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Halkos, George and Tzeremes, Nickolaos

University of Thessaly, Department of Economics

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By

George Emm. Halkos and Nickolaos G. Tzeremes

Department of Economics, University of Thessaly
Korai 43, 38333, Volos, Greece

Abstract

The question of why some multinational corporations perform better than others is in the centre of the analysis of many international business disciplines and the subject of a never-ending debate. In that respect this paper provides empirical evidence by combining strategic management theories and performance measurement techniques. Specifically, it illustrates a way of strategic performance measurement by emphasising the impact of home country's national culture on MNCs' performance. Our empirical evidences suggest that home country's national culture has a direct impact on MNCs' performance. Additionally, the results clearly indicate that MNCs with higher performance have clear and distinct characteristics.

Keywords: Multinational Performance, National Culture, Cultural Distance Index, Data Envelopment Analysis.

JEL Classification: C61, C67, F23, M16

1. Introduction

Th role of national culture and its impact on multinational performance has been debated and sometimes underestimated. In particular, strategic management field has traditionally focused on business concepts that affect firm performance answering to the question of why some firms perform better than others (Hoskisson *et al.* 1999). Since late 1980s the dominant paradigm regarding those issues is the Resource-Based View (RBV) of the firm (Wernerfelt, 1984; Barney, 1991; Grant, 1991; Peteraf, 1993; Amit and Schoemaker, 1993; Collis, 1994), focusing on internal, firm-specific factors and their effect on performance. RBV explains why some firms in the same industry perform better than the others.

On the other hand, efficiency and productivity literature has been developed substantially over the last decades producing a number of studies using many sophisticated quantitative techniques applied in different empirical settings. However the theory behind the overall efficiency was developed only to a small extent and while we have a great advance in measurement field, the theoretically grounded research on efficiency and multinational performance is still lacking. At the same time, in strategic management not enough attention has been paid to performance measurement issues (Banker *et al.*, 1996; Majumdar, 1998). Hence, this stream of research could benefit from productivity research and its advancement in performance measurement. Relying on these considerations, we believe that there is a need to combine both research streams.

More specifically, using Data Envelopment Analysis (hereafter DEA) we establish performance measurements for a sample of 100 multinational corporations. Then based on the national cultures of the efficient corporations (peers or comparative set) obtained from our DEA analysis, we test the impact of national culture on multinationals' performance by reconstructing Kogut and Singh's (1988) index based on Hofstede's cultural dimensions. Finally, we test the cultural distance index in a logistic regression in order to clarify whether the multinational performance may be influenced by multinationals' home country national culture.

The structure of the paper is the following. Section 2 defines the variables used and section 3 presents the proposed method for analysing initially these variables. In section 4 we compute the cultural distance index while in section 5 we discuss our proposed econometric model specification. Section 6 discusses the empirical results derived while the final section concludes the paper.

2. Data and definition of variables

In order to measure the effect of national culture on multinational performance we use a sample of 100 multinational corporations as has been provided by UNCTAD (2007). UNCTAD ranks the world's largest non-financial MNCs by their foreign assets and presents data on assets, sales and employment. In our DEA analysis the inputs used are home and foreign assets (both measured in thousand dollars), numbers of home and foreign employees and numbers of home and foreign affiliates. Finally, the outputs used are home and foreign sales (both measured in thousand dollars). The variables of home and foreign assets have been used in our analysis as inputs in order to capture the physical or tangible resources as has been characterised by several authors (Teece, 1980; Hoskisson and Hitt, 1990; Chatterjee and Wernerfelt, 1991) as a source of economies of scale or scope (Tallman and Li, 1996) due to the fact that can be shared or transferred among the business units (Porter, 1987; Haspeslagh and Jemison, 1991).

Furthermore, foreign and home employees have been used as inputs following the earlier studies by Penrose (1959) and Chandler (1962) which regarded 'human' resources and its efficient use as a source of competitive advantage (Markides and Williamson, 1994, 1996). Following Hennart and Reddy (1997), Okamoto and Sjoholm, (2003) and Dunning (1994), this study uses the number of home and foreign affiliates as inputs due to the fact that among the affiliates the transfer of knowledge and R&D is generated which in turn can result in competitive advantage and increase multinational performance (Barney, 1991). Several authors in measuring multinationality and firm performance have been using return on assets (ROA) as an indicator of

measurement (Daniels and Bracker, 1989; Geringer *et al.*, 1989; Sullivan, 1994a, b; Ramaswamy, 1995; Hitt *et al.*, 1997; Riahi-Belkaoui, 1998; Gomes and Ramaswamy, 1999).

However as Fisher and McGowan (1983) suggest there are several drawbacks when using accounting ratios for measuring firm performance. Following, Daniels and Bracker (1989) this study uses as outputs home and foreign sales in order to measure the performance of the multinational corporations. Finally, Hofstede's four cultural dimensions have been used, which are the power distance (PDI), the uncertainty avoidance (UAI), the individualism versus collectivism (IDV) and masculinity versus femininity (MAS) (Hofstede, 1980).

3. Measuring MNCs' performance

We may think of Data Envelopment Analysis (DEA) as measuring the overall efficiency of a given MNC by calculating an efficiency ratio equal to a weighted sum of outputs over a weighted sum of inputs. For each MNC or Decision Making Unit (DMU) these weights are derived by solving an optimization problem which involves the maximization of the efficiency ratio for that DMU subject to the constraint that the equivalent ratios for every DMU in the set is less than or equal to 1 (or 100%).

That is, DEA seeks to determine which of the N DMUs determine an envelopment surface or an efficient frontier. DMUs lying on the surface are deemed efficient, while DMUs that do not lie on the frontier are termed inefficient, and the analysis provides a measure of their relative efficiency. As mentioned, the solution of the model dictates the solution of (N) linear programming problems, one for each DMU. It provides us with an efficiency measure for each DMU and shows by how much each of a DMU's ratios should be improved if it were to perform at the same level as the best performing countries in the sample.

The fundamental feature of DEA is that efficiency score of each DMU depends on the performance of the sample of which it forms a part. This means that DEA produces relative, rather than absolute, measures of efficiency for each DMU under consideration. DEA evaluates a

DMU as overall efficient if it has the best ratio of any output to any input and this shows the significance of the outputs/inputs taken into consideration.

Under the restriction of Constant Returns to Scale (hereafter CRS), Charnes *et al.* (1978) specify the linear programming problem representing the fitting of an efficient production surface to the data. Given the assumption of CRS, the size of the MNC is not considered to be relevant in assessing its efficiency. Under the assumption of CRS introduced by Charnes *et al.* (1978) relative smaller MNCs, can produce outputs with the same ratios of input to output, as can larger MNCs. This is because the assumption implies that there are no economies (or diseconomies) of scale present, so doubling all inputs will generally lead to a doubling in all outputs.

One of the major determinants that this study used DEA modelling was the fact that it can incorporate multiple inputs and outputs. In order to calculate overall efficiency, information on output and input is required. This makes it particularly suitable for analysing the efficiency of MNCs by providing references. Possible sources of inefficiency can be determined. By identifying the 'peers' for the MNCs, which are not efficient, DEA provides a set of potential role models (which is essential to our analysis) for ways of improving their efficiency.

However, some major disadvantages when using this technique have to be mentioned. Having a deterministic nature DEA produces results that are particularly sensitive to measurement error. If one MNC's inputs are understated or its outputs overstated, then that MNC can distort the shape of the frontier and reduce the efficiency scores of nearby MNCs. It only measures efficiency relative to best practice within the particular sample. Thus, it is not meaningful to compare the scores between two different studies because differences in best practice between the samples are unknown. Despite the limitations, DEA is a useful tool for evaluating the effect of MNCs' home country national culture on their performance.

Mathematically, the efficiency score of MNC c, assuming that MNCs minimise the use of inputs given outputs, is determined by solving a linear optimization problem (Charnes *et al.*, 1978). Let us consider n MNCs where MNC f uses the amount of x_{if} of input i and produces the

amount of y_{of} of output *o*. We assume that $x_{if} \geq 0, y_{of} \geq 0$ and that each MNC uses at least one input to produce at least one output. By denoting the input weights by β_i *(i=1,…,m)* and output weights by μ_o *(o=1,…,s)* the optimization problem, assuming constant returns to scale, can be formulated as follows:

$$\max_{\mu,\beta} w_c = \sum_{o=1}^{s} \mu_o y_{oc} \tag{1}$$

$$s.t. \sum_{i=1}^{m} \beta_i x_{ic} = 1 \tag{2}$$

$$\sum_{o=1}^{s} \mu_o y_{of} - \sum_{i=1}^{m} \beta_i x_{if} \leq 0, f = 1,...,n; \tag{3}$$

$$\mu_o, \beta_i \geq \phi; o = 1,...,s; i = 1,...,m \tag{4}$$

where ϕ is a small positive constant.

The maximizing problem is called the multiplier problem and it determines the efficiency score of a MNC *c* by maximizing the sum of its weighted outputs (1) so that the sum of its weighted inputs equals one (2) and so that the weighted outputs of all MNCs minus the weighted inputs of all MNCs is less than or equals zero (3). This setting implies that MNCs are either at the efficiency frontier or below it and the efficiency scores vary between 0 and 1 (or from 0 to 100 in percentages).

By denoting the input weights of a MNC *c* by θ and the input and output weights of other MNCs by λ_f *(f=1,…,n)* we can write the dual of the maximizing problem when constant returns to scale prevail as follows:

$$\min_{\theta,\lambda,s_o^+,s_i^-} t_c = \theta - \phi \sum_{o=1}^{s} s_o^+ - \phi \sum_{i=1}^{m} s_i^- \tag{5}$$

$$s.t. \sum_{f=1}^{n} \lambda_f y_{of} - s_o^+ = y_c, o = 1,...s; \tag{6}$$

$$\theta x_{ic} - \sum_{f=1}^{n} \lambda_f x_{if} - s_i^- = 0, i = 1,...m. \quad (7)$$

$$\lambda_f, s_o^+, s_i^- \geq 0 \quad (8)$$

The variables s_o^+, s_i^- are called *slack variables* measuring the excess of inputs and outputs. The small positive constant ϕ guarantees that inputs and outputs are positive and that slack variables do not influence the target function t_c. The minimizing problem is called the envelopment problem and it determines the efficient use of inputs for MNC *c* (5) so that the outputs of MNC *c* equal to the sum of weighted outputs of other MNCs (6). In addition, the weighted inputs of MNC *c* must equal the weighted inputs of other MNCs (7). The optimal value of parameter θ in equation (7) determines the amount MNC *c* should reduce its use of inputs in order to be at the efficiency frontier and positive values of λ_f determine those MNCs that dominate MNC *c* i.e. form its comparative set.

4. Computing the cultural distance index

As in most studies (Benito and Gripsrud, 1992; Barkema, *et al.* 1996; Cho and Padmanabhan, 2005; Slangen, 2006), we are measuring cultural distance by reconstructing the Kogut and Singh (1988) index based on our DEA results. This index is based on Hofstede's (1980) four cultural dimensions for organisational culture and it represents the aggregate measure of over 117,000 observations (IBM employees) across 50 countries. Even though Hofstede's work has been widely criticised, the size of the sample and the dimensions' stability over time have been a source of credibility and reliability[1].

The restructured cultural distance index based on Kogut and Singh's (1988) index is calculated as follows:

[1] See Kogut and Singh (1988) and Hofstede (2002) for a discussion of the pros and cons of Hofstede's work.

$$CD_{Aj} = \sum_{i=1}^{4} \left\{ \left(I_{ij} - I_{if} \right)^2 / V_i \right\} / 4 \qquad (9)$$

where I_{ij} = index of the value of the ith cultural dimension of the jth overall efficient MNC (comparative set obtained from DEA analysis); V_i = variance of the index of the ith dimension; f = Inefficient MNC; CD_{Aj} = the average cultural distance of the jth overall efficient MNCs; (comparative set obtained from DEA analysis) from the inefficient MNCs.

Hofstede's cultural dimensions are meant to measure each country's organisational culture. The dimensions were categorised into "power distance" – large vs. small; "uncertainty avoidance" – strong vs. weak; "individualism" vs. "collectivism"; and "femininity" vs. "masculinity" (Hofstede, 1980).

5. Model Specification

Let us now use the binomial logistic regression in formulating a model of explaining the influence of cultural distance calculated in equation 9 against MNCs' overall efficiency calculated from our DEA analysis. In similar principles to our work, among others, two well-known studies on international business literature conducted by Agarwal (1994) and Kogut and Singh (1988) have used the binomial logistic regression model measuring the effect of the cultural variables and their interactions on the choice of firms' entry mode strategy. Firstly we need to define the distributional properties of the dependent variable, (for more details on the properties and applications of logistic regression see Halkos, 2006; Gujarati, 1988; Kleinbaum, 1994; Hosmer and Lemeshow, 1989; Collett, 1991; Kleinbaum *et al.,* 1999; Hair *et al.,* 1998; Sharma, 1996).

The logit form of the model is a transformation of the probability Pr(Y=1) that is defined as the natural log odds of the event E(Y=1). That is

$$\text{logit}\,[\Pr(Y=1)]=\ln[\text{odds}\,(Y=1)]=\ln\left[\frac{\Pr(Y=1)}{1-\Pr(Y=1)}\right] \qquad (10)$$

In the general case, where the dichotomous response variable Y, denotes whether (Y=1) or not (Y=0) the characteristic under investigation (efficiency score ≥ the sample's average efficiency score – efficiency score < the sample's average efficiency score) is linked with the k regression variables $X=(X_1, X_2, \ldots, X_k)$ via the logit equation, we have

$$P(Y=1)=\frac{\exp\left\{\beta_0+\sum_{k=1}^{K}\beta_k X_k\right\}}{1+\exp\left\{\beta_0+\sum_{k=1}^{K}\beta_k X_k\right\}} \qquad (11)$$

This is equivalent to $\text{logit}\,\Pr(Y=1|\,X)=\beta_0+\sum_{k=1}^{K}\beta_k X_k$ due to (10).

The regression coefficients β's of the proposed logistic model quantifies the relationship of the independent variables to the dependent variable involving the parameter called the *Odds Ratio* (OR). As odds we define the ratio of the probability that implementation will take place divided by the probability that implementation will not take place. That is

$$\text{Odds}\,(E\,|\,X_1, X_2, \ldots, X_n)=\frac{\Pr(E)}{1-\Pr(E)} \qquad (12).$$

6. Empirical Results

According to the derived results from the solution of the CCR model (DEA analysis), it emerges that eighteen MNCs are appearing to be efficient in terms of transforming their inputs into maximum outputs and therefore have the a score value of overall efficiency of 100% (Table 1). The rest eighty two MNCs are calculated as inefficient and therefore have efficiencies scores below 100%. Analysing the results appearing in table 1 we realise that MNCs with efficient scores are British Petroleum Company Plc, Carrefour, CRH Plc, Koninklijke Ahold, Nestlé SA, Nokia, Royal Dutch/Shell Group, Statoil Asa, Total, Vodafone Group Plc, ExxonMobil, Chevron Texaco, Nissan Motor Co Ltd, ConocoPhillips, Wal-Mart Stores, Thomson Corporation,

Samsung Electronics and Verizon. Looking at the home countries of the efficient MNCs we realise that five MNCs have their origins in the USA, two in the UK, two in the Netherlands and two in France. According to Hofstede's cultural dimensions it seems that USA, UK and Netherlands have similar cultural characteristics (Hofstede, 1980). Furthermore, looking at the origin of the rest of the efficient MNCs we realise that this observation seems to be valid (Finland, Switzerland, Norway and Canada).

Table 1 also provides information regarding the industry in which the efficient firms are operating. Most of the efficient MNCs are operating in the 'Petroleum expl./ref./distr.' industry. Additionally, looking at the twelve inefficient MNCs we realise that the lowest performances have been reported for Scottish Power (29.09%), Telefonica SA (28.28%), National Grid Transco (27.72%), RWE Group (27.57%), E.on (27.47%), Inbev (26.03%), Electricite De France (25.66 %), Vivendi Universal (21.88%), AES Corporation (21.46%), Sanofi-Aventis (16.54%), General Electric (14.83%) and CITIC Group (13.89%). Again it seems that the inefficient MNCs (at least the majority of them) with the lowest performances have common national culture characteristics (China, France, Germany, Spain).

In Table 1 MNCs have been ranked according to their efficiency scores. The last column shows us how many times the efficient MNC constitute a reference and comparison criterion for the inefficient MNCs (the numbers in parentheses). That is, how many times the specific multinational appears to be a member of the comparative set. However the information for the inefficient MNCs provided in the same column is very essential for the rest of our analysis and the construction of the cultural distance index. Therefore, when looking the multinational with the lowest performance 'CITIC Group' we realise that the comparative or reference set is 'ConocoPhillips' (69) and 'Wal-Mart Stores' (75) which act as benchmarks for the inefficient firm. As has been mentioned this feature of DEA analysis is very important for our analysis because it provides as with the comparative sets of the inefficient MNCs and thus we are able to construct cultural distance indexes relative to those comparative or reference sets.

In that respect Table 2 provides information about the scores of the four Hofstedes' cultural dimensions (Hofstede, 1980) for every multinational and the scores of the cultural distance index as have been calculated taking into account the comparative set for every inefficient MNC. However, as expected the efficient multinationals have a cultural distance value equal to 0. For instance in order to calculate the cultural distance value for 'CITIC Group' we use the comparative set of DEA analysis. Therefore, due to the fact that 'CITIC Group' has as comparative set 'ConocoPhillips' (69), which its home country is the USA and 'Wal-Mart Stores' (75), which again its home country is the USA, we calculate separately the two CD indexes and then we provide the average value of these two indexes as provided in equation (9), which is equal to 5.44. The same calculation has been conducted for every multinational in our data set (see table 2).

Table 1: Overall efficiency scores, comparative sets, rankings and company characteristics

Rankings	codes	Company name	Home country	Industry	Overall Efficiency	Comparative Set
1	8	British Petroleum Company Plc	United Kingdom	Petroleum expl./ref./distr.	100.00	(21)
1	9	Carrefour	France	Retail	100.00	(4)
1	12	CRH Plc	Ireland	Lumber and other building material dealers	100.00	(1)
1	25	Koninklijke Ahold	Netherlands	Retail	100.00	(45)
1	32	Nestlé SA	Switzerland	Food & beverages	100.00	(4)
1	33	Nokia	Finland	Telecommunications	100.00	(13)
1	40	Royal Dutch/Shell Group	Netherlands	Petroleum expl./ref./distr.	100.00	(1)
1	45	Statoil Asa	Norway	Petroleum expl./ref./distr.	100.00	(1)
1	51	Total	France	Petroleum expl./ref./distr.	100.00	(9)
1	55	Vodafone Group Plc	United Kingdom	Telecommunications	100.00	(0)
1	61	ExxonMobil	United States	Petroleum expl./ref./distr.	100.00	(33)
1	65	ChevronTexaco	United States	Motor vehicles	100.00	(25)
1	67	Nissan Motor Co Ltd	Japan	Motor vehicles	100.00	(6)
1	69	ConocoPhillips	United States	Petroleum expl./ref./distr.	100.00	(53)
1	75	Wal-Mart Stores	United States	Retail	100.00	(50)
1	84	Thomson Corporation	Canada	Media	100.00	(1)
1	91	Samsung Electronics	Republic of Korea	Electrical & electronic equipment	100.00	(51)
1	93	Verizon	United	Telecommunications	100.00	(8)

			States			
2	29	Metro AG	Germany	Retail	99.16	25, 65, 69, 75, 91
3	30	Mittal Steel Company NV	Netherlands	Steel	95.36	25, 84
4	89	Hitachi Ltd	Japan	Electrical & electronic equipment	94.46	69, 75, 91, 93
5	64	Honda Motor Co Ltd	Japan	Motor vehicles	92.36	61, 67
6	78	Petronas - Petroliam Nasional Bhd	Malaysia	Petroleum expl./ref./distr.	89.40	61, 69
7	82	Matsushita Electric Industrial Co., Ltd.	Japan	Electrical & electronic equipment	88.78	69, 75, 91, 93
8	62	Toyota Motor Corporation	Japan	Motor vehicles	84.47	61, 67, 69
9	13	DaimlerChrysler	Germany	Motor vehicles	78.54	69, 75, 91, 93
10	76	Altria Group Inc	United States	Tobacco	77.12	69, 75, 91, 93
11	97	BHP Billiton Group	Australia	Mining & quarrying	75.79	25, 61, 69, 75, 91
12	50	Thyssenkrupp AG	Germany	Metals and metal products	74.62	25, 69, 75, 91
13	95	Duke Energy Corporation	United States	Electricity, gas and water	70.37	69
14	70	Hewlett-Packard	United States	Computer and related activities	69.53	25, 61, 69, 75, 91
15	99	Motorola Inc	United States	Telecommunications	67.75	25, 61, 65, 69, 75, 91
16	38	Repsol YPF SA	Spain	Petroleum expl./ref./distr.	67.67	9, 25, 51, 69
17	87	Johnson & Johnson	United States	Pharmaceuticals	67.01	69, 75, 91, 93
18	23	GlaxoSmithKline	United Kingdom	Pharmaceuticals	65.88	8, 25, 33, 91
19	100	Nortel Networks	Canada	Telecommunications	65.07	8, 32, 33, 61
20	57	Volvo	Sweden	Motor vehicles	64.69	8, 25, 33, 91
21	52	Unilever	United Kingdom	Diversified	64.07	8, 25, 33
22	3	BASF AG	Germany	Chemicals	63.49	25, 61, 65, 75, 91
23	68	IBM	United States	Computer and related activities	63.38	25, 61, 69, 75, 91
24	2	Astrazeneca Plc	United Kingdom	Pharmaceuticals	62.91	8, 25, 33, 91
25	20	ENI	Italy	Petroleum expl./ref./distr.	62.78	25, 61, 65, 69, 75, 91
26	56	Volkswagen AG	Germany	Motor vehicles	62.43	61, 67, 91
27	39	Roche Group	Switzerland	Pharmaceuticals	62.06	8, 32, 33
28	77	Alcan Inc.	Canada	Metal and metal products	61.78	8, 32, 33
29	35	Philips Electronics	Netherlands	Electrical & electronic equipment	61.69	8, 25, 33, 91
30	79	Dow Chemical Company	United States	Chemicals	61.45	25, 61, 69, 75, 91
31	59	Ford Motor	United States	Motor vehicles	61.14	61, 67, 69
32	73	Sony Corporation	Japan	Electrical & electronic equipment	58.34	25, 61, 69, 75, 91
33	10	Christian Dior SA	France	Textiles	56.61	61, 67, 69
34	72	Procter & Gamble	United States	Diversified	55.73	25, 65, 69, 75, 91
35	36	Pinault-Printemps	France	Wholesale trade	55.66	25, 51, 65, 69, 75

		Redoute SA				
36	66	Pfizer Inc	United States	Pharmaceuticals	54.38	69, 75, 91
37	90	Marubeni Corporation	Japan	Wholesale trade	53.75	45, 69, 91, 93
38	81	McDonald's Corp.	United States	Retail	52.71	8, 61, 75
39	83	United Technologies Corporation	United States	Transport equipment	52.41	25, 65, 69, 75, 91
40	11	Compagnie De Saint-Gobain SA	France	Non-metallic mineral products	52.06	25, 51, 65, 69, 75
41	63	Hutchison Whampoa	Hong Kong	Diversified	50.51	33, 61 69, 75, 91
42	37	Renault SA	France	Motor vehicles	49.58	25, 69, 75, 91
43	44	Siemens AG	Germany	Electrical & electronic equipment	49.10	25, 61, 65, 75, 91
44	26	L'Air Liquide Groupe	France	Commodity chemicals	48.91	9, 25, 51, 69
45	86	Singtel Ltd.	Singapore	Telecommunications	48.88	8, 61, 75
46	85	Coca-Cola Company	United States	Food & beverages	48.37	8, 25, 61, 65, 91
47	5	Bertelsmann	Germany	Media	47.76	25, 61, 65, 75, 91
48	34	Novartis	Switzerland	Pharmaceuticals	47.23	8, 33, 91
49	21	Fiat Spa	Italy	Motor vehicles	47.21	25, 65, 69, 75, 91
50	47	Suez	France	Electricity, gas and water	47.12	9, 25, 51, 69
51	98	Alcoa	United States	Metals and metal products	46.28	25, 69, 75, 91
52	27	Lafarge SA	France	Non-metallic products	46.02	12, 25, 51
53	6	BMW AG	Germany	Motor vehicles	45.84	33, 61,91
54	4	Bayer AG	Germany	Pharmaceuticals/chemicals	44.67	25, 61, 65, 75, 91
55	16	Diageo Plc	United Kingdom	Consumer goods/distillers & vintners	44.17	8, 25, 33, 91
56	88	Abbott Laboratories	United States	Pharmaceuticals	43.56	8, 25, 69, 75
57	94	Bristol-Myers Squibb	United States	Pharmaceuticals	42.15	25, 61, 65, 69, 75, 91
58	46	Stora Enso	Finland	Paper	41.84	25, 61, 65, 75, 91
59	60	General Motors	United States	Motor vehicles	41.49	69, 75, 91
60	7	British American Tobacco	United Kingdom	Tobacco	39.68	25, 65, 69, 75, 91
61	53	Veolia Environnement SA	France	Water supply	38.35	25, 69, 75
62	28	Lvmh Moët-Hennessy Louis Vuitton SA	France	Textiles and leather	37.32	25, 61, 65, 75, 91
63	14	Deutsche Post AG	Germany	Transport and storage	35.33	69, 75, 91, 93
64	92	Wyeth	United States	Pharmaceuticals	34.59	25, 61, 69, 75, 91
65	22	France Télécom	France	Telecommunications	34.47	8, 25, 69, 75
66	15	Deutsche Telekom AG	Germany	Telecommunications	33.92	8, 61, 75, 91
67	71	Mitsubishi Corporation	Japan	Wholesale trade	33.85	25, 69, 75
68	48	Telecom Italia Spa	Italy	Telecommunications	33.34	69, 75
69	19	Endesa	Spain	Electric services	32.43	65, 69, 91

70	74	Mitsui & Co Ltd	Japan	Wholesale trade	30.74	65, 69, 91
71	1	Anglo American	United Kingdom	Mining & quarrying	29.35	9, 25, 51, 65, 69
72	43	Scottish Power	United Kingdom	Electric utilities	29.09	65, 69, 75, 91
73	49	Telefonica SA	Spain	Telecommunications	28.28	61, 67, 69, 75, 91
74	31	National Grid Transco	United Kingdom	Energy	27.72	61, 69, 91
75	41	RWE Group	Germany	Electricity, gas and water	27.57	25, 51, 65, 69, 75
76	17	E.on	Germany	Electricity, gas and water	27.47	65, 69, 91
77	24	Inbev	Netherlands	Consumer goods/brewers	26.03	8, 25, 61, 69, 75
78	18	Electricite De France	France	Electricity, gas and water	25.66	69, 75, 91, 93
79	54	Vivendi Universal	France	Diversified	21.88	8, 40, 69
80	80	AES Corporation	United States	Electricity, gas and water	21.46	8, 25, 61, 75, 91
81	42	Sanofi-Aventis	France	Pharmaceuticals	16.54	8, 32, 33, 61
82	58	General Electric	United States	Electrical & electronic equipment	14.83	8, 51, 69, 75
83	96	CITIC Group	China	Diversified	13.89	69, 75

Table 2: Cultural characteristics and cultural distance indexes

Company name	**PDI**	**IDV**	**MAS**	**UAI**	**CD**	**Company name**	**PDI**	**IDV**	**MAS**	**UAI**	**CD**
Anglo American	35	89	66	35	1.85	Total	68	71	43	86	0
Astrazeneca Plc	35	89	66	35	1.03	Unilever	35	89	66	35	1.33
BASF AG	35	67	66	65	0.9	Veolia Environnement SA	68	71	43	86	2.28
Bayer AG	35	67	66	65	0.9	Vivendi Universal	68	71	43	86	2.77
Bertelsmann	35	67	66	65	0.9	Vodafone Group Plc	35	89	66	35	0
BMW AG	35	67	66	65	0.82	Volkswagen AG	35	67	66	65	1.07
British American Tobacco	35	89	66	35	0.55	Volvo	31	71	5	29	1.73
British Petroleum Company Plc	35	89	66	35	0	General Electric	40	91	62	46	0.68
Carrefour	68	71	43	86	0	Ford Motor	40	91	62	46	1.26
Christian Dior SA	68	71	43	86	2.45	General Motors	40	91	62	46	0.05
Compagnie De Saint-Gobain SA	68	71	43	86	1.86	ExxonMobil	40	91	62	46	0
CRH Plc	35	89	66	35	0	Toyota Motor Corporation	56	46	95	92	2.53
DaimlerChrysler	35	67	66	65	0.62	Hutchison Whampoa	68	25	57	29	4.06
Deutsche Post AG	35	67	66	65	0.62	Honda Motor Co Ltd	56	46	95	92	1.89
Deutsche Telekom AG	35	67	66	65	0.67	ChevronTexaco	40	91	62	46	0
Diageo Plc	35	89	66	35	1.03	Pfizer Inc	40	91	62	46	0.05
E.on	35	67	66	65	0.68	Nissan Motor Co Ltd	56	46	95	92	0
Electricite De France	68	71	43	86	2.34	IBM	40	91	62	46	0.36
Endesa	57	51	42	86	2.75	ConocoPhillips	40	91	62	46	0
ENI	50	76	70	75	1.17	Hewlett-Packard	40	91	62	46	0.36
Fiat Spa	50	76	70	75	1.17	Mitsubishi Corporation	56	46	95	92	4.64
France Télécom	68	71	43	86	2.58	Procter & Gamble	40	91	62	46	0.36
GlaxoSmithKline	35	89	66	35	2.09	Sony Corporation	56	46	95	92	4.3
Inbev	38	80	14	53	1.28	Mitsui & Co Ltd	56	46	95	92	3.79

Koninklijke Ahold	38	80	14	53	0	Wal-Mart Stores	39	80	52	48	0
L'Air Liquide Groupe	68	71	43	86	1.21	Altria Group Inc	40	91	62	46	0.04
Lafarge SA	68	71	43	86	1.95	Alcan Inc.	39	80	52	48	0.5
Lvmh Moët-Hennessy Louis Vuitton SA	68	71	43	86	2.34	Petronas - Petroliam Nasional Bhd	104	26	50	36	8.3
Metro AG	35	67	66	65	0.9	Dow Chemical Company	40	91	62	46	0.36
Mittal Steel Company NV	38	80	14	53	0.83	AES Corporation	40	91	62	46	0.39
National Grid Transco	35	89	66	35	0.12	McDonald's Corp.	40	91	62	46	0.09
Nestlé SA	34	68	70	58	0	Matsushita Electric Industrial Co.. Ltd.	56	46	95	92	3.74
Nokia	33	63	26	59	0	United Technologies Corporation	40	91	62	46	0.36
Novartis	34	68	70	58	0.84	Thomson Corporation	60	18	39	85	0
Philips Electronics	38	80	14	53	1.45	Coca-Cola Company	40	91	62	46	0.36
Pinault-Printemps Redoute SA	68	71	43	86	1.86	Singtel Ltd.	74	20	48	8	5.75
Renault SA	68	71	43	86	2.41	Johnson & Johnson	40	91	62	46	0.04
Repsol YPF SA	57	51	42	86	1.47	Abbott Laboratories	40	91	62	46	0.48
Roche Group	34	68	70	58	0.66	Hitachi Ltd	56	46	95	92	3.74
Royal Dutch/Shell Group	38	80	14	53	0	Marubeni Corporation	56	46	95	92	4.66
RWE Group	35	67	66	65	1.16	Samsung Electronics	40	91	62	46	0
Sanofi-Aventis	68	71	43	86	2.62	Wyeth	40	91	62	46	0.36
Scottish Power	35	89	66	35	0.16	Verizon	40	91	62	46	0
Siemens AG	35	67	66	65	0.9	Bristol-Myers Squibb	40	91	62	46	0.36
Statoil Asa	31	69	8	50	0	Duke Energy Corporation	40	91	62	46	0
Stora Enso	33	63	26	59	1.19	CITIC Group	80	20	66	30	5.44
Suez	68	71	43	86	1.21	BHP Billiton Group	36	90	61	52	0.37
Telecom Italia Spa	50	76	70	75	0.82	Alcoa	40	91	62	46	0.46
Telefonica SA	57	51	42	86	2.42	Motorola Inc	40	91	62	46	0.36
Thyssenkrupp AG	35	67	66	65	0.96	Nortel Networks	39	80	52	48	0.42

Working with the five variables analysed previously we derive the logit form of the fitted model, which may be represented as:

$$\text{logit}\,[\Pr(Y=1)] = \beta_0 + \beta_1\,\text{CD} + \beta_2\,\text{PDI} + \beta_3\,\text{IDV} + \beta_4\,\text{MAS} + \beta_5\,\text{UAI} + \varepsilon_t$$

where Y denotes the dependent variable as 1 for efficiency scores higher or equal to the sample's median performance value (≥ 60.41) and 0 for efficiency scores below to the samples' median performance value (< 60.41), the beta terms are the parameters to be estimated, and ε_t is the disturbance term, assumed to be normally distributed with 0 mean and variance 1.

The results of the fitted model are presented in Table3. We may compute the difference which estimates the percentage change (increase or decrease) in the odds for every 1 unit change in X_i holding all the other X_s fixed. The coefficient of cultural distance (CD) is $\hat{\beta}_1$ = -0.704,

which implies that the relative risk of this particular variable is $e^{\hat{\beta}1}$=0.495 and the corresponding percentage change is $e^{\hat{\beta}1}$-1=-0.505. This means that in relation to cultural distance the efficiency of multinationals decreases by almost 50% ceteris paribus. In the case of PDI the result is $\hat{\beta}_2$ =-0.005, which implies that the relative risk of this particular variable is $e^{\hat{\beta}2}$= 0.995 and the corresponding percentage change is $e^{\hat{\beta}2}$ -1= -0.005. This means that in relation to PDI the efficiency of multinationals decreases by almost 0.5% all other remaining fixed.

In the case of IDV the result is $\hat{\beta}_3$ =-0.041, which implies that the Relative Risk of this particular variable is $e^{\hat{\beta}3}$ = 0.960 and the corresponding percentage change is $e^{\hat{\beta}3}$ -1= -0.04. This means that in relation to IDV the efficiency of multinationals decreases by almost 4% all other remaining fixed. Furthermore, in the case of MAS the result is $\hat{\beta}_4$ = 0.001, which implies that the Relative Risk of this particular variable is $e^{\hat{\beta}4}$= 1.001 and the corresponding percentage change is $e^{\hat{\beta}4}$ -1= 0.001. This means that in relation to MAS the efficiency of multinationals increases by almost 0.1% all other remaining fixed. Finally, in the case of UAI the result is $\hat{\beta}_5$ = -0.2, which implies that the relative risk of this particular variable is $e^{\hat{\beta}5}$= 0.980 and the corresponding percentage change is $e^{\hat{\beta}5}$ -1= -0.02. This means that in relation to MAS the efficiency of multinationals decreases by almost 2% all other remaining fixed. The negative signs in the coefficients of CD, PDI, IDV and UAI were expected according to our hypotheses (H5, H1, H3 and H2). In addition the positive sign in the coefficient for MAS was also expected according to our forth hypotheses (H4).

The individual statistical significance of the β estimates is presented by the Wald (Chi-square). The significance levels of the individual statistical tests (i.e. the P-values) are also presented and correspond to Pr>Chi-square. Note that only CD and IDV (as well as the constant term) are statistically significant for a 0.05 statistical level. To assess the model fit we compare the log likelihood statistic (-2 log) for the fitted model with the explanatory variables with this value that corresponds to the reduced model (the one only with intercept). The likelihood ratio statistic for comparing the two models is given by the difference LR=(-2log $\hat{L}_R$)-(-2log $\hat{L}_F$)= 124.981, where the subscripts R and F correspond to the Reduced and Full model respectively. That is, in our case the overall significance of the model is X^2= 124.981 with a significance level of P= 0.005. Based on this value we can reject H_0 (where H_0: β_0= β_1= β_2=0) and conclude that at least one of the β coefficients is different from zero.

Finally, the Hosmer and Lemeshow value equals to 8.649 (with no statistical significance). The non-significant X^2 value indicates a good model fit in the correspondence of the actual and predicted values of the dependent variable.

Based on the the results of our logistic model we can argue that cultural distance has an effect on MNC performance wich indicates the acceptance of our main hypothesis (H5). Furthermore, the results indicate that the higher the cultural distance of the efficient and the inefficient MNC the higher was the CD value. Therefore, our results support the study by Lee and Yu (2004), which indicates that national culture has an effect on multinational performance. The results reveal that the companies with higher performances have their origins and are influenced from national cultures which enable them to structure such relationships that ensure them to transfer of proprietary knowledge across borders. This in turn is the key in multinational success through increased performance effects (Kogut and Zander, 1993; Teece, 1977).

Therefore, efficiency is negatively influenced by the cultural distance. In our analysis we also try to establish the cultural characteristics which enable such structures and increase MNCs' performance, however only IDV is statistically significant. The sign in the case of IDV is supported by the literature and therefore our third hypothesis (H3) finds support and indicates that higher individualism cultures have a negative effect on multinational performance. The rest of our hypotheses are not supported due to the fact that our empirical evidences are not statistically significant.

Table 3**:** Logistic Regression results

Variables		**Estimates**	**Odds Ratio**
Constant		5.078*	160.379
	Wald	4.912	
Cultural Distance Index (CD)		-0.704*	0.495
	Wald	5.301	
Power Distance Index (PDI)		-0.005	0.995
	Wald	0.038	
Individualism/Collectivism Index (IDV)		-0.041*	0.960
	Wald	4.029	
Masculinity/ Femininity Index (MAS)		0.001	1.001
	Wald	0.010	
Uncertainty Avoidance Index (UAI)		-0.200	0.980
	Wald	1.984	
Cox and Snell R^2	0.126		
Nagelkerke R^2	0.168		
Hosmer Lemeshow	8.649		
Likelihood Ratio	124.981*		

Notes: * p< 0.05.

7. Conclusions

According to Ohmae (1989) nations have become less important to MNCs due to the 'borderless' environment. In addition, Ohmae claims that MNCs have their own internal culture which is independent of their original nationalities. Our paper comes in contradiction with this view and provides empirical evidence which supports that MNCs' national cultures shape their internal cultures and structures which have an effect in their ability to take advantage of their internationalisation. In addition this influence has an effect on their performances. Our empirical results provide evidence that MNCs with higher performances have different national cultural characteristics from the inefficient MNCs.

Therefore, cultural values act as structuring relationships that ensure the transfer of proprietary knowledge across borders, which in turn is the key in multinational success through

increased performance effects (Kogut and Zander, 1993; Teece, 1977). Our results are supported by the study of Davison and Mc Fetidge (1985) which imply that national culture affects the flow of technological know how.

Furthermore, our results indicate that national cultures shape the management and the administration of MNCs. In addition, it can increase the cost of technology implementation which can complicate the transformation process of MNCs and therefore can complicate organizational transformation processes (Bartlett, 1986; Beamish *et al.*, 1994). In fact the effect of national culture on MNCs' performance according to Sullivan (1994a, b) is due to the new systems, structures and other organisational settings that have been used in order for the MNCs to fit and compete to their new global environment. The success of this change and reconfiguration of their internal systems (Benito and Welch 1997, p. 7) to their new global environment will have a direct impact on their performance. This change and reconfiguration according to our results is obliged by MNCs' national cultures and thus has a direct impact on their performances.

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