International Journal of Economics and Financial Issues
Vol. 3, No. 2, 2013, pp.345-354
ISSN: 2146-4138
www.econjournals.com

Market Structure and Performance of Tunisian Banks

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ABSTRACT: The objective of this research is to examine the relationship between market structure and the performance of the Tunisian banking system over the period 1990-2009. The Data Envelopment Analysis (DEA) method was used to assess the scores of x-efficiency and scale efficiency, the hypotheses of the market power theory and those of the efficient structure theory were tested. Our Results have shown that x-efficiency has had a positive and significant effect on the performance of the Tunisian commercial banks as well as the hypothesis of x-efficiency.

Keywords: Bank performance; Market structure; X-efficiency; DEA; Tunisian banks.
JEL classifications: G21; G28; L1

1. Introduction

Faced with the new international financial architecture, the performance of Tunisian banks has been affected by financial liberalization. Indeed, the various measures of the latter have increased interbank competition. Being exposed to advantage of the requirements of these various changes, the bank was marked by extensive restructuring, including the strategy of concentration seems the best solution for better banking performance.

In this context, increasing the concentration of banking in theory allows to create value, gain market power and generate economies of scale and scope in order to seek greater efficiency.

Our present study is in this context which is to analyze the structure-performance relationship of the Tunisian banks. Thus, we will try to answer the following research question: ***what explained the performance of Tunisian banks, by market structure or efficiency?***

It is through this work of dividing up the article into three parts. The second will be devoted to a brief review of the literature, the third will deal with the adopted research methodology, and finally the fourth part will present the results provided along with their interpretations.

2. Theories and Synthesis of Empirical Studies

The idea that the market structure may influence the performance of firms derived from the advanced industrial economy. In this context, many empirical studies have attempted to highlight the link between the performance of the banking system and market structure.

There are two competing theories explaining the relationship between bank performance and market structure: the theory of Market Power (MP) and the theory of Efficient Structure (ES). Regarding the theory of MP, it includes two hypotheses: Structure-Conduct-Performance hypothesis (SCP) and Relative Market Power hypothesis (RMP).

First we begin by SCP hypothesis, referring to the work of Fu and Heffernan (2009), the SCP paradigm posits that there is a relationship between the unidimensional structure of a market linking on the one hand firms behavior in the presence to their performance on the other hand. In other words, each bank will tend to use its market power to increase interest rates on loans and reduce those paying deposits. Therefore, the more concentrated the banking system, the more it is able to earn higher profits and thereafter the more it efficient will be.

In addition, the RMP hypothesis stresses that only firms with large market shares that are able to properly diversify their products, can exercise market power to set prices for their products and earn high profits (Berger, 1995).

With regard to the theory (ES), it has also two hypotheses: the hypothesis of x -efficiency [1] (ESX) and the hypothesis of scale efficiency [2] (ESS).

ESX hypothesis assumes that the most efficient-x firms can earn higher profits due to production technology and a superior management that allow them to reduce their costs (Berger, 1995). Thus, high levels of x-efficiency give the banks the opportunity to earn higher profits and be more efficient.

However, the difference in the profitability of firms is not only caused by differences in management skills. Indeed, firms that have management techniques and technologies of production may have different economies of scale. In this context, according to ESS the assumption, this difference is due in part to differences in the levels of efficiency of scale that relates the size and cost of production and is linked to the performance analysis of scales. At this regard, those who produce at output levels close to the point of minimum average cost can achieve significant efficiencies of scale (Berger, 1995). Thus, banks that produce at scales more efficient compared to other competitors have lower unit costs and higher profits.

Yu and Neus (2005) studied the structure-performance relationship of the banking sector Allmend, and the results they found back up the ESS hypothesis and the SCP hypothesis.

Park and Weber (2006) studied the hypothesis of the theory MP and those of the ES theory for a sample of Korean banks over the period 1992-2002. They found a support of the ES theory (hypothesis ESX and ESS). Indeed, their results showed that efficiency had a positive effect on the performance of these banks.

Chortareas et al., (2009) studied a sample of banks for a number of Latin American countries during the period 1997-2005. To do this, they tested the hypothesis of the MP theory and those of the ES theory, these authors have used DEA method[3] to estimate x-efficiency and scale efficiency scores. Chortareas et al., (2009) argue that efficiency improvement has increased the performance of banks in Latin America thus supporting the assumptions of the ES theory.

Fu and Heffernan (2009) examined the relationship between market structure and performance of the Chinese banking system for the period 1985-2002, a period when the area was subjected to a gradual but significant reform. Their results showed that x-efficiency in this sector has decreased significantly and most banks operated below the levels of efficiencies of effective scale. Thus, for them the hypothesis of the ES theory is unverified while the hypotheses of the MP theory are confirmed.

As for Mensi and Zouari (2011), they have tried to distinguish between the MP theory and the ES theory using DEA method to estimate x-efficiency scores and those of efficiency of scale, they found support for the second theory. This result suggests that during the period 1990-2005, Tunisian banks have sufficiently adopted a competitive behaviour and have improved their performance, not because of their market power, but by improving the efficiency of their operations.

3. Research Methodology

In this section we will analyze the relationship structure-performance of Tunisian banks. To do this, the model specification will be discussed in the first part and the measure of the efficiency of these banks will be the second part.

3.1 Model Specification

To study the relationship structure-performance banking, we propose to test the empirical validity of two hypotheses that are part of the theory of market power (MP), namely: the hypothesis of Structure-Conduct-Performance (SCP) and the hypothesis of Relative Market Power (RMP), and the

[1] The concept of x-efficiency has been the subject of numerous studies to measure the shortfall due to poor knowledge of the technical aspects of production and misallocation of resources.

[2] The phenomenon of scale efficiency relates the size and cost of production and relates to the analysis of economies of scale. In this context, according Chaffai and Dietsch (1999), a bank benefits from increasing returns or economies of scale when it has not yet reached the optimal size which minimizes costs.

[3] DEA: Data Envelopment Analysis.

two hypotheses that are part of the theory of Efficient Structure (ES), namely: the hypothesis of x-efficiency (ESX) and the hypothesis of efficiency of scale (ESS).
Estimating function is[4]:

$$ROA_{i,t}=\alpha_0+\beta_1 CONC_t+\beta_2 MS_{i,t}+\beta_3 XEFF_{i,t}+\beta_4 SEFF_{i,t}+\beta_5 \log TA_{i,t}+\beta_6 OWN_{i,t}+\varepsilon_{i,t} \quad (1)$$

With:

- $ROA_{i,t}$: it's question of the variable reflecting the performance of bank i in the year t, measured by return on assets[5].
- $CONC_{t,}$: the variable reflecting market concentration for the year t, we use the HHI Herfindahl-Hirschman to measure this variable[6].
- $MS_{i,t}$: it is the market share in terms of deposit of bank i in the year t[7].
- $XEFF_{i,t}$: it is the x-efficiency of bank i in the year t estimated by the DEA method.
- $SEFF_{i,t}$: it is the scale efficiency of bank i in the year t estimated by the DEA method.

The bank i control variables in the year t:

- $log\ TA_{i,t}$: the size of the bank measured by the logarithm of total assets of bank i in the year t.
- $OWN_{i,t}$: the ownership structure of the bank i in year t. It takes the value 0 for state banks and the value of 1 for private banks. . It takes the value 0 for public banks and the value of 1 for private banks.

- $\varepsilon_{i,t}$: the error terms.

However, for the SCP and RMP hypotheses are verified, the sign of the coefficients of CONC and MS should be significant and positive. Similarly, a coefficient of XEFF significant and positive supports the hypothesis of XEFF. The coefficient of SEFF should be positive and significant if the hypothesis SEFF is true.

Moreover, according to Berger (1995), it is possible that measures of concentration and market share are endogenous in the model of the ES, that is to say, the most efficient firms may belong to concentrated markets and / or have large market shares. Thus, if the hypotheses of the ES theory are valid, it is necessary that the efficiency has a significant positive effect on the market structure. So to ensure this condition, two additional equations are to be estimated:

$$CONC_t=\alpha+\beta_1 XEFF_{i,t}+\beta_2 SEFF_{i,t}+\beta_3 logTA_{i,t}+\beta_4 OWN_{i,t}+\varepsilon_{i,t} \quad (2)$$

$$MS_{i,t}=\alpha+\beta_1 XEFF_{i,t}+\beta_2 SEFF_{i,t}+\beta_3 logTA_{i,t}+\beta_4 OWN_{i,tt}+\varepsilon_{i,t} \quad (3)$$

Thus, the necessary condition is verified when the signs of the coefficients XEFF and SEFF are significant and positive in the equations (2) and (3), that is to say $\beta 1 > 0$ and $\beta 2 > 0$. In other words, the most efficient banks are performing and can belong to concentrated markets and / or have large market shares.

3.2 Efficiency of banks: a DEA analysis

First we start by introducing some methodological elements necessary for the efficiency measure, and then we proceed to the presentation of the sample and data.

3.2.1 DEA

For the purpose of our study, we choose the DEA (Data Envelopment Analysis) to measure efficiency. We consider this approach as the most appropriate for the following reasons: First, this approach provides a higher degree of flexibility because it does not force us to choose a functional form of the border that links inputs and outputs imposed to all banks in our sample. Second, this method allows easy decomposition of technical efficiency into pure technical efficiency and scale efficiency and x-efficiency into technical efficiency and allocative efficiency when input prices are included. Third, the scores obtained with the DEA can obtain an aggregate score, which indicates the efficiency of each bank in relation to a set of compatible banks.

This method initially introduced by Charnes et al., (1978) is a non-parametric approach, based on sample data; the data envelopment analysis involves using mathematical programming to

[4] We apply the model of Fu and Heffernan (2009).
[5] ROA= resulting net / total assets.
[6] The Herfindahl-Hirshman index uses market share as the main variable. It is defined as the sum of the squares of the share of each bank in the market.
[7] It is the ratio of total bank deposit of each in relation to the sum total of all deposit banks in the sample.

construct an efficient virtual frontier. Operations on that border correspond to 100% efficient entities, while those outside this boundary are not totally efficient.

In this context, the DEA has been defined by Charnes and al (1978) as: "A mathematical programming model applied to observed data (That) provides a new way of obtaining empirical estimates of external relationships such as the production functions and /or efficiency production possibility surfaces that are the cornerstones of modern economics".

The DEA can be considered in two ways: input orientation and one output, the results differ depending on whether they adopt the assumption of constant returns to scale (CRS model: Constant Return to Scale) or returns scale variables (VRS model: Variable Return to Scale).

These two models are presented in the following paragraphs:

*** CRS model**

Referring to Kalaitzandonakes et al., (1992), we consider a sample of k firms where each uses M inputs to produce different N outputs.

Baskets of inputs and outputs are reduced by the DEA to a pair (input, output) qualified by Charnes and al (1978): virtual input and virtual output.

For a firm in the sample, we can obtain this measure by solving the following mathematical programming model:

$$Max_{\alpha,\beta} \alpha Y_i / \beta X_i$$

S.C

$$\alpha Y_j / \beta X_j \leq 1$$

For j = 1,2,…..k

Where:

α et β are the vectors of coefficients to be estimated;

Yi and Xi respectively vectors reviewing inputs and outputs of the firm "i".

For each firm, the program maximizes the ratio of virtual output / virtual input, forcing not to exceed 1. Thus, firms in the sample are necessarily located on or below the efficient frontier.

Charnes and Cooper (1962) have developed a process for fractional programming models for a formulation of the previous model in the following linear form:

$$Min\theta$$

S.C

$$Y\lambda \geq Y_i$$

$$\theta X_i - X\lambda \geq 0$$

$$\theta \text{ any, } \lambda \geq 0$$

Where:

Y = [Y1, ..., Yk] is a matrix N * k outputs.

X = [X1, ..., XK] is a matrix M * k inputs.

Yi and Xi are respectively, the vectors of inputs and outputs of the firm "i".

θ is a scalar of arbitrary sign.

λ is a vector of dimension k positive coefficients to be estimated.

The optimal solution is a measure of its technical efficiency is given by the resolution of this problem.

*** The VRS model**

According to Coelli et al., (1998): "the CRS assumption is only appropriate when all firms are operating at an optimal scale. Imperfect competition constraints on finance etc, way cause a firm to be not operating at optimal scale".

VRS model is proposed for the first time by Banker and al (1984), this model is an extension of the CRS model but takes into account situations where returns to scale are not constant. In this case, the CRS model can be modified taking into account the hypothesis of variable returns to scale. Simply add a constraint on the parameters of intensity CRS model, we obtain:

$$Min\theta$$

S.C

$$Y\lambda \geq Y_i$$

$$\theta X_i - X\lambda \geq 0$$

$$\theta \text{ any, } \lambda \geq 0$$

$$N1'\lambda = 1$$

Where: N1 is a N * 1 vector of units.

To Coelli et al., (1998), a good measure of scale efficiency of a firm is the difference between the index of technical efficiency obtained through DEA type CRS and the obtained by the DEA type VRS. On the same database to get such a measure, these researchers suggest performing a DEA, CRS type and another VRS type. If there is a difference for a given firm in the efficiency index measured by these two types of DEA, this implies that the firm does not operate at an optimal scale. The scale inefficiency is the result of the difference between CRS technical inefficiency and VRS technical inefficiency.

In this work, we use the DEA input-oriented variable returns to scale. First, the input-oriented method allows us to determine the cost savings of input possible to achieve for each unit of the sample if it was as efficient as the firm best practices. Second, this method can test the hypothesis of scale variable returns that is most consistent with the environment of imperfect competition in which credit institutions operating in Tunisia, in fact, the hypothesis scale constant returns is only appropriate if the firm operates at an optimal scale, which is not always the case.

3.2.2 Application

The period of this study corresponds to the post- liberalization and covers the years range between 1990 and 2009.

The data used are taken from the annual reports of the APTBEF[8].

*** Presentation of the sample**

The selection of banks is exclusively on Tunisian commercial banks for two reasons. On the one hand, they play the most important role in financing the economy, and secondly, to avoid difficulties due to lack of data.

The sample consists of 10 commercial banks which are as follows:

STB : Sociétés Tunisiennes de Banques
BNA: Banque Nationale Agricole
BIAT: Banque International Arabe de Tunisie
BH: Banque de l'Habitat
AB: Amen Bank
BAT: Banque Attijari de Tunisie
UIB: Union Internationale de Banques
BT: Banque de Tunisie
ATB: Arab Tunisian Bank
UBCI: Union Bancaire pour le Commerce et l'Industrie

*** Definition of data**

Before defining the data, we choose the approach as related to banking production. And considering the operation of the Tunisian banking system where banks use deposits collected to be involved in a credit policy, it seemed more logical to adopt the approach of mediation. This approach assumes that the bank collects deposits to transform them into loans including labor and capital in the process of transformation, as opposed to the production approach which assumes that the bank uses labor and capital to produce deposits and loans.

Thus, according to the intermediation approach, inputs, their costs, prices and outputs are shown in the following table 1:

Inputs:

- L = number of bank employees.
- K = net fixed assets.
- F = total bank deposit.

[8] L'Association Professionnelle Tunisienne des Banques et des Etablissements Financiers.

Table 1. Inputs, their costs, prices and outputs

Inputs, their costs and prices			Outputs
Inputs	*Input costs*	Price of inputs:	. Y1: total customer loans .Y_2 : securities portfolio
. L: labor . K: physical capital . F: financial capital	. CL: labor costs . Ck: cost of physical capital . CF: cost of financial capital.	. WL = CL / L . WK = CK / K . WF = CF / F	

Input costs:
. CL: payroll.
. CK: capitalized value + depreciation and provisions.
. CF: expenses incurred on foreign cash and deposits on customer loads + expense on bonds + miscellaneous losses.
Price of inputs:
. WL = CL / L
. WK = CK / K
. WF = CF / F
outputs:
. Y1 = wallet discount receivable + customer loans on special resources + other loans to customers.
. Y2 = is a line item in the balance sheet.

4. Empirical Results and Interpretations

First, we will look to the scores of x-efficiency and scale efficiency of Tunisian commercial banks in our sample, then the structure-performance relationship of the latter for the period 1990-2009.

4.1 X-efficiency and scale efficiency of Tunisian commercial banks

The mean values of x-efficiency scores and scale efficiency[9] are outlined in the following table 2:

Table 2. Scores on the x-efficiency and scale efficiency during the period 1990-2009

Public banks			Private banks		
Banks	x-efficiency	scale efficiency	Banks	x-efficiency	scale efficiency
STB	0,366	0,898	BIAT	0,361	0,824
BNA	0,534	0,931	AB	0,27	0,740
BH	0,503	0,893	UBCI	0,270	0,705
BAT[10]	0,455	0,719	BT	0,318	0,711
UIB[11]	0,498	0,739	ATB	0,538	0,612
medium	0,471	0,836	medium	0,351	0,718
medium	X-efficiency industry average = 0,413 scale efficiency industry average = 0,777				

X-efficiency of the sector during the period 1990-2009 is estimated at 41.3%. This is reflected by the fact that inefficiency cost is on average around 58.7%. In other words, the inefficiency term reflects a waste of resources in the Tunisian banking sector of around 58.7%.

It should be noted that the analysis of our results shows that seven banks are 100% efficient-x, which shows that the reduced size of our sample is a problem. According to Weill (2006), DEA has a drawback that is a reduced number of observations relative to the number of inputs and outputs can lead to a large number of banks by 100% efficient default not because they dominate the other banks, but simply because no other bank or any linear combination of its banks are comparable.

[9] The application used to calculate- efficiency and scale efficiency scores is provided by the software DEAP version 2.1.
[10] Ex BS until 2005.
[11] The UIB was privatized in November 2002.

For efficiencies of scale, in particular, we will look at determining the contribution of a change in size to reduce banking costs. The results suggest that banks in our sample, whether public or private, have a degree of scale efficiency using relatively large, it is about 77.7%. This means that banks can reduce their costs on average 22.3% increase in their size.

4.2 Structure-Performance Relationship of Tunisian Banks

For the three estimated[12] models, the correlation matrix is to verify the degree of correlation between variables, revealing that the level of correlation between them is very small which justifies the absence of multi collinearity[13].

As the data are panel data, we have to specify the fixed effects estimates or random effects. Therefore, the Hausman specification test for three models is required[14]. We note that this test is not significant for the first two models, hence the need to Breush Pagan test. This is significant for the first model (significant at 5%) and the second (significant at 1%), so estimates for these two models is the random effects. In the third model, the Hausman test is significant (significant at 5%), so the estimate is fixed effects[15].

Table 3. Results of estimating the random effects model 1

roa	Coef	Std. Err	z	P>|z|
conc	-1598912	0626742	-2.55	0.011**
ms	-0305453	0236798	-1.29	0.197
xeff	0052008	0005460	4.58	0.000*
seff	-0011194	0042673	-0.26	0.793
logta	0001625	0006116	0.27	0.791
own	-0014678	0003697	-3.97	0.000*
cons	0260653	0123636	2.11	0.035
R-sq: within = 0.0332 Between = 0.3084 Number of obs = 200 Number of groups = 10				

* A significant at 1%.
** A significant at 5%.

According to Table 3, the coefficient of the variable CONC is negative and significant. This implies that the profitability of Tunisian commercial banks in our sample decreases along with the concentration. In other words, the monopoly of the big banks is an obstacle to bank performance. This negative correlation can be explained by the fact that the banks benefiting from the rule of "too big to fail" may be involved in more risky activities, claiming being insured and saved by the regulatory authorities that could sometimes be forced to act as lender of last resort.

Thus, we can say that the concentration is less beneficial in terms of profitability of these banks than the competition. It is therefore necessary to improve the conditions of the latter in the Tunisian banking sector to ensure greater profitability.

Thus, the SCP hypothesis that there is a significant and positive relationship between concentration and bank performance is not checked in the Tunisian context.

Regarding the variable MS, it is not significant in the first model; this suggests that market shares in deposits of Tunisian commercial banks do not influence their performance. So the RMP hypothesis which states that banks with larger market shares would be most beneficial is not verified in the Tunisian context.

However according Table 3, the coefficient of the variable XEFF shows a positive and significant sign. This is reflected by the fact that the profitability of Tunisian commercial banks increases with x-efficiency. More specifically, these banks are more efficient than others because the

[12] Estimates using STATA 10.
[13] See annex1
[14] See annex2
[15] See annex3

quality of their organizations allowing them to generate better physical flows or financial transactions processing, giving them the opportunity to earn higher profits.

Table 4. Results of estimating random effects model 2

CONC	Coef.	Std. Err.	z	P>|z|
XEFF	0303661	0552110	5.50	0.000*
SEFF	0198153	0094358	2.10	0.036
LogTA	0844632	0279679	3.02	0.003
OWN	-0922658	2306645	-0.40	0.687
_conc	0128784	0445612	2.89	0.004
R-sq: within = 0.4124 Between = 0.8583 Number of obs = 200 Number of groups = 10				

* A significant at 1%.

Table 5. Resultants of estimating fixed effect model 3

Ms	Coef.	Std. Err	t	P>|t|
xeff	0278278	.0111099	2.50	0.013**
seff	-0980319	.0156697	-6.26	0.000
logta	0060152	.0021103	2.85	0.005
own	-0265865	.0056718	-4.69	0.000
_cons	092035	.0360237	2.55	0.011
R-sq: within = 0.4725 Between = 0.0535 Number of obs = 200 Number of groups = 10				

** A significant at 5%.

It's quite important to recall that the hypothesis of ESX is checked only if x-efficiency has a positive and significant effect on the market structure (CONC and MS). In this case, the tables (4) and (5) show that XEFF is positively and significantly on the CONC and MS, consequently, this hypothesis is verified in the Tunisian context.

As for the SEFF coefficient, it is not significant in the first model, thus our results do not favor the hypothesis of the ESS which stipulates that a positive and significant relationship between scale efficiency and bank performance. Therefore, this hypothesis is not satisfied in the Tunisian context. Turning now to the interpretation of control variables. The results shown in Table (3) show that the size of the bank approximated by the variable log TA is not significant; this suggests that the advantage of the performance of Tunisian commercial banks in our sample is not influenced by the size.

This table shows that the dummy variable for ownership structure (OWN) is significantly and negatively correlated with the performance of Tunisian commercial banks. Therefore, public banks are more efficient than their private counterparts. This can be explained by the fact that the profitability of these banks is favored by the shareholding by public institutions, most of which have trained staff and able to operate in a free market economy with significant management capabilities. In addition, we can say that in a developing country as Tunisia, the state plays the crucial role in the economic life and the private sector alone is unable to ensure the proper functioning of the economy.

5. Conclusion

In this study, we investigated the structure-performance relationship of 10 Tunisian commercial banks for the period 1990-2009. To this end, we tested the hypothesis of the theory of market power MP (SCP hypothesis and the hypothesis RMP) and those of the theory of efficient structure ES (XEFF hypothesis and the hypothesis SEFF).

In the case of the theory of efficient structure, in particular, the scores of x-efficiency and those of scale efficiency were obtained using the non-parametric method for estimating the efficiency DEA. The results showed that the banks in our sample showed an average level of efficiency-x (41.3%) and a relatively high level of scale efficiency (77.7%) over the studied period.

However, the empirical validity of the relationship between market structure and bank performance has shown that there is a strong support for the hypothesis of x-efficiency (ESX). While, Structure-Conduct-Performance (SCP) hypothesis of relative market power (RMP) and scale efficiency (ESS) have not been verified in the Tunisian context. This suggests that the period chosen, the performance of Tunisian commercial banks is conditioned by improving their efficiency-x.

Regarding the used control variables, the results showed that public banks are more efficient than private banks, and the size does not affect the banking performance.

To conclude, it should be noted that there are other fields of research that can be explored. Indeed, it would be very interesting to study the structure-performance relationship of Tunisian banks selling insurance products: Bank-insurance.

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Appendix

Appendix 1:
Correlation matrix between the variables:
pwcorr roa conc ms xeff seff logta own

	roa	conc	ms	xeff	seff	logta	own
roa	1.0000						
conc	-0.1797	1.0000					
ms	-0.1113	0.0017	1.0000				
xeff	0.0861	0.0254	0.2111	1.0000			
seff	-0.0159	0.1427	-0.4907	-0.1463	1.0000		
logta	0.0098	-0.1185	0.3026	-0.0309	-0.0772	1.0000	
own	-0.0943	0.0891	-0.4979	-0.0088	0.3604	-0.2063	1.0000

Appendix 2:
Hausman tests:

	Hausman test statistic	significance
Model 1	0,9103	not significant
Model 2	0,5391	not significant
Model 3	0,0108	significant

Appendix 3:
Breush Pagan tests:

	Test statistic Breush Pagan	significance	Effet fixe / Effet aléatoire
Model 1	0,0268	significant	random effect
Model 2	0,0000	significant	random effect
Model 3	-	-	fixed effect