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Distributional Properties of Financial Ratios and Performance of the Furniture Industry: A Comparison Based on Critical Financial Factors

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ABSTRACT

Benchmarking performance of furniture manufacturers on an international level can be a challenging proposition. A sample of furniture companies was drawn from the Global Advantage database. These companies manufactured kitchen cabinets, household furniture, office and institutional furniture, and represented three geographical regions, namely North America, Europe, and Asia (South). To compare firms, a set of financial ratios was evaluated to identify which ratios best measure furniture manufacturers performance.

Analysis of multiple financial ratios suggests the most critical financial factors when measuring company performance are *Liquidity*, *Operating Efficiency*, and *Capital Turnover*. The financial ratio components of Liquidity are current ratio, quick ratio, and working capital to total assets ratio. For Operating Efficiency, earnings before interest and taxes and operating income to total assets are the main ratio components. For Capital Turnover, the financial ratio components are sales to total assets and sales to inventory.

Other results suggest that companies from America and Europe have better performance in terms of Capital Turnover than companies from Asia. It appears there is no difference in performance when comparing Liquidity and Operating Efficiency by region between the years 2000 and 2002. When the comparison was made, based on furniture industry sectors, the kitchen cabinet and household furniture sectors were found to have better Liquidity performance for the years 2001 and 2002 compared to the office and institutional furniture sector.

Finally, when looking at trends in performance by region, it was found that while Asia is still lagging in performance, it is catching up with America and Europe. In terms of furniture industry sectors, since 1997 the kitchen cabinet sector has had the most positive trend in all three performance measures.

Keywords: distributional properties, financial ratios, critical financial factors, kitchen cabinets, household furniture, office and institutional furniture, North America, Europe, Asia

Introduction and Objectives

Benchmarking is an effective Total Quality Management tool that allows companies to become innovators. Innovation is a critical success factor companies need to embrace if they are to be leaders of their industries. A benchmarking study can only be accomplished when key performance information is available. But, due to its sensitivity, financial information is often not shared making it difficult to perform benchmarking studies. The use of publicly available data can partially overcome this difficulty and can be used to make comparisons based on performance indicators from a few business processes such as financial, internal operations, and human resources. Comparing company performance is a key step in a benchmarking process. Traditionally, benchmarking studies in the wood furniture industry have focused on internal aspects of the industry in the United States. Few of these studies have attempted to compare performance of American furniture manufacturers with their main competitors in Europe and Asia.

Beyond financials, comparing performance of key business processes through the use of a few critical performance indicators facilitates gap analysis. The purpose of gap analysis is to find differences between the business processes that yield expected results and those processes that do not. Gap analysis helps identify who the best achievers are and what specific best practices they use to obtain results. When comparing company performance, information on comparable key business processes is required. Along these lines, generic business processes that companies may have in common include operations planning, business strategy, financial and accounting, human resource management, information technology, and marketing.

This paper has two objectives. The first objective is identification of the most important measures of furniture manufacturers' financial performance and outlining of statistical procedure to identify key performance indicators. The second objective is to describe the financial performance of publicly held kitchen cabinet, household, office and institutional furniture manufacturers from America, Europe, and Asia.

Financial Ratios as a Measure of Company Performance

Ratio analysis as defined by Helfert (1994) is the use of a variety of ratios to analyze the financial performance and condition of a business from different viewpoints (such as manager, owner, or creditor). In practice, when using financial ratios, most research has focused on failure models (Beaver 1966, Lev 1973, Fadel and Parkinson 1978). A second approach has been to use financial ratios for predictive purposes. Toward this end, Copeland and Ingram (1982) used multiple discriminatory analysis to predict the rating change of municipal bonds; more recently, Laitinen (2002) used factor analysis and logistic regression to predict the performance of European companies. The following is a summary of the main studies that use financial ratios for purposes such as prediction of performance of a unique company, comparison of performance among various companies, and the stability of financial ratios over time.

Beaver (1966, 1968) focused on the function and use of financial ratios, specifically for evaluation of credit-worthiness, variability, and prediction of failure. Originally, Beaver used 30 ratios for data computation based on popularity, previous performance, and definition of the ratios in terms of a "cash -flow" concept. Based on the lowest probability of error, he divided these 30 ratios into six groups, and

selected only one ratio from each group. In the same line of research, Lev (1969) examined the adjustment of financial ratios by corporations to predetermined targets based on industry-wide averages. The objectives of this research were the use of alternative accounting measurement rules to adjust financial ratios, speed of adjustment to the target, and influences on the periodic adjustment coefficient. Five categories of financial ratios were selected, namely short-term liquidity, long-term solvency, short-term capital turnover, long-term capital turnover, and return on investment ratios. Because ratios within each category were found to be highly inter-correlated with each other, one representative of each category was considered sufficient to measure performance. The selected ratios were current ratio and quick ratio, equity/total debt, sales/inventory, sales/total assets, and net operating income/total sales.

Deakin (1972) examined the implication of discriminant analysis of predictors of business failure. He used 14 ratios grouped into four categories to predict business failure: non-liquid assets, liquid assets to total assets, liquid assets to current debt, and liquid assets turnover. These ratios were the same as those used by Beaver (1966, 1968). The stability, quality, and good predicting characteristics of ratio analysis have been demonstrated by many authors including Pinches et al. (1975). They used factor analysis to find seven ratios stable over the long term, including return on investment, capital turnover, inventory turnover, financial leverage, receivables turnover, short-term liquidity, and cash position. Fadel and Parkinson (1978) also found ratios to be good predictors; they found that cash flow ratios are good estimators of future returns on capital employed. The quality of ratio analysis was assessed by Altman (1968). He used ratio analysis as an analytical technique to predict corporate bankruptcy. In this study, Altman used multiple discriminant analysis as a tool. Altman limited the source of data used to manufacturing corporations where ratios were extracted from balance sheets and income statements and classified by category including liquidity, profitability, leverage, solvency, and activity ratios with a total of 22 ratios selected.

Peles and Schneller (1989) concentrated on the time series behavior of financial ratios when corporate distress is revealed. In their study, the time series properties of going-concern firms were examined. Their results showed, that for the six financial ratios under examination, the data was consistent with a partial adjustment process with finite adjustment durations. The authors arbitrarily adopted a list of five financial ratios from Lev (1969).

Salmi et al. (1990) used factor and transformation analysis to find stable categories of financial ratios for testing hypotheses concerning accrual ratios, cash flow ratios, and market-based ratios. They used interrelated criteria such as theoretical considerations, stable statistical properties in earlier studies, relevance in financial and security analysis practice, and availability and unproblematic calculation from financial statements, and security data as a basis for selecting financial ratios.

Constand (1994) made a comparison between the distributional properties of financial ratios from Japanese and American companies. He studied whether financial ratios in specific industries are comparable between the United States and Japan in terms of both their average and distributional characteristics.

Konings and Roodhooft (1997) also used financial ratios to illustrate a new econometric methodology to test the cross-sectional dynamic behavior of financial ratios. This study employed

financial ratios taken from Lev (1969), Frecka and Lee (1983), Lee and Wu (1988), Peles and Schneller (1989), and Chen and Ainina (1994). Konings and Roodhooft considered this set of financial ratios representative of the most important categories of financial ratios. Finally, Ezzamel and Mar-Molinero (1990) exposed some of the problems associated with the transformation of the raw data and the deletion of outliers in order to improve approximation to normality in their study of the distributional properties of financial ratios in manufacturing companies in Great Britain. They used two broad guidelines to select their financial ratios: 1) ratios should represent the main financial patterns of UK manufacturing companies, and 2) at least one of the ratios selected must be similar to those used by Deakin (1976) for comparison purposes. In a similar study, So (1987) examined some of the empirical evidence related to the outliers and the non-normal distribution of financial ratios. So used 11 ratios that cover assets, liquidity, profitability, and debt/equity ratios.

Watson (1990) studied the cross-sectional multivariate distributional properties of financial ratios for manufacturing companies, multivariate outlier detection, and transformation methods that can be used to approximate multivariate normality and provided an analysis of financial ratio data to illustrate these methods. He selected four of the 11 ratios that Deakin (1976) analyzed on a univariate basis to analyze using multivariate methods. The four ratios are current assets to sales, quick assets to sales, current assets to current liabilities, and net income to total assets. Similar to Watson, Laitinen (2002) investigated the possibilities of uniform financial rating of technology companies in Europe from the perspective of a potential investor. He used six factors to measure performance from the point of view of a potential investor.

One of the most significant contributions to the study of increasing company performance in the wood products manufacturing sector came from Rich (1974a, 1974b, 1974c), who published a series of articles on defining mission, vision and goals, determining strategy, and improving response to socioeconomic pressures. In recent years, several other researchers have studied micro- and macro-economic dynamics of the furniture industry. Main contributions in terms of defining differences between companies within this industry sector, industry development and possibilities for expansion came from Bush and Sinclair (1991), Kingslien and Greber (1993), Lee and Greber (1996), Hoff et al. (1997), Schuler et al. (2001), Melton et al. (2002), and Buehlmann and Schuler (2002). In addition, stock analysts, such as Whelan and Maklari (2002), annually publish a general outlook for the furniture industry. This type of report, however, lacks the scientific background necessary to draw conclusions about the issues under study.

Klassen (2000), Melton et al. (2002), Pepke (2002), Schuler (2001), Vlosky and Chance (2001), Pakarinen (1999), and Vlosky et al. (1998) also studied concepts such as just-in-time, waste, and value-added as related to lean systems and lean manufacturing in the wood products industry. One of the latest studies of the secondary wood products manufacturing companies was conducted by Gagnon and Michael (2003). A few private consultants have addressed the competitiveness of small- and medium-sized furniture companies (Raymond 1999, 2002) through presentations at trade shows and conferences.

As suggested through the studies mentioned, financial ratios can be used to effectively measure company performance. But, not all financial ratios can be used for that purpose because a set or group of financial measures could potentially be metrics for the same aggregate or factor such as company

performance, liquidity, or stockholder satisfaction. Another important concern found in the literature is the difficulty associated with the normality of the financial ratios. Researchers used elimination of outliers or transformation of data as a mechanism to overcome the lack of normality with success.

Methods

In order to analyze the performance of companies in the furniture industry using financial ratios, the following steps are required: sample identification, sample source, performance measurements, univariate analysis, factor analysis, and performance ranking. A test to compare performance by region and industry codes is desirable; however, due to the nature of the ranking procedure, statistical methods such as analysis of variation (ANOVA) and Tukey test were not performed. Instead visual trend analysis from graphs and data was made.

Data

For this study, the sample consisted of all companies manufacturing kitchen cabinets (US SIC 243), household furniture (US SIC 251), and office and institutional furniture (US SIC 252) with financial records in the Global Advantage database (Standard & Poor's 2003) between the years 1997 and 2002. The initial sample of 103 companies classified by geographical region and country is listed in **Table 1**.

Table 1. Number of furniture companies by region and country of incorporation with records in the Global Advantage database.

Country	Number
North America	
Canada	4
United States	22
Europe	
Norway	4
Germany	9
Great Britian	5
Spain	1
Finland	1
Sweden	5
Denmark	4
France	4
Netherlands	2
Asia	
Malaysia	17
Thailand	3
Japan	14
Singapore	3
Korea	1
Indonesia	1

China (Hong Kong)	1

There are precedents for use of financial ratios from public-access databases. Lev (1969), Peles and Schneller (1989), Osteryoung and Constand (1992), Constand (1994), and Poston and Harmon (1994) took their data from COMPUSTAT (Standard & Poor's database). Laitinen (2002) took the data from AMADEUS (European database). Ezzamel and Mar-Molinero (1990) extracted their data from EXSTAT database (UK financial database equivalent to Standards & Poor's in the United States). There are many other examples of the use of financial data from similar databases.

Fieldsend et al. (1987) studied the statistical properties of financial ratios and the ratio proportionality in British companies. They found that financial ratios vary across industry sectors and company size. Hence, in order to define the final sample for this research, all companies with total assets above the 90 percentile or below the 10 percentile (calculated from the whole sample) were deleted from the initial sample of 103 companies. In all, 11 companies did not fall into the percentile range, resulting in a final sample of 92 companies. A similar procedure was applied by Constand (1994) in his comparison of distributional characteristics between American and Japanese companies.

Financial Ratios as Performance Measurements

Barnes (1987), in his review of financial ratios studies, mentioned that there are no absolute tests for the importance of variables, the significance of particular variables, and the pros and cons of various statistics. He did, however, draw a pool of financial ratios to measure and compare performance by region and industry sector.

The selection of financial ratios for this study was based on a combination of ratios used by Beaver (1966), Lev (1969), Altman (1968), Deakin (1972), and Peles and Schneller (1989). These ratios according to Konings and Roodhooft (1997) represent the most important categories when measuring and comparing company performance (**Table 2**).

Table 2. List of financial ratios selected for this study.

Ratio	Description	Computational Formula
Current ratio	Potential creditors use this ratio to measure company's liquidity or ability to payoff short-term debts.	Current Assets / Current Liabilities
Quick ratio	Considered a more reliable indicator of a company's ability to meet its short-term financial obligations.	(Cash + Accounts Receivable) / Current Liabilities
Total equity to total debt	A measure of the extent to which the creditors have financed the business compared to the owners. Long-term solvency.[a]	Total Equity / Total Debt
Sales to total assets	Illustrates the sales-generating ability of the company's assets.[b] Long-term capital turnover.	Sales / Total Assets
Earnings before interest and taxes margin	Measure of the true productivity of the company's assets.[b]	Revenue-Expenses
Working capital to assets	Measure of net liquid assets relative to the total capitalization.[b]	Working Capital / Assets
Operating income to total assets	Shows the ability to earn a return on total assets.	Operating Income / Total Assets
Sales to inventory	Measures the effective use of the inventory. Short-term capital turnover.[a]	Sales / Inventory

[a] Konings and Roodhooft 1997
[b] Altman 1968

Univariate Analysis

Each individual ratio was analyzed to confirm the assumption of normality. Whenever this assumption was rejected, outliers were identified and deleted and the Box-Cox transformation applied in order to approach normality. Where the raw data contained negative values, the Box-Cox (with $\lambda = 0$) transformation method was not appropriate since the logarithmic function cannot be applied to negative values. In this case, the last best normal approximation was held.

Factor Analysis

Measuring the performance of several financial ratios can be reduced to a few critical dimensions, and this can be achieved by using factor analysis. Exploratory factor analysis was used in this research, which included the generation of a correlation matrix, extraction of the factor that accounted for most of the variance, and the transforming or rotation of factors to make them more interpretable (Tamimi 1995).

A common factor is an abstraction, a hypothetical dimension that affects at least two of the variables (Stewart 1981). Each factor (or component) is estimated as being a linear (weighted) combination of the observed variables. As many factors as there are variables could be extracted, but generally most of them would contribute little, and so only a few factors are obtained that capture most of the variance. The initial extraction generally includes the restriction that the factors be orthogonal and independent of one another. These common factors account for nearly all of the common variance.

Factor analysis was used to reduce the number of financial ratios to a few principal components. All factors having eigenvalues greater than 1 (Kaiser's criterion) or close to 1 are included in the analysis. Whenever necessary, a refinement of the initial method was performed (such as factor rotation) where the initial factor method did not clarify which factors represented each component of interest. Reducing the number of indicators is important because modern approaches of Total Quality Management, such as benchmarking and the balanced scoreboard procedure, suggest monitoring of only a few key critical performance measures.

For this study, it was very important to reduce the number of performance critical measures to a lowest possible minimum. In light of this, the number factors considered were reduced from eight to three using factor analysis. This method is reflected in previous work by Luo (1998), Stavenga et al. (2006), Hann et al. (2003), Thomas and Walter (1985), and Khorana and Nelling (1997) who all conducted factor analysis to reduce factors (all started with less than 11 input variables) in their research.

Many papers related to critical performance measures state that the fewer critical indicators a company handles, the better the opportunity to focus on their core strategy and business activities. Literature on financial ratios suggests that the eight indicators selected are the most critical; however, several of these measure the same factor, as shown by our factor analysis. The advantage of reducing the number of factors from eight to three is that the new underlying indicators are suggested as a

measure of performance. Additionally, companies in this industry can use them to more easily explain business performance to their shareholders.

Standardization of Factor Scores Using a Ranking Scale

Once the common factors were defined, factor scores were generated for each data point. A ranking scale (ranging from 0 to 4) was used to rank those factor scores as follows:

- 0 to 1: strongly underachieving,
- 1 to 2: underachieving,
- 2 to 3: average performance, and
- 3 to 4: outstanding performance.

This ranking range arose from the diversity of accounting rules across countries (Basu et al. 1998). Because this study compares performance of companies from different countries, it was appropriate to standardize a common comparison metric such as the ranking procedure described. Furthermore, according to Laitenen (2002), this type of ranking procedure of financial ratios is not as sensitive to international differences in accounting rules and practices as a single cardinal measure. In order to proceed with this ranking method, the median, and the first and third quartiles of each factor's scores were calculated.

A similar procedure was used by Ezzamel and Mar-Molinero (1990) who introduced Chebyshev's inequality to identify outliers in their study of distributional properties of financial ratios. For this study, however, quartiles were used instead of the standard deviation to determine upper and lower bounds.

While the use of ranks may yield non-normally distributed data (which usually adopts a rectangular distribution), if sample size is larger than 30 (Wuensch 2003), the assumption of normality will hold. Since the sample size was larger than 30 for each year, the assumption of normality holds.

Limitations

An international empirical comparison of financial ratios among kitchen cabinet, household furniture, and office and institutional furniture manufacturing companies may have been appropriate; however, the industry codes across regions are not well suited for this purpose.

Combining data from different years can lead to serious statistical errors because each year is different. Barnes (1987) states that prediction models built with financial ratios cannot be extrapolated over time because ratios are not stable over time. In addition, over time the relationships between the variables are very unstable. Dombolena and Khoury (1980) found a substantial amount of instability in financial ratios in their research of the stability of ratios over time. Shifting economic, social, technological, and cultural factors make each year unique. Therefore, data from each year must be considered as a different population.

The distributional properties of financial ratios have been analyzed many times (Ezzamel and Mar-Molinero 1990, So 1987, Watson 1990). In some of these studies, few financial ratios failed to reach normality, even after applying power transformations or eliminating outliers. Several researchers studied the behavior of financial ratios in terms of Markov chains or random walks (Konings and RoodHooft 1997, Peles and Scheller 1989, Gallizo and Salvador 2003) with the purpose of being more precise and accurate when predicting or forecasting company performance. David and Peles (1993) mentioned that there are two types of "shocks" that affect firm's performance through time: 1) shocks affecting only a specific company and 2) shocks affecting common companies in the industry. These shocks may bring specific actions to one company or to the whole industry.

According to Watson (1990), bankruptcy models by Altman et al. (1977), auditor models by Mutchler (1985), and bond rating models by Copeland and Ingram (1983), all assumed multivariate normality for financial ratio data which may not be necessarily true in all cases. In this study, multivariate normality was assumed because this is exploratory research (Wuensch 2003), but the univariate normality was tested.

It was not the objective of this paper to predict performance of the furniture manufacturers using financial ratios, which is a complex problem due to the behavior of financial ratios and their adjustment process to a certain target influenced by many factors (Lev 1969, Altman 1968). There is evidence that classification models (factor analysis) are more efficient than those employing logistic regression (Efron 1975) when working with financial ratios. Efron's results were used by DeVaney (1994) in the study of financial ratios as predictors of household insolvency.

Finally, means test among data from regions and standard industrical calssification (SIC) codes was not performed due to statistical validity issues. Only a visual analysis of trends supported by the standardization of factor scores was made in order to identify which regions or SIC codes might have been a better performers than others.

Results

Sample Size Adjustment and Univariate Analysis

The sample was adjusted for each year in analysis depending on several factors. First, if a company had total assets under the 10th percentile or above the 90th percentile, the observation was deleted from the sample. Total assets were calculated in U.S. currency using historic yearly average exchange rates for every country. Second, if univariate normality did not hold, transformation and outlier deleting procedures were applied to ensure that the assumption of univariate normality held for each financial ratio. Frecka and Hopwood (1983) found that deleting some outliers can help to achieve univariate normality and reduce variability. Third, if a company was missing a value in the database, the observation was not considered for the analysis.

Table 3 summarizes the outlier and transformation procedures applied to each variable for every year in order to achieve normality. In all cases, a confidence level of $\alpha = 0.05$ was used. For most cases, either transformations or elimination of outliers was necessary to achieve normality. The only variable that passed the univariate normality test (Kolmogorov-Smirnov) for all years was sales to total assets. Working capital to assets passed the normality test for all years except 1999 and 2000 without any

changes to the raw variable. In some cases (total equity to total debt for 1999 and 2001, earnings before interest and taxes [EBIT] for 1999 and 2000, quick ratio for 2001, and operating income to total assets for 2000) the normality could not be achieved even after applying transformation or eliminating outliers. In these cases, histograms, measures of kurtosis and skewness, and other descriptive statistics were analyzed in order to select the best approximation to normality. These results match Ezzamel and Mar-Molinero's (1990) findings. They found that elimination of outliers had higher impact than transformations in approximating univariate normality.

Table 3. Univariate normality analysis results and final transformation used for factor analysis.[a]

Year	Current ratio	Quick ratio	Total equity to total debt	Sales to total assets	EBIT	Working capital to assets	Operating income to total assets	Sales to inventory
2002	TR & OUT	TR & OUT	TR	NA	OUT	NA	OUT	TR
2001	TR	OUT[b]	TR[b]	NA	OUT	NA	OUT	TR
2000	TR	TR	TR & OUT	NA	OUT[b]	OUT	NA[b]	TR
1999	TR	TR	TR[b]	NA	OUT[b]	OUT	OUT	TR
1998	TR	TR	TR & OUT	NA	OUT	NA	NA	TR
1997	TR	TR	TR & OUT	NA	OUT	NA	NA	TR

[a] TR = Box-Cox transformation with λ = 0; OUT = elimination of outliers; NA = raw variable holds normality.
[b] Failed test; however, histograms and descriptive statistics look normal after transformation and elimination of outliers.

Correlation Matrix

Correlation calculations for year 2002 show strong correlations between several financial ratios (**Table 4**). This indicates that some of the financial ratios might be grouped together, since they are measuring the same underlying factors. For example, current ratio and quick ratio are strongly correlated (R^2 = 0.80) because they are both measures of short-term liquidity (Lev 1969). EBIT margin and operating income to total assets are also strongly correlated (R^2 = 0.88) because both measure the effectiveness and productivity of the company. Likewise, working capital to total assets and quick ratio (R^2 = 0.80) and working capital to total assets and current ratio are strongly correlated (R^2 = 0.95) because both relationships are related in terms of current assets.

Other relatively strong relationships are total equity to total debt and quick ratio (R^2 = 0.44) and sales to total assets and sales to inventories (R^2 = 0.47) which measure how effective the company is in controlling and selling its current assets.

Table 4. Correlation matrix of performance measurements in 2002.

	V1	V2	V3	V4	V5	V6	V7	V8
V1	1							
V2	**0.468175**	1						

V3	0.394648	−0.01037	1					
V4	0.166652	0.186188	**0.801285**	1				
V5	0.062487	0.322556	0.149832	0.282937	1			
V6	0.347158	0.013125	0.437288	0.349698	0.213902	1		
V7	−0.07246	0.08315	0.205059	0.293184	**0.87477**	0.113114	1	
V8	0.183613	0.26594	**0.797557**	**0.953821**	0.341219	0.344457	0.297121	1

Notes:
V1: Sales / Inventory (Box-Cox transformation)
V2: Sales / Total assets
V3: Quick ratio (Box-Cox transformation and elimination of outliers)
V4: Current ratio (Box-Cox transformation and elimination of outliers)
V5: Operating Income / Total assets (Elimination of outliers)
V6: Total equity / Total debt (Box-Cox transformation and elimination of outliers)
V7: EBIT margin (Elimination of outliers)
V8: Working capital / Total assets

When correlation analysis was performed for all financial ratios for the years between 1997 and 2001, correlations similar to those in 2002 were found (**Table 5**). The highest correlation for all years was found between working capital to total assets and current ratio (minimum R^2 = 0.91 in 1997 and maximum R^2 = 0.95 in 2002). The second strongest relationship was between current ratio and quick ratio (minimum R^2 = 0.72 in 2000 and maximum R^2 = 0.86 in 2002). The third highest relationship was EBIT and operating income to total assets (minimum R^2 = 0.67 in 1997 and maximum R^2 = 0.88 in 2002). The first two relationships are clearly a measure of Liquidity. Toward this end, Altman (1968) found that working capital to total assets was the best measure of liquidity. The second correlation can be interpreted as a measure of Operating Efficiency. Another important correlation found was sales to total assets and sales to inventory which, together, indicate a measure of Capital Turnover.

Table 5. Correlations and regression coefficients for performance measures for years 1997 to 2002.

Year	Correlations and regression coefficient		
2002	WCTA & CR (R^2 = 0.95) WCTA & CQ (R^2 = 0.80)	EBIT & OITA (R^2 = 0.88) STA & SI (R^2 = 0.47)	CR & QR (R^2 = 0.80) TETD & QR (R^2 = 0.44)
2001	WCTA & CR (R^2 = 0.93) CR & QR (R^2 = 0.78) TETD & CR (R^2 = 0.45)	EBIT & OITA (R^2 = 0.82) TETD & QR (R^2 = 0.53) QR & SI (R^2 = 0.42)	WCTA & CQ (R^2 = 0.81) WCTA & TETD (R^2 = 0.46)
2000	WCTA & CR (R^2 = 0.92) WCTA & CQ (R^2 = 0.69) TETD & QR (R^2 = 0.52)	EBIT & OITA (R^2 = 0.82) WCTA & TETD (R^2 = 0.59) STA & SI (R^2 = 0.51)	CR & QR (R^2 = 0.72) TETD & CR (R^2 = 0.53) OITA & STA (R^2 = 0.48)
1999	WCTA & CR (R^2 = 0.94) WCTA & CQ (R^2 = 0.78) TETD & QR (R^2 = 0.56)	CR & QR (R^2 = 0.82) WCTA & TETD (R^2 = 0.63) OITA & STA (R^2 = 0.54)	EBIT & OITA (R^2 = 0.79) TETD & CR (R^2 = 0.60) STA & SI (R^2 = 0.51)
1998	WCTA & CR (R^2 = 0.92) EBIT & OITA (R^2 = 0.75) WCTA & TETD (R^2 = 0.52)	CR & QR (R^2 = 0.86) STA & SI (R^2 = 0.60)	WCTA & CQ (R^2 = 0.82) OITA & STA (R^2 = 0.59)
1997	WCTA & CR (R^2 = 0.91) EBIT & OITA (R^2 = 0.67) OITA & STA (R^2 = 0.50)	CR & QR (R^2 = 0.84) STA & SI (R^2 = 0.61)	WCTA & CQ (R^2 = 0.81) TETD & OITA (R^2 = 0.55)

CR = current ratio; EBIT = earning before interest and taxes margin; OITA = operating income / total assets; QR = quick ratio; SI = sales inventory; STA = sales / total assets; TETD = total equity / total debt; and WCTA = working capital / total assets.

Factor Analysis

Owing to the high level of correlations among the financial ratios in the analyses (**Tables 4 and 5**), a factor analysis was performed to reduce the number of performance measures to focus analysis on the most critical factors. According to Kaiser's criterion (Kaiser 1958), only factors with eigenvalues greater than 1 will be extracted from the factor analysis results. Hence, for all years, three main factors were retained. To illustrate the amount of variance accumulated for the three main factors, calculations for 2002 are shown in **Table 6**. It can be seen that three factors accounted for 80 percent of the model variance.

Table 6. Results of factor analysis for year 2002.

# of Factor	Eigenvalue	Proportion of variance
1	3.43	0.430
2	1.64	0.200
3	1.33	0.170
4	0.90	0.110
5	0.48	0.060
6	0.09	0.010
7	0.09	0.010
8	0.03	0.004

In order to better interpret the meaning of each factor, varimax rotation was performed since the initial factor method was not clear enough to identify which variables belong to which factors. Variables were considered to be part of a factor according to the loading on that factor. Loadings of 0.8 (see **Table 7** for loadings in 2002) or higher were considered for identifying factor components.

Table 7. Varimax rotation results and financial ratios loadings for factor analysis of 2002.

Financial ratio	Loads on Factor 1	Loads on Factor 2	Loads on Factor 3
Quick ratio	0.935	0.010	0.058
Current ratio	0.915	0.209	0.026
Working capital to assets	0.897	0.248	0.089
Total equity to total debt	0.547	0.014	0.215
Sales to inventory	0.282	-0.164	0.832
EBIT	0.1527	0.939	−0.074
Operating income to total assets	0.134	0.944	0.178
Sales to total assets	−0.004	0.249	0.844

Application of varimax rotation clarified the interpretation of each factor meaning. The variables quick ratio, current ratio, and working capital to total assets had high scores for factor 1. This factor was named Liquidity. The variables EBIT margin and operating income to total assets had high scores

for factor 2. Thus, the second factor was named Operating Efficiency. Finally, the variables sales to inventory and sales to total assets had high scores for factor 3. Therefore, this factor was named Capital Turnover.

For all other years, varimax rotation was performed in order to clarify the loading on each factor. **Table 8** shows factor analysis results for all years. Note that similar results were found for all years, except 1997 where the variables sales to assets and sales to inventory were loaded in factor 2 instead of factor 3. In this case and because every year is analyzed independently, it is still possible to compare performance in that year by changing the name of the factor for that year only. Also, from **Table 8**, the variable total equity to total debt was loaded in factor 1 only for years 2000 and 2001. Because this ratio is also a measure of Liquidity, the significance of this factor does not change.

Continuing with the results found in **Table 8**, it can be noted that the most important factor (in terms of explaining model variance) for each year was composed of the quick ratio, current ratio, and working capital to total assets. In years 2000 and 1999, the ratio total equity to total debt was added to this factor as mentioned previously. The second most important factor grouped ratios EBIT and operating income to total assets, with the exception of 1997, where this factor was the third most important. Finally, the factor formed by ratios sales to total assets and sales to inventory was third most important. For all years, the three factors together accounted for a minimum of 80 percent (2002) to a maximum of 85 percent (1998) of the model variance.

Table 8. Factor analysis for 1997–2002.

Year	Factors composition			Factors name			Variance explained by factors
	Factors 1	Factors 2	Factors 3	Factors 1	Factors 2	Factors 3	
2002	QR, CR, WCTA	EBIT, OITA	STA, SI	Liquidity	Operating efficiency	Capital turnover	80%
2001	QR, CR, WCTA	EBIT, OITA	STA, SI	Liquidity	Operating efficiency	Capital turnover	81%
2000	QR, CR, WCTA, TETD	EBIT, OITA	STA, SI	Liquidity	Operating efficiency	Capital turnover	81%
1999	QR, CR, WCTA, TETD	EBIT, OITA	STA, SI	Liquidity	Operating efficiency	Capital turnover	84%
1998	QR, CR, WCTA	EBIT, OITA	STA, SI	Liquidity	Operating efficiency	Capital turnover	85%
1997	QR, CR, WCTA	STA, SI	EBIT, OITA	Liquidity	Capital turnover	Operating efficiency	83%

CR = current ratio; EBIT = earning before interest and taxes margin; OITA = operating income / total assets; QR = quick ratio; SI = sales inventory; STA = sales / total assets; TETD = total equity / total debt; and WCTA = working capital / total assets.

Once the factors were identified, the performance ranking procedure was applied to each individual year in the sample. The three performance factors (as defined above) were assigned a score on a five-point scale for each company allowing company performance to ranked accordingly. By ranking as such, comparison among the different world regions and sectors of furniture industry was possible.

Standardization of Factor Scores

Table 9 shows the results of standardization of factor scores. This ranking was made in order to compare and make inferences about the three performance measures (Liquidity, Operating Efficiency, and Capital Turnover) of the study. The ranking was made by region and by furniture sector. Information on each year under study (from 1997 to 2002) is presented. Additionally, for each year the number of companies (n) whose information was valid is also indicated. Because of the nature of the scale used, statistical comparison is beyond the scope of this paper. Nonetheless, due to the fact that the study is comparing data from different countries, the use of a standardized ranking makes sense.

Table 9. Standarization of factor scores by region and furniture sector.

Year No. of firms	By region			By furniture sector[a]		
	America	Europe	Asia	Kitchen cabinet	Household	Office
Liquidity						
2002 n	2,77 22	2,45 19	2,42 18	3,32 22	2,16 19	1,89 18
2001 n	2,82 17	2,44 27	2,35 26	3,07 17	2,2 25	2,00 28
2000 n	2,8 15	2,14 22	2,63 24	2,35 17	2,29 21	2,79 23
1999 n	2,65 20	2,41 29	2,5 24	2,25 20	2,46 24	2,72 29
1998 n	2,82 16	2,19 21	2,58 19	2,25 16	2,41 17	2,74 23
1997 n	3,12 17	2,05 17	2,41 17	2,54 13	2,35 20	2,65 20
Operating efficiency						
2002 n	2,92 22	2,45 19	2,37 18	2,89 22	2,39 19	2,32 18
2001 n	2,82 17	2,46 26	2,33 27	2,79 17	2,56 25	1,94 28
2000 n	3,07 15	2,32 22	2,38 24	2,06 17	2,81 21	2,61 23
1999 n	3,15 20	2,38 29	2,13 24	2 20	3,08 24	2,38 29
1998 n	2,69 16	2,53 21	2,34 19	2,44 16	2,65 17	2,44 23
1997 n	2,71 17	2,53 19	2,29 17	2,31 13	2,65 20	2,50 20
Capital turnover						
2002 n	3,07 22	2,77 19	1,96 18	2,61 22	2,59 22	2,32 18
2001 n	3 17	2,82 27	1,85 26	2,68 17	2,48 25	2,24 28
2000 n	3 15	2,73 22	1,96 24	2,29 17	2,29 21	2,83 23
1999 n	3,05 20	2,86 29	1,67 24	2,2 20	2,38 24	2,86 29
1998 n	2,86 16	3 21	1,63 19	2,25 16	2,29 17	2,83 23
1997 n	2,53 17	3,26 19	1,59 17	2,08 13	2,5 20	2,75 20

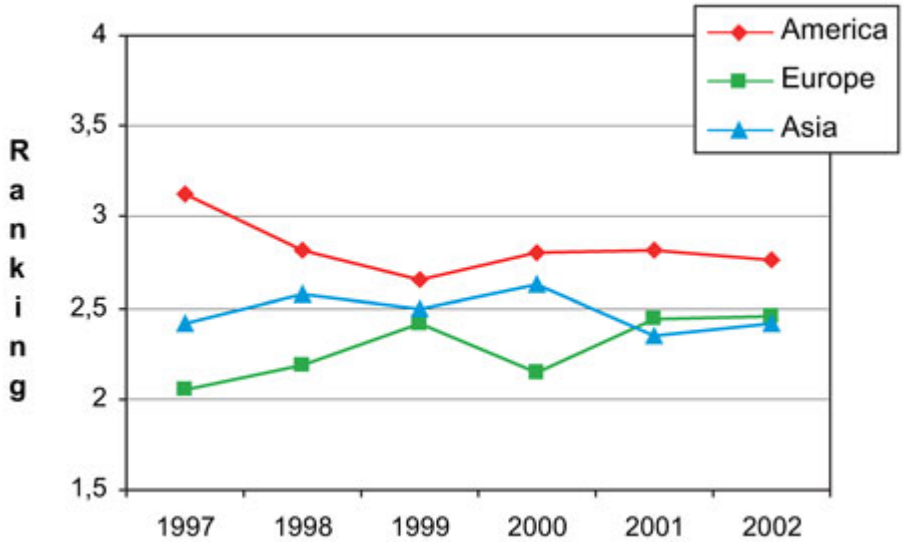
[a] SIC 243: kitchen cabinet sector; SIC 251: household sector; SIC 252: office / institutional sector.

In the following section, a descriptive analysis of the behavior of each critical financial measure is presented for all years under study.

Liquidity

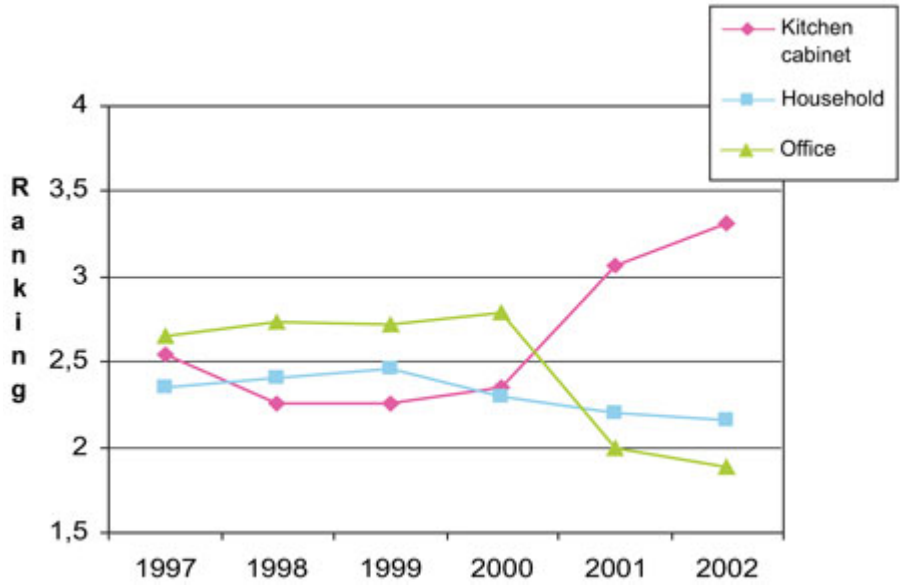
Figure 1 shows companies from Europe and Asia have adjusted their performance in the last five years and increased their Liquidity. In slight contrast, American companies have maintained the highest, steady, but slightly decreasing level of Liquidity. This is perhaps due to the fact that holding of inventory runs counter to the theory and practice of lean manufacturing.

Figure 1. Liquidity performance by region.



When the same measure of Liquidity was used to compare performance of the furniture sectors, marked change over the last five years was found. **Figure 2** presents the behavior from 1997 to 2002 of Liquidity for all three sectors; interestingly, the performance of the kitchen cabinet sector was shown to be distinctly different from the other two in 2002 and 2001. This is not surprising since many furniture companies in these sectors have ceased operations during this time period (Curting 2004). This is perhaps due to the fact that the more operating profit the company has, the more working capital and better ability to meet payments it will have (Altman 1968).

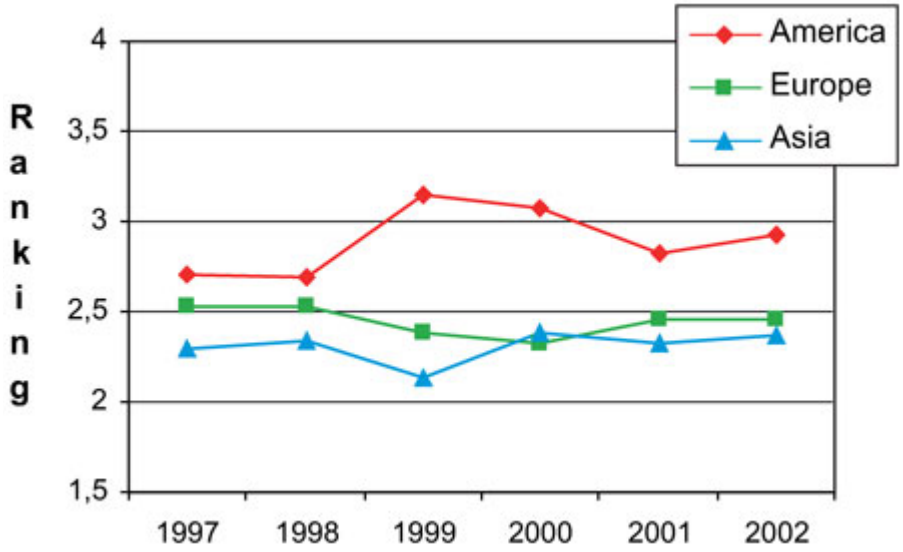
Figure 2. Liquidity performance by industry sector.



Operating Efficiency

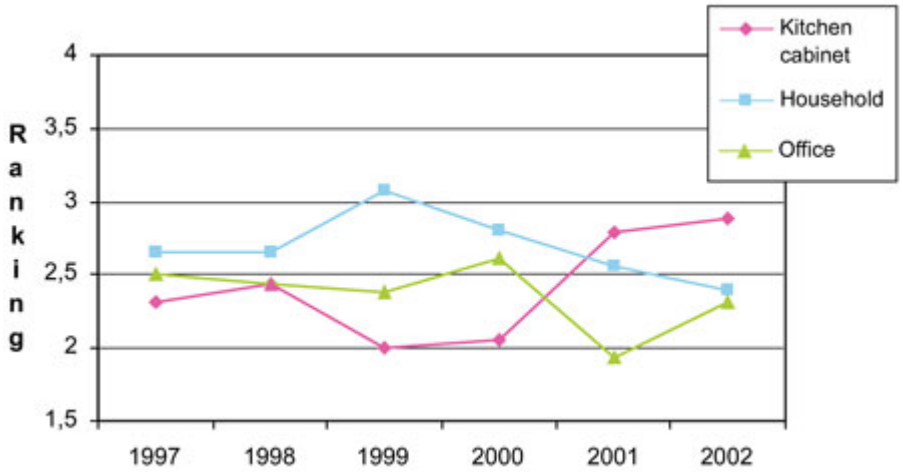
Figure 3 shows the behavior from 1997 to 2002 in Operating Efficiency performance. The North American region was the highest performing while European and Asian regions had similar, but lower, performance over the same time period. It appears that in 1999, the North American region experienced a distinct increase in Operating Efficiency from 2.69 to 3.15. This may have been a temporary trend, because from 2000 to 2002 no distinct difference is observed.

Figure 3. Operating Efficiency performance by region.



According to **Figure 4**, there was no clear pattern in terms of Operating Efficiency performance by the furniture industry sector. Despite a lack of statistical difference between sectors for the remaining years, the Operating Efficiency performance trended down for the furniture sector.

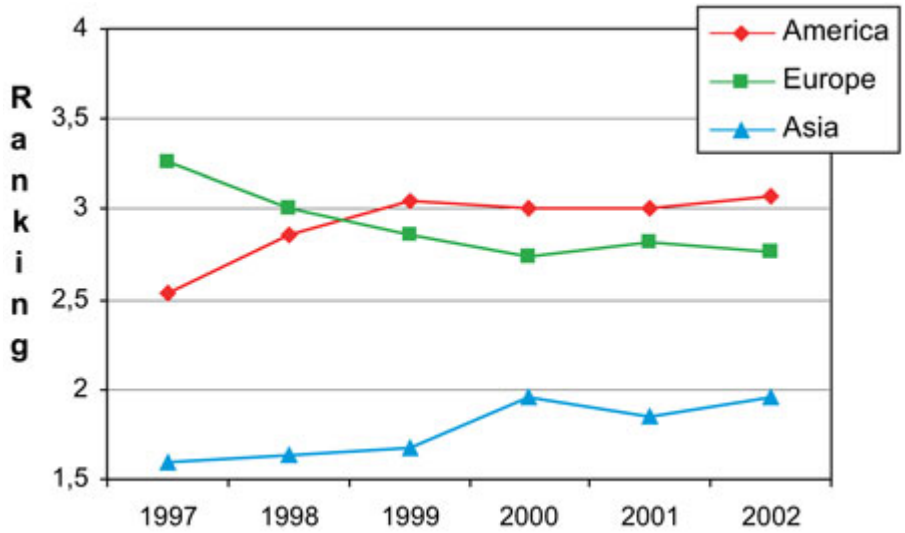
Figure 4. Operating Efficiency performance by furniture industry sector.



Capital Turnover

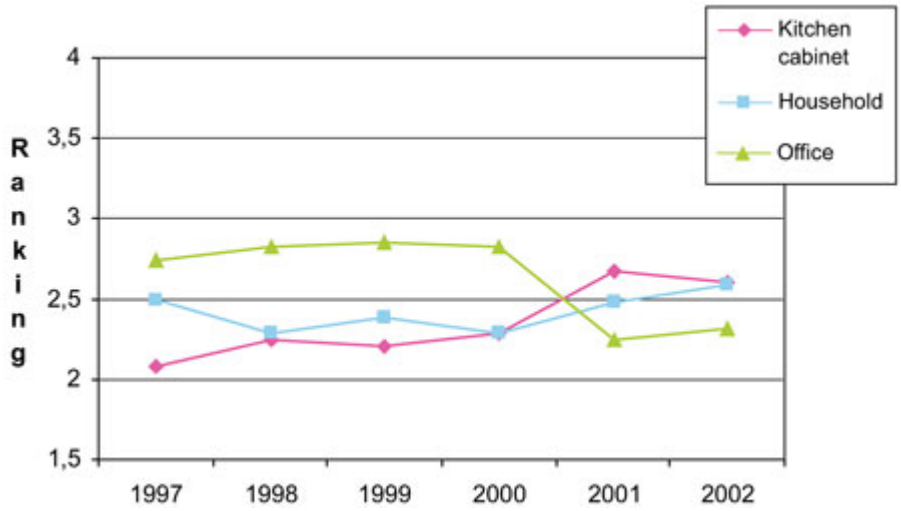
In terms of Capital Turnover, America and Europe were found to outperform Asia (**Fig. 5**). While America and Europe had been comparable since 1997, Asia was at the bottom of this performance metric. Since this measure reflects sales to total assets and sales to inventory ratios, results may be an indication that America and Europe sell more products than Asia. Conversely, results may reflect the fact that a large portion of Asia's production is sold in America and Europe, thus tying up capital for periods during product transportation. Nonetheless, it appears that Asia is increasing its performance while America and Europe are holding steady. This observation may also be an indication of the growing power of Asian companies.

Figure 5. Operating Efficiency performance by region.



An indication of a decrease in Capital Turnover performance for the office and institutional furniture sector is clearly shown in **Figure 6**. Over the same period, the kitchen cabinet and household furniture sectors increased their performance in this factor.

Figure 6. Capital Turnover performance by furniture industry sector.



Discussion

Results of this study indicate that Liquidity is the most important performance measure when comparing company performance using financial ratios. Current ratio, quick ratio, and working capital to total assets are the main components of this performance measure. These ratios are the best indicators of the capability of a company to meet their financial obligations. If a company is not performing well in at least one of these three ratios, it is an indication of a serious debt and lack of assets to respond to that debt. It was shown that furniture companies from the North American region performed better than European and Asian furniture companies in this indicator. This may imply that American companies have better access to credit than companies from other regions, perhaps because they have the ability to better support loans. It has been said that the furniture industries in North America, especially in the United States, lag in adoption of new technologies and in innovation and that unwillingness to borrow money from commercial lenders may be one reason for not investing in new equipment technology. Results of this study, however, show that compared to other regions, the furniture industry in North America, and especially in the United States, may have a competitive edge to faster renew their technology due to better Liquidity performance. At least theoretically, if all the countries had the same strict lending practices, the companies with better Liquidity performance (American companies) would have better access to loans from the banking sector to renew their equipment than Asian or European companies.

Results also have shown that the kitchen cabinet industry might have had a better Liquidity performance than the household and office furniture sectors. This is not surprising since this furniture industry sector has proven to be more efficient in recent years.

In terms of internal performance, most companies strive for an “efficient-processing system” that can operate over a lean platform. Reduction of waste and better resource utilization are key elements of successful lean production systems. Implementation of such systems will be reflected in the Operating Efficiency of the company. Lengthy cycle times, low customer response, lower material yields, and low production per employee are the main internal performance indicators that affect Operating Efficiency negatively. Results of this study suggest that the Operating Efficiency of American furniture manufacturers is better than that of furniture companies from the European and Asian regions. It is

not clear what has caused this outcome; however, the better utilization of assets seems to provide some answers. Although American furniture companies may not be the world leaders in technology, managers know how to utilize their assets the best, perhaps due to high cost of labor and related expenses. Also, there has been a rapid adoption of lean systems in many furniture companies in the United States. These could be reasons why American furniture companies have a better Operating Efficiency compared to European and Asian regions. Analyzing Operating Efficiency by furniture industry sector, it can be seen that the general pattern in kitchen cabinets is upwards, reflecting the vitality of this sector, which outperformed the other two sectors in years 2001 and 2002.

In terms of Capital Turnover, results showed that European and American furniture companies have better performance than Asian furniture companies. An explanation, as stated previously, may be in faster adoption of lean systems in many American and European companies. For furniture companies in these two regions, it is very important to reduce inventory handling in order to reduce financial costs. Labor, materials, and overhead costs are difficult to reduce if lean strategies are not adopted and successfully implemented. In the past, inventory reduction has been perhaps the most critical aspect when adopting lean manufacturing system. In the case of Asian furniture companies, it seems that lean manufacturing systems and inventory reduction are still maturing. The fact that labor is several times cheaper in Asia, has not yet turned the focus on inventory reduction strategies.

Conclusions

It is important to highlight the findings concerning the statistical properties of the financial ratios used in this research. When input data was analyzed to test distributional properties of financial ratios, it was found that none of the tested financial ratios held the assumption of univariate normality in all of the years studied, with the exception of the sales to total assets ratio. These results are very similar to findings of Ezzamel and Mar-Molinero (1990), So (1987), and Watson (1990). Therefore, transformation or elimination of outliers in order to hold univariate normality was necessary.

Furthermore, strong consideration was given to treat each year as a different population since technological, economic, social, and political issues affect each year differently. Previous research has shown that financial ratios are unstable over time. There are no available longitudinal studies on the impact of economical, political, technological, or social world events on financial ratios and company performance.

Once the behavior of financial ratios was analyzed, factor analysis results showed that company performance in the furniture industry can be measured by means of three different critical factors: Liquidity, Operating Efficiency, and Capital Turnover. The first factor is composed of quick ratio, current ratio, and working capital to total assets ratio. The second factor is composed of EBIT and operating income to total assets ratio, and the third factor is composed of sales to total assets and sales to inventory ratios.

After the financial ratios were grouped into factors or aggregates, it was possible to standardize the factors' scores by using a ranking scale to visually compare trends and performance of the furniture industry using only three main critical financial factors. Although an ANOVA test could not be run due to statistical restrictions, it can be implied from the information gathered that the North American region and the European region have better performance than the Asian region for all years in the

study when measuring capital turnover. In terms of Liquidity, the North American region outperformed European and Asian regions in 1997. From the ranking procedure, it can be seen that it is likely that the North American region also outperformed European and Asian regions when measuring Operating Efficiency in 1999. For all other years, there was no visible evidence of any difference.

Data from furniture companies was not only compared by region, but also by furniture industry sector. Kitchen cabinet and household furniture manufacturers outperformed office and institutional furniture manufacturers in years 2001 and 2002 when measuring Liquidity. When Operating Efficiency was measured, the analysis shows that kitchen cabinet manufacturers outperformed household furniture and office and institutional furniture manufacturers in 1999. In terms of Capital Turnover, it seems that no sector of the furniture industry was superior.

Finally, it is interesting to observe the behavior of each critical financial factor for all years in the study. From this pattern, it can be seen that the Asian region is catching up with the North American and European regions in terms of Capital Turnover, especially in the last three years. Also, the behavior for all years suggests that the household furniture sector and office and institutional furniture sectors are declining respective to the kitchen cabinets sector when all sectors are compared using all three performance measures.

Although financial performance measures such as Capital Turnover, Liquidity, and Operating Efficiency are not pure measures of competitiveness, analysis of their behavior helps in understanding the dynamics of the business of manufacturing and selling of furniture.

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