industry accounted for 10.81% of the variance. The authors claimed that the definition of the business unit used in the COMPUSTAT database could be combining several true business units, so, if actual data for business unit were available, this figure could have been higher.
- Year effects accounted for 2.34% of total variance.
- A negative covariance between corporation and industry of – 2.27% was identified. Rumelt (1991) found a small positive covariance in his research and decided to set it to zero in the final results presentation. The interpretation of this negative covariance is that the corporation would have an influence in the selection of industries in which it participates.
- The model explained only 46.3% of the variance, so the error term was larger than previous studies.

The same manufacturing data was analyzed using Rumelt´s (1991) model delivering comparable results. Business unit effects were the major component with 33.8% of the variance, industry accounted for 11.64% (of which 4.44% were year-industry interaction and 7.20% industry only), corporate effects showed up with 2.05% of total variance, year effects accounted for only 0.40% of the variance, and a small, negative covariance between corporate-industry of –1.42% was identified.

In other broad economic sectors, like Mining and Agriculture, Retailing, Transport, Services, Lodging and Entertainment, industry influence was much greater so that when the aggregate results were examined industry accounted for over 17% of the variance. In Lodging and Entertainment, industry was the largest component of variance accounting for 64.3% of total variance and in Services industry accounted of 47.37% of total variance. Manufacturing, as the authors put it, was the outlier with industry accounting for only 10.81% of the variance (McGAHAN; PORTER, 1997, p. 26). Since much of the discussion was done using the aggregated results, comparing these with previous studies made on manufacturing data only, the similarity with previous works was not so evident.

A comparison of all these studies on manufacturing data is presented in Table 1. Although there is a discrepancy related to the corporation effect there is remarkable coincidence in the other components of the variance given the differences in the data and

method used. The largest component of variance has always been the individual business unit characteristics accounting from a third to half of the total variance. Industry is significant, but its influence is somewhere between 10 and 20% of the total variance, and part of that is due to interaction with year.

Table 1 - Comparative summary of previous studies on variance composition of performance (manufacturing firms)

	Schmalensee	Rumelt	Roquebert et al.	McGahan & Porter, Rumelt model	McGahan & Porter
Year	n.a.	0%	0.5%	0.40%	2.34%
Industrial sector x year	n.a.	7.84%	2.3%	4.44%	n.a.
Industrial sector, fixed	n.a.	8.32%	10.2%	7.20%	10.81%
Industrial sector, total	19.59%	16.16%	12.5%	11.64%	10.81%
Corporation	n.a.	0.80%	17.9%	2.05%	n.a.
Corporation - industry covariance	-0.62%	0%	n.a.	-1.42%	-2.27%
Market share	0.62%	n.a.	n.a.	n.a.	n.a.
Business unit/segment	n.a.	46.37%	37.1%	33.79%	35.45%
Model	19.59%	63.33%	68.0%	46.46%	46.33%
Unexplained variance, error	80.41%	36.67%	32.0%	53.54%	53.67%

Source: McGAHAN; PORTER, 1997; ROQUEBERT; PHILLIPS; WESTFALL, 1996; RUMELT, 1991; SCHMALENSEE, 1985.

Other authors also explored the theme using different methodologies and approaches, but reaching conclusions that are consistent with the previous summary of more specific studies. Wernerfelt and Montgomery (1988) used Tobin´s *q* to measure firm performance and found results similar to Schmalensee (1985). Hansen and Wernerfelt (1989) decomposed the profit rates into its economic and organizational components concluding that both models are highly significant and proposed an integrated model that had more explanatory power than the two individual ones. Powell (1996) using a survey and interview methodology examined the executives perceptions of the factors confirming that industry factors could explain around 20% of total variance and left the balance unexplained. Mauri and Michaels (1998) using a smaller sample of the COMPUSTAT database found that, although industry membership could explain a small proportion of total variance (around 6%), it had a much stronger influence on the strategies pursued by the business units, measured by R&D and advertising intensities. McGahan (1999) using the same data of McGahan and Porter (1997) with a modified methodology explored the variance composition of performance measured by different metrics (Tobin´s *q*, traditional accounting profitability and a hybrid measure, return on replacement value of assets). Conclusions also confirmed that firm effects are more important than industry effects, but indicated that industry effects were more stable and predictable. McGahan and Porter (1999) explored the issue of persistence of the various effects. Hawawini, Subramanian and Verdin (2003) also explored other value-based measures of performance and the removal of firms of extreme positive and negative performances from the sample. They found that the other forms of performance measure yielded similar results and that the remaining companies after removal of top and bottom performers exhibited a variance composition with higher industry effect than the whole sample. McNamara, Vaaler and Devers (2003) used the Compustat database to develop an analysis with 17 moving windows of four years covering the period from 1978 to 1997 uncovering the dynamics of variance composition change. Industry effects seem to be on a reducing path reaching 3.5% in the last window while the corporate effect seems to be gaining importance. The business unit, however, continues to be the most significant source of variance.

All previous studies used data of the American economy. Claver, Molina and Tari (2002) analyzed 679 Spanish companies during the period 1994-1998 finding a similar variance composition: the firm accounted for 42.69% of total variance, industry effects for only 4.84% and year effects were again almost negligible at 0.36%.

The Brazilian Economic Environment during the Turbulent Years of 1998 to 2001.

The 90´s have been a decade of reforms for the Brazilian economy. The most significant event was the success of the Real plan that was introduced in 1994 and finally succeeded, after five previous stabilization plans have failed, in curtailing yearly inflation from 5,154% in the 12 months prior to the plan to 1.7% by the end of 1998. The reforms also included trade liberation with average duty charges on imports dropping from 32.2% in average in 1990 to 12.1% in 1995, privatization of state controlled companies in numerous sectors and deregulation. Alongside these positive events, the deficit in the country current account soared due the valuation of Real against the dollar and the boom in demand (PINHEIRO; GIAMBIAGI; MOREIRA, 2001). In 1998, Brazil was living through the end of that cycle. The Asian crisis in the end of 1997 and the Russian moratorium in 1998 compounded a situation where the capital flows started to leave the country at an impressive rate. In 50 days during August and September 1998, Brazilian reserves dropped by US$ 30 billion. Monetary policy struggled to maintain exchange rate and interest rates rose to above 40% a year. With all these uncertainties, the GNP grew only 0.2% over previous year and the unrealistic exchange rate with an overvalued Real caused exports to drop from 1997 level (Ibid.).

In January 1999, Brazil allowed the Real to float freely and the exchange rate that was R$1.21 per dollar peaked to R$2.16 receding to R$1.79 by the end of 1999. Inflation did not explode, however, as feared. This, the good management of the financial system, the new deal with the IMF, and the good agricultural crop allowed the country to go through the adjustment without a severe recession as happened in Mexico and South Korea.

By the end of 2000 the Brazilian economy seemed in great shape. Inflation was below 6%, exchange rate was maintained at 1999 level, GNP resumed growth with 4%, and exports rose to US$ 55 billion making the trade balance less than US$0.7 billion deficit, with most macroeconomic indicators showing an improvement over 1999 (BNDES, 2001).

The positive expectation of the end of 2000 did not materialize itself in 2001. After a promising first quarter, the worsening of the Argentinean crisis and US recession reduced the money inflow into Latin American markets and restricted the export performance. The electric energy crisis followed with the worse draught in the last 70 years affecting the electric supply of the country (greatly dependent on hydroelectric generation) forcing energy rationing in several states during the second half of the year. Finally, the terrorist attack in the US created a strong risk aversion throwing the emerging economies in a state of great confusion. The combination of all these events made the exchange rate suffer another strong devaluation and GNP growth stalled in the second half of the year (PINHEIRO; GIAMBIAGI; MOREIRA, 2001).

In summary, the years of 1998 to 2001, to say the least, have not been normal years. Firms' performances have certainly been affected by all these macroeconomic impacts. It is also logical to expect that these impacts should have affected the several industry sectors differently. Export sectors, for instance, were greatly favored in 2001. The large agricultural crop should have an impact in associated sectors like Fertilizers and Agricultural Equipment. This is certainly an environment where industry and year influences have a great potential to exert influence in firms performance.

Method and data

Availability of reliable data is one of the major difficulties for this type of studies. *Gazeta Mercantil*, a leading business news agency and newspaper, publishes the *Balanço Anual* report since 1977, consolidating published financial reports from a growing number of firms. In 2001, more than 10,000 firms were included in the analysis. The firms are grouped in 55 industry sectors, which are, in turn, divided in sub-sectors. Companies were assigned to the sub-sector that most typically represents their major business. This classification has been subjected to continuous revision throughout the years, so, for this study, we used the most recent 2001 classification and adjusted previous years accordingly. Fifteen sub-sectors were selected where the firms were known not to be greatly diversified and so total company results could be interpreted as results of a business unit operating in the sub-sector. Among these sub-sectors, only firms that had published results in at least 3 of the 4 years and had total net sales above R$ 10 million in 2001 were considered. In total, we collected results for 252 firms for a total of 938 observations.

The ratio of operational income to total assets was used as a measure of performance. This choice makes the study most comparable to previous ones and avoids part of the variations originated from financial structure. The analysis was, however, repeated using the ratios of net income to total assets and net income to net revenues with similar results.

Before engaging in the main analysis a more traditional descriptive analysis of the distribution of performance results was made. The components of variance technique is widely used in the field of genetics, but it application in business has been limited. It assumes that the results we are observing are caused by different random factors and calculates the portion of the total variance caused by each of these factors. More formally, in this case, the ratio of operational income to total assets is modeled as:

$$r_{i,k,t} = \mu + \gamma_t + \alpha_i + \delta_{it} + \phi_k + \varepsilon_{i,k,t} \qquad (1)$$

Where $r_{i,k,t}$ is the ratio of operational income to total assets of an individual firm in the sample. The index i represents the sub-sectors or industries as named in previous studies, in this case $i=1,2,...,15$. The index k represents the individual firms, in this case $k=1,2,...,252$. The index t represents the different years considered, in this case $t=1998,1999,2000, 2001$. The term μ is the average result of all firms taken as one group, in the case of this study it was 3.8% The term γ_t is the influence of the year, so that the sum $\mu+\gamma_{1998}$ represents the average result for the year 1998 for all firms considered. Year effects should reflect macroeconomic impacts that commonly influence all firms in a particular year. Business cycles and financial markets are main drivers of year effects (McGAHAN, 1999). The term α_i represents the influence of the industry i and the term δ_{it} represents the interaction effect of year and industry, in the case of this study, the sum $\mu+\gamma_{1998}+\alpha_1+ \delta_{1,1998}$ represents the average result for the year of 1998 and for the industry 1. The term α_i is equivalent to what was called industry effects in other studies. Industry effects appear when the average performance of a particular industry is abnormally high or low. They reflect factors that affect the incumbents of an industry commonly for the whole span of time analyzed. Barriers to entry, technology revolutions, widespread diversification opportunities are examples. The interaction year – industry captures factors that commonly affect the members of a particular industry in a particular year. An exceptional agricultural crop in particular years, affecting mostly industries related to agriculture would be an example. The term ϕ_k is the individual contribution of the firm k to its results. It includes everything that is not explained by year or industry and is specific to the firm k. These firm effects reflect unique firm characteristics that affect its performance in a constant way for the entire period analyzed. They are a measure of how much one specific firm differs in sustainable way from others due to its unique

characteristics. They can be seen as a measure of its competitive advantage over the whole period under study (McGAHAN, 1999). If a long period is analyzed, this competitive advantage would have to be effective during the whole period length to be captured here. Finally, the error term $\varepsilon_{i,k,t}$ is the residual, not explained by the model.

This model is very similar to the one used by Rumelt (1991) with the exception that it does not account for corporate effects. Since the database consists of individual firms there are no corporate effects. Indexes have been adjusted in the model to reflect this and the corporate effects component has been removed.

The variance components method treats the four terms (γ_t, α_i, δ_t, ϕ_k) in the model as random effects and so the variance of the term $r_{i,k,t}$ is given by:

$$\sigma_r^2 = \sigma_\gamma^2 + \sigma_\alpha^2 + \sigma_\delta^2 + \sigma_\phi^2 + \sigma_\varepsilon^2 \qquad (2)$$

These variances can be estimated by several methods. The traditional way, used and described by Rumelt (1991) is the ANOVA method based on the calculation of the *Expected mean squares matrix.* The ANOVA method provides an integrative approach to estimating the variance components, and allows for significance tests, but it is not without problems. Estimates are generally biased and the components can be negative, which, by definition, is impossible. In fact, Rumelt (1991) found a small, negative variance component for year in his sample A. An alternative to ANOVA estimation is provided by the maximum likelihood estimation. Maximum likelihood methods are based on quadratic forms and, typically require an iterative solution. One of these methods that does not require an iterative solution is called MIVQUE(0) (Minimum Variance Quadratic Unbiased Estimators). In MIVQUE(0) there is no weighing of the random effects (thus the zero after MIVQUE) so an iterative solution is not required. The current statistcal software packages, like SPSS, offer several options of estimation of variance components. An extensive coverage of the variance components technique is given by Searle, Casella and McCulloch (1992).

Results and discussion

The first approach to analyzing the data is a purely descriptive analysis to acquire an overview of the problem and judge the type of distributions that are being dealt with. Observations were approximately evenly divided by year, 220 relating to 1998, 231 for 1999, 245 for 2000 and 242 for 2001. Distribution by sector was much more uneven and a descriptive analysis of the data by sector can be seen in Table 2.

Table 2 - Descriptive analysis of data. Brazilian companies 1998-2001.

Sub-sector	Observations	Mean	Minimum	Maximum	Std. Deviation	Skewness	Kurtosis
Oil derived chemicals	39	11.3	-5.9	47.8	12.5	0.97	0.94
Steel	58	-0.5	-34.8	10.5	7.8	-1.70	5.50
Petrochemical products	200	3.8	-42.0	48.8	12.8	0.31	1.78
Fertilizers	85	2.1	-64.6	32.6	13.6	-1.70	6.90
Glass products	30	7.7	-2.3	24.6	8.3	0.73	-0.72
Automotive parts	95	2.3	-40.3	66.3	15.7	0.89	3.42
Household appliances	41	-4.0	-57.3	15.7	14.4	-1.71	4.14
Agricultural equipment and machines	60	-0.2	-43.4	35.7	14.2	0.01	1.38
Textiles - towels and bed products	34	1.5	-36.0	13.0	8.9	-2.92	10.51

Electric conductors	18	-5.2	-66.7	8.1	18.0	-2.70	8.20
Perfumes	25	7.5	-15.9	36.8	13.2	0.49	0.42
Tanning	34	9.4	-10.0	96.1	17.3	4.02	19.82
Furniture	53	5.7	-4.7	33.4	8.7	1.29	0.95
Pharmaceuticals	117	9.3	-43.2	55.8	17.1	0.12	0.45
Ceramic products	49	0.2	-13.2	31.9	8.0	1.46	4.40
Total	938	3.8	-66.7	96.1	13.9	0.28	5.03

Source: research and analysis made by the authors on original data from Balanço Anual da Gazeta Mercantil.

Average return on assets was 3.8%, which is a low figure reflecting the poor performance of Brazilian economy during this period. The yearly averages have not shown much difference with 3.0% for 1998, 2.9% for 1999, 4.8% for 2000 and 4.1% for 2001. The total standard deviation for the ratio of operational income to total assets of 13.9 percentage points is slightly smaller than the 16.7 found by Rumelt (1991) and 15.7 found by McGahan and Porter (1997). The distribution of the total sample is clearly different from normal as seen by the Skewness and Kurtosis coefficients.

Fig. 1 shows the histogram of the whole sample plotted against the normal distribution curve. The small Skewness of 0.28 and the observation of the graph indicate the distribution is almost symmetric, slightly skewed to the left, toward more negative return of assets values. The kurtosis coefficient indicates a leptokurtic distribution or a distribution that is more peaked than the normal distribution, which would have a kurtosis coefficient of 3. Intuitively, this indicates a distribution where part of the shoulders have been shaved of and added to the tails and to the peak (SPANOS, 1999). When these coefficients are observed by sector, however, a different picture seems to emerge. In the two sectors with the largest (above 100) number of observations (Petrochemical products and pharmaceuticals), the distributions also were close to symmetrical, but the kurtosis coefficient was significantly less than 3 indicating platykurtic (opposite of leptokurtic) distributions. One possible explanation for this could be the direct competition among the firms within the same industry. The better performance of one of them could impact negatively the performance of other players. This certainly needs further study, but the issue offers interesting possibilities.

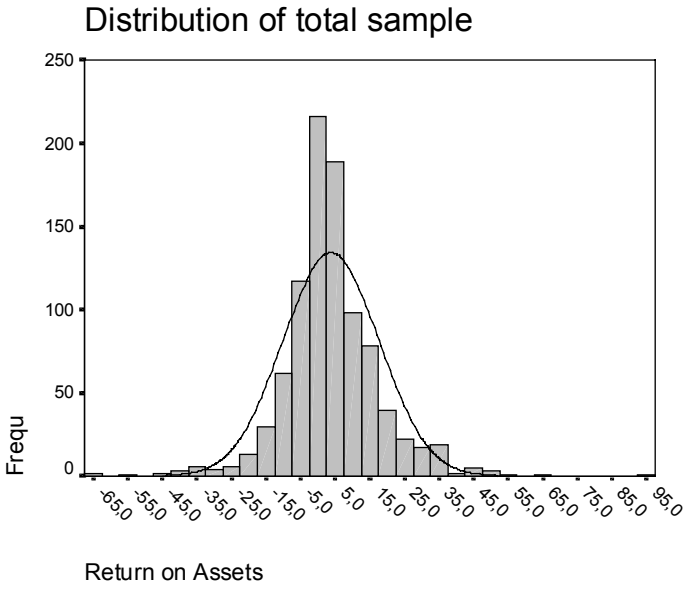

Figure 1

The second approach to analyzing the data is the variance components analysis. This was performed using iterative and non-iterative methods and the results are presented in Table 3. Maximum likelihood method converged quickly in 9 iterations.

Table 3 - Results of variance components analysis on Brazilian companies

	ANOVA	MIVQUE	Maximum Likelihood	ANOVA	MIVQUE	Maximum Likelihood
Year	-0.1	-0.1	0	0%	0%	0%
Industry	8.6	14.4	8.5	4.4%	7.1%	4.3%
Year x industry interaction	5.6	4.2	4.8	2.9%	2.1%	2.4%
Individual firm	102.4	106.4	107.3	52.7%	52.3%	54.0%
Error	77.9	78.3	78.0	40.0%	38.5%	39.3%
Total	194.4	203.2	198.6	100.0%	100.0%	100.0%

Source: calculations made by the authors.

When the composition of the variance is compared to the previous studies shown in Table 1, some aspects are noticeable. The so much discussed external turbulent environment, shocks, currency devaluation, does not seem to affect the variance of performance in a significant way. Similar findings were observed in previous studies made mostly with North American data in different periods. The largest component of variance is, again, the individual firm characteristics. Year does not show to be a significant factor. The variance due to the sub sector accounts for less than 10% of the total variance by all methods of calculation. Finally, the model is able to explain close to 60% of the variance, which is comparable to previous studies. The small negative values obtained for year effects should be treated as no influence of the factor year. The maximum likelihood method is theoretically superior and, in this case, provides results very similar to the ANOVA estimation.

The third approach is to analyze the variance in profits under the standard assumptions of ordinary least squares. Dummy variables were created to represent year, industry and firm-specific effects. Before looking at the individual coefficients of the dummy variables, the percent of variance explained by each group of variables (R^2 and adjusted R^2) was analyzed and tested with F-tests to assess the importance of each group of variables. Following Rumelt (1991) and McGahan and Porter (1997), nested ANOVA techniques were used where the groups of variables are introduced in order allowing the evaluation of the additional explanatory power brought by the inclusion of the group of variables over the previous model. It has to be noted that this model, given the computational difficulties, represents a restricted version of equation (1) since the interaction of year-industry is not being considered and its influence will be spread among the other variables. Order of introduction is critical since the after the first variable has been introduced, any variance explained by it will not be considered in the testing of subsequent variables even if they also explain this variance. To maximize the sensitivity to year factors, year dummies were introduced first, followed by industry dummies and finally by the firm dummy variables. Table 4 shows the results.

Table 4 - Test of significance of regression

	R^2 change	R_{adj}^2 change	F-change	Significance of F change
Year	0.3%	0.0%	1.018	0.384
Industry	8.3%	6.9%	5.932	0.000
Firm	60.0%	50.1%	5.546	0.000
Full Model	68.6%	57.0%	5.913	0.000

Source: authors.
Note: year dummies were introduced first, followed by industry and firm dummies were last.

Year effects add no explanatory power to the model, even being the first variables introduced. This is consistent with the previous analysis of components of variance that only indicated a variance caused by the interaction of year and industry. This interaction was not modeled in this case and the corresponding variance must have been absorbed by the industry and firm effects. This finding, although consistent with previous studies is remarkable given the economic conditions prevailing in Brazil during the years analyzed, and the very different economic environment during these years. Industry influence explains a limited amount of the variance, providing and R^2 change of only 0.083. The introduction of the firm effect in the model shows it is clearly the most significant factor bringing the R^2 to 0.686.

The regression approach also allows the analysis of the coefficients for each year, sector and individual firm. The coefficients of the firm dummy variables represent a measure of the effect of the firm idiosyncratic factors that have a lasting effect throughout the years, excluded from other effects like, year, industry and error. They are a measurement of the individual firms sustainable competitive advantage or disadvantage, during the period under analysis, expressed as its influence on return on assets. The histogram of these coefficients can be seen in fig. 2. As already predicted in the variance component analysis, the individual firm has a large influence in the final results. Several firms have coefficients with absolute values of more than 15%, meaning that the individual factors associated with the firm, contribute to the final performance by such an amount. These coefficients could be used in future researches as a measure of these factors when analyzing individual firms or as a criteria to group firms like low, high and medium performers. Using the coefficients could be superior to using the actual results since they reflect only the unique firm effects and not the composition of all effects.

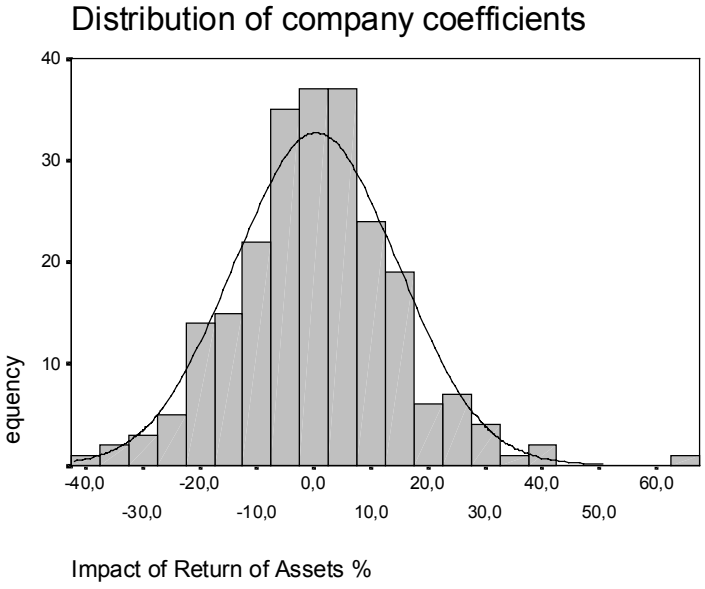

Figure 2

Conclusions

The first part of the objective we set forth in this paper was the review of common findings of previous research. Although viewed by some as contradictory, previous studies on variance components can be reconciled and generalizations are possible when studies are compared looking for similarities instead of differences. In manufacturing, where the majority of studies were developed, it is quite clear that the largest variance component is, by a wide margin, the one associated with individual firm/business unit characteristics that have a lasting effect throughout the years. Firms differ for several reasons (NELSON, 1991, CARROLL, 1993), but these studies on variance composition prove that a good proportion of that heterogeneity is lasting and affect firms' results year after year. These so-called firm effects are able to explain something like a third to half of the total variance of performance.

The longer the period analyzed, the smaller this proportion since the firm factors need to be lasting for the whole period under analysis. So, for shorter periods of 4 to 5 years, firm effects are even more important.

Industry effects are also clearly present and statistically significant. Their size, however, runs second to firm effects. They account for 10 to 20% of total variance in performance. Part of that effect is fixed and lasting, and another part is due to interaction with year, representing the influence of factors that affect differently the several industries in a particular year. Factors, that affect an industry as a whole, do come through as influencing the results of individual firm performance, but that effect is limited, given the large differences among individual firms. This certainly argues against the extremist position based on the IO approach. These combined results clearly indicate that both IO and resource-based approach are complementary as Wernerfelt (1995) suggested.

Year effects are non-existent or, whenever statistically significant, very small. This implies that virtually no year factors affecting commonly all firms in a given year have been identified. The effect of year manifests itself only through its interaction with industry (identified within the industry effect) and through its interaction with the firm (still unidentified and part of the error term). This finding is quite intriguing and led to the second objective of this paper. Much more turbulent economic environments are known to exist outside the US economy where all previous studies have been made. Emerging economies are a natural place to look for answers.

The second part of the objective was to explore the variance components of firms exposed to a highly turbulent environment, like Brazil during 1998 to 2001, and compare the results with previous findings in more stable and developed economies. It would be reasonable to expect that the intense shocks suffered during the last few years would cause larger year effects and possibly affect industries differently increasing the variance caused by these effects. The turbulence should also increase the error term due to its effects on individual firms. Results have shown that this is not the case. No factor associated only with year could be detected. Interaction of year and industry was not greater than that found in previous studies with US data. Industry effects were identified, but accounted for less than on tenth of total variance. Individual firm factors were still the most important component of variance accounting for more than half of the observed variance. These results suggest that focus on individual firm capabilities and resources that affect performance are even more important, in turbulent environments. Being in the “right” sector so as to “take advantage” of certain economic shocks and changing of rules does not find sound statistical support. Being good at what you do is still, and maybe even more than ever, the golden rule.

This paper has several limitations. The first relates to the available data, which is limited and could not include large multidivisional firms, so some sectors could not be considered. The choice of an indicator of performance like the ratio of operational profit to total assets is a crude estimate of performance; possibly future studies could explore other non-financial based measures. Accounting practices and the degree of informality of Brazilian economy is another issue. A promising point to be explored in future studies is the one covered, initially, by McGahan and Porter (1997) when they compared the differences in variance components of other economic sectors. Industry played a much more important role in non-manufacturing sectors. Larger time series are also desirable, but ways to treat dependency of the data must be developed. Again, McGahan and Porter (1997) made a partial attempt to cover this issue modeling the dependency on the previous year, but the resulting model did not explain more of the variance than Rumelt´s (1991) simpler model. Finally, the use of the individual firm coefficients of the regression as a measure of sustainable competitive advantage offers an interesting possibility for future studies as a possibly better metric than pure performance figures. Despite these shortcomings, the results here presented show very encouraging signs

of convergence with previous studies and indicate that there are several avenues for new approaches, clearly inviting further research.

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