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Table of Contents

1. REITs in Turkey: Fundamentals vs. Market.....	662
Emrah Önder, Nihat Taş, Ali Hepşen	
2. Unemployment Modelled Through M G ∞ Systems	677
Manuel Alberto M. Ferreira, José António Filipe, Manuel Coelho	
3. Cointegration and Structural Breaks in the EU Sovereign Debt Crisis.....	680
Nuno Ferreira, Rui Menezes, Sónia Bentes	
4. The Board's Attributes and Their Influence in Company's Performance. A Review over the Recent Literature	691
Vítor Pereira , José Filipe	
5. The Partnership as a Factor of Sustainable Growth for the Companies in the Information Technology Sector in Brazil.....	702
Daniel Correia de Albuquerque, José António Filipe, Manuel Alberto M. Ferreira	
6. Networks of Networks: The Last Frontier of Complexity-A Book Review	708
Manuel Alberto M. Ferreira	

REITs in Turkey: Fundamentals vs. Market

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Abstract –Financial performance evaluation of real estate investment trusts (REITs) is a kind of multi-criteria decision making (MCDM) problem. It is very important for a firm to monitor a wide range of performance indicators in order to ensure that appropriate and timely decisions and plans can be made. Suitable performance measures can ensure that managers adopt a long-term perspective and allocate the company's resources to the most effective activities. The aim of this study is to evaluate the financial performance model of Turkish Real Estate Investment Trusts (REITs) during 2012-2013 period using multi criteria decision techniques. Analytical Network Process (ANP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methodologies are used for the outranking of trusts. This model is applied to a case study for the financial performance evaluation of 24 REITs (Akfen, Akış, Akmerkez, Alarko, Ata, Atakule, Avrasya, Doğuş, Emlak Konut, İdealist, İş, Kiler, Martı, Nuro, Özderici, Pera, Reysaş, Saf, Sinpaş, Torunlar, TSKB, Vakıf, Yapı Kredi Koray and Yeşil) in Turkey. Financial performance indicators namely Asset Growth Rate, Operating Costs / Net Sales, Return on Asset, Net Profit Margin, Return on Equity, Current Ratio, Long Term Assets / Total Assets and Quick Ratio are used for ranking the firms. The findings of this paper would help REIT managers and investors for creating more effective investment strategies. For the management side, rises, falls, and turning points of the fundamental indicators puts into perspective the effects of investment and financing policies created to deal with them. For the investors' side, comparing fundamental and market values provide them to analyze REITs are over or undervalued in the financial market.

Keywords—REITs, Financial Performance Evaluation, Analytical Network Process (ANP), TOPSIS Method, Real Estate Sector, Multi Criteria Decision Making, Correlation

1. Introduction

As a developing country, Turkey has been going through wide-scale urbanization as a result of the rapid industrialization since 1950's. Increase in population and migration from rural to urban areas have triggered development in the cities. Today, based on results of the survey Emerging Trends in Real Estate Europe, prepared jointly by PricewaterhouseCoopers and the Urban Land Institute clearly indicates that Istanbul is ranked as the fourth most attractive real estate investment market among all European Cities in 2013 (PWC and ULI, 2013). The Turkish city was ranked first in the previous two Emerging Trends Europe reports, and is another top pick this year. With half of its 75 million people under the age of 29, there are several factors driving or affecting the infrastructure requirements in Turkey. These factors are increase in population and household income level, continued migration from rural to urban areas, renewal of existing housing, modernization and the development of the retail market, increase in the number of multinational and large national companies, leading to office space requirements in the commercial cities, and the geographical position of Turkey being a bridge between Europe, Central Asia and the Middle East puts emphasis on the development of the logistics sector and related construction (ISPAT, 2010). In addition to them, national and international specialists agree that Turkey will reach even more important positions in future. The role that the real estate sector and its main player real estate investment trusts will assume become more important in this future projection for Turkey. (GYODER, 2012).

In general, real estate investment trusts (REITs) are closed-end investment companies which are managing portfolios composed of real estates, real estate based projects and capital market instruments based on real estates. They serve as financial intermediaries to facilitate the flow of funds from investors to real estate sector of the economy (Corgel et.al, 1995). According to the Turkish Association of Real Estate Investment Companies, real estate investment trusts (REITs) are professional investment companies that will shape the real estate industry of the future in Turkey and they are one of the most important innovations to appear on financial markets in recent years. REITs are important investment vehicles for bringing corporate capital to the financing resource-starved real estate sector as well as developing large and quality projects. REITs have eliminated the problem of liquidity, the most fundamental problem facing investments in real estate. Moreover, by bringing together the savings of individual and corporate investors into a common pool, they are able to realize large profit-generating real estate projects. The main goal of REITs in Turkey is to create a source of financing for the real estate sector, which has been experiencing problems in this area. Permitting public investment and directing the funds collected to the real estate sector are just two new sources. They are also enabling investors with limited savings to benefit from the increased value created by pooling of their resources, which enables them to invest in large, productive real estate investments, which would otherwise be beyond the reach of small-scale

investors. Furthermore, REITs want to be able to form a corporate and professional investment base in Turkey. They also have, as one of their goals, the creation of an alternative and transparent model to various inadequate practices that have been going on in the real estate sector. In order to promote the formation and growth of the industry, authorities have provided REITs with some important tax incentives as well as flexibility in managing their portfolios. In Turkey, one another important role of REIT's is to eliminate the unrecorded real estate market and to bring transparency to the real estate sector. This role is achieved by the help of appraisal firms. Transactions and the portfolio valuation of REIT's are based on appraisal reports from independent appraisal firms which are certified by the Capital Markets Board of Turkey (CMB).

A REIT regime exists in Turkey primarily under the administrative supervision of the CMB, a regulatory and supervisory agency. The REIT practices were introduced to the Turkish capital markets for the first time with the legal framework prepared in 1995 and with the first IPO in 1997. Currently, there are 30 REITs registered with the CMB with shares still quoted on the Borsa Istanbul (BIST). In addition, the REIT index consists of stocks of real estate investment trusts traded on the BIST market. REIT index series are also set at 21,180.77 at the last trading day of 1999. Table 1 presents the historical consolidated portfolio structure of REITs in Turkey and Table 2 summarizes general information of REITs as of 2013 third quarter (Capital Markets Board, 2014).

Table 1. Historical Consolidated Portfolio Structure of REITs in Turkey

All Real Estate Investment Trusts						
Year	Number of REITs	Market Capitalization (Thousand TRY)	R (%)	MCMI (%)	GB (%)	
2011/09	23	18,742,054	66	11.33	5.19	
2011/12	23	20,769,996	63	11.27	5.45	
2012/03	24	22,104,329	63	10.70	6.58	
2012/06	24	21,771,855	64	9.82	6.53	
2012/09	24	22,561,915	67	6.44	8.32	
2012/12	25	24,086,877	66	8.18	6.48	
2013/03	27	27,232,324	65	5.87	10.47	
2013/06	28	29,487,413	66	6.17	12.61	
2013/09	30	32,399,777	64	11.91	5.31	

Notes: R%: Proportion of Real Estates, Real Estate Projects and Rights in the Portfolio; MCMI%: Proportion of Money and Capital Market Instruments in the Portfolio; GB%: Proportion of Affiliates in the Portfolio

Source: Capital Markets Board of Turkey, www.cmb.gov.tr

Table 2. General Information of REITs in Turkey (2013 3rd Quarter)

Name of Company	Registered Capital (TRY)	Paid in Capital (TRY)	Number Of Outstanding Shares	Asset Allocation %				Total Assets (TRY)	Stock Price (TRY)	Market Value (TRY)
				Real Estate Investments	Affiliates	Money and Capital Market Instruments	Other			
1 AKFEN REIT	1,000,000,000	184,000,000	184,000,000	53.04	44.14	0.11	2.71	1,211,880,553	1.36	250,240,000
2 AKIŞ REIT	200,000,000	128,200,841	128,200,841	83.21	5.80	1.77	9.22	980,160,476	3.03	388,448,549
3 AKMERKEZ REIT	75,000,000	37,264,000	37,264,000	72.86	0.00	22.56	4.58	183,691,044	14.35	534,738,400
4 ALARKO REIT	20,000,000	10,650,794	10,650,794	47.93	0.00	48.48	3.60	351,584,056	19.30	205,560,324
5 ATA REIT	50,000,000	23,750,000	23,750,000	53.78	0.00	39.75	6.47	28,627,933	1.69	40,137,500
6 ATAKULE REIT	200,000,000	84,000,000	84,000,000	73.66	0.00	25.04	1.30	246,107,529	1.10	92,400,000
7 AVRASYA REIT	480,000,000	72,000,000	72,000,000	74.46	0.00	24.72	0.20	81,336,047	0.56	40,320,000
8 DOĞUŞ REIT	500,000,000	93,780,000	93,780,000	82.24	0.00	17.29	0.47	236,478,371	3.50	328,230,000
9 EGS REIT	75,000,000	50,000,000	50,000,000	33.63	0.00	66.31	0.00	54,626,138	-	-
10 EMLAK KONUT REIT	4,000,000,000	2,500,000,000	2,500,000,000	52.76	0.00	18.07	29.16	10,573,606,000	2.73	6,825,000,000
11 HALK REIT	1,500,000,000	673,638,704	673,638,704	75.84	0.00	18.88	5.28	867,935,912	1.25	842,048,380
12 İDEALIST REIT	200,000,000	10,000,000	10,000,000	83.51	0.00	8.71	7.78	8,980,436	1.81	18,100,000
13 İŞ REIT	2,000,000,000	630,000,000	630,000,000	77.40	0.02	15.46	7.13	1,459,105,092	1.33	837,900,000
14 KILER REIT	1,400,000,000	124,000,000	124,000,000	69.50	14.17	0.79	15.54	499,851,709	1.34	166,160,000
15 MARTI REIT	200,000,000	110,000,000	110,000,000	57.31	0.00	0.47	23.10	240,868,087	0.44	48,400,000
16 NÜROL REIT	40,000,000	40,000,000	40,000,000	79.88	0.00	0.82	19.30	769,135,052	5.76	230,400,000
17 ÖZAK REIT	300,000,000	157,000,000	157,000,000	61.91	35.21	0.47	2.41	1,073,236,521	2.23	350,110,000
18 ÖZDERİCİ REIT	250,000,000	100,000,000	100,000,000	77.36	0.00	9.11	13.53	179,716,411	0.94	94,000,000
19 PANORA REIT	90,000,000	87,000,000	87,000,000	97.39	0.02	0.55	609,974,103	4.00	348,000,000	
20 PERA REIT	250,000,000	89,100,000	89,100,000	87.88	1.87	0.85	9.40	215,173,884	0.47	41,877,000
21 REYSAŞ REIT	500,000,000	217,000,000	217,000,000	73.52	4.25	9.17	13.05	502,625,998	0.47	101,990,000
22 SERVET REIT	1,000,000,000	52,000,000	52,000,000	84.45	0.00	15.03	0.52	202,894,264	2.68	139,360,000
23 SAF REIT	2,000,000,000	886,601,669	886,601,669	70.56	0.79	10.22	17.67	933,099,256	0.86	762,477,435
24 SINPAŞ REIT	1,000,000,000	600,000,000	600,000,000	54.43	5.34	2.02	38.21	2,144,437,707	1.06	636,000,000
25 TORUNLAR REIT	1,000,000,000	500,000,000	500,000,000	62.08	8.46	15.19	14.27	5,660,905,000	3.39	1,695,000,000
26 TSKB REIT	200,000,000	150,000,000	150,000,000	93.54	0.00	2.94	3.52	360,969,421	0.92	138,000,000
27 VAKIF REIT	300,000,000	106,200,000	106,200,000	71.40	0.00	28.37	0.24	198,186,135	9.28	985,536,000
28 YAPI KREDİ KORAY REIT	100,000,000	40,000,000	40,000,000	52.62	34.07	8.79	4.53	117,724,243	1.39	55,600,000
29 YENİ GİMAT REIT	250,000,000	53,760,000	53,760,000	97.21	0.25	0.00	2.54	1,303,061,475	14.30	768,768,000
30 YEŞİL REIT	1,000,000,000	235,115,706	235,115,706	59.74	0.00	0.06	40.20	1,103,798,443	0.51	119,909,010

Source: Capital Markets Board of Turkey, www.cmb.gov.tr

2. Literature Review

Firm-specific fundamental variables of real estate investment trusts including Asset Growth Rate, Operating Costs / Net Sales, Return on Asset, Net Profit Margin, Return on Equity, Current Ratio, Long Term Assets / Total Assets and Quick Ratio that may affect their stock return. The first study to investigate the REIT performance in literature was written by Smith and Shulman (1976). This study compared the performance (quarterly returns) of sixteen REITs to the S&P index, savings accounts, and fifteen closed-end funds over the 1963–1974 periods by using the Jensen measure. They found that equity REITs outperformed savings accounts and the S&P index for the 1963–1973 periods. However, the performance of REIT stocks was so bad in 1974 that their REIT sample underperformed the S&P index for the entire 1963–1974 period if the recession year of 1974 was included. In addition to this, the well-known study related to REIT performances belong to Redman and Manakyan (1995). They examined the risk-adjusted performance of REITs from 1986 to 1990 in relation to financial and property characteristics of their portfolios. The Sharpe measure of risk-adjusted rate of return was regressed against financial ratios (gross cash flow, leverage, asset size) and property investment ratios for a sample of equity and mortgage REITs. The result of their study is financial ratios, location of properties (more specifically, in the western United States) and types of real estate investment determine the risk-adjusted performance. Cannon and Vogt (1995) examined possible agency problems in Real Estate Investment Trusts (REITs) by contrasting the performance, structure and compensation of the two REIT forms (“self-administered REITs” and

“advisor REITs”) from 1987 through 1992. The market performance of the two REIT forms was analyzed by using the Jensen measure and the Sharpe measure. Results show that “self-administered REITs” outperformed “advisor REITs” over the sample period. On the other hand, some papers focus on risk and return characteristics of REITs. Chan, Hendershott and Senders (1990) analyzed monthly returns on an equally weighted index of eighteen to twenty-three equity REITs that were traded on major stock exchanges over the 1973–1978 period. They employed a three-factor Arbitrage Pricing Model (APM) as well as Capital Asset Pricing Model (CAPM). They found that with CAPM there was an evidence of excess real estate returns, especially in the 1980s; but with APM, this evidence disappeared. Kuble, Walther and Wurtzback (1986) investigated the risk-adjusted return performances of 102 REITs whose shares traded on various stock exchanges over the period 1973–1985. Share performance was measured through a comparative analysis with the S&P 500 Index, using the Jensen measure for excess returns. The results of the research indicated that significant Jensen alpha or excess returns occurred during ten years of the thirteen-year period analyzed. Kim, Mattila and Gu (2002) investigated the performance of hotel real estate investment trusts (REITs) over the 1993–1999 period in comparison with the overall market and six other REIT sectors (office, industrial, residential, health care, retail and diversified). The Jensen Index was employed to measure the performance of each REIT sector relative to the market portfolio. A one-way analysis of variance (ANOVA) was conducted and the Tukey multiple comparison method was used to enable performance comparisons across the REIT sectors.

The results indicate that hotel REITs carried the highest market risk as compared to other REIT sectors. The risk-adjusted return of hotel REITs was in line with that of the overall market.

Financial performance evaluation using multi criteria decision making methods is a popular research area in literature. Chen, Hsu and Tzeng (2011) developed a performance evaluation and interrelation model for hot spring hotels in their study. They selected 30 hot spring hotels for use with the optimum performance evaluation model and used DEMATEL to draw a relationship diagram for hot spring hotel performance evaluation. Then ANP was utilized to determine the weights of the evaluation criteria and prioritize them accordingly. They have defined the top six criteria that can enhance the performance of hot spring hotels.

Yu and Hu (2010) developed an integrated multi criteria decision making approach that combines the voting method and the fuzzy TOPSIS method to evaluate the performance of multiple manufacturing plants in a fuzzy environment. They used voting to determine the appropriate criteria weights and used proposed approach to evaluate the performance of five chosen manufacturing plants.

Nili, Ardakani and Schekarchizadeh (2012) offered a new method for evaluating performance in production industries. Five large plants were selected as a sample and a method based on the Balance Score Card (BSC) system and TOPSIS technique was implemented in them. They found which indexes should be considered when evaluating performance in the chosen plants.

Pal and Choudhury (2009) suggested that customers distinguish four dimensions of service quality in the case of the retail banking industry in India, namely, customer-orientedness, competence, tangibles and convenience. They used TOPSIS to evaluate and ranking the relative performance of the banks across the service quality dimensions.

Büyükoğuzkan and Çifçi (2012) proposed a novel hybrid MCDM approach based on the fuzzy DEMATEL, fuzzy ANP, and fuzzy TOPSIS methodologies to evaluate green suppliers for the need of improving green supply chain management

(GSCM) initiatives. They formulated a new evaluation model by defining possible green supplier evaluation criteria Based on the literature survey and with the validation of industrial experts. Shyur (2006) modeled the commercial-off-the-self (COTS) evaluation problem as an MCDM problem and proposed a five-phase COTS selection model, combining the technique of ANP and modified TOPSIS. The results showed that the proposed method is practical for ranking competing COTS products in terms of their overall performance with respect to multiple interdependence criteria.

Tsai, Huang and Wang (2008) proposed combining the concepts of the ANP and TOPSIS models to evaluate and rank property-liability insurance company performance. Their study used limited financial data for the performance evaluation and The Tokio Marznrue Newa (0.8767) insurance company is identified as the optimal insurance company by applying ANP in obtaining criteria weight and TOPSIS in ranking on those results.

Saen (2010) suggested a model for evaluating the best power plants in the presence of weight restrictions by using a data envelopment analysis (DEA) model. The proposed model does not demand exact weights from the decision maker (DM).

3. Overview of Data

The aim of this study is to evaluate the financial performance model of Turkish Real Estate Investment Trusts (REITs) using multi criteria decision techniques. To achieve this objective, below financial ratios of 24 REITs are employed for the period from 2012 3rd quarter to 2013 3rd quarter. For Turkish REIT market, this study gathers firm-specific fundamental variables of 24 REITs (Akfen, Akiş, Akmerkez, Alarko, Ata, Atakule, Avrasya, Doğuş, EmlakKonut, İdealist, İş, Kiler, Martı, Nuro, Özderici, Pera, Reysaş, Saf, Sinpaş, Torunlar, TSKB, Vakıf, YapıKrediKoray and Yeşil). Table 3 shows the details of variables in the decision model.

Table 3. Variables in the Decision Model and Their Terminology

Firm-Specific Variables	Terminology
C1: Asset Growth Rate %	$(\text{Total Assets}_t - \text{Total Assets}_{t-1}) / \text{Total Assets}_{t-1}$
C2: Operating Costs / Net Sales %	$(\text{Operating Costs}) / (\text{Net Sales})$
C3: Return on Asset %	$(\text{Net Income}) / (\text{Total Assets})$
C4: Net Profit Margin %	$(\text{Net Income}) / (\text{Net Sales})$
C5: Return on Equity %	$(\text{Net Income}) / (\text{Shareholders' Equity})$
C6: Current Ratio	$(\text{Current Assets}) / (\text{Short-term Liabilities})$
C7: Long-term Assets / Total Assets %	$\text{Long-term Assets} / (\text{Total Assets})$
C8: Quick Ratio	$(\text{Current Assets} - \text{Inventories}) / (\text{Short-term Liabilities})$

4. Methodology

In this part of the study, the Analytic Network Process, TOPSIS method and proposed converting scale method will be given.

4.1. Analytical Network Process

ANP proposed by T. L. Saaty (1996) is a general form of the Analytic Hierarchy Process (AHP). ANP is one of the multi criteria decision making techniques which consider the dependence among criteria and alternative. Therefore it offers several advantages over other MCDM techniques. There are mainly six steps in ANP.

- Step 1.** Define decision problem
- Step 2.** Determine dependencies among clusters (outer dependence) and elements of the clusters (inner dependence)
- Step 3.** Pairwise comparisons of the elements and clusters
- Step 4.** Determine the supermatrix and weighted supermatrix
- Step 5.** Calculate the limit supermatrix.
- Step 6.** Select the best alternative.

The general form of the supermatrix can be described as follows:

$$W = \begin{matrix} & \begin{matrix} C_1 & C_2 & & C_m \end{matrix} \\ \begin{matrix} C_1 \\ C_2 \\ \vdots \\ C_m \end{matrix} & \begin{matrix} e_{11} & e_{12} & \dots & e_{1n_1} & e_{21} & e_{22} & \dots & e_{2n_2} & \dots & e_{m1} & e_{m2} & \dots & e_{mn_m} \end{matrix} \\ \begin{matrix} e_{11} \\ e_{12} \\ \vdots \\ e_{1n_1} \\ e_{21} \\ e_{22} \\ \vdots \\ e_{2n_2} \\ \vdots \\ e_{m1} \\ e_{m2} \\ \vdots \\ e_{mn_m} \end{matrix} & \begin{bmatrix} W_{11} & W_{12} & \dots & W_{1m} \\ W_{21} & W_{22} & \dots & W_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ W_{m1} & W_{m2} & \dots & W_{mm} \end{bmatrix} \end{matrix} \tag{1}$$

Where C_m denotes the m th cluster, e_{mn} denotes the n th element in the m th cluster and W_{ij} is the principal eigenvector of the influence of the elements compared in j th cluster to the i th cluster. If the j th cluster has no influence on the i th cluster,

then $W_{ij}=0$ (Tzeng and Huang, 2011). Three cases are shown in Figure 1 to demonstrate how to form the supermatrix based on the specific network structures.

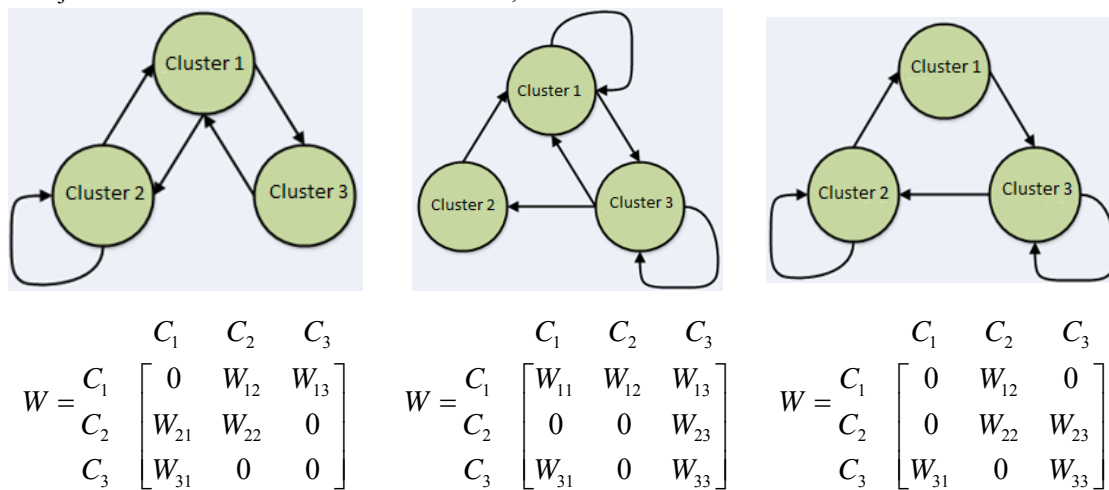


Figure 1. Structure of three cases and their supermatrices respectively.

After forming the supermatrix, the weighted sums to unity exactly. This step is very similar to the concept of a Markov chain for ensuring the sum of

these probabilities of all states is equal to 1 (Ishizaka, and Nemery, 2013). Next, we raise the weighted supermatrix to limiting power such as equation below to get the global priority vectors.

$$\lim_{k \rightarrow \infty} W^k \quad (2)$$

4.2. Using Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to rank the alternatives

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was first presented by Yoon (1980) and Hwang and Yoon (1981), for solving multiple criteria decision making (MCDM) problems based upon the concept that the chosen alternative should have the shortest Euclidian distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS). For instance, PIS maximizes the benefit and minimizes the cost, whereas the NIS maximizes the cost and minimizes the benefit. It assumes that each criterion require to be maximized or minimized. TOPSIS is a simple and

useful technique for ranking a number of possible alternatives according to closeness to the ideal solution. Expanded developments of TOPSIS were done by Chen and Hwang in 1992, Lai, Liu and Hwang (1994). This MCDM technique is widely used in many fields, including financial performance evaluation, supplier selection, tourism destination evaluation, location selection, company evaluation, selecting the most suitable machine, ranking the carrier alternatives (Behzadian, 2012). One of the advantages of TOPSIS is that pair-wise comparisons are avoided. TOPSIS is conducted as follows (Tsauro, 2011).

Step 1. Establish a decision matrix for the ranking. TOPSIS uses all outcomes (x_{ij}) in a decision matrix to develop a compromise rank. The viable alternatives of the decision process are A_1, A_2, \dots, A_n . The structure of the decision matrix denoted by $X = (x_{ij})_{n \times m}$ can be expressed as follows:

$$X = \begin{matrix} & \begin{matrix} m \text{ Criteria} \\ C_1 & C_2 & \dots & C_j & \dots & C_m \end{matrix} \\ \left. \begin{matrix} x_{11} & x_{12} & \dots & x_{1j} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2j} & \dots & x_{2m} \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ x_{i1} & x_{i2} & \dots & x_{ij} & \dots & x_{im} \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ x_{n1} & x_{n2} & \dots & x_{nj} & \dots & x_{nm} \end{matrix} \right\} \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_i \\ \vdots \\ A_n \end{matrix} \end{matrix} \quad \left. \vphantom{\begin{matrix} x_{11} \\ x_{21} \\ \vdots \\ x_{i1} \\ \vdots \\ x_{n1} \end{matrix}} \right\} n \text{ Alternatives} \quad (3)$$

x_{ij} is the outcome of i^{th} alternative with respect to j^{th} criteria. $W = (w_1, w_2, \dots, w_j, \dots, w_m)$ is the relative weight vector about the criteria, and w_j represents the weight of the j^{th} attribute and $\sum_{j=1}^m w_j = 1$.

Step 2. Normalize the decision matrix using the following equation:

$$r_{ij} = \frac{w_{ij}}{\sqrt{\sum_{k=1}^n w_{kj}^2}} \quad i=1,2,3,\dots,n \quad j=1,2,3,\dots,m \quad (4)$$

Step 3. Weighted normalized decision matrix is calculated by multiplying the normalized decision matrix by its associated weights as:

$$v_{ij} = w_j r_{ij} \quad i=1,2,3,\dots,n \quad j=1,2,3,\dots,m \quad (5)$$

Step 4. Identify the positive ideal solution (PIS) and negative ideal solution (NIS), respectively, as follows:

$$PIS = A^* = \{v_1^*, v_2^*, \dots, v_m^*\} \quad (6)$$

$$= \left\{ \left(\max_i v_{ij} \mid j \in \Omega_b \right), \left(\min_i v_{ij} \mid j \in \Omega_c \right) \right\}$$

$$NIS = A^- = \{v_1^-, v_2^-, \dots, v_m^-\} \quad (7)$$

$$= \left\{ \left(\min_i v_{ij} \mid j \in \Omega_b \right), \left(\max_i v_{ij} \mid j \in \Omega_c \right) \right\}$$

Ω_b is associated with benefit criteria, and Ω_c is associated with cost criteria.

Step 5. Determine the Euclidean distance (separation measures) of each alternative from the ideal and negative-ideal solution as below respectively:

$$d_i^* = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^*)^2}, \quad i=1,2,3,\dots,n \quad (8)$$

$$d_i^- = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^-)^2}, \quad i=1,2,3,\dots,n \quad (9)$$

Step 6 Calculate the relative closeness of the i^{th} alternative to ideal solution using the following equation:

$$RC_i = \frac{d_i^-}{d_i^* + d_i^-} \quad i=1,2,3,\dots,n \quad (10)$$

$$RC_i \in [0, 1]$$

Step 7. By comparing RC_i values, the ranking of alternatives are determined. The higher the closeness means the better the rank. Ranked the alternatives starting from the value that closest to 1 and in decreasing order.

4.3. Converting Simple Correlation Matrix into Saaty's 1-9 Scale

Operations shown below are made to generate n score matrix from simple correlation matrix as an alternative to financial expert's scores.

For each of n criteria x_1, x_2, \dots, x_n ,

Step 1. Get simple correlation matrix.

$$R = [r_{ij}]_{n \times n} \quad (11)$$

Step 2. Define scaling multiplier:

$$\text{Scaling Multiplier} = SM = \frac{n}{|r_{\max}| - |r_{\min}|} \quad (12)$$

Step 3. $\forall k = 1, 2, \dots, n$, get upper triangular score matrix UN_k for x_k :

$$UN_k = [n_{ij}]_{(n-1) \times (n-1)} \quad (13)$$

and

for $\{i \neq k, j \neq k \text{ and } i < j\}$

$\forall \{i = 1, 2, \dots, n \text{ ve } j = 2, 3, \dots, n\}$,

$$\text{score}_{ij} = n_{ij} = \begin{cases} RS_{ij}, & \text{if } RS_{ij} > 0 \\ \frac{1}{|RS_{ij}|}, & \text{if } RS_{ij} < 0 \end{cases} \quad (14)$$

where

$$\text{RawScore}_{ij} = RS_{ij}$$

$$= \begin{cases} SM \cdot AD_{ij} + \text{sgn}(AD_{ij}), & \text{if } AD_{ij} \neq 0 \\ 1, & \text{if } AD_{ij} = 0 \end{cases} \quad (15)$$

and

$$\text{AbsoluteDifference}_{ij} = AD_{ij} = |r_{ki}| - |r_{kj}| \quad (16)$$

$\text{sgn}(\)$: Sign (or signum) function that extracts the sign of a real number. For any real number c , it is defined as

$$\text{sgn}(c) = \begin{cases} \frac{|c|}{c}, & c \neq 0 \\ 0, & c = 0 \end{cases} \quad (17)$$

Step 4. Get lower triangular score matrix

$$LN_k = [l_{ji}]_{(n-1) \times (n-1)} \text{ for } x_k \quad (18)$$

$$l_{ji} = \frac{1}{n_{ij}} \quad (19)$$

Step 5. Get score matrix M :

$$M = [LN + UN + I_{(n-1) \times (n-1)}]_{(n-1) \times (n-1)} \quad (20)$$

5. Combining ANP and TOPSIS to Determine the Rank of Alternatives

The proposed model of this paper uses an combined method of correlation analyze, Analytical Network Process (ANP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for ranking the REITs in Turkey depends on their financial performances. Figure 2 shows the steps of the proposed method. In this financial performance evaluation there are 8 criteria. An interview was performed with the financial expert in order to identify weight coefficients. Past

experience and the back-ground of the financial expert are utilized in the determination of the criteria and 8 criteria to be used for REITs evaluation are established. The outputs of the ANP are determined as the input of TOPSIS method. Data are used for the period September 2012 to September 2013 (5 quarters). The sample period is dependent on quarterly data availability. The sample includes 24 REITs (Akfen, Akiş, Akmerkez, Alarko, Ata, Atakule, Avrasya, Doğuş, EmlakKonut, İdealist, İş, Kiler, Martı, Nuro, Özderici, Pera, Reysaş, Saf, Sinpaş, Torunlar, TSKB, Vakıf, Yapı Kredi Koray and Yeşil). Financial ratios have been grouped as Asset Growth Rate, Operating Costs / Net Sales, Return on Asset, Net Profit Margin, Return on Equity, Current Ratio, Long Term Assets / Total Assets and Quick Ratio.

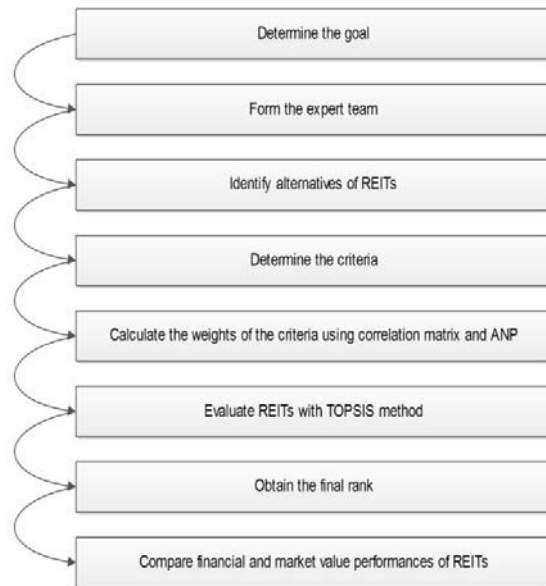


Figure 2. Steps of proposed method

As a result, 8 criteria were used in evaluation and decision model is established accordingly. Decision model structured with the determined firms and criteria is provided in Figure 3. After forming the ANP diagram for the problem, the weights of the criteria to be used in evaluation process are calculated by using ANP method. In this phase, supermatrix is obtained by converting correlation matrix data into Saaty's 1-9 scale. This transformation is possible, because all criteria data was quantitative. Also the financial expert is given the task of forming individual pairwise comparison matrix by using the Saaty's 1-9 scale. Both output of the ANP method and expert judgments were used to calculate final weight values (average of

two outputs) of criteria. The limit supermatrix is derived by raising the supermatrix to powers.

The results obtained from the calculations based on the pairwise comparison matrix of financial expert's choice values are presented in Table 4.

Table 4. Results of criteria by expert judgments

Criteria	Weights	CR
C1: Asset Growth Rate %	0.1042	
C2: Operating Costs / Net Sales %	0.0430	
C3: Return on Asset %	0.2055	
C4: Net Profit Margin %	0.2199	0.0052
C5: Return on Equity %	0.2389	
C6: Current Ratio	0.0272	
C7: Long Term Assets / Total Assets %	0.1420	
C8: Quick Ratio	0.0194	

Consistency ratios of the expert's pairwise comparison matrixes are calculated as 0.0052. It is less than 0.1. So the weights are shown to be consistent and they are used in the financial performance evaluation.

The ANP structure is modelled in the following network.

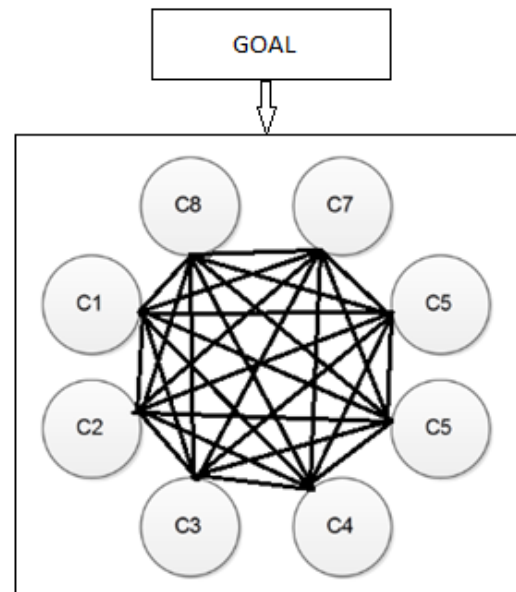


Figure 3. Criteria relationships as an ANP diagram

Table5. Correlation Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
C1	1							
C2	-0.02621	1						
C3	-0.11505	-0.11114	1					
C4	0.010931	-0.86219	0.1270652	1				
C5	-0.06622	-0.07192	0.850795	0.0934032	1			
C6	-0.04407	-0.03736	0.129331	0.0309897	0.08470287	1		
C7	0.056756	-0.31257	0.1222486	0.2588015	0.12787279	-0.45721	1	
C8	-0.02578	-0.07448	0.1734237	0.0576245	0.10678744	0.93416	-0.34225	1

Table6. Supermatrix obtained from simple correlation matrices

		Criteria							
		C1	C2	C3	C4	C5	C6	C7	C8
Criteria	C1	0.0000	0.0485	0.0683	0.0466	0.0622	0.0482	0.0521	0.0424
	C2	0.1187	0.0000	0.0666	0.5351	0.0645	0.0464	0.1687	0.0545
	C3	0.2148	0.0779	0.0000	0.0862	0.5552	0.0754	0.0698	0.0891
	C4	0.1067	0.5268	0.0742	0.0000	0.0743	0.0448	0.1309	0.0497
	C5	0.1582	0.0626	0.5444	0.0724	0.0000	0.0601	0.0718	0.0647
	C6	0.1351	0.0515	0.0754	0.0516	0.0701	0.0000	0.3123	0.5355
	C7	0.1480	0.1692	0.0718	0.1485	0.0926	0.2080	0.0000	0.1641
	C8	0.1184	0.0635	0.0993	0.0596	0.0811	0.5173	0.1943	0.0000

Table7. Limit Supermatrix

		Criteria							
		C1	C2	C3	C4	C5	C6	C7	C8
Criteria	C1	0.0498	0.0498	0.0498	0.0498	0.0498	0.0498	0.0498	0.0498
	C2	0.1257	0.1257	0.1257	0.1257	0.1257	0.1257	0.1257	0.1257
	C3	0.1362	0.1362	0.1362	0.1362	0.1362	0.1362	0.1362	0.1362
	C4	0.1224	0.1224	0.1224	0.1224	0.1224	0.1224	0.1224	0.1224
	C5	0.1273	0.1273	0.1273	0.1273	0.1273	0.1273	0.1273	0.1273
	C6	0.1598	0.1598	0.1598	0.1598	0.1598	0.1598	0.1598	0.1598
	C7	0.1266	0.1266	0.1266	0.1266	0.1266	0.1266	0.1266	0.1266
	C8	0.1523	0.1523	0.1523	0.1523	0.1523	0.1523	0.1523	0.1523

Table 8. Results of criteria by ANP used correlation matrix data as input

Criteria	Weights
C1: Asset Growth Rate %	0.050
C2: Operating Costs / Net Sales %	0.126
C3: Return on Asset %	0.136
C4: Net Profit Margin %	0.122
C5: Return on Equity %	0.127
C6: Current Ratio	0.160
C7: Long Term Assets / Total Assets %	0.127
C8: Quick Ratio	0.152

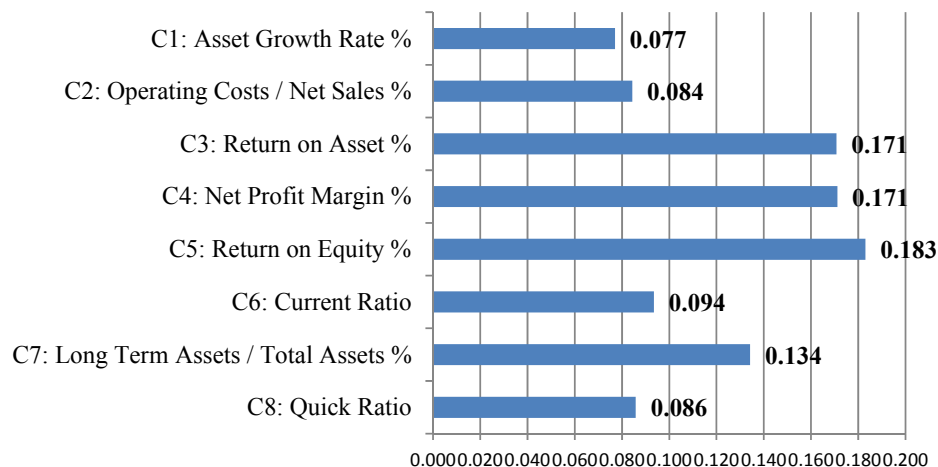


Figure 4. Resulting weights of criteria obtained with correlation matrix based ANP and expert judgments

Return on Equity (0.183), Return on Asset (0.171), Net Profit Margin (0.171) and Long Term Assets / Total Assets (0.134) are determined as the four most important financial ratios for the performance of the REITs. Asset Growth Rate (0.077),

Operating Costs / Net Sales (0.084), Quick Ratio (0.086) and Current Ratio (0.094) are determined as the four least important financial ratios for the performance of the REITs.

Table 9. Input values of the TOPSIS analysis for Sep 2013

Weights		0.077	0.084	0.171	0.171	0.183	0.094	0.134	0.086
REITs	Criteria	C1	C2	C3	C4	C5	C6	C7	C8
Akfen REIT		0.1302	0.1901	-0.0256	-1.065	-0.0442	1.07	0.9569	1.11
Akiş REIT		6.4411	0.2836	-0.0285	-0.5234	-0.0425	1.16	0.9309	1.26
Akmerkez REIT		0.0899	0.0709	0.2467	0.7485	0.2527	8.51	0.7673	8.51
Alarko REIT		0.5312	0.1321	0.1327	1.485	0.1335	119.37	0.434	102.62
Ata REIT		1.562	1.1829	0.004	0.2137	0.0041	142.38	0.5379	122.42
Atakule REIT		0.0848	0.4497	-0.0052	-0.2418	-0.0053	111.11	0.7472	111.1
Avrasya REIT		0.0127	0.016	0.0293	0.0175	0.0293	135.59	0.7452	135.58
Doğuş REIT		0.189	0.2257	0.0408	0.8375	0.041	35.95	0.8253	35.89
EmlakKonut REIT		0.3828	0.0482	0.0838	0.4517	0.1745	0.65	0.6092	0.78
İdealist REIT		-0.0329	6.5022	-0.0265	-5.5077	-0.0266	173.23	0.0006	14.28
İş REIT		0.1195	0.0246	0.0629	0.2847	0.0812	0.47	0.7881	0.1
Kiler REIT		0.0513	0.0879	0.0009	0.0085	0.0014	0.24	0.6183	1.15
Martı REIT		0.121	0.3621	-0.05	-1.2999	-0.0946	0.4	0.7099	0.06
Nurol REIT		0.5519	2.2605	-0.0095	-1.1443	-0.1171	0.25	0.1379	1.32
Özderici REIT		0.376	9.988	-0.0358	-58.328	-0.0661	5.88	0.0344	0.46
Pera REIT		-0.0191	0.2385	-0.021	-0.4202	-0.029	0.14	0.9308	0.7
Reysaş REIT		0.1852	0.1042	0.0153	0.2986	0.0224	0.1	0.8457	0.17
Saf REIT		0.2921	1.7049	0.005	0.708	0.0208	0.92	0.7379	1.17
Sinpaş REIT		0.1205	0.1915	0.0098	0.0628	0.02	0.6	0.4698	0.63
Torunlar REIT		0.297	0.106	-0.0028	-0.0987	-0.0057	0.3	0.6888	0.3
TSKB REIT		0.0384	0.1835	-0.032	-0.883	-0.0517	0.44	0.9584	0.5
Vakıf REIT		0.0277	0.2857	0.0165	0.6568	0.0167	60.04	0.7152	59.8
YapıKrediKoray REIT		0.0594	0.2073	-0.2313	-0.9845	-0.8769	0.45	0.2587	1.14
Yeşil REIT		-0.0058	0.0685	0.0098	0.0406	0.0479	0.99	0.2385	0.26

Finally, TOPSIS method is applied to rank the REITs. The priority weights of REITs with respect to criteria, calculated by using pairwise comparison of experts, correlation matrix and ANP shown in

Figure 4, can be used as input of TOPSIS (Table 9). The weighted normalized decision matrix can be seen from Table 10.

Table 10. Weighted REIT evaluation for Sep 2013

REITs	Criteria	C1	C2	C3	C4	C5	C6	C7	C8
Akfen REIT		0.00149	0.00130	-0.01115	-0.00311	-0.00839	0.00032	0.03889	0.00038
Akiş REIT		0.07383	0.00194	-0.01242	-0.00153	-0.00807	0.00034	0.03783	0.00044
Akmerkez REIT		0.00103	0.00048	0.10748	0.00218	0.04799	0.00251	0.03118	0.00295
Alarko REIT		0.00609	0.00090	0.05781	0.00433	0.02535	0.03525	0.01764	0.03554
Ata REIT		0.01790	0.00809	0.00174	0.00062	0.00078	0.04205	0.02186	0.04240
Atakule REIT		0.00097	0.00307	-0.00227	-0.00071	-0.00101	0.03281	0.03036	0.03848
Avrasya REIT		0.00015	0.00011	0.01277	0.00005	0.00556	0.04004	0.03028	0.04696
Doğuş REIT		0.00217	0.00154	0.01778	0.00244	0.00779	0.01062	0.03354	0.01243
EmlakKonut REIT		0.00439	0.00033	0.03651	0.00132	0.03314	0.00019	0.02476	0.00027
İdealist REIT		-0.00038	0.04444	-0.01155	-0.01606	-0.00505	0.05116	0.00002	0.00495
İş REIT		0.00137	0.00017	0.02740	0.00083	0.01542	0.00014	0.03203	0.00003
Kiler REIT		0.00059	0.00060	0.00039	0.00002	0.00027	0.00007	0.02513	0.00040
Martı REIT		0.00139	0.00247	-0.02178	-0.00379	-0.01797	0.00012	0.02885	0.00002
Nurol REIT		0.00633	0.01545	-0.00414	-0.00334	-0.02224	0.00007	0.00560	0.00046
Özderici REIT		0.00431	0.06827	-0.01560	-0.17013	-0.01255	0.00174	0.00140	0.00016
Pera REIT		-0.00022	0.00163	-0.00915	-0.00123	-0.00551	0.00004	0.03782	0.00024
Reysaş REIT		0.00212	0.00071	0.00667	0.00087	0.00425	0.00003	0.03437	0.00006
Saf REIT		0.00335	0.01165	0.00218	0.00207	0.00395	0.00027	0.02999	0.00041
Sinpaş REIT		0.00138	0.00131	0.00427	0.00018	0.00380	0.00018	0.01909	0.00022
Torunlar REIT		0.00340	0.00072	-0.00122	-0.00029	-0.00108	0.00009	0.02799	0.00010
TSKB REIT		0.00044	0.00125	-0.01394	-0.00258	-0.00982	0.00013	0.03895	0.00017
Vakıf REIT		0.00032	0.00195	0.00719	0.00192	0.00317	0.01773	0.02906	0.02071
YapıKrediKoray REIT		0.00068	0.00142	-0.10077	-0.00287	-0.16653	0.00013	0.01051	0.00039
Yeşil REIT		-0.00007	0.00047	0.00427	0.00012	0.00910	0.00029	0.00969	0.00009
Min or Max		+	-	+	+	+	-	+	-
A ⁺		0.07383	0.00011	0.10748	0.00433	0.04799	0.00003	0.03895	0.00002
A ⁻		-0.00038	0.06827	-0.10077	-0.17013	-0.16653	0.05116	0.00002	0.04696

By using TOPSIS method, the ranking of REITs are calculated. Table 11 shows the evaluation results and final ranking of REITs.

Table 11. TOPSIS results for Sep 2013

REITs	d_i^*	d_i^-	RC_i
Akfen REIT	0.150	0.268	0.641
Akiş REIT	0.133	0.278	0.677
Akmerkez REIT	0.073	0.359	0.830
Alarko REIT	0.103	0.313	0.753
Ata REIT	0.143	0.269	0.653
Atakule REIT	0.150	0.267	0.641
Avrasya REIT	0.142	0.278	0.662
Doğuş REIT	0.123	0.287	0.701
EmlakKonut REIT	0.101	0.313	0.755
İdealist REIT	0.170	0.245	0.590
İş REIT	0.113	0.299	0.725
Kiler REIT	0.139	0.277	0.666
Martı REIT	0.163	0.257	0.612
Nurol REIT	0.153	0.256	0.626
Özderici REIT	0.245	0.189	0.435
Pera REIT	0.148	0.271	0.646
Reysaş REIT	0.131	0.284	0.684
Saf REIT	0.135	0.280	0.674
Sinpaş REIT	0.135	0.281	0.675
Torunlar REIT	0.139	0.276	0.665
TSKB REIT	0.153	0.266	0.635
Vakıf REIT	0.135	0.278	0.672
YapıKrediKoray REIT	0.309	0.193	0.385
Yeşil REIT	0.136	0.283	0.676

Depends on the RC_j values, the rankings of the alternatives for the years 2012-2013 are shown in

Table 12. Last column shows the overall financial performance of REITs for the 5 quarters.

Table 12. Performance ranking for the quarters (Sep 2012-Sep 2013)

REITs	12-Sep	12-Dec	13-Mar	13-Jun	13-Sep	<i>Overall</i>
Akmerkez REIT	1	2	1	1	1	1
EmlakKonut REIT	9	8	3	2	2	2
Doğuş REIT	8	3	7	5	5	3
İş REIT	12	10	6	4	4	4
Akiş REIT	3	11	9	6	7	5
Kiler REIT	5	6	5	11	12	6
Torunlar REIT	7	4	8	9	13	7
Reysaş REIT	10	7	12	7	6	8
Alarko REIT	18	15	10	3	3	9
Nurol REIT	4	5	2	19	20	10
Atakule REIT	2	1	19	20	17	11
Sinpaş REIT	13	13	16	8	9	12
Vakıf REIT	15	12	15	10	11	13
Avrasya REIT	16	20	4	15	14	14
TSKB REIT	11	9	13	17	19	15
Ata REIT	6	18	22	12	15	16
Akfen REIT	14	14	14	16	18	17
Yeşil REIT	23	16	23	14	8	18
Saf REIT	22	23	17	13	10	19
Martı REIT	17	17	11	21	21	20
Pera REIT	19	19	18	18	16	21
İdealist REIT	21	21	20	22	22	22
Yapı Kredi Koray REIT	20	22	21	24	24	23
Özderici REIT	24	24	24	23	23	24

Table 13. Financial Performance vs. Market Value Performance of REITs in Turkey (Between +3 or-3 is Fair)

REITs	Financial Performance	Market Value Performance	Position
Akmerkez REIT	1	15	Undervalued
EmlakKonut REIT	2	6	Undervalued
Doğuş REIT	3	4	Fair
İş REIT	4	10	Undervalued
Akiş REIT	5	1	Overvalued
Kiler REIT	6	21	Undervalued
Torunlar REIT	7	13	Undervalued
Reysaş REIT	8	19	Undervalued
Alarko REIT	9	12	Fair
Nurol REIT	10	24	Undervalued
Atakule REIT	11	8	Fair
Sinpaş REIT	12	20	Undervalued
Vakıf REIT	13	2	Overvalued
Avrasya REIT	14	5	Overvalued
TSKB REIT	15	11	Overvalued
Ata REIT	16	3	Overvalued
Akfen REIT	17	16	Fair
Yeşil REIT	18	22	Undervalued
Saf REIT	19	7	Overvalued
Martı REIT	20	18	Fair
Pera REIT	21	17	Overvalued
İdealist REIT	22	23	Fair
Yapı Kredi Koray REIT	23	14	Overvalued
Özderici REIT	24	9	Overvalued

6. Concluding Remarks

Overvalued describes that the market value of a firm is considered too high for its fundamentals. That is to experience a market value decline and return to a level which better reflects its financial status and fundamentals. It is also the opposite of undervalued. Undervalued describes that the market value of a firm is considered too low for its fundamentals. That is to experience a market value rise and return to a level which better reflects its financial status and fundamentals. This research proposes an analytic tool for comparing financial and market value performance for 24 REITs(Akfen, Akiş, Akmerkez, Alarko, Ata, Atakule, Avrasya, Doğuş, EmlakKonut, İdealist, İş, Kiler, Martı, Nurol, Özderici, Pera, Reysaş, Saf, Sinpaş, Torunlar, TSKB, Vakıf, Yapı Kredi Koray and Yeşil) in Turkey that includes the consideration of financial ratios. Total financial performance of

firms is divided into eight groups including Asset Growth Rate, Operating Costs / Net Sales, Return on Asset, Net Profit Margin, Return on Equity, Current Ratio, Long Term Assets / Total Assets and Quick Ratio. Market performance is percentage difference between market values of each REITs during selected period. The proposed method takes advantage of ANP to determine weights using dependencies. Supermatrix is obtained by converting correlation matrix data into Saaty's 1-9 scale. After ANP and correlation analysis most important ratios are found. Return on Equity (0.183), Return on Asset (0.171), Net Profit Margin (0.171) and Long Term Assets / Total Assets (0.134) are determined as the four most important financial ratios for the performance of the REITs. Finally, TOPSIS method is applied to rank the REITs. Our model shows that although Akmerkez REIT is the best financial performing REIT during Sep 2012- Sep 2013, its market value is relatively low. Therefore its market value is expected to rise

and return to a level which better reflects its financial status and fundamentals. On the other hand, Özderici REIT is one of the worst financial performing REITs during Sep 2012- Sep 2013; its market value is relatively high. Therefore its market value is expected to decline and return to a level which better reflects its financial status and fundamentals. The findings of this paper would help REIT managers and investors for creating more effective investment strategies. For the management side, rises, falls, and turning points of the fundamental indicators puts into perspective the effects of investment and financing policies created to deal with them. For the investors' side, comparing fundamental and market values provide them to analyse REITs are over or undervalued in the financial market.

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Unemployment Modelled Through $M|G|\infty$ Systems

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Abstract - Using results on the $M|G|\infty$ queue busy period, it is presented an application of this queue system in the unemployment periods parameters and distribution function study.

Keywords - $M | G | \infty$, busy period, unemployment.

1. The Model

In the $M|G|\infty$ queue system

- The customers arrive according to a Poisson process at rate λ
- Receive a service which time length is a positive random variable with distribution function $G(\cdot)$ and mean α
- When they arrive, each one finds immediately an available server
- Each customer service is independent from the other customers' services and from the arrivals process
- The traffic intensity is $\rho = \lambda\alpha$.

It is easy to understand how the $M | G | \infty$ queue can be applied to the unemployment study. Then

- λ is the rate at which occur the firings, supposed to occur according to a Poisson process
- The service time is the time between the worker firing and the moment he/she

finds a new job.

In a queue system a busy period is a period that begins when a customer arrives at the system finding it empty, ends when a customer abandons the system letting it empty and in it there is always at least one customer present. So in a queuing system there is a sequence of idle and busy periods.

In the $M | G | \infty$ queue system the idle periods have an exponential length with mean λ^{-1} .

But the busy period's distribution is much more complicated. In spite of it, it is possible to present some results as it will be seen.

For what interests in this work

- A busy period is a period of unemployment
- An idle period is a period of full employment.

The results that will be presented are on unemployment periods length and their number in a certain time interval.

2. Unemployment Periods Length

Call D the random variable unemployment period length. According to the results known for the $M | G | \infty$ queue busy period length distribution

$$- E[D] = \frac{e^{\rho} - 1}{\lambda} \quad (2.1)$$

whichever is a worker unemployment time length distribution, see (Takács, 1962)

- As for $Var[D]$ depends on the whole unemployment time length distribution probabilistic structure. But Sathe, see (Sathe, 1985), demonstrated that

$$\lambda^{-2} \max \left[e^{2\rho} + e^\rho \rho^2 \gamma_s^2 - 2\rho e^\rho - 1; 0 \right] \leq Var[D] \leq \lambda^{-2} \left[2e^\rho (\gamma_s^2 + 1) (e^\rho - 1 - \rho) - (e^\rho - 1)^2 \right] \quad (2.2),$$

where γ_s the unemployment time length coefficient of variation

- If a worker unemployment time length distribution function is

$$G(t) = \frac{e^{-\rho}}{(1 - e^{-\rho})e^{-\lambda t} + e^{-\rho}}, t \geq 0, \quad (2.3)$$

the D distribution function is

$$D(t) = 1 - (1 - e^{-\rho})e^{-e^{-\rho}\lambda t}, t \geq 0 \quad (2.4),$$

see (Ferreira, 1991)

- If the unemployment time length of a worker is such that

$$G(t) = 1 - \frac{1}{1 - e^{-\rho} + e^{-\rho + \frac{\lambda}{1 - e^{-\rho}} t}}, t \geq 0 \quad (2.5)$$

the D distribution function is

$$D(t) = 1 - e^{-(e^\rho - 1)^{-1} \lambda t}, t \geq 0 \quad (2.6),$$

see (Ferreira, 1995)

- For α and ρ great enough (very intense unemployment conditions) since $G(\cdot)$ is such that for α great enough $G(t) \cong 0, t \geq 0$,

$$D(t) \cong 1 - e^{-\lambda e^{-\rho} t}, t \geq 0 \quad (2.7),$$

see (Ramalhoto and Ferreira, 1994).

Note:

- As for this last result, begin noting that many probability distributions fulfill the condition $G(t) \cong 0, t \geq 0$ for α great enough. The exponential distribution is one example.
- As for the meaning of α and ρ great enough, computations presented in (Ramalhoto and Ferreira, 1994) show that for $\lambda = 1$, after $\rho = 10$ it is reasonable to admit (2.7) for many distributions.

3. Mean Number of Unemployment Periods in a Time Interval

After the renewal processes theory, see (Çınlar, 1975), calling $R(t)$ the mean number of unemployment periods that begin in $[0, t]$, being $t = 0$ the beginning instant of an unemployment period, it is possible to obtain, see (Ferreira, 1995),

$$R(t) = e^{-\lambda \int_0^t [1 - G(v)] dv} + \lambda \int_0^t e^{-\lambda \int_0^u [1 - G(v)] dv} du \quad (3.1)$$

and, consequently,

$$e^{-\rho} (1 + \lambda t) \leq R(t) \leq 1 + \lambda t \quad (3.2),$$

see Ferreira (2004).

Also,

$$A) \quad G(t) = \frac{e^{-\rho}}{(1 - e^{-\rho})e^{-\lambda t} + e^{-\rho}}, t \geq 0$$

$$R(t) = 1 + \lambda e^{-\rho} t \quad (3.3)$$

$$B) \quad G(t) = 1 - \frac{1}{1 - e^{-\rho} + e^{-\rho + \frac{\lambda}{1 - e^{-\rho}} t}}, t \geq 0$$

$$R(t) = e^{-\rho} + (1 - e^{-\rho})^2 + \lambda e^{-\rho} t + e^{-\rho} (1 - e^{-\rho}) e^{\frac{\lambda}{1 - e^{-\rho}} t} \quad (3.4)$$

$$C) \quad G(t) = \begin{cases} 0, & t < \alpha \\ 1, & t \geq \alpha \end{cases}$$

$$R(t) = \begin{cases} 1, & t < \alpha \\ 1 + \lambda e^{-\rho} (t - \alpha), & t \geq \alpha \end{cases} \quad (3.5)$$

D) If the unemployment time length is exponentially distributed

$$e^{-\rho \left(1 - e^{-\frac{t}{\alpha}}\right)} + \lambda e^{-\rho} t \leq R(t) \leq e^{-\rho \left(1 - e^{-\frac{t}{\alpha}}\right)} + \lambda t \quad (3.6)$$

4. Concluding Remarks

So that this model can be applied it is necessary that the firings occur according to a Poisson process at constant rate. It is an hypothesis that must be tested.

Among the results presented, (2.1), (2.2), (2.7) and (3.2) are remarkable for its simplicity and also for requiring only the knowledge of the firings rate λ , the mean unemployment time α , and the unemployment time variance.

The other results are more complex and demand the goodness of fit test for the distributions indicated to the unemployment times.

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Cointegration and Structural Breaks in the EU Sovereign Debt Crisis

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Abstract - First signs of a sovereign debt crisis spread among financial players in the late 2009 as a result of the growing private and government debt levels worldwide. Late 2010, Trichet (then President of the ECB) stated that the sovereign debt crisis in Europe had become systemic. In an established crisis context, it was searched for evidence of structural breaks and cointegration between interest rates and stock market prices. A 13 year time-window was used in six European markets under stress. The results identified significant structural breaks at the end of 2010 and consistently rejected the null hypothesis of no cointegration.

Keywords - Stock Markets Indices; Interest Rates; Structural Breaks; Cointegration; EU Sovereign Debt Crisis

1. Introduction

The strategic positioning of European economies, namely interest rate fluctuations, stock market crises, regional effects of oil prices, regional political developments etc, makes them vulnerable to real and external shocks. In this context, Kurov [18] found that the monetary policy actions in bear market periods that have a strong effect on stocks can be revealing of greater sensitivity to changes in investor sentiment and credit market conditions. Overall, the results showed that the investor sentiment plays a significant role in monetary policy's effect on the stock market. Previous studies (e.g. Baker *et al.* [7]; Kumar and Lee [17] revealed that the investor sentiment predicts cross-section and aggregate stock returns indicating that it moves stock prices and, therefore, affects expected returns. This raises the question of whether the effect of monetary news on stocks is at least partially driven by the influence of FED or ECB policy on investor sentiment.

As a result of the financial crisis, modeling the dynamics of financial markets is gaining more popularity than ever among researchers for both academic and technical reasons. Private and public economic agents take a close interest in the movements of stock market indexes, interest rates, and exchange rates in order to make investment and economic policy decisions.

The most broadly used unit root test used to identify stationarity of the time series studied in the applied econometric literature is the Augmented Dickey Fuller test (henceforth ADF). However, several authors have stated that numerous price time series exhibit a structural change from their usual trend mostly due to significant policy changes. These economic events are caused by economic crises (e.g. changes in institutional arrangements, wars, financial crises, etc.) and have a marked impact on forecasting or analyzing the effect of policy changes in models with constant coefficients. As a result, there was strong evidence that the ADF test is biased towards null of random walk where there is a structural break in a time series. Such finding triggered the publication of numerous papers attempting to estimate structural breaks motivated by the fact that any random shock has a permanent effect on the system.

In the current context of crisis, this study analyzes structural break unit root tests in a 13 year time-window (1999-2011) for six European markets under stress, using the United States of America (US), the United Kingdom (UK) and Germany (GE) as benchmark. Considering the problems generated by structural breaks, two unit root tests were employed to allow for shifts in the relationship between unconditional mean of the stock markets and interest rate, namely: Zivot and Andrews [36] (henceforth ZA) and Lumsdaine and Papell [25] (henceforth LP). The ZA unit root test captures only the most significant structural break in each variable. A new approach to

capture structural breaks was introduced by LP with the argument that a unit root test which identifies two structural breaks is much more robust. LP uses a modified version of the ADF test by incorporating two endogenous breaks. These two tests were chosen because they have three main advantages. Firstly, their properties are easily captured as they are ADF based tests. Secondly, the timing of the structural break is determined endogenously, and lastly, their computational implementation is easily accessible. To confirm the presence of structural breaks detected by ZA and LP tests, this paper also employs the method developed by Bai and Perron [3-6], (henceforth BP). This third test consistently estimates multiple structural changes in time series, their magnitude and the time of the breaks. However, it must be stressed that the consistency of the test depends on the assumption that time series are regime-wise stationary. This implies that breaks and break dates accurate with BP are only statistically reliable when the time series is stationary around a constant or a shifting level. If the time series is nonstationary, BP tests may detect that the time series has structural breaks.

A limitation of the ADF-type endogenous break unit root tests, e.g. ZA and LP tests, is that critical values are derived while assuming no break(s) under the null. Nunes *et al.* [30] and Lee and Strazicich [22-23] showed that this assumption leads to size distortions in the presence of a unit root with one or two breaks. As a result, one might conclude when using the ZA and LP tests that a time series is trend stationary, when, in fact, it is nonstationary with break(s), i.e. spurious rejections might occur. To address this issue, Lee and Strazicich [24] proposed a one-break Lagrange Multiplier (henceforth LM) unit root test as an alternative to the ZA test, while Lee and Strazicich [25] suggest a two-break LM unit root test as a substitute for the LP test. In contrast to the ADF test, the LM unit root test has the advantage that it is unaffected by breaks under the null. These authors proposed an endogenous LM type unit root test which accounts for a change in both the intercept and also in the intercept and slope. The break date is determined by obtaining the minimum LM t-statistic across all possible regressions. More recently, several studies started to apply the LM unit root test with one and two structural breaks to analyze the time series properties of macroeconomic variables (e.g. Chou [12]; Lean and Smyth [20-21]).

Based on the studies cited above, we concluded the first part of the analysis assuming that the break

date is unknown and data-dependent. The distinct tests applied aimed to detect the most important structural breaks in the stock market and the interest rate relationship of all markets under analysis.

Having linked the source of the breaks found with some economic events during the time window under study, it was possible to advance with the second part of the analysis in which the main goal was to explore a possible cointegration relationship between interest rates and stock market prices. Therefore, the Gregory and Hansen [15] regime shift model (henceforth G-H) was used to find evidence of structural regime shifts that could explain the contamination of the severe EU debt crisis. The results identified the most significant structural breaks at the end of 2010 and consistently rejected the null hypothesis of no cointegration. Moreover, they showed that both the regional credit market and stock market have reached a nearly full integration in both pre and post crisis periods.

2. Unit root tests and cointegration under structural breaks

Structural changes or “breaks” appear to affect models based on key economic and financial time series such as output growth, inflation, exchange rates, interest rates and stock returns. This could reflect legislative, institutional or technological changes, shifts in economic policy, or even be due to large macroeconomic shocks such as the doubling or quadrupling oil prices of the past decades. A variety of classical and Bayesian approaches are available to select the appropriate number of breaks in regression models. Their diversity is essentially based on the type of break (e.g. breaks in mean; breaks in the variance; breaks in relationships; single breaks; multiple breaks; continuous breaks and some kind of mixed situations better described by smooth switching models).

The conventional stability and unit root tests are often associated with the concept of “persistence” of innovations or shocks to the economic system. In this context, the debate has been centered on whether shocks to macroeconomic time series have temporary or permanent effects. While Nelson and Plosser [29] suggested that most macroeconomic time series are best characterized by unit root processes implying that shocks to these series are permanent, Perron [32-33] challenged this by providing some evidence that the null hypothesis of a unit root test may be rejected for many macroeconomic time series if we allow for a

one-time shift in the trend function. Thus, it would be preferable to describe and characterize many macroeconomic time series as having temporary shocks (stationary) around a broken deterministic trend function. In essence, if there is a break in a deterministic trend, then the unit root tests (which implicitly assume the deterministic trend as correctly specified) will incorrectly conclude that there is a unit root, when, in fact, there is not. The policy effects can vary depending on both the nature of the non-stationarity associated with the macroeconomic variables, and the econometric modeling. Since the main focus of this paper is on the demand for money (interest rate) and stock markets, we could state that this relationship was subject to serious parameter instabilities (especially during periods of economic crises, institutional arrangements, wars, financial crises, etc.), which had a strong impact on capturing of policy changes effects. Many aggregated economic time series (consumption, income, interest rates, money, stock prices, etc.) display strong persistence with sizable fluctuations in both mean and variance over time. The classical approach to hypothesis testing is based on the assumption that the first two population moments (unconditional) are constant over time (covariance stationary) and hence unit roots pose a challenge for the usual econometric procedures.

Cointegration theory is very dependent on the existence of unit roots and is focused on the (long-run) equilibrium relationships. This relation, known as the cointegration relationship between the economic variables, shapes some economic equilibrium. It is well-known that some economic variables should not move freely or independently of each other; thus these connections persuade some econometricians to test for cointegration relationships within unit root tests by unconventional methods. Notwithstanding, an important limitation associated with the ADF test is the absence of any structural break effects. Dealing with finite samples, the standard tests for unit root (non-stationarity hypothesis test) are biased toward accepting the null hypothesis when the data-generating process is, in fact, stationary. Several other approaches to studying the estimated parameters stability are widely presented in the literature. Different theories on phases of economic development and growth postulate that an economic relationship changes over time. In the last three decades, the impact of structural changes on the result of econometric models has been of great concern. In this context, Perron [32] argued that if a structural break in a series is ignored, unit root tests

can be erroneous in rejecting the null hypothesis; on the other hand, if there is a break in the deterministic trend, unit root tests will mistakenly conclude that there is a unit root when, in fact, there is not. In short, an undetected structural break in a time series may lead to rejecting of the null hypothesis of unit roots.

Basically, there are two points of view on structural change modeling. The first assumes the structural change modeling as a known break point, and the other as unknown break points. Modeling structural changes by setting the break points in advance allows potential break-dates to be identified *ex ante* and the parameter constancy to be tested via the inclusion of interactive-dummy variables into the econometric models. In such cases, the hypothesis of a structural break can be tested by applying standard tests of significance with respect to estimated coefficients of these dummy variables. However this kind of test was subject to severe criticism due to the arbitrary nature of selected break-dates and the inability to identify when exactly the structural breaks had occurred. Therefore, another approach was proposed to model the structural breaks by assuming that the break date(s) are *ex ante* unknown. Each approach had several applications in the literature and presented different implications. A large number of papers derived asymptotic distributions for the null hypotheses of the structural change tests using different econometric approaches. The best known works in the enormous literature produced hitherto include Perron [32], Zivot and Andrews [36], Banerjee *et al.* [8] and Gregory and Hansen [15]. All these papers address unknown structural breaks procedures.

In this study, the authors carried out several tests with different variants in order to capture different structural breaks approaches in the relationship between stock market prices and interest rates. The estimation of the two breaks is performed simultaneously in both the time trend and the intercept. To this end, the following tests were performed and compared.

2. Data analysis

2.1. Zivot and Andrews test

The ZA is the most widely adopted endogenous one-break test. Building on Perron's exogenous break test, it only considers a break under the alternative but not under the null when carrying out unit root testing.

Of the three types of ADF test proposed by Perron, the authors applied the one in which the H_a is a break in the intercept and in the slope coefficient on the trend at an unknown breakpoint. Estimating by OLS:

$$\Delta y_t = \alpha + \theta_1 D_{1t}(\lambda) + \beta t + \theta_2 D_{2t}(\lambda) + \gamma y_{t-1} + \sum_{i=1}^p \delta_i \Delta y_{t-i} + u_t \quad (1)$$

Thus many sequential regressions are computed where $D1t(\lambda)$ and $D2t(\lambda)$ change each time. The t-test statistic (concerning $\gamma=0$) is also computed in each regression. Zivot and Andrews [36] re-examined the Nelson-Plosser dataset and found a number of problems with the unit-root tests employed; thereafter, the literature documented an exhaustive list of empirical studies which employed this test (e.g. Ranganathan and Ananthakumar [34]).

2.2. Lumsdaine and Papell test

Considering only one endogenous break may not be sufficient and lead to a loss of information, particularly when there is in fact more than one break. Lumsdaine and Papell [25] introduced a new approach to capture structural break with the argument that a unit root test that shows two structural breaks is much more robust. They contently reverse conclusions of many studies which fail to reject the null with the presence of one break. The LP test extends the tests for two structural breaks; models which consider two breaks in the intercept are known as AA, and those with two breaks in the intercept and slope of the trend are designated CC (also known as “crash-model”). The LP CC model can be specified as

$$\begin{cases} H_0 : x_t = c + x_{t-1} + \varepsilon_{1t} \\ H_A : x_t = c + \beta t + d_1 D_{1t} + d_2 D_{2t} + \varepsilon_{2t} \end{cases} \quad (2)$$

where $D_{1t}=1$ for $t > TB1 + 1$ and 0 otherwise, $D_{2t}=1$ for $t > TB2 + 1$ and 0 otherwise and $TB1$ and $TB2$ are the dates corresponding to the break points (mean shifts). The testing strategy employed in LP is similar to ZA, which implies following the ADF regression tests. The LP procedure generates a final t-statistic which is the greatest in absolute value (the most favorable for rejecting the null hypothesis). Consequently, the estimated breakpoints ($TB1$ and $TB2$) correspond to the minimum t-statistic.

The crucial effect of the trend property of the variables for the structural break estimation was

recognized by several authors. Ben-David and Papell [11] showed that the test power was affected by the inclusion of a trend variable where there is no upward trend in data. Otherwise it is inconvenient since the model may not capture some important patterns of the data without trend.

With this subjacent, Ben-David and Papell [10] and Ben-David *et al.* [9], used tests for a unit root against the alternative of broken trend-stationarity allowing for one and respectively two endogenous break points. This procedure, developed by Zivot and Andrews [36] and Lumsdaine and Papell [25], rejects the unit root null in favor of broken trend-stationarity for long-term US GDP. In all cases, the estimated breaks coincide with the Great Depression and/or World War II.

In accordance with this different conception of the distinct unit root tests allowing structural breaks, some more recent papers have combined several approaches to efficiently capture any sign of structural change (e.g. Marashdeh and Shrestha [27]; Ranganathan and Ananthakumar [37]).

2.3. Bai and Perron test

In The Bai and Perron [3-6] methodology to estimate and infer multiple mean breaks models based on dynamic linear regression models. They estimate the unknown break points given T observations by the least squares principle, and provide general consistency and asymptotic distribution results under fairly weak conditions, allowing for serial correlation and heteroskedasticity. In Bai *et al.* [2-3] the authors developed a sequential procedure to test the null hypothesis of one structural change versus the alternative of one plus one break in a single regression model. Thus, the pure structural change model is considered in several studies and is defined as $j = 1, \dots, m + 1$, $t_0=0$ and $t_{m+1} = T$. The dependent variable is subject to m breaks and c_j is the mean of the series, r_t for each regime j. The model allows for general serial correlation and heterogeneity of the residuals across segments. The pure structural change model can be estimated as follows. For each m-partition, the least squares estimate of c_j is obtained by minimizing the sum of squared residuals, where minimization occurs over all possible m-partitions.

Several authors have recently implemented the BP test for multiple break dates (e.g. Yu and Zivot [35]; Dey and Wang [13]).

2.4. Lee and Strazicich test

The first part of this empirical analysis ends with the LS test also known as LM test due to Langlege multipliers. The main advantage over previous tests is that they are not affected by structural breaks under the null hypothesis because the critical values of the ADF-type endogenous break unit root tests (such as ZA and LP) were derived while assuming no break(s) under the null. The test employed in this paper (model A, known as the “crash model”) could be briefly described considering: $Z_t = [1, t, D_{1t}, D_{2t}]'$ where $D_{jt} = t - T_{BJ}$ for $t > T_{BJ} + 1, j = 1, 2$ and 0 otherwise. Consequently, it could be evidenced that DGP incorporated breaks under the null ($\beta = 1$) and alternative hypothesis ($\beta > 1$) as already noted. Making the value of β uncertain, we could rewrite the both hypotheses as

$$\begin{cases} H_0: y_t = \mu_0 + d_1 B_{1t} + d_2 B_{2t} + y_{t-1} + v_{1t}, \\ H_A: y_t = \mu_1 + \gamma_t + d_1 D_{1t} + d_2 D_{2t} + v_{2t}. \end{cases} \quad (3)$$

Where v_{1t} and v_{2t} are stationary error terms. The LM unit root test statistic is obtained from one specific regression. Arghyrou [1] designed this component as the LM score principle. The LM test statistic is determined by testing the unit root null hypothesis that The LM unit root test determines the time location of the two endogenous breaks, whereas represent each combination of break points] using a grid search as follows: The break time should minimize this statistic.

Critical values for a single break and two-break cases are tabulated from Lee and Strazicich [22-23] respectively. Another approach to searching for unit roots with breaks by allowing nonstationarity in the alternative hypothesis is adopted in several studies following the Lee and Strazicich procedure testing.

2.5. Gregory and Hansen test

Gregory and Hansen [15] used a residual-based test for cointegration in a multivariate time series with regime shifts; they proposed the ADF tests, which are

intended to test the null hypothesis of no cointegration against the alternative of cointegration in the presence of a possible regime shift. This test examines whether there has been a one-time shift in the cointegration relationship by detecting any cointegration in the possible presence of such breaks and presents four different approaches. A single-equation regression with structural change starting with the standard model of cointegration (model 1):

$$y_{1t} = \mu + \alpha^T y_{2T} + \varepsilon_t, t = 1, \dots, n \quad (4)$$

In this case, if there is stated a long-run relationship, μ and α are necessarily defined as time-invariant. The G-H approach consider that this long-run relationship could shift to a new long run relationship by introducing an unknown shifting point that is reflected in changes in the intercept μ and/or changes to the slope α defining Model 2 and 3 in the following form (model 2 - level shift (C)):

$$y_{1t} = \mu_1 + \mu_2 \alpha^T y_{2T} + \varepsilon_t, t = 1, \dots, n \quad (5)$$

This model represents a level shift in the cointegration relationship, and is modeled as a change in the intercept μ variable μ_1 and μ_2 represent the intercept before and at the time of the shift. In order to account for the structural change, the authors introduced the dummy variable definition:

$$\varphi_{t\tau} = \begin{cases} 0 & \text{if } t \leq [n\tau], \\ 1 & \text{if } t > (n\tau). \end{cases} \quad (6)$$

where the unknown parameter represents the relative timing of the change point and $[.]$ denotes integer part. Model 3: Level Shift with Trend (C/T):

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \beta_t + \alpha^T y_{2t} + \varepsilon_t, t = 1, \dots, n \quad (7)$$

In this model, the authors extended the possibilities by introducing a time trend β_t into the level shift model. And finally, the model 4 - Regime Shift (C/S):

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha^T y_{2t} + \alpha^T y_{2t} \varphi_{t\tau} + \varepsilon_t, t = 1, \dots, n \quad (8)$$

The last model integrates a shift in the slope vector, which permits the equilibrium relation to rotate and a parallel shift. For this case, α_1 is the cointegrating slope coefficient before the regime shift, and α_2 is the change in the slope coefficients, whereas $(\alpha_1 + \alpha_2)$

is the cointegrating slope coefficient after the regime shift.

Concerning the software, all routines applied were run with WinRATS Pro 8.0 and are available in Estima website.

3. Dataset

The variables under study cover daily data from April 1999 to December 2012 and are expressed in levels after a logarithmization procedure. For instance, the stock market price (Pi), the (Y1) and (Y10) are the government bond yield and the interest rates at 1 year and 10 years, respectively. All the three variables have been collected for each selected market (Portugal (PT), Spain (SP), France (FR), Ireland (IR), Italy (IT) and Greece (GR)) from the European countries under most stress in the recent years. We also included the GE, UK and US markets as a benchmark. All data have been collected and are available online from Datastream database.

4. Results and Discussion

Table 1 – Unit-root tests (variable PI). (**) indicates critical values at 1%. The optimal lag length was determined by SBC.

Variable	ZA ^a		BP		LP ^a		IS (1 break)		IS (2 breaks)		
	TB1	Statistic	TB1	TB2	TB1	Statistic	TB1	Statistic	TB1	TB2	Statistic
PI_FR	Sep-03	-3.203	Aug-01	Oct-08	Sep-03	-3.203	Oct-08	-2.232	Sep-01	Oct-08	-2.322
PI_GE	Sep-08	-3.012	May-02	Feb-08	Sep-08	-3.012	Aug-02	-2.209	Aug-02	Aug-11	-2.288
PI_GR	Nov-05	-11.216 **	Feb-00	Nov-05	Nov-05	-11.216 **	Nov-05	-33.488	Sep-00	Nov-05	-33.674
PI_IR	Aug-04	-3.153	Jul-05	Sep-08	Aug-04	-3.153	Oct-08	-1.637	Oct-08	May-10	-1.664
PI_IT	May-08	-4.233	Nov-04	Jul-08	May-08	-4.233	Sep-08	-1.497	Mar-07	Sep-08	-1.519
PI_PT	Aug-03	-2.631	May-01	Aug-11	Aug-03	-2.631	Feb-06	-1.356	Feb-06	Jul-11	-1.384
PI_SP	Aug-04	-3.012	Dec-05	Oct-08	Aug-04	-3.012	Aug-11	-1.871	Sep-04	Aug-11	-1.907
PI_UK	May-08	-2.777	Aug-01	Aug-08	May-08	-2.777	Jul-02	-2.277	Jul-02	Oct-08	-2.382
PI_US	May-03	-3.217	May-02	Jul-05	May-03	-2.217	Sep-01	-2.004	Sep-01	Jan-03	-2.043

Notes:

^a Both Intercept and Trend

Table 2 - Unit-root tests (variable Y1(**) indicates critical values at 1%. The optimal lag length was determined by SBC.

Variable	ZA ^a		BP		LP ^a		IS (1 break)		IS (2 breaks)		
	TB1	Statistic	TB1	TB2	TB1	Statistic	TB1	Statistic	TB1	TB2	Statistic
Y1_FR	Sep-07	-16.770 **	Sep-07	Jun-12	Sep-07	-16.770 **	Sep-07	-44.846	Dec-04	Sep-07	-45.173
Y1_GE	Feb-06	-2.048	Sep-03	Apr-08	Feb-06	-2.048	Feb-02	-4.271	Jul-01	Nov-02	-4.553
Y1_GR	Dec-10	-9.454 **	Jan-01	Apr-12	Dec-10	-9.454 **	Aug-11	-29.466	Aug-01	Aug-11	-29.893
Y1_IR	Sep-07	-16.770 **	Sep-07	Jun-12	Sep-07	-16.770 **	Sep-07	-44.846	Dec-04	Sep-07	-45.173
Y1_IT	Dec-10	-13.682 **	May-09	Jul-12	Dec-10	-13.682 **	Aug-11	-34.480	Mar-06	Aug-11	-34.730
Y1_PT	Sep-07	-13.643 **	Sep-07	Jun-12	Sep-07	-13.643 **	Sep-07	-34.106	Sep-07	Aug-11	-34.279
Y1_SP	Sep-07	-16.308 **	Sep-07	Jun-12	Sep-07	-16.308 **	Sep-07	-40.038	Sep-07	Aug-11	-40.278
Y1_UK	Feb-06	-2.048	Sep-03	Apr-08	Feb-06	-2.048	Feb-02	-4.271	Jul-01	Nov-02	-4.553
Y1_US	Feb-06	-2.048	Sep-03	Apr-08	Feb-06	-2.048	Feb-02	-4.271	Jul-01	Nov-02	-4.553

Notes:

^a Both Intercept and Trend

Table 3 - Unit-root tests (variable Y10). (**) indicates critical values at 1%. The optimal lag length was determined by SBC.

The authors ran a full battery of unit-root tests in line with similar studies (e.g. Pahlavani *et al.*, [31]; Narayan and Smyth [28]; and more recently Maican *et al.* [26]. Thus, readers can make their own decision on mean reversion for a particular series, rather than only the best results with no mention of the number and specifications of tests tried. The results of the unit root testing procedures are presented in the tables below, starting with the price index (PI variable) (Table 1) which was implemented using both the intercept and trend options (ZA and LP tests). The corresponding time of the structural break (TB1 and TB2) for each variable is also shown in each test. For the PI variable in the established crisis period, the ZA and the LP tests fail to reject the null hypothesis of a unit-root at the 1 percent significance level in all countries except Greece. This means that the price index series of the remaining countries are non-stationary. For the 1 year interest rate (variable Y1) series (Table 2), both ZA and LP tests fail to reject the null hypothesis of a unit-root at 1 percent significance level in three countries – GE, US and UK.

Variable	ZA ^a		BP		LP ^a		IS (1 break)		IS (2 breaks)		
	TB1	Statistic	TB1	TB2	TB1	Statistic	TB1	Statistic	TB1	TB2	Statistic
Y10_FR	Dec-10	-18.352 **	Oct-09	Mar-11	Dec-10	-18.352 **	Mar-11	-55.576	May-07	Mar-11	-56.203
Y10_GE	Nov-10	-17.990 **	Jul-01	Nov-10	Nov-10	-17.990 **	Oct-10	-44.003	Dec-06	Oct-10	-44.313
Y10_GR	Dec-10	-18.223 **	Dec-10	Apr-11	Dec-10	-18.223 **	May-10	-55.352	Jun-05	May-10	-55.450
Y10_IR	May-03	-21.050 **	Feb-03	Mar-03	May-03	-21.050 **	Mar-02	-58.377	Mar-02	Apr-08	-58.534
Y10_IT	Nov-10	-20.006 **	May-11	May-11	Nov-10	-20.006 **	Mar-11	-60.285	Oct-03	Mar-11	-61.385
Y10_PT	Dec-10	-17.942 **	Jan-03	Mar-11	Dec-10	-17.942 **	Mar-11	-57.906	Aug-03	Mar-11	-57.984
Y10_SP	Dec-10	-19.066 **	Feb-04	Mar-11	Dec-10	-19.066 **	Mar-11	-57.571	Dec-03	Mar-11	-57.631
Y10_UK	Nov-10	-19.551 **	Nov-10	Jul-11	Nov-10	-19.551 **	Nov-10	-55.155	Mar-09	Nov-10	-55.350
Y10_US	Nov-10	-19.195 **	Aug-09	Nov-10	Nov-10	-19.195 **	Sep-10	-46.077	Sep-00	Nov-10	-47.352

Notes:

^a Both Intercept and Trend

The analyses of the 10 year interest rate (variable Y10) series reveal that all countries are stationary (Table 3). In light of these results, the cointegration hypothesis was tested with the PI variable of all European countries (except GR) against the Y1 variable of GE (Table 4). The three most economically developed countries (GE, UK and US) revealed a similar pattern in the interest rate series, which could suggest a strong contagious phenomenon between them. The structural break points defined through the different tests consistently coincide with important dates through the time-window analyzed, with special emphasis on the US. According to Lee *et al.* [24] and citing Ghoshray and Johnson [14], by allowing for the possibility of a break in the null, the LM test can be considered genuine evidence of stationarity; this means that we can rely more on the break points calculated by the minimum LM test than those estimated by the remaining tests. This could lead to size distortion which increases with the magnitude of the break; this does not occur with the LM test as a different detrending method is used. Following these assumptions and focusing on the structural break points identified by the LM test (two breaks), all dates related to 2001-2003 reveal the economic impact of the September 11 attacks on the US, namely in New York City and Washington D.C. in 2001 and the repercussions in the following years with the concerted military action against Iraq.

Further, a mild recession in 2001, caused partly by the bursting of the dot-com bubble, prompted the Fed (led by Chairman Alan Greenspan) to lower the target federal funds rate from 6% to 1.75% in an effort to stimulate employment. The Fed kept interest rates low for the next two years; it dropped to just 1% - the lowest rate in 50 years - in summer 2003, and only rose again one year later. The Fed's shift to this historically low interest rate coincided with the mid-2003 acceleration of housing prices. Although the outlook for the euro area's financial system has improved since late 2003, some potential sources of risk and

vulnerability remain. Within the financial system, pockets of fragility may still exist notably in the European banking sector. By late 2003, the US was in the midst of the most serious world economic setback, originated by the credit boom (interest rates were at a 50-year-low and mortgage credit stood at an all-time high) and the housing bubble (prices had exceeded all previous levels).

The first half of 2004 was characterized by a trend towards gradual economic recovery. However, there were still some obstacles hindering the growth of the world economy; for example, a rise in the price of oil per barrel to record high contributed to raise expectations in the major economic areas. In the US, 1.2 million new jobs were created, and core inflation rose from 1.1% to 1.9%, leading the Federal Reserve to raise interest rates by 25 basis points to 1.25%. However, the European Central Bank kept the interest rate on the main refinancing operations at 2%. The Nasdaq rose 2.22% and the Dow Jones and S&P 500 showed variations of 0.18% and 2.60%. In the Eurozone, the Paris CAC 40 and IBEX 35 went up 4.92% and 4.41%, while the DAX in Frankfurt rose 2.64%.

During 2005, major equity markets continued their upward trend and the longer term interest rates declined.

As a result of concerns about the potential inflationary consequences of the ample liquidity supply and possible lagged effects of the sharp rise in energy prices on price and wage setting, the ECB raised interest rates by 25 basis points in early December 2005. The marked depreciation of the euro against the dollar from May 2005 could have also played a role. In the run-up to this decision, the ECB had considerably stepped up its use of moral suasion to signal its readiness to raise interest rates "at any time". Despite this move, the monetary policy remained accommodated. This partly offset the easing of overall monetary conditions due to the weakening

of the euro; the ECB had taken this step in an attempt to bring short-term rates to a neutral position, as the United States Federal Reserve had done since July 2004.

Meanwhile, when the downturn in housing prices finally began in 2006, everyone had difficulty repaying their mortgages as home equity loans shrank. Subprime borrowers were, by definition, more prone to default on their mortgages than the average person. In addition, they were more likely to be poor and unemployed so had painfully few alternatives to defaulting. The resulting wave of subprime foreclosures fueled the aforementioned downward spiral of prices, as it prompted a glut in housing supply and a contraction of housing demand. The tendency of increasing prices (to enable increased subprime lending) was another dangerous feedback loop of the housing bubble. As housing prices rose, banks became more inclined to increase subprime lending, which in turn spurred greater housing demand, thereby accelerating the price increase. While such cycles seemed to enable the bubble to inflate itself, they still depended on adherence to the irrational belief that housing prices would rise indefinitely. Bankers who allowed rising prices to overshadow the risks of subprime lending did so in this belief. Mimicking and reinforcing homebuyers' representativeness heuristic (i.e. the belief that recent trends would continue unabated), the behavior of such bankers further challenges the assumed rationality of key economic actors.

By 2007, more than just a few farsighted economists were noting that the unprecedented rise in housing prices might be an unsustainable bubble (though most still underestimated the bubble's economic significance). Having plateaued in 2006, housing prices in 2007 stood on the edge of a precipice. They plummeted from the second quarter of that year until the first quarter of 2009, and fell 5% every three months i.e. faster than they had climbed. Housing prices continued to decline more gradually after 2009, sinking steadily through 2012 when they approached the pre-bubble, century-long average.

In 2008, developments took a turn for the worse, and the growth slowdown became acuter. In early 2009, the conclusion was that this would be a deeper recession than the average of "Big Five" (those in Spain, 1977; Norway, 1987; Finland, 1991; Sweden, 1991 and Japan, 1992). The conjuncture of elements is illustrative of the two channels of contagion: cross-

linkages and common shocks. There can be no doubt that the US financial crisis of 2007 spilled over into other markets through direct linkages. For example, German and Japanese financial institutions sought more attractive returns in the US subprime market. Due to the fact that profit opportunities in domestic real estate were limited at best and dismal at worst. Indeed, in hindsight, it became evident that many financial institutions outside the US had considerable exposure to the US subprime market. Similarly, the governments of emerging markets had experienced stress, although of mid-2009 sovereign credit spreads had narrowed substantially in the wake of massive support from rich countries for the IMF fund. European banks began to face liquidity problems after August 2007, and German banks continued to lend heavily to peripheral borrowers in the mistaken belief that peripheral countries were a safe outlet. Net exposure rose substantially in 2008. Speculators focused on Greek public debt on account of the country's large and entrenched current account deficit as well as because of the small size of the market in Greek public bonds. Greece was potentially the start of speculative attacks on other peripheral countries – and even on countries beyond the Eurozone, such as the UK – that faced expanding public debt.

Greece thus found itself in a very difficult position in early 2010 and imposed cuts and raised taxes in order to pay high interest rates to buyers of its public debt. The country was able to access markets in January and March 2010, but the rate of interest was high on both occasions - well in excess of 6 percent. On 2 May 2010, the EU announced a support package for Greece, put together in conjunction with the IMF fund. Lapavistas [19] documented that the sovereign debt crisis that broke out in Greece at the end of 2009 was fundamentally due to the precarious integration of peripheral countries in the Eurozone. Its immediate causes, however, lie with the crisis of 2007-9. The result in the Eurozone was a sovereign debt crisis, exacerbated by the structural weaknesses of monetary union. Meanwhile, with the global economy likely to perform indifferently in 2010-11 and given the high regional integration of European economies, exports were unlikely to prove the engine of growth for Europe as a whole. The austerity policy ran the risk of resulting in a major recession.

There was a sharp drop in stock prices in August 2011 in markets across the US, Middle East, Europe and Asia. This was due to fears of contagion of the European sovereign debt crisis to Spain and Italy, as

well as concerns over France's current AAA rating, as well as slow economic growth in the United States and the downgrading of its credit rating. Severe volatility of stock market indexes continued for the rest of the year. In April, the S&P rating agency lowered the US credit rating to 'negative' from 'stable'. Most developments in global financial markets between early September and the beginning of December were driven by news on the euro area sovereign debt crisis. In the midst of evaluation downgrades and political uncertainty, market participants demanded higher yields on Italian and Spanish -government debt. Meanwhile, difficulties in meeting fiscal targets in a recessionary environment weighed on prices for Greek and Portuguese sovereign bonds.

These are but a few insights into the dates of structural breaks given in Tables 1 to 3. The crisis in the different financial markets (e.g. credit, debt, derivatives, property and equity) are just the tip of the iceberg of a severe financial crisis of huge proportions worldwide. In Europe, the sovereign debt crisis should be considered as spreading across a broad front from the instability of each country, leading to an employment crisis and in turn a social crisis, and eventually turning into a political crisis. The contagion phenomenon is quite evident in the results; the US/UK/GE trio are often the "head" of the problem followed by the remaining emergent markets (IR, FR, SP, PT and IT). The Greek case is not discussed further in this study due to the deep crisis in which the country is submerged. This trend can be observed in both the PI and the Y1 variables (Tables 1 and 2).

The cointegration hypothesis was tested by performing the relationship between the stock market prices and interest rates (Table 4). Bivariate cointegration was considered for this purpose, allowing for structural break tests between the price indexes of each stock market and the interest rate at 1 year of European market benchmark (GE).

This test detects regime-shift as well as stable cointegration relationships. Thus, the rejection of the null hypothesis does not entangle the instability of the cointegration relationship. The differentiation of these situations is made using stationarity tests and with the structural breaks previously presented. It is possible to infer the US influence on the European equity markets through the timing of structural breaks (Tables 1 to 3) and because both variables show prolonged upward and downward movements (resumed in Table 4).

Table 4 - Cointegration results

Results of the test for Cointegration with Structural Breaks				
Variables PI(Market) and Y1 (GE):	Cointegration models	Minimum T-Statistic	1% Critical Values	5% Critical Values
FR	C	-3.244	-5.130	-4.610
	CT	-3.515	-5.450	-4.990
	CS	-3.410	-5.470	-4.950
GE	C	-4.253	-5.130	-4.610
	CT	-4.079	-5.450	-4.990
	CS	-3.119	-5.470	-4.950
IR	C	-4.204	-5.130	-4.610
	CT	-3.508	-5.450	-4.990
	CS	-3.177	-5.470	-4.950
IT	C	-5.003	-5.130	-4.610
	CT	-4.753	-5.450	-4.990
	CS	-4.667	-5.470	-4.950
PT	C	-3.864	-5.130	-4.610
	CT	-3.494	-5.450	-4.990
	CS	-2.819	-5.470	-4.950
SP	C	-4.306	-5.130	-4.610
	CT	-3.776	-5.450	-4.990
	CS	-3.506	-5.470	-4.950
UK	C	-4.493	-5.130	-4.610
	CT	-3.671	-5.450	-4.990
	CS	-2.647	-5.470	-4.950

Note: The critical values from Gregory-Hansen (1996a)

5. Conclusion

This paper explored possible structural changes in the stock market and interest rate variables as well as the relationship between them. With this purpose, first the ZA, the LP and the LS (1 break) were employed to test for the presence of structural breaks with unknown timing in the individual series; multiple structural breaks were then detected with BP and LM (2 breaks) tests. Secondly, the G-H test was used for cointegration between stock market prices and the interest rates for the European markets under stress and infected by the vast sovereign debt crisis since 2003. The results effectively revealed that there was a relationship between the two variables in all analyzed countries which implies important economic repercussions. Conducting monetary policy by targeting a monetary aggregate requires reliable quantitative estimates of the demand for money determined by the interest rate behavior.

It has become clear that today's equity markets around the world are no longer national markets. Stock indexes in both the US and worldwide have dropped dramatically; investors and stock traders in different markets around the world wait for new announcements given by listed companies and adjust their portfolio according to news from other markets. This phenomenon revealed how international and

interconnected the stock markets have become. While these interactions between stock markets and interest rates have been approved, more critical questions arise for both economic researchers and investors: Are these linkages only important in the short run or are there even long-run equilibrium relationships between financial markets? Equilibrium that allows investors and researchers to use information about one market to predict the performance of another in the long run? It is important for both financial, economic theory and practical asset management to know whether financial markets are cointegrated or not.

An examination of the crisis reveals that economies are already quite integrated, and this resulted in its spread from the US to the rest of the world.

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The Board's Attributes and Their Influence in Company's Performance.

A Review over the Recent Literature

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Abstract - This article provides a discussion supported on the review of the recent literature that analyses the relationship between board's attributes and the company performance. Furthermore, we discuss the methodology used and identify its limitations. Finally, we present some problems to solve these limitations and show other interesting topics for future research.

Keywords - Board's attributes; board's characteristics; company performance; corporate governance; boards of directors.

1. Introduction

The beginning of the twenty-first century started with some scandals in important world companies, like the examples of Enron and WorldCom, among many other situations. In general, the stock prices of these companies were very high and suddenly they have fallen down.

As said by Berk & DeMarzo (2007) the reasons behind these bankruptcies are associated with fraud that derived from the manipulation of accounting statements. These situations impose some questions like the following one: Why the board of directors did not do anything?

Good governance increases the value of the firm. However, bad governance has a high opportunity cost.

Corporate governance is the system by which companies are directed and controlled in order to prevent fraud. At the same time, this topic is about possible conflicts of interests between the different stakeholders of a company. One of the most known conflicts of interests is between the managers and the investors which result from the separation between ownership and control.

In order to align these interests, some types of incentives exist for cases of good behavior and punishments for the cases of bad behavior. The owning of stocks of the company is an example of incentive. The fire of a manager for poor performance can be presented as an example of punishment.

According to Berk & DeMarzo (2007) there are three types of directors: inside, gray and outside. Inside directors are for example the employees who have a direct relationship with the firm. Gray directors are for example the bankers who have a business relationship with the firm. Finally, outside directors are all the other directors.

One topic that is frequently studied by researchers is related with the study of the best type of directors. Weisbach (1988) study proved that there is a more powerful relationship between prior performances and the probability of managers to be fired if the board is composed in majority by outside directors. However, this topic is very complex and very difficult to explain because there are a lot of other aspects that may affect the performance of the companies.

Another topic that is very commonly analyzed about boards is the influence of their size on the company's performance. Yermack (1996) argued that board size is inversely related with firm value. He used a sample of 452 large U.S. industrial corporations to prove that.

2. Board of Directors' Theoretical Perspectives

In general, there are four main views related to the functions the board of directors should undertake

(Zahra & Pearce II (1989)):

- legalistic perspective,
- resource dependence,
- class hegemony,
- agency theory.

These perspectives have a lot of differences among them, for example in terms of the board characteristics that can influence the company performance. Moreover, every perspective considers a different role taken by the board. Even the theoretical origins are very distinct. For example, the agency theory derives from the area of economics and finance and the “legalistic perspective” proceeds from corporate law.

The first perspective - the legalistic - says that boards can influence the performance of the companies by doing their legally mandated responsibilities. This theory says that the board is responsible for selecting the CEO and monitoring its own performance. In this perspective, there is no interference by the board in the day-to-day operations. Related to the attributes that are relevant to the director’s performance, this perspective emphasizes four attributes: board composition, characteristics, structure and process.

The second perspective - “resource dependence” - argues that the board can help the firm regarding its general environment. According to Zahra & Pearce II (1989), this approach also takes into consideration the fact that boards can provide favorable interorganizational relationships. Moreover, this perspective includes another aspect: the strategy, which gives a wider view compared to the legalistic perspective.

Thirdly, there is the perspective related to “class hegemony” that in general is closer to the Marxist sociology. This perspective claims that boards are a way to keep the actual capitalist elite power. At the same time, according to this perspective, the CEO has much power and it can minimize the power of the board.

Finally, the agency theory perspective considers the board as the ultimate system of corporate control. This theory considers that with too much liberty the executives will have an incentive to pursue their own

objectives, which can be different from the objectives of the shareholders.

One important difference between agency theorists and class hegemony academics is that the first uses in general market measures and the second uses mainly accounting measures.

3. The Board’s Attributes and Their Influence in the Company Performance

Taking into consideration the four theoretical perspectives analysed before there are four main board attributes that influence the company performance:

- composition,
- characteristics,
- structure,
- process.

As said by Zahra & Pearce II (1989) these four attributes are tremendously correlated and do not show the entire picture about the boards of directors. However, these four attributes represent an important part of the research that is made about the relationship between the boards and the company performance.

According to Zahra & Pearce II (1989) the board composition attribute incorporates the different types of directors and the size of the board. In the case of characteristics, they integrate the director’s background and its personality. Thirdly, the board structure attribute consider for example the types of committees and the sharing of information among them. Finally, the process attribute is about the ways the board makes its deliberations.

Accordingly, the objective of this research is to discuss the recent literature developments in terms of the relationship between the boards of director’s attributes and the company performance.

In order to achieve this objective a group of well-known literature databases was used in order to find the most relevant articles, namely: Web of Science, Scopus, B-on and Proquest. The results obtained present 15 articles of major interest to analyse and to discuss.

The analysis among the various articles involved the comparison of the following aspects (table 1): dimensions that are analyzed, organization performance criteria, control variables, sample, analytical approaches and major findings.

In terms of the dimensions that are analyzed (table 1), most of the articles try to explain the impact of board size in the company performance (in this case 12 of the total number of articles). The second most analysed dimension is the board composition (with 6 articles). Other topic of greater attention is the board independence (with a total of 5 articles).

Now considering the organization performance criteria (dependent variable) the most commonly used measure is the ROA (return on assets) that appears in 7 articles. Others commonly used measures of performance are ROE and Tobin's Q.

In the majority of the cases the analytical approach that is used is the regression complemented with Pearson correlations. However, there are some articles that use more powerful methods, such as two-stage least square or generalized method of moments.

With the application of the regression most of the authors choose to include control variables in the regression model. The majority decided to control the size of the firm using the natural log of assets. Some had used a ratio to control the effect of leverage dividing the total debt by the total assets.

In terms of the sample used in the studies the majority of the authors appealed to companies from a single country and that were publicly listed.

Furthermore, the major findings showed that smaller boards and more independent boards are in general good for the company's performance. However, we need to be aware that not all the articles achieve these results, what means that there are contradictions when the results are compared.

4. Discussion

As is common with the majority of the empirical studies in corporate governance there are several econometric problems. The most relevant problems were identified by Börsch-Supan & Köke (2002) as follows: endogenous variables considered wrongly as exogenous variables; the use of a convenience sample; some of the variables have large errors and some of the databases have a lot of errors.

Firstly, in order to avoid the problem of endogeneity Börsch-Supan & Köke (2002) recommend to use panel data and at the same time to take into consideration the unobserved firm characteristics. Regardless, to the articles analyzed not all had used panel data what can be a problem in order to validate the results. Moreover, not all had considered in careful way the unobserved part of the model.

Secondly, the sample selection bias also occurs in the majority of the articles, because the samples were composed only by listed companies. We have to remember that in most of the cases the listed companies have good performances which will affect the dependent variable of the model, normally a measure of performance.

Thirdly, Börsch-Supan & Köke (2002) suggest that all the studies should include data about shareholder type, debt structure, composition, market power and takeover activity. The analysis of the literature showed that the majority of the regressions do not include the market power neither the takeover activity factors. The other three were in general included in the models.

Our analysis also detected that a great part of the studies involved data from a single country confirming the scarcity of multi-country level studies.

Moreover, there is an excessive focus in the analysis of the effects of the board's characteristics in company performance when compared to the studies that analyze the influence of board's member's characteristics in the company performance.

5. Avenues for Future Research

The analysis of the recent empirical studies about the relationship between the board's attributes and the company performance showed that some of the typical problems remained. So, it is clear that in the future the researchers need to be more careful about the inclusion of the necessary control variables in order to have good estimation results.

Moreover, it is necessary to produce wider studies which may include various countries in the analysis. We have for example the recent article from Black, de Carvalho, Khanna, Kim, & Yurtoglu (2013) that shed some light on this issue.

The choice of the dependent variable has shown also several limitations and the use of accounting measures of performance or the use of market measures of performance do not guarantee reasonable results. So, it is necessary to combine different types

of performance measures in order to obtain better results.

Table 1. Board Attributes and Corporate Financial Performance

Study (Year)	Dimensions	Performance Criteria	Control Variables	Sample	Analytical Approaches	Major Findings
Kim (2005)	Board network density Board external social capital	ROA	Lagged ROA Age of the firm Log (assets) Debt / equity ratio Board age Group affiliated company dummy Board education level Board average age Board size	199 publicly traded Korean companies (1990-1999)	GLS random effects model	Firm value is positively influenced by a moderate level of board network density. Firm performance is positively affected by member's elite school networks.
Ghosh (2006)	Board size Proportion of non-executive CEO remuneration	ROA PERF (arithmetic average of RoA, return on sales (RoS) and return on equity (RoE)) Adjusted Tobin's Q (ratio of market value of equity to the book value of debt)	Dummy variables to control for firm ownership (public versus private) Logarithm of size of board of directors Logarithm of total assets netted for depreciation Cash flows divided by total assets Logarithm of number of years since incorporation Leverage = (total assets – equity capital) / total assets Percentage share price change Dummy variable indicating uncertainty in the economic environment	127 listed manufacturing firms in India for 2003 (classified in nine industries).	Regression	Larger boards tend to diminish the firm performance. Positive effect between the number of non-executive directors and firm performance. The compensation of the CEO has a relevant effect on the company performance.

Table 1. Board Attributes and Corporate Financial Performance (continued)

Study (Year)	Dimensions	Performance Criteria	Control Variables	Sample	Analytical Approaches	Major Findings
Juras & Hinson (2008)	Board independence Board size	Net interest margin ROA ROE Efficiency ratio	Natural log of assets	1440 bank-year observations (1999-2003)	OLS regressions	The results obtained contradict the hypotheses elaborated under the agency theory.
Dunn & Sainty (2009)	Shareholder orientation Board independence Firm risk	CSP Score (retrieved from the Canadian Social Investment Database)	EPS ROE Log of total assets	104 Canadian firms	Regression Pearson correlation	Board independence is positively associated with social performance but shareholder orientation is not. Exists a positive relationship between social performance and financial performance. The same happen to the case of debt.
O'Connell & Cramer (2010)	Board size Smaller firms Board composition	ROA Financial Q (Sum of market capitalization plus long and short-term debt over the book value of total assets) RET (The one-year raw stock market return.)	Proportion of the company owned by the directors	44 Irish non-financial firms with significant data listed on the Irish Stock Exchange in 2001.	Regression Two-stage least square	Board size shows a relevant negative relationship with firm performance For the case of smaller firms the relationship between board size and firm performance is less negative

Table 1. Board Attributes and Corporate Financial Performance (continued)

Study (Year)	Dimensions	Performance Criteria	Control Variables	Sample	Analytical Approaches	Major Findings
Qianbing & Pingping (2010)	CEO age CEOs' education levels Non-executive director proportion	The quantity of company patent claims	Company total assets Establishing time	318 listed companies in Shenzhen stock market - 2009	Regression analysis	Company innovation performance is positively correlated with CEO education level
García-Ramos & García-Olalla (2011)	Board size Board independence CEO Duality Board Activity	Market-to-book value ratio as the proxy for Tobin's Q	Lag value of Tobin's Q Natural logarithm of the total value of assets Quotient between total debt and assets Year factors Country factors Industry level factors	77 family businesses from Spain, Portugal and Italy.	Two Steps System Estimator of the Generalized Method of Moments (GMM)	Smaller and more independent boards do not conduce to better firm performance In the case of nonfounder-led family firm the performance is positively affected by the board size. For the case of founder-led family businesses the board has a negative effect on performance.
Ferrer (2012)	Board size Board independence Duality of the Chairman's role and the Chief Executive Officer's role Multiple directorial positions Managerial ownership	Share price – closing share price of the stock at the end of the calendar year. Return on equity (ROE)	Log of the company's total assets Total liabilities divided by total assets Length of time that an entity's shares have been traded in the Philippine Stock Exchange (PSE) up to December 31, 2009.	29 listed property companies in the Philippines	Regression ANOVA	The firm performance is positively influenced by the managerial ownership.

Table 1. Board Attributes and Corporate Financial Performance (continued)

Study (Year)	Dimensions	Performance Criteria	Control Variables	Sample	Analytical Approaches	Major Findings
Turki & Sedrine (2012)	Ownership concentration Managerial ownership Board size Outside directors Board leadership structure	Market-to-book - natural logarithm of the market value of equity divided by the book value of equity.	Natural logarithm of the book value of total assets. Ratio of total debt to total assets. Ratio of net working capital to the book value of assets. Beta coefficient of the stock.	23 non-financial companies listed on the Tunisian Stock Exchange (TSE)	Regression Two-stage least squares (2SLS)	Presence of endogeneity plus a two-way causality in the case of ownership variables and market to book performance.
Ghabayen (2012)	Audit committee size Audit committee composition Board size Board composition	ROA – earnings before tax divided by total assets.	-	102 non-financial listed companies from the Saudi Market (Tadawul)	Regression	Firm performance is not affected by audit committee size, audit committee composition and board size.
Al-Matari, Al-Swidi, Fadzil, & Al-Matari (2012)	CEO duality CEO tenure Audit committee size Board size Board composition	ROA	Natural log of total assets Ratio of total liabilities to total assets	136 non-financial firms (2009) – Kuwait stock exchange	Multiple linear regression analysis	Firm performance is negatively influenced by the effects of CEO tenure and leverage.

Table 1. Board Attributes and Corporate Financial Performance (continued)

Study (Year)	Dimensions	Performance Criteria	Control Variables	Sample	Analytical Approaches	Major Findings
Ferrero-Ferrero, Fernández-Izquierdo, & Muñoz-Torres (2012)	Board size Independent board composition Board fees Chairman duality Level of debt	Earnings before extraordinary items and after taxes to total assets (EBEAT)	Natural log of total assets Dummy variable that takes in consideration the differences of the financial industry when comparing to the others sectors. Temporal dummies for different years	Standard & Poor's 500 index firms (2005-2008)	Three-stage least squares estimation method	The economic period affect the efficiency of the board.
Shukeri, Shin, & Shaari (2012)	Managerial ownership Board size Board independence CEO duality Ethnic diversity	ROE	-	300 Malaysian public listed companies	Multiple regression analysis Correlation analysis	The firm ROE is positively affected by the board size and ethnic diversity. Board independence affects negatively the ROE.
Y. A. Al-Matari, Al-Swidi, Fadzil, & Al-Matari (2012)	Board composition CEO duality Board size Audit committee independence Audit committee activity Audit committee size	Tobin's q	The book value of the total assets of the company. The percentage of total liabilities to total assets.	146 non-financial companies in Saudi Stock Market (TADWAUL) - 2010	Pearson correlation Multiple linear regression	In general the results contradict the agency theory which emphasizes that boards of directors tend to diminish the agency cost.

Table 1. Board Attributes and Corporate Financial Performance (continued)

Study (Year)	Dimensions	Performance Criteria	Control Variables	Sample	Analytical Approaches	Major Findings
Liang, Xu, & Jiraporn (2013)	Board size Board composition Board functioning	ROA ROE Operating income minus operating expenses/total assets Problem loans/total loans Natural log of total problems loans Net charge-offs/total loans Natural log of (gross charge-offs minus recoveries) Net charge-offs/total loans Natural log of (gross charge-offs minus recoveries)	Natural log of total assets Total loans/total assets Equity/total assets Dummy variable equal 1 if a bank has been listed at the end of the year and 0 otherwise Dummy variable equal 1 if a bank has been listed at the end of the year and 0 otherwise Percentage of shares held by the largest shareholders if the largest shareholder is government or government agency Percentage of shares held by the largest shareholders if the largest shareholder is a foreign investor Percentage of shares held by the largest shareholders if the largest shareholder is a private investor Herfindahl index of shareholdings of the second to tenth largest shareholders Natural log of weighted average GDP per capita of cities that a bank's branches are located	52 Chinese banks (2003-2010)	Regression	Bank performance is positively influenced by the ratio of independent directors. Bank performance is negatively influenced by the board size.

Finally, no one of the classical corporate governance theories fully explains the major issues involved in this area, and so there is a need to develop a broader theory.

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The Partnership as a Factor of Sustainable Growth for the Companies in the Information Technology Sector in Brazil

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Abstract – In the last decade, some companies in the field of information technology had been significant growth while others have not reached the same results. We also observed that some of these companies began to adopt strategies with a focus on partnership. There are a number of questions about the partnership as a factor of sustainable growth for the companies in the information technology Sector. This article presents some concepts and interpretations based on literature review, expert opinion, field research via questionnaires and the own professional experience.

Keywords – Partnership, Sustainable Growth, Information Technology Sector

1. Introduction

The economic restructuring observed in recent decades is implying a reorganization of the management processes of companies, based on a new organizational logic. Social changes, cultural and organizational policies, inherent in the global economy, indicate the transition from industrial society to knowledge society. Additionally, the values and the rules of coexistence that must guide the behaviour of economic agents - individuals, companies or Government - are in constant process of discussion, refinement, assimilation and transformation. This is why we must devote special attention to the conditions and opportunities that arise constantly.

The strategic importance of sustainable growth for the research and to support the construction of a future in which the development goes beyond the preservation of nature, whereas within a holistic perspective, is related to the economic, social and

political progress. Only through the involvement of all these issues, can actually be a long-term qualitative growth. The concept of economic development shall then be increasingly subjected to the sieve, initiated by movements that have arisen around the world, in particular, from the 1980. In broad terms, sustainable growth depends on integration of economic, social and environmental process.

The degree of commitment of the company with the society must be very large, because it is an undeniable obligation. Today it is unacceptable that a company operates without any concerns about the impact on the population well-being, whichever it is the workforce or not. This is emphasized when you acknowledge that company does not exist without society, that there is no supplier market without consumer market, because both require a location, an environment to settle. Organizations are beginning to realize that the credibility of the companies is the result of effective and constant practice of values such as respect, honesty, transparency in relations with its stakeholders, integrity in the financial statements and concern for the environment and the community.

For companies, it is an enormous challenge to continue advancing at the same time, in economic, social and environmental development, to guarantee a sustainable growth. It is necessary to emphasize the importance of partnering receipts, corporate partnerships with other private companies, with community organizations, non-governmental

organizations or government institutions to which the transformation movement not insulated, but articulate, since, in this way, reduce the fragmentation of care and extends the reach of business activities, observing, there, a large space to rationalize the use of resources. The subject developed in this article is experienced by a large number of business organizations, giving emphasis to the Information Technology sector companies that are looking to their operations in Brazil.

2. Research Aims

The territorial extension of Brazil, transport difficulties and the cultural differences led the researchers to analyze several concepts which, applied to companies in the information technology sector, could contribute to their sustainable growth. Several concepts such as partnering receipts, local presence, relationships, skill and ethics were studied in Albuquerque (2010). The application of these concepts allowed the effective analysis of sustainable growth of information technology companies in the North-East of Brazil and, through these factors, how to promote growth strategies. The purpose of this article is to analyze the concept of partnering revenues and, as a consequence, to analyze the way to contribute to the sustainable growth of information technology companies in Brazil.

In Brazil, the number of companies, whether small, medium or large, is very expressive. These companies have very different characteristics regarding their organizational structure, culture and power structure. In general, many of these companies have low life cycle or switch their presence in the various states of the country as far as they obtain specific projects in one or another state. Along this professional experience, as employee of IBM for 20 years, one of the researchers has met many difficulties arising from the “variable” growth considering a set of information technology companies in the North-East region, which is reflected on the results of the present study. The fickle growth above brings some uncertainties that impact in planning and, consequently, interfere in the results of the companies.

These events constitute obstacles to the managerial function with an impact on employees performance and business partnerships. It should be emphasized that the decline in business growth is harmful to the country as a whole and to the society in general.

3. Literature Review

3.1 Sustainable Growth

The concept of growth can be found in the texts of Smith (1778) [1979], based on the increase in the wealth produced. The truth is that the growth was only seen on its quantitatively expressed outlook, representing a variation on rents, profits and wages, without any other kind of concern. Moura (1978, p. 391) cites:

“... the entire history of economic analysis is also the history of analysis of development ...”.

A long growth viewpoint is a part of human thought, being always present in constant search of improvement of living conditions. However, the scientific theories of growth such as the ones that exist today are relatively recent in literature. Sustainability is a systemic concept related to the continuity of economic aspects, social, cultural and environmental human society.

The word sustainability as an isolated idea doesn't have much sense. It is a relational concept and a goal to pursue. The concept set out in the report of the Brundtland Commission is very well known (1991, p. 46), considered as:

“the process that seeks to meet the needs and aspirations of the present without compromising the ability of future generations to meet their own needs, or as a process of change in which the exploitation of resources, the direction of investments, the directions of technological development, and institutional change are in accordance with the current and future needs”.

The vision of the future, the desire to protect human life and nature in the long run is central on the concept of sustainability.

According to Filipe (2006, p. 8):

“Sustainable development, desirable in societies, should be carried out through a responsible decision-making process and, as far as possible, should be based on consensus. In this process, the economic activities, the environment and the well-being of human populations should be integrated and should seek for the necessary sustainability balances in the future”.

“Sustainability” is nowadays used as an umbrella term for all human activities.

According to several theorists, for a human development to be sustainable, in the broad sense, it

needs to keep in mind its environmental, social, economic, political and cultural dimensions.

3.2 Partnership

In the context of the knowledge-based economy, companies seek to reshape their structures and the organization of work facing the global market, in which economic barriers are disrupted and businesses adopt strategies of licensing, franchising, joint ventures and/or partnerships. Rapid renewal requirements of products and services lead to the formation of consortia and partnerships, with the investment and risk sharing, and to search for new technologies in universities and research centers. Thus, globalization has resulted in the establishment of various systems of alliances and cooperative networks.

According to Hitt (2002), involving their strategic alliances are the partnerships among firms, considering their resources, skills and core competencies combined to pursue mutual interests to design, manufacture and distribute goods and services. According to Lewis (1992), alliances provide unique opportunities for the development of strength with a uniquely broad set of partners, including customers, suppliers, competitors, distributors, universities and companies of several natures. Faulkner and Rond (2000) define the term "alliance", which at a certain point in the past meant a particular relationship and today it is used as an "umbrella" term to characterize a wide range of business-to-business relationships.

The need for a differential competitive position can boost organizations to collaborate on various segments and it may be a contentious argument to some competitors and partners in several situations. To realize that there are, in fact, a gap between what organizations would like to do and what concretely they can do, these organizations have in fact realized that it was necessary to add forces and discover ways to optimize their resources, their knowledge, their potential and that the best way to do it would be by adding efforts to other related organizations (Noletto, 2000).

3.3 Information Technology Sector

The information technology sector has been growing since the 1990s at rates higher than the world average. Information technology is the basic infrastructure to many sectors, since, currently, there are aspects of life that are decoupled from electronic

applications. When you approach it, it is necessary to have in mind the transformations that have been taking place in the areas of knowledge that govern computer products, as well as in their production processes. Today, the contents for the hardware components (integrated circuits) and software correspond almost to the entire value of the equipment. Thus, the competitiveness of this sector can be related to scientific domain of the following areas: microelectronics, software, communication networks, multimedia and wireless communication.

The participation of the computer industry in the Brazilian economy has grown significantly over the past recent years. In turn, when the technological sector is more broadly examined by including the telecommunications branch, it turns out that the thread had its momentum in the late 90s, in the course of privatization of fixed telephony companies in the country. After a period of strong flow of investments in the country, since 1999, the participation of the communications sector (telecommunications, computing and audiovisual) in the Brazilian GDP has maintained approximately constant levels, as a result of the cooling of the investments in the sector and throughout the economy in general. Specifically in relation to the software market, the participation of the sector in GDP is compatible with what happens with this participation in most of the developed countries.

In 2002, Brazil had the 7th world's software market (1.3% of world production), with sales of 7.7 billion dollars (2001), comparable in size to the ones in China and India (7.9 billion and 8.2 billion respectively). The industry's growth rate is about 11 percent per year since 1995, the largest segment of it, three times higher than that of hardware and approximately five times higher than the growth rate of GDP. However, very little is for export sales. In some countries like Ireland, for example, mostly of what is produced is geared to the external market. As regards the distribution of activities in the sector, the evolution of Brazilian software market shows that the production of software has been keeping at a constant level, whereas the services segment has been experiencing great progress.

4. Methodology

This stage of the article reports to the way research was conducted. That is, the type of search, the company chosen for the study, the region and the factors that contribute to its sustainable growth, in

addition to the instruments used for data collection and analysis of the results. From the definition of the goals of research, it was decided to use the questionnaire as a method of data collection. We tried to examine the factors that contribute the most to the sustainable growth of information technology companies of Brazil. Two criteria of choice were adopted: companies (clients) users of solutions (hardware, software, and services) provided by IBM for at least two years; and IBM Business Partners. To validate the research instrument, the researchers sent the questionnaire to three customers and asked each to assess the following aspects: clarity of the questions and adequacy to the theme proposed. In addition, asked to submit suggestions.

The questionnaire was sent to each respondent, nominally in order to convey a sense of personalization and importance to the research, in order to ensure a higher return and attention in their responses. The practical knowledge acquired for the companies, during the 20 years of work in IBM Brazil outlined before, favored the receptivity of respondents in answering the questions suggested in the script, and gave greater flexibility so that they could complement what they considered relevant. All the steps were very satisfactory.

Considering the population of customers they are more than business partners. The questionnaire was sent to 85 customers and business partners, totaling 45 130. From the 85 questionnaires sent to clients, 47% (40) were answered, and among those that were sent to business partners, 51% (23) were answered. The questionnaires returned and answered are enough to give consistency to the survey. The choice of professionals will be searched on three levels: strategic, tactical and operational (directors, managers and employees), the need for information of all that influence, somehow, in decision-making involving information technology solutions.

After the end of the empirical research, the next step was the transcription of the questionnaires in their entirety, for a subsequent evaluation of the information received. Various readings and a deep examination of the collected material has permitted to develop the analysis and interpretation of data and information. All data and information were analyzed, following the order of the questions contained in the questionnaires.

5. Results

Studying the placement of those involved in research about partnership, the questions focused on the topics: choice of manufacturer or business partner to provide a solution; quality of an information technology solution when provided jointly by the manufacturer and business partner.

5.1 Customer Results

In order to examine the manufacturer's choice or business partner to provide a solution was to put the following question:

Question 1 – Please think on the following situation: your company has possibilities to do business with the manufacturer or with a business partner. Both have the same ability to present technical and commercial solutions. In such circumstances, dealing with the manufacturer or with his business partner is indifferent in their decision making?

The following result was obtained: from the total of 40 customers, 32% (14) considered that the fact of dealing with the manufacturer or business partner is indifferent in decision-making, as 5% (2) stated that fully agree, 27% (11) stated that agree and 3% (1) stated that this factor does not interfere in the decision. It may be noted that 62% (25) have answered no to this question, 50% (20) disagree and 12% (5) declared to fully disagree. Based on these positions, it is concluded that the ability to present solutions by the manufacturer or by the business partner is not the only factor that matters to the client in decision-making.

In addition to the aspects related to the choice of the manufacturer or business partner, the quality of a solution was examined, when provided by the manufacturer and business partner, by considering the question:

Question 2 - in the North-East of Brazil, the solutions presented by the manufacturer of Information Technology that are complemented by business partners' solutions become more attractive than those provided without the partnership. Do you agree with this statement?

The following result was obtained: from the total of 40 customers, 75% (30) stated that the solutions presented by the manufacturers and complemented by business partners become more attractive than those provided without the partnership: 15% (6) stated that

fully agree and 60% (24) stated that agree. Meanwhile 12% (5) stated that this does not interfere in the decision. It may be pointed out that only 10% (4) said no to this question, 7% (3) disagree and 3% (1) declared to fully disagree. In addition, 3% have not responded to the survey. Based on these positions, it is concluded that when solutions are presented jointly by the manufacturer and business partner they become more attractive to the customer, which reinforces the hypothesis that the partnership interferes positively in sustainable growth.

5.2 Business Partners Results

The business partners were asked the same questions above with the following results:

Question 1 - from the total of 23 business partners, there has been no responses (0) regarding item "completely agree", 30% (7) agreed with the fact that dealing with the manufacturer or business partner is indifferent in decision-making and 9% (2) stated that this factor does not interfere in the decision. It should be noted that 61% (14) said no to this question, 48% (11) disagree and 13% (3) declared to fully disagree. Based on these positions, it is concluded that, in the view of business partners, the ability to present solutions by the manufacturer or by the partner is not the only factor that matters to the client in decision-making.

In addition to the aspects related to the choice of the manufacturer or business partner, it was examined whether the quality aspect of an information technology solution, when provided by the manufacturer and business partner, as posed in the "question 2" above, with the following result.

Question 2 - from the total of 23 business partners, 91% (21) stated that the solutions presented by the manufacturers and complemented by business partners become more attractive than those provided without the partnership: 56% (13) stated that fully agree and 35% (8) stated that agree. Meanwhile nobody has stated that this factor does not interfere with the decision and 9% (4) said they disagree with this question. Based on these positions, it is concluded that, in the view of business partners, when solutions are jointly presented by the manufacturer and business partner become more attractive to the customer, which reinforces the hypothesis that the partnering receipts interferes positively on sustainable growth.

The views of customers and business partners have converged on the partnership, because 75% (30)

and 91% (21) business partners agreed that the solutions presented by the information technology manufactory, which are complemented by business partners solutions, become more attractive than those provided without the partnership.

6. Conclusions

This study revealed to have a great richness in data and information as what regards the review of the literature. Due to the breadth and diversity of the theme object of research, this work is substantiated considering a set of several theorists, which strengthened the analysis and the interpretations of researchers in this study. For the development of this work, a number of factors were studied that contribute to the sustainable growth of information technology companies in Brazil such as: partnerships, local presence, relationship, skills and ethics. This article focused on the partnerships factors. Based on the theoretical foundation and through the methodology used, it was possible to understand the perception of customers and business partners regarding the partnerships.

Another checked feature refers to the competitive edge in business, as a result of the application of these factors in business practice. It was observed that the great geographical extension of Brazil associated with the pressure that companies are suffering in the quest to redesign their structures and organizations to meet the challenges of the globalized market, led to the formation of consortia and partnerships aimed at the investment and risk sharing, in addition to the search for new technologies. The partnerships provide an unique opportunity for developing an exceptionally broad range of companies, including customers, suppliers, competitors, distributors, universities and companies of other natures, which combine their skills and competencies, aimed at the achievement of mutual interests to design, manufacture and distribute goods and services.

It was found that many customers expect that information technology companies contribute to the construction of a better society and adopt an ethical conduct in their network of relationships. Based on the analysis of the results of the survey, it was found that the strategies that involve partnerships have contributed to the sustainable growth of information technology companies in Brazil. The relevance of this work to the academia is to address a theme of great emphasis on current events, which may be included

in models of management and production companies or future research.

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Networks of Networks: The Last Frontier of Complexity-A Book Review

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Abstract – Along this work the book "Networks of Networks: The Last Frontier of Complexity", 978-3-319-03517-8 published in Springer Series "Understanding Complex Systems" is reviewed. This book theme importance is evident and enormous since it deals with something essential to nowadays everybody's life, the "Critical Infrastructures". In the various chapters these devices are studied, exemplified and modelled in order to find the tools to solve their problems of governing, managing, maintenance, security and preservation (with special attention to natural catastrophes problems). It is emphasized that their performance and effectiveness depend not only on the reliable physical components but also on the human behavior understanding at individual and collective levels.

Keywords – Networks, networks of networks, complexity.

1. Introduction

In the preface of this book the main Editors, Gregorio D'Agostino and Antonio Scala, begin identifying the infrastructures on which rely the modern life in fully developed countries and nominee, among others, Electric Systems, Aqueducts, Communication Assets, Fresh Food Distribution Chains, Gas Ducts, Oil Pipelines, Transports and Financial Networks. Then emphasize that their availability depend not only on the reliable physical components but also on the human behavior understanding at individual and collective levels.

Then call the attention for the inter-dependence of these critical infrastructures, easily perceived and admitted in any common sense approach.

Evidently, a global conceptual approach of this kind of system configures one the following devices:

- A huge network of networks,

- A lot of networks of networks.

The last, chosen in this book, configures a much more intuitive and understandable analysis mode.

The situation described above is the one of a complex problem in the sense that very little is known about it. And then constitutes a very promising and interesting field of research demanding an interdisciplinary approach.

All this justifies the title of the book: "Networks of Networks: The Last Frontier of Complexity" and the papers in it are in accordance.

Still in the preface, the main Editors enumerate some, among others of course, Information-based services provided to our developed society: Web, E-mail, E-commerce, E-health, Web-based entertainment, SCADA systems, ... to conclude that the infrastructures are required to become smart into a smart technological environment. Of course this establishes new challenges to be overcome getting more and more knowledge, through more and more research, on Networks of Networks.

The book is composed of three parts: Theoretical Approaches, Applications and Phenomenological Models. In the sequence of this review a section is devoted to each one. Then there will be a section on the mathematical models used in the book and finally, in the last section, an overall review, synthetizing the former sections, is presented.

2. Theoretical Approaches

The first part, "Theoretical Approaches", constitutes a general overview on the Networks of Networks (Net O Nets) in particular on the Interdependent Networks that are the ones that really interest. These part chapters are contributions stemming from the

Statistical Physics approach.

As modeling Interdependent Networks consists in defining different graphs and the interaction among them, two different approaches are used and explained:

-Multiplex Approach,

-Interacting Networks.

Static approaches are considered in chapters 1-3 and the dynamics of the systems in chapters 4, 5.

Chapters 1-5 are theoretical and conceptualizing. They constitute the basis supporting the interventions in these structures. All are almost surveys on this subject. An approach close from the ones typical of Statistical Physics makes sense.

Being maybe the most difficult part to read, it is very delightful.

3. Applications

In the second part, "Applications", very interesting examples of Networks of Networks applications are presented:

-Epidemic propagation,

-Traffic Routing,

-Electrical Power System Blackout Mitigation Strategies,

-The fact that Complexity Power Systems does not reduce to the Interaction among Physical Components,

-And, to end this part, quite surprisingly, not a common critical structure, but the most complex "system of systems": The Human Body.

In general, the whole book is devoted to the problems of governing, managing, maintenance, security and preservation (with special attention to natural catastrophes problems) of these Critical Structures here considered Networks of Networks. And the number and choice of practical examples considered allow saying that from this point of view it is complete and gives an integrated approach to this problem.

This is the most agreeable part of the book, due to the friendly reading and the stylist way in which the most of the chapters are written.

4. Phenomenological Models

The third part, "Phenomenological Models", deals with the attempts to reproduce the Critical Infrastructure real behavior. The various methodologies are examined with a special look to the Simulation. The conflicts between urgency of results and time needed to design a good experience, recovering data enough (and its cost) are considered. Also the very difficult problem of modeling the human behavior, so much studied and never solved, is studied.

To deal successfully with the Critical Infrastructures the quality of the models used to reproduce its real behavior is evidently mandatory. This problem approach in this part of the book is quite complete and scrupulous.

It is the "work" part of this book. In fact, the construction of models work requires patience and perseverance: many tries and errors. And, of course, a bit of patience is needed to read it.

5. Mathematical Models

In what concerns the mathematical models presented, very important for this book, to note that many researchers support the use of Mathematics in the complexity study but only easy Mathematics¹. This is not a correct position. About a complex problem nothing or very few is known². So, when using Mathematics, it is not possible to know *a priori* if it is necessary either easy or difficult Mathematics. In this book the Mathematics used is the adequate and there are not unnecessary complications.

The mathematical tools used fall mainly in the scope of Operations Research and Probability and Statistics. They are important in the great amount of models present, being the most of more famous referred and also presented. The Editors point themselves the

¹ Certainly because of the responsibilities in the recent world financial crisis attributed to bankers ignorance in mathematical models, supposedly complicated.

² In the beginning of the book there is a phrase, "Sometimes life is complicated, sometimes is just complex", that resumes perfectly this concept.

absence of I/O Models and some missing of System Risk Analysis and Time Series Analysis. Note also the missing of Queuing Theory and Game Theory.

6. Overall Review

Nowadays life is composed of a lot of networks of networks, or even of only a huge network of networks. From a methodological point of view, the conception of networks of networks is much friendlier in permitting a good analysis than the one of the huge network of networks. In any case always complexity is faced. This justifies the title of this wonderful book edited by Gregorio D'Agostino and Antonio Scala. Although it is always risky to call to anything "the last..." the texts in this book are convincing in stressing this point of view.

The book is composed of three parts: Theoretical Approaches, Applications and Phenomenological Models. In particular, the first part constitutes a general overview on the Networks of Networks (Net O Nets) in particular on the Interdependent Networks that are the ones that really interest. In general, the whole book is devoted to the problems of governing, managing and preserving (with special attention to the security and the resistance to natural catastrophes problems) Networks of Networks.

Along this book, a lot of practical examples of this kind of devices are considered. From this point of view it may be said that it is complete and gives an integrated approach to this problem.

Finally to refer the mathematical models presented. Many researchers support the use of Mathematics in the complexity study but only easy Mathematics. This not a correct position since a complex problem is a one about which nothing or very few is known. So, when using Mathematics, it is not possible to know a priori if it is necessary either easy or difficult Mathematics. In this book the Mathematics used is the adequate and there are not unnecessary complications.

Concluding, this is a very interesting book, very pleasant to read, essential either for beginners in this matter or senior researchers. This book is really a research book, fundamental in the Networks of Networks study, very pleasant to read, essential either for beginners in this matter or senior researchers.

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