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CORPORATE GOVERNANCE, STRATEGY, AND SUPPLY MANAGEMENT PERFORMANCE: AN EMPIRICAL ANALYSIS OF COMPANIES LISTED IN THE SÃO PAULO STOCK EXCHANGE

Wesley Mendes-da-Silva
*Ervin L. Black**

I. SUMMARY

Recently, increased competition has prompted companies to enhance their organizational efficiency. One of the areas most influenced by this pressure is supply management, which uses a large percentage of corporate assets and has the potential to negatively affect customer service. Another central area of organizational efficiency is corporate governance, which is regarded as a determining factor for administrative excellence.

This paper examines whether the corporate governance structures of firms with diversified suppliers differ from those of firms with more specialized or concentrated suppliers. This study consists of multiple cross sections that cover the period between 1997 and 2001 and incorporates data collected from 176 industrial companies from fourteen industrial segments that listed stocks in *Bovespa*, the São Paulo Stock Exchange. This study based its exploration on the premise that minimized inventory and minimized *days' sales in inventory ratios* define the best-performing supply management.¹

The two following propositions summarize the principal results of this study. First, increased independence of the chairman of the board of directors tends to result in less efficient supply management. This conclusion is drawn from the following two findings: (i) an independent chairman of the board uses more diversified suppliers than an internal chairman and (ii) greater

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¹ Number of days it takes to turn over the inventory one time.

supplier diversification is directly associated with a larger inventory. Second, an independent board of directors correlates with less efficient results due to its significant and positive association with *day's sales in inventory ratio*. These results collectively suggest that strategies utilized by independent corporate governance structures tend to result in less efficient supply management.

II. INTRODUCTION

Undoubtedly, a company's performance largely depends on the executives' choices in management strategies. In their seminal study, Jensen and Meckling (1976, 308–9) discuss the agency theory, which examines the relationships between principals (e.g., stockholders) and their agents (e.g., executives). Company owners have strategic interests in improving the company's performance. However, the decision-making power lies in the hands of the executives who are hired by the owners through the advice of the directors. According to this view, the following factors determine the company's maximum performance: (i) the technical competence of the executives chosen to direct the company's activities, (ii) the alignment of executives' interests with owners' interests, and (iii) the adequacy of the corporate governance structures responsible for balancing the relationship between principals and agents.

One example of the competing interests at stake here is that of the shareholders' strategic interests, which may lie in choosing to diversify the company's portfolio of suppliers. On the other hand, company executives may let their personal needs and desires interfere with the task of diversifying suppliers. Aside from the conflict of interests between shareholders and executives, relationships between the company and its suppliers affect the structure of the company's supply network. When the company chooses to work with a small number of suppliers, it tends to have more cooperative and long-lasting relationships with its suppliers. Conversely, if the company chooses a more diversified supplier system, the company will develop short-term relationships based on lowest-price competition among suppliers.

The majority of studies on corporate governance focus on economics and finance, concentrating on the impact of governing structures on the economic and financial development of companies. Consequently, studies on corporate governance in terms of supply management are negligible. The recognition that supply

management constitutes a significant part of corporate management, especially in industrial companies, motivated this study. This article fills the performance measurement gap by examining the relationship between corporate governance structures, supplier diversification strategies, and the supply management performance of Brazilian industrial companies.

The study is comprised from multiple cross sections covering the period between 1997 and 2001, including data from 176 industrial companies from fourteen different industries trading on *Bovespa*, the São Paulo Stock Exchange. This study based its exploration on the premise that two factors define the best-performing supply management: minimized inventory and minimized *days' sales in inventory ratio*.

The following sections of this paper more fully explain the findings of this study. Section Three presents the theoretical basis for the study, including the basic theory of corporate governance and a comparison of two different supply management performance principles. Section Four then details the methodology employed to conduct the study. Section Five discusses the results of the study, ending with the conclusions in Section Six.

III. THEORETICAL BASIS OF THE STUDY

A. Corporate Governance

In developed countries, agency problems² result in high costs for shareholders. Corporate governance, which is concerned with

² According to many authors, including Bebchuk and Fried (2003), agency problems can arise from (i) profit-sharing bonuses, contingency fees, sales commissions, merit raises, executive stock options, and various other contractually specified methods of setting the amount of the agent's financial compensation in proportion to measurable results; (ii) organizational hiring and promotion policies for people in responsible positions (agents) that emphasize identifying and selecting candidates whose reputation (based ideally on past performance) indicate they are "well-motivated," "dedicated to the ethics of the profession," and generally "of good character" — i.e., people who feel a strong sense of moral obligation to do their best to do what they have promised to do, even when no one is likely watching; (iii) institutional arrangements of accountability (such as boards of directors, auditing committees, inspector generals' offices, professional society ethics committees, and government regulatory boards) for detecting and then punishing extreme dereliction of duty, either by simply firing and disgracing (or perhaps de-licensing) the unworthy agent or possibly by aggressively pursuing civil or criminal penalties through the

increasing the security of investors' returns, aims at guaranteeing disclosure, accountability, owners' equity, and compliance with local laws. By doing so, corporate governance ameliorates problems that result from the separation of ownership and control in modern corporations (La Porta et al. 1998). Corporate governance oversees the control and monitoring systems established by the controlling shareholders so that executives are required to make their decisions of resource allocation according to shareholder interests. Effective corporate governance requires the following: (i) a separation and balance of powers between executive officers, the board of directors, and stockholders; (ii) the presence of independent members on the board of directors, although not all members are required to be independent; and (iii) a convergence of interests for controlling shareholders, members of the board of directors, and all other members of the company.

B. Supplier Diversification

Studies conducted in Brazil and in other countries have indicated that the cost of inventory has a large impact on the general costs of production (Gonçalves 2004). In many companies, particularly industrial companies, a large percentage of the assets consist of inventory. Inventory consists of any quantity of physical goods that are conserved, unproductively, for any given time period (Moreira 1992, 464). Maintaining inventory means incurring costs, such as opportunity costs from the idle capital, potential costs due to lost or damaged inventory, and storage and handling costs. On the other hand, maintaining inventory allows the company to: (i) improve its services through improved responsiveness in the delivery process, (ii) increase product availability, (iii) purchase or produce lower-cost goods by using economies of scale, and (iv) adjust to fluctuations in supply and demand (Moreira 1992; Slack et al. 1996; Gaither and Frazier 1998; Chase et al. 1998; Chopra and Meindl 2003; Viana 2000; Bowersox and Closs 2001; Ballou 2001, 249–338).

Two important hypotheses enhance understanding of the strategic purchasing choices that logistics managers make. The first

courts; or (iv) arrangements such as elections whereby the agent's principals may periodically scrutinize the recent performance of the agent and competing candidates for the job may make their case for replacing the incumbent agent by revealing his or her shortcomings and showing how performance might be improved through a change in command.

hypothesis postulates that companies should limit the number of suppliers (*single-sourcing*) to establish lasting relationships with suppliers, thereby obtaining better supplier performance (Adkins and Diller 1983; Reck and Long 1985; Dwyer et al. 1987; Newman 1988; Rubin and Carter 1990). In an analysis of *single-sourcing*, Swift (1995) reveals that purchasing managers who choose a *single-sourcing* strategy are initially less interested in low prices and more interested in the future life of a product. *Single-sourcing* structures ensure a greater ability to make technical support and integrity available to the client compared to multiple-sourcing structures.

The second hypothesis suggests that companies should maintain a diversified portfolio of suppliers (*multiple-sourcing*) to stimulate competition between the suppliers, thereby obtaining better performance for the company (Foster 1992, 38–46; Foster and Barks 1990). Historically, purchasing managers have maintained two or more active suppliers for each product group to keep costs low. The competition among suppliers reduces prices, improves the quality of service, and reduces the risk of lack of materials (Monks 1987). In addition, a diversified supply system provides an effective means of controlling suppliers' behavioral patterns (Krause et al. 2000, 33–35; Krause and Scanell 2002, 14). Slack summarizes some of the advantages and disadvantages of *single-sourcing* vs. *multiple-sourcing* supply schemes (Slack et al. 1996, 417). Figure 1 below shows the results.

Figure 1 – Advantages and Disadvantages of *Single-* and *Multiple-Sourcing*

Strategy	Advantages	Disadvantages
<i>Single-Sourcing</i>	<ul style="list-style-type: none"> • Better quality inventory due to greater availability of quality-control systems • Stronger and longer-lasting relationships • Greater dependence results in greater commitment and effort • Better communication • Greater cooperation in the development of new products and services • More economies of scale • Greater confidentiality 	<ul style="list-style-type: none"> • Greater vulnerability to problems if failures occur in the supply source • Greater effect of fluctuations in demand on individual suppliers • Greater opportunity for suppliers to increase prices when no other supplier is available

Strategy	Advantages	Disadvantages
<i>Multiple-Sourcing</i>	<ul style="list-style-type: none"> • Greater opportunity for buyer to drive prices down due to competition among suppliers • Easier to switch to a different supplier in the event of failure by another supplier • Greater knowledge of sources and specialization 	<ul style="list-style-type: none"> • Less opportunity to encourage the commitment level of the supplier • More difficult to develop efficient systems for quality control • Greater effort required for communication • Less investment on the part of the suppliers • More difficult to obtain economies of scale

According to Chopra and Meindl (2003) and Bowersox and Closs (2001), one of the basic objectives of logistics management is to minimize the inventory in order to reduce total logistical costs. Executives increasingly recognize and appreciate concepts like *just in time* and *zero inventory* as they try to capture value by reducing idle inventories. Chopra and Meindl further maintain that executives can reduce inventory by decreasing the costs incurred for orders and transportation as well as by implementing discount schemes based on total annual volume rather than individual purchase quantities. Either scheme, however, is practical to the extent that managers maintain good relationships with suppliers. Accordingly, one of the principal challenges for inventory managers is to reduce the amount of unused inventory without jeopardizing the ability to deliver goods to customers promptly.

However, the goal of reducing inventory is incompatible with the goal of diversifying suppliers. Generally speaking, companies can achieve cost savings by establishing solid and exclusive relationships with a small number of suppliers. Companies need suppliers they can trust in order to benefit from functioning with lower levels of inventory (Monks 1987, 264). Strategic partnerships with suppliers reduce costs as suppliers provide goods that have more compatibility with the buyer's processes and purposes. Cost savings materialize with a drop in the number of returns and decreases in idle inventory.

According to Chen and Yang (2002, 60), companies now want to reduce the number of their suppliers and establish long-term, purchaser-supplier relationships with fewer suppliers for the purpose of securing a competitive edge by improving their supply efficiency. The principle, known as *just in time*, involves working

with the fewest number of suppliers possible—perhaps as few as one supplier for every group of materials—thus allowing managers to cultivate long and committed relationships with the suppliers, improve the replenishment system, and achieve the consequential reduction of expenses incurred for inventory and supplies (Chase et al. 1998, 482). Using Brazilian companies, Mendes-da-Silva and Pontual (2004) provide evidence that managers need to develop lasting relationships with a limited number of suppliers while seeking to minimize idle inventory.

C. Corporate Governance and Supply Management

Corporate governance studies have been largely limited to analyses of the impact of governance on productivity in industrial companies. Köke (2001) analyzes 841 German companies between 1986 and 1996 and finds evidence that companies with more concentrated power structures tend to enjoy higher productivity than companies with less concentrated power structures. According to Nickell, Nicolitsas, and Dryden (1997), managers in companies with highly concentrated ownership work under greater pressure and tighter controls.

Similarly, research conducted by Januszewski, Köke, and Winter (2001) deals with the behavioral patterns of 500 German companies between 1986 and 1994. In their research, they find strong, albeit inconclusive, evidence supporting the hypothesis that companies led by the majority shareholder have greater productivity, except in cases where the majority shareholder is a financial institution. This finding indicates that an independent chairman of the board may not ensure the most productive governance structure.

In turn, Destefanis and Sena's (2004) study explores the relation between corporate governance systems adopted by Italian industries and their respective technical efficiency. From 1994 to 1997 they analyzed 3,728 companies from nine industrial sectors. Their analysis notes that although quite a few studies on the issue have been conducted, the relationship between corporate governance and organizations' technical efficiency is still unclear. According to the study, companies with high concentrations of ownership benefit from the owners' significant interest in maximizing organizational profits, even though the expropriation of minority stockholders is a risk. This study demonstrates that high

concentrations of ownership positively affect a company's technical efficiency.

Studies on the correlations between corporate governance and supply management performance are almost non-existent. With this in mind, this study seeks to explore what impact, if any, independence of the board and the chairman of the board have on inventory management patterns.

IV. METHODOLOGY

A. Sample, Data, and Variables

The sample consists of data from companies from fourteen different industrial segments. Table 1 illustrates the frequency of each industry. The authors collected data from the Economática® Database and the Annual Information Reports (IAN) that the companies send to the Brazilian Securities and Exchange Commission (CVM).

Table 1 – Frequency of Participating Companies by Economic Sector

Sector	Frequency	Percentage	Sector	Frequency	Percentage
Chemical	27	15.3	Industrial Machines	10	5.7
Textile	26	14.8	Others	10	5.7
Metallurgy	24	13.6	Paper and Cellulose	8	4.5
Vehicles and Parts	18	10.2	Electric Energy	6	3.4
Food and Drinks	15	8.5	Mining	4	2.3
Electronics	11	6.3	Petroleum and Gas	3	1.7
Construction	11	6.3	Minerals and Metals	3	1.7
			Total	176	100.0

Source: Created from the research data of the authors (2005).

As of May 2001, 289 of the 459 companies listed on the São Paulo Stock Exchange had their data registered on the Economática® Database. The authors limited their study to manufacturing companies that had available data for at least three

of the five years from 1997 to 2001. As a result, they analyzed a total of 176 manufacturing companies with outstanding shares of stock. Table 2 describes the calculation of performance variables for supply management, corporate governance, and supplier diversification. Employing the method recommended by Hair et al. (1998), outliers were removed to ensure a normal distribution of the data.

Table 2 – Description of Studied Variables

	Variable – Description	Conceptual Sources
Dependent Variables	InEstq – Natural log of the inventory value in balance sheet of a company <i>i</i> in year <i>t</i> , adjusted for inflation.	Moreira (1992); Bowersox and Closs (2001); Chopra and Meindl (2003)
	<p>Hforn* – Index of concentration of the three main suppliers of company <i>i</i> in year <i>t</i> calculated by the equation:</p> $Hforn = \sum_{i=1}^3 \left(\frac{f_i}{F} \times 100 \right)^2$ <p>Where f_i is the value of the purchases carried through with a certain supplier and F is the total value of purchases by the company <i>i</i> in year <i>t</i>. The value of <i>Hforn</i> is maximized when the participation of a sole supplier in the purchases of the company reaches 100%, and in these terms $Hforn = 10.000$.</p>	Mendes-da-Silva and Pontual (2004); Foster (1992); Newman (1989); Rubin and Carter (1990)
	Pme* – Days' sales in inventory for company <i>i</i> , in year <i>t</i> . It is calculated by the expression (Inventory/Cost of Goods Sold) × 360.	Moreira (1992); Bowersox and Closs (2001); Chopra and Meindl (2003)

	Variable – Description	Conceptual Sources
Corporate Governance Variables	<i>Indpr*</i> – A bifurcated variable that expresses the independence of the chairman of the board of a company. It is assigned a value = 1 if the chairman of the board does not simultaneously occupy a position as an executive officer (independent), and a value = 0 in the alternative (not independent).	Bhagat and Black (2002)
	<i>Indco*</i> – Proxy that measures the degree of independence of the board of directors of the company. It is expressed by the fraction of total members of the board of directors that are independent (the percentage of the board that does not simultaneously belong to the board of directors and hierarchy of executives of the company) in year <i>t</i> .	Bhagat and Black (2002); Dutra and Saito (2002)
	<i>Hpod*</i> – Index of concentration of voting power controlled by the three main shareholders. Calculated by the following equation: $Hpod = \sum_{i=1}^3 \left(\frac{p_i}{P} \times 100 \right)^2$ Where <i>p_i</i> is the number of common shares of a company <i>i</i> controlled by a certain stockholder, and <i>P</i> represents the total quantity of common shares of the considered company.	Hoskisson et al. (1994)
Control Variables (VC)	<i>Estd*</i> – A Politomic variable that expresses the Brazilian state where the headquarters of the company are installed. Value = 1 if in São Paulo; value = 2 if in Minas Gerais; value = 3 if in Santa Catarina; value = 4 if in Paraná; value = 5 if in Rio Grande do Sul; value = 6 if in Rio de Janeiro; value = 7 if in Amazonas; value = 8 if in Mato Grosso; value = 9 if in Ceará; value = 10 if in Bahia; value = 11 if in Espírito Santo; value = 12 if in Rio Grande do Norte.	N/A

Control Variables (VC)	Sect* – A Politomic variable that expresses the industrial sector in which the company operates. Value = 1 if in metallurgy; value = 2 if in chemistry; value = 3 if in electric energy; value = 4 if in vehicles/parts; value = 5 if in textiles; value = 6 if in food/drinks; value = 7 if in electronics; value = 8 if in construction; value = 9 if in industrial machines; value = 10 if in mining; value = 11 if in petroleum/gas; value = 12 if in nonmetallic minerals; value = 13 if in paper/cellulose; value = 14 if in other sectors.	N/A
	lnTamf* – The size of company <i>i</i> expressed by the natural log of the total assets of the company in year <i>t</i> , adjusted for inflation.	Bhagat and Black (2002)
	Ano* – Politomic variable that expresses the year to which the data referring to company <i>i</i> belongs. Value = 1 if it is from 1997; value = 2 if it is from 1998; value = 3 if it is from 1999; value = 4 if it is from 2000; value = 5 if it is from 2001.	N/A
	lnTamc* – Natural log of the number of members of the board of a company <i>i</i> , in the year <i>t</i> .	Bhagat and Black (2002)

Operational source: *Econômica[®] data base; *IAN/CVM.

B. The Models

The following three hypotheses examine the alleged existence of a meaningful relationship between corporate governance, supplier diversification strategies, and supply management performance of Brazilian industrial companies:

H1: *Companies will have better supply management performance (as demonstrated by lower inventory values (lnEstq) and lower days' sales in inventory ratio (Pme)) when both the chairman of the board (Indpr) and the other members of the board (Indco) are independent of the company.*

H2: *The independence of the board (Indco) and the independence of the chairman of the board (Indpr) are significantly and negatively associated with supplier*

concentration in the firm (Hform) due to the conflict of interests between stockholders and executives.

H3: *Significant association exists between single-sourcing (Hform) and supply management performance.*

To test the hypotheses, the authors formulated a multivariate regression model for each of the dependent variables. Equations (1), (2), and (3) illustrate the models.

(1)

$$\ln Estq_i = \beta_0 + \beta_1 Indco_i + \beta_2 Indpr_i + \beta_3 \ln Tamc_i + \beta_4 Hpod_i + \beta_5 Hform_i + \sum_{j=1}^k \psi_j VC_{ji} + \xi$$

(2)

$$Hform_i = \beta_0 + \beta_1 Indco_i + \beta_2 Indpr_i + \beta_3 \ln Tamc_i + \beta_4 Hpod_i + \sum_{j=1}^k \psi_j VC_{ji} + \xi$$

(3)

$$Pme_i = \beta_0 + \beta_1 Indco_i + \beta_2 Indpr_i + \beta_3 \ln Tamc_i + \beta_4 Hpod_i + \beta_5 Hform_i + \sum_{j=1}^k \psi_j VC_{ji} + \xi$$

Based on the first hypothesis (**H1**) that companies will have better supply management performance (as demonstrated by lower inventory values ($\ln Estq$) and lower *days' sales in inventory ratio* (Pme)) when both the chairman of the board ($Indpr$) and the other members of the board ($Indco$) are independent of the company; one expects coefficients β_1 and β_2 in equations (1) and (3) to be negative and statistically significant. The second hypothesis (**H2**) posits that the independence of the board ($Indco$) and the independence of the chairman of the board ($Indpr$) are each significantly and negatively associated with supplier concentration in the firm ($Hform$) and leads one to expect that coefficients β_1 and β_2 in equation (2) should assume significant negative values ($\beta_1 < 0$; $\beta_2 < 0$). The third hypothesis (**H3**), which deals with the relationship between supplier concentration and supply management performance, proposes that coefficient β_5 should be statistically significant in equations (1) and (3).

The authors selected control variables (CV)³ to make up for possible third-variable effects on the dependent variables ($Hform$, $\ln Estq$, and Pme) and the independent variables ($Indpr$, $Indco$, and

³ If the independent control variables have significant correlation with any of the variables but do not receive consideration in the proposed models, the relationship between variables cannot be accurately verified.

Hpod). The study uses the following control variables: (i) the Brazilian state where the company's headquarters are located (*Estd*), (ii) the industrial sector of the company (*Sect*), (iii) the size of the firm (*lnTamf*), (iv) the fiscal year to which the information belongs (*Ano*), and (v) the size of the board of directors (*lnTamc*). Table 2 defines all of the other variables.

V. EMPIRICAL RESULTS

Table 3 shows the absence or presence of correlation between the variables. As expected, there seems to be a strong correlation between firm size (*Tamf*) and the following three factors: (i) the independence of the board of directors (*Indco*), (ii) the independence of the chairman of the board (*Indpr*), and (iii) the size of the board of directors (*Tamc*). The industrial sector (*Sect*) and the state where the company is headquartered (*Estd*) each correlate with both inventory values (*Estq*) and supplier diversification levels (*Hforn*). This expected correlation reflects the differing state economies that varied supplier disposition by region. These variations by sector create unique, regional, supplier diversification strategies and inventory management practices.

Table 3 – Matrix of Correlations between the Variables Studied

	1	2	3	4	5	6	7	8	9	10	11
1. <i>Estq</i>	1										
2. <i>Pme</i>	-.008	1									
3. <i>Hforn</i>	-.004	.008	1								
4. <i>Indco</i>	.105**	.049	-.033	1							
5. <i>Indpr</i>	.148**	.037	-.128*	.563**	1						
6. <i>Tamc</i>	.141**	-.056	-.080	.335**	.292**	1					
7. <i>Hpod</i>	-.063	.064	.086	-.146**	-.121**	-.276**	1				
8. <i>Estd</i>	.075*	-.023	.105*	.030	.044	-.004	-.074*	1			
9. <i>Tamf</i>	.849**	-.011	.039	.136**	.161**	.179**	-.063	.073*	1		
10. <i>Sect</i>	.082*	.033	-.170**	.022	.058	.097**	.003	-.017	.044	1	
11. <i>Ano</i>	.032	.031	.022	-.030	-.042	-.015	.098**	.000	.003	.000	1

Source: Created by the authors from the data (2005).

Notes: **Significance at 1%; *Significance at 5%; N minimum: 386; N Maximum: 880.

The study used a *T*-test to verify the existence of meaningful difference in the mean values assumed by the dependent variables (*Estq*, *Pne*, and *Hforn*) between companies with independent chairmen of the board and those without independent chairmen.

Before proceeding with the *T*-test, the equality of the variance between these two sets of companies was also tested. According to the *Levene Test*, the hypothesis of the equality of the variances could not be rejected at a significance level of 5%. Accordingly, both the diversification of the supplier portfolio ($t = -2.389$; Sig. < 0.05) and the quantifiable value of the inventory ($t = 3.954$; Sig. < 0.05) prove to be significantly different for companies that maintain the independence of the chairman of the board (*Indpr*) as compared to those companies that do not.

Table 4 – Calculations from *T*-test of the Equality of Means as Applied to Independence of the Chairman of the Board (*Indpr*)

Dependent Variables	<i>t</i> statistics	Df	Sig. (2-tailed)	Average Deviation	Standard Error of Deviation	Interval of Deviation with 95% Confidence	
						Low	High
<i>Estq</i>	3.954	700	0.000	191,831.993	48,518.954	96,571.881	287,092.105
<i>Pme</i>	0.972	352.115	0.331	103.293	106.220	-105.61377	312.200
<i>Hfor</i>	-2.389	342	0.017	-1,207.168	505.391	-2201.236	-213.100

Source: Created by the authors using data from the study (2005).

Note: Statistics software SPSS® 12.0 was used for the treatment of the data.

Table 5 illustrates the results of the multivariate regressions. In analyzing the results of the calculated parameters for a multivariate regression, Granger and Newbold (1974, 111–20) and Savin and White (1977) recommend checking the regression results for the presence of spurious regression (first-order autoregressive errors).⁴ In this study, the value of the Durbin-Watson statistic is closer to 2, suggesting no autocorrelation.⁵

These statistics support the hypothesis that the independence of the chairman of the board of directors (*Indpr*) is significantly and

⁴ If two stationary variables are generated as an independent random series, when one of those variables is regressed on the other, the *t*-ratio on the slope coefficient is expected not to be significantly different from zero and the value of R^2 is expected to be very low. This seems obvious because the variables hold no relation to one another. However, if two variables are trending over time, a regression of one on the other could have a high R^2 even if the two are totally unrelated. Therefore, if standard regression techniques are applied, the end result could be a regression that “looks” good under standard measures (significant coefficient estimates and a high R^2), but which really has no value. Such a model would be termed a “spurious regression” (Brooks 2002, 367–68).

⁵ According to Judge, Hill, Griffiths, Lütkepohl, and Lee (1988, 394–95), the Durbin-Watson test statistic *d* indicates the likelihood of autocorrelation. A value of *d* close to 0 indicates positive autocorrelation, a value close to 4 indicates negative autocorrelation, and a value around 2 suggests no autocorrelation.

negatively associated with the concentration of suppliers (*Hfor*). Therefore, companies with a chairman of the board that is independent from its directors generally have greater supplier diversification ($t = -2.154$; $\text{Sig} < 0.05$). However, the independence of the board of directors (*Indco*) is not significantly associated with the concentration of suppliers, supporting the rejection of part of **H2**. A third measure of corporate governance, the concentration of stockholders' voting power (*Hpod*), is positively associated with the concentration of the portfolio of suppliers. Therefore, this study supports the idea that *single-sourcing* is significantly associated with the independence of the chairman of the board and the concentration of stockholders' voting power.

Table 5 – Calculated Parameters for Multiple Regression

Dependent Variables	Independent Variables	Expected Sign	Standardized Coefficients (Beta)	Statistic t (R ²) [d]	Sig.
LnEstq	(Constant)			-2.627	0.009
	<i>Indco</i>	(-)	-0.034	-0.937	0.349
	<i>Indpr</i>	(-)	-0.031	-0.855	0.393
	Lntamc		0.095***	2.706	0.007
	<i>Hpod</i>	(-)	-0.004	-0.114	0.909
	<i>Estd</i>		-0.037	-1.237	0.217
	Lntamf		0.834***	24.566	0.000
	Sect		-0.175***	-5.647	0.000
	<i>Ano</i>		0.009	0.310	0.756
	Hfor	? √	-0.141***	-4.723	0.000
		N = 335		(0.735)[1.403]	
<i>Hfor</i>	(Constant)			-0.311	0.756
	Indco	(-) ^x	0.074	1.100	0.272
	<i>Indpr</i>	(-) [√]	-0.143**	-2.154	0.032
	<i>Lntamc</i>		-0.028	-0.441	0.660
	Hpod	(+)	0.097*	1.683	0.093
	<i>Estd</i>		0.057	1.024	0.306
	<i>Lntamf</i>		0.090	1.459	0.145
	Sect		-0.186***	-3.320	0.001
	<i>Ano</i>		-0.014	-0.268	0.789
		N = 335		(0.067)[1.522]	

Dependent Variables	Independent Variables	Expected Sign	Standardized Coefficients (Beta)	Statistic t (R ²) [d]	Sig.
<i>Pme</i>	(Constant)			0.438	0.662
	Indco	(-) ^x	0.117*	1.696	0.091
	<i>Indpr</i>	(-)	0.035	0.509	0.611
	Lntamc	(-)	-0.163**	-2.467	0.014
	<i>Hpod</i>	(-)	0.032	0.530	0.596
	<i>Estd</i>		-0.029	-0.504	0.615
	<i>Lntamf</i>		-0.039	-0.618	0.537
	<i>Sect</i>		0.045	0.762	0.447
	<i>Ano</i>		0.040	0.721	
	<i>Hforn</i>		0.021	0.371	0.472
	N = 335			(0.046)[2.011]	0.711

Source: Created by the authors based on data from the study (2005). This table presents the results of the multiple regression, using each of three dependent variables: *lnEstq*, *Hforn*, and *Pme*. Table 2 defines the dependent and independent variables. The authors processed the data on the statistics software SPSS® version 12.0; they selected the option *Enter*.

Notes: *Significant at 10%; **significant at 5%; ***significant at 1%; ^x: hypothesis rejected; √: hypothesis not rejected; boldface type: statistically significant variables; coefficient of determination (R²): between parentheses; statistic Durbin-Watson [d]: between brackets.

Analysis of the size of a company's inventory (*lnEstq*) reveals that *single-sourcing* is significantly associated with the size of the inventory ($t = -4.723$; $\text{Sig} < 0.01$). This result corroborates the *just in time* principle that endorses lasting relationships with fewer suppliers for more reliable deliveries and improved supply management (Gianesi and Corrêa 1996). Therefore, the authors cannot reject hypothesis **H3** at the significance level of one percent. Additionally, the size of the board of directors (*lnTamc*) and the size of the company (*lnTamf*) are each positively associated with the size of the company's inventory ($t = 2.706$; $\text{Sig} < 0.01$).

Only two variables proved to be significantly associated with the average *days' sales in inventory ratio* (*Pme*). The independence of the board of directors (*Indco*) at the significance level of ten percent has a marginally positive association with *Pme* ($t = 1.696$; $\text{Sig} < 0.1$). The correlation suggests that, generally, the more independent the board, the higher the *days' sales in inventory ratio*. In other words, the study suggests that companies with an independent chairman of the board tend to have less efficient supply management systems. On the other hand, *Indpr* (independence of the chairman of the board of directors) has no significant relation to the average *days' sales in inventory ratio* or

the size of the inventory. Accordingly, this result half confirms and half rejects hypothesis **H1** that companies will have better supply management performance when both the chairman of the board and the board itself are independent of the company.

The second significant independent variable (the size of the board of directors (*lnTAMC*)) had a negative association with the dependent variable *Pme*. This association suggests that, generally, the greater the size of the board of directors, the lower the *days' sales in inventory ratio*. In other words, companies with larger boards of directors have more effective supply management, indicated by lower *days' sales in inventory ratio* ($t = -2.467$; $\text{Sig} < 0.05$). Figure 2 summarizes the results for the three formulated hypotheses.

Figure 2 – Summary of the Results of the Study

		Governance and supplier diversification strategy variables (independent variables)			
		<i>Indco</i>	<i>Indpr</i>	<i>Hpod</i>	<i>Hfor</i>
Strategy and supply management performance variables (dependent variables)	<i>lnEstq</i>				(-)1%
	<i>Hfor</i>		(-)5%	(+)10%	
	<i>Pme</i>	(+)10%			
Expected outcomes for the hypotheses	H1 : positive association between the independence of the board of directors and supply management performance	Negative	Negative		
	H2 : positive association between the independence of the board of directors and supplier diversification	Negative	Negative		
	H3 : significant association between supplier diversification and supply management performance				?

Note: The sign of the coefficient obtained in the model is enclosed by parentheses. The percentage represents the level of statistical significance of the coefficient based on the t-statistic. The sign indicated for each hypothesis **H1**, **H2**, and **H3** reflects the originally expected outcome.

VI. CONCLUSION

Strategic decisions by the highest level of management are crucial to a company's pursuit of superior performance. However, executive officers may interfere with a company's chosen strategies by pursuing personal interests at the expense of corporate objectives. In order to increase shareholder value, management systems should represent corporate interests and not the personal interests of the executive officers.

With such agency problems in mind, this study explores what impact, if any, the independence of a chairman has on inventory management patterns. This study based its exploration on the premise that the best-performing supply management systems are defined by two factors: (i) minimized inventory and (ii) minimized *days' sales in inventory ratio*. Interestingly, this study shows that the independence of the chairman of the board of directors is positively associated with the size of inventory, whereas the independence of the board of directors is positively associated with the *days' sales in inventory ratio*.

This study shows that an independent chairman of the board uses more diversified suppliers than an internal chairman.⁶ It further indicates that greater supplier diversification has direct association with a larger inventory.⁷ Therefore, this study can conclude that the independence of a chairman of the board of directors tends to result in less efficient supply management. The independence of the board of directors also turns out to have a negative impact on supply management performance. According to the above analysis, the independence of the board of directors is significantly and positively associated with the *day's sales in inventory ratio*.⁸ In other words, the more independent the board, the higher *days' sales in inventory ratio*, or the company retains idle inventory for a longer period of time. As such, the results collectively suggest that the independent corporate governance

⁶ This result may reflect the reality of agency costs since executives who opt to maintain a more diversified supplier portfolio most likely attempt to minimize their employment risks rather than maximize shareholders' interests.

⁷ However, the independence of the entire board of directors does not have an impact on supplier diversification strategies.

⁸ It was expected that a more independent board of directors would be associated with lower values for the variable *Pme (day's sales in inventory ratio)*, but the results are contrary to the expectation.

structure tends to be associated with less efficient supply management.

Although this study is limited to manufacturing companies listed on the São Paulo Stock Exchange and only covers a specific period of time, which in turn limits its general usage, some aspects of the study encourage future research. Future studies may use different proxies and time periods from those employed in this study. Future studies could also explore the correlations between different corporate governance variables and other indicators of inventory management performance, such as punctuality and speed.

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