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Influence of Corporate Education on Firms' Performance

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Mechanisms that influence organizational performance of firms, like investments in corporate education, still are not deeply studied when industries and countries are considered in the analysis. The main objective of this paper is study the influence of corporate education on performance of firms from different countries and over time, through a repeated measure multilevel modeling. Using a sample of 242 companies from 9 countries over 8 years (2007-2014), totaling 1,257 observations, it is verified that investments in corporate education are representative to differentiate companies' mean performance and growth rates in recent years.

Keywords: Corporate education; investment; firm's performance; repeated measure; multilevel modeling.

1. INTRODUCTION

Lots of studies try to verify the influence of some variables on other one mostly recognized as performance variable, or dependent variable. In this perspective, this paper uses the technique known as repeated measure multilevel regression, that allows one to explore the effects of corporate education investment, as well as the

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industry and the country of origin, on firm's performance over time.

In other words, this paper tries to contribute to the study about the source of heterogeneity in company performance over time, specifically in terms of the industry and the country of origin effects. Thus, a three-level approach have to be used, being the first one elated to the time variation (repeated measure), the second to the firms' investment in corporate education and activity sector characteristics and the third to the countries' variables.

2. LITERATURE REVIEW

The importance of multilevel models has increasing in the past few years, with application in many fields. In social sciences, specifically, seminal publications deserve mention, like [1,2,3,4,5,6,7,8,9,10,11,12,13,14].

Some other studies were published to evaluate a specific type of performance, through firms, industries and countries' influences, like [15,16, 17,18,19,20,21,22,23,24,25,26,27,28]. More recently, [29] published an interesting paper discussing multilevel models in the field of education.

In the next section the model itself will be explained.

3. METHODOLOGY

Firstly, in this section, the model proposed is presented, following what was described by [27]. Thus, three-level models consist of 3 sub-models, in which there are t = 1, ..., T_{ij} years at level 1, which are nested in each i = 1, ..., n_j firms that, in turn, are nested in j = 1, ..., J countries. Hence, it is given for level 1 that:

$$y_{tij} = \pi_{0ij} + \pi_{1ij}.YEAR_{tij} + e_{tij} \quad (1)$$

Where:

- t: 1,2, …,T_{ij} (years), j=1,2 …, J (countries) and i=1,2, …, n_j (firms);
- YEAR: variable related to the period of analysis;
- π_{0ij}: expected value of performance variable (mean) of company ij in year 1;
- π_{1ij} is the growth rate of company ij's performance variable; and
- σ^2 is the variance of ε_{ij} (variance of a specific firm over time).

Each level 1 coefficient becomes a dependent variable in the level 2 model, like presented in equation (2).

$$\pi_{pij} = \beta_{p0j} + \sum_{q=1}^{Q_p} \beta_{pqj}.X_{qij} + r_{pij} \quad (2)$$

Where:

- β_{pqj} (q = 0, 1, ..., Q_p) are the level 2 coefficients;
- X_{qij} is the vector of level 2 predictive variables; and
- r_{pij} is the random effect at level 2.

Likewise, the level 3 model can be written as:

$$\beta_{pqj} = \gamma_{pq0} + \sum_{s=1}^{S_{pq}} \gamma_{pqs}.W_{sj} + u_{pqj} \quad (3)$$

Where:

- γ_{pqs} (s = 0, 1, ..., S_{pq}) are the level 3 coefficients;
- W_{sj} is the vector of predictive variables at level 3; and
- u_{pqj} is the random effect of level 3.

The database of the 500 Best and Biggest Companies issued by Revista Exame was the source for this research. Initially, data were extracted for all sets of companies available in the database for the period from 2007 to 2014. The original database contained companies from 22 countries over 8 years, totaling 7,384 observations. After a treatment that excluded observations with missing values and with less than three periods, as well as countries with less than three firms, in the final database remained 1,257 observations, with 242 firms from 9 countries.

The adopted performance variable was the adjusted profitability disseminated in the above mentioned ranking. The level 2 variable related to the activity sector was obtained from the same database. These and other variables (levels 2 and 3) are displayed in Chart 1.

The hypotheses for testing are in line with the logic proposed by [30] and can be described as follows:

Hypothesis 1: There exists significant variability in company performance over time.
Hypothesis 2: There exists significant variability in performance, over time, among firms from the same country.
Hypothesis 3: There exists significant variability in performance, over time, between firms from different countries.
Hypothesis 4: Companies' performance follows a linear trend over time and there is significant variance among them.
Hypothesis 5: The firms' characteristics, such as investment in corporate education, explain the performance variation over time.
Hypothesis 6: The countries' characteristics, such as the competitiveness ratio, per capita GDP or insertion in the G8 explain performance differences among the companies over time.

To verify each of these hypotheses, the following models have to be applied.

3.1 Null Model

Level 1 (Repeated Measure):

$$PERF_{tij} = \pi_{0ij} + e_{tij} \quad (4)$$

PERF: performance variable represented by adjusted profitability;
t=1,2, …,T_{ij} (years), j=1,2 …, J (countries) and i=1,2, …, n_j (firms);
π_{0ij}: expected (mean) PERF of firm ij in year 1 (2007).

Level 2 (Firm):

$$\pi_{0ij} = \beta_{00j} + r_{0ij} \quad (5)$$

β_{00j}: mean of expected PERF'S in 2007 for country j.

Level 3 (Country):

$$\beta_{00j} = \gamma_{000} + u_{00j} \quad (6)$$

γ_{000}: general mean of expected PERF's in 2007.

3.2 Linear Trend Model without or with Random Effects

Level 1 (Repeated Measure):

$$PERF_{tij} = \pi_{0ij} + \pi_{1ij}.YEAR_{tij} + e_{tij} \quad (7)$$

π_{1ij}: growth rate of firm ij's PERF.

Level 2 (Firm):

$$\pi_{0ij} = \beta_{00j} + r_{0ij} \quad (8)$$

$\pi_{1ij} = \beta_{10j}$ (without random effects)
$\pi_{1ij} = \beta_{10j} + r_{1ij}$ (with random effects)
β_{10j}: mean of expected growth rates in country j.

Level 3 (Country):

$$\beta_{00j} = \gamma_{000} + u_{00j} \quad (9)$$

$\beta_{10j} = \gamma_{100}$ (without random effects)
$\beta_{10j} = \gamma_{100} + u_{10j}$ (with random effects)
γ_{100}: mean of growth rates of expected PERF's.

3.3 Full Model

Level 1:

$$PERFtij = \pi 0ij + \pi 1ij.YEARtij + etij \quad (10)$$

Level 2:

$$\pi 0ij = \beta 00j + \beta 01j.(IND) + \beta 02j.(RET) + \beta 03j.(CORPEDUC) + r0ij$$
$$\pi 1ij = \beta 10j + \beta 11j.(IND) + \beta 12j.(RET) + \beta 13j.(CORPEDUC) + r1ij \quad (11)$$

Level 3:

$$\beta_{00j} = \gamma_{000} + \gamma_{001}.(ICN) + \gamma_{002}.(PPC) + \gamma_{003}.(G8) + u_{00j}$$
$$\beta_{01j} = \gamma_{010} + \gamma_{011}.(ICN) + \gamma_{012}.(PPC) + \gamma_{013}.(G8)$$
$$\beta_{02j} = \gamma_{020} + \gamma_{021}.(ICN) + \gamma_{022}.(PPC) + \gamma_{023}.(G8)$$
$$\beta_{03j} = \gamma_{030} + \gamma_{031}.(ICN) + \gamma_{032}.(PPC) + \gamma_{033}.(G8)$$
$$\beta_{10j} = \gamma_{100} + \gamma_{101}.(ICN) + \gamma_{102}.(PPC) + \gamma_{103}.(G8) + u_{10j}$$
$$\beta_{11j} = \gamma_{110} + \gamma_{111}.(ICN) + \gamma_{112}.(PPC) + \gamma_{113}.(G8)$$
$$\beta_{12j} = \gamma_{120} + \gamma_{121}.(ICN) + \gamma_{122}.(PPC) + \gamma_{123}.(G8)$$
$$\beta_{13j} = \gamma_{130} + \gamma_{131}.(ICN) + \gamma_{132}.(PPC) + \gamma_{133}.(G8) \quad (12)$$

The coefficients have the same meaning as explained before.

4. RESULTS

While Table 1 presents the decomposition of variance among the levels, Tables 2 and 3 display the results of the models, including the

trend at level 1, without and with the random effects, respectively.

Firstly, one can verify that 8.834% of the performance variability occurred among firms (χ^2 = 877.242, p<0.01) and a relevant percentage of performance variation (91.165%) was due to the time evolution in each firm (Tabel 1). On the other hand, it is verified that only 0.001% of variance is due to differences among countries (χ^2 = 10.778, p>0.05).

While the model without random effects (Table 2) shows that the variable related to the period (trend) with a fixed effect is significant (t = 6.476, p<0.01), through the analysis of Table 3 one can notice that the variance component for the linear trend is also significant (χ^2 = 712.448, p<0.01).

Thus, the results presented in Tables 1, 2 and 4 support hypotheses 1, 2 and 4, but not hypothesis 3, what makes hypothesis 6 be discarded. In order to verify the validity of hypothesis 5, the model proposed becomes automatically a two-level regression, without the trhird level presented in equation (12). The new results are now presented in Table 4.

Chart 1. Definition of level 2 and 3 variables

Level 2 variables (firm)	
Activity Sector (Services, Industry, Warehousing / Retailing)	Dummy Variables: Services: IND = 0 and RET = 0 Industry: IND = 1 and RET = 0 Warehousing / Retailing: IND = 0 and RET = 1
Percentage of Investment in Corporate Education	CORPEDUC
Level 3 variables (country)	
Competitiveness of Nations Index	ICN
per capita GDP	PPC
Participation in G8	Dummy: Non Participation in G8: G8 = 0 Participates in G8: G8 = 1

Table 1. Null model

Fixed effect	**Coefficient**	**Standard error**	**t**
General mean PERF (γ_{000})	1.169	1.507	0.776
Random effect	**Variance component**	**df**	χ^2
Time variation (e_{tij})	8102.459		
Variation among firms (r_{0ij})	785.145**	233	877.242
Variation among countries (u_{00j})	0.098	8	10.778
Decomposition of variance	**% per level**		
Level 1 (time)	91.165		
Level 2 (firm)	8.834		
Level 3 (country)	0.001		

*** p<0.01*

Table 2. Linear trend model without random effects

Fixed effect	**Coefficient**	**Standard error**	**t**
General mean PERF (γ_{000})	-8.103**	1.392	-5.821
General mean of PERF growth rates (γ_{100})	2.053**	0.317	6.476
Random effect	**Variance component**	**df**	χ^2
Level 1			
Time variation (e_{tij})	8003.127		
Level 2			
Initial RENT of firms (r_{0ij})	737.594**	233	874.213
Level 3			
Mean RENT of countries (u_{00j})	0.037	8	10.513

*** p<0.01*

Table 3. Linear trend model with random effects

Fixed effect	Coefficient	Standard error	t
General mean PERF (γ_{000})	-7.964**	1.396	-5.705
General mean of PERF growth rates (γ_{100})	2.012**	0.348	5.782
Random effect	**Variance component**	**df**	χ^2
Level 1			
Time variation (e_{tij})	7996.120		
Level 2			
Initial RENT of firms (r_{0ij})	642.743**	233	733.667
Change rate of firms' trends (r_{1ij})	1.247**	233	712.448
Level 3			
Mean RENT of countries (u_{00j})	0.174	8	3,259
Change rate of countries' trend (u_{10j})	0.007	8	2.196

*** p<0.01*

Table 4. Full two-level model

Fixed effect	Coefficient	Std. error	T
General mean PERF (β_{00})	-10.027**	1.717	-5.839
Influence of industrial sector on general mean PERF (β_{01})	4.127**	0.117	35.273
Influence of retailing sector on general mean PERF (β_{02})	5.478*	2.698	2.030
Influence of corporate education on general mean PERF (β_{03})	7.787**	0.897	8.681
General mean of PERF growth rates over time (β_{10})	3.007**	0.412	7.298
Influence of industrial sector on general mean of PERF growth rates over time (β_{11})	-1.927**	0.478	-4.031
Influence of retailing sector on general mean of PERF growth rates over time (β_{12})	-1.343*	0.696	-1.929
Influence of corporate education on general mean of PERF growth rates over time (β_{13})	0.979**	0.112	8.741
Random effect	**Variance component**	**df**	χ^2
Level 1			
Time variation (e_{ti})	8002.587		
Level 2			
Initial PERF of firms (r_{0i})	667.101**	238	738.558
Change rate of firms' PERF trend (r_{1i})	1.398**	238	717.895

** p<0.05; ** p<0.01*

Through the analysis of the results presented in Table 4, one can notice that investments in corporate education is representative, and with a positive signal, to differentiate both mean performance and performance growth rate among firms over time, what helps to support hypothesis 5.

5. CONCLUSION AND SUGGESTIONS

This king of modeling allows researchers to assess important aspects in databases with longitudinal characteristics. The definition of hypotheses and the main objective about what is being investigated is crucial to help researchers reach interesting findings and, in this sense, multilevel models offer new possibilities of testing different and more complicated hypotheses.

The positive relation between corporate education investment and the performance of firms over time demonstrates the importance of the knowledge to bring more quality in firms' operations, what results in better performances and indicators. It's important to emphasize that high administrations of companies are understanding this kind of fact more accurately in the past few years, independently of industry or country of origin of their firms.

Clearly different models can be applied to confirm the findings. The behavior of companies that operate in other countries also can be investigated. Finally, different periods of time could bring different aspects to the analysis, given that the period considered in this paper includes the explosion of the international financial crisis in many countries, what makes people and firms search for more education, as a kind of career diversification.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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