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THE EFFİCİENCY OF BANKİNG SECTOR İN TURKEY: NONPARAMETRİC CONDİTİONAL APPROACH BASED ON PARTİAL FRONTİER

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Abstract

This paper focuses on nonparametric efficiency analysis based on robust estimation of Partial Frontiers. A nonparametric estimator is proposed achieving strong consistency and asymptotic normality. In this context, the main aim of this paper is how changed efficiency score of this sector in this period. So, the paper analysed 17 different banks with 1999 to 2016 period in the Turkish banking sector. Overall, it does show us that the Turkish banking sector focused on output-oriented efficiency from 1999 to 2016.This result is supported by m-order and super-efficiency firms scores. Then, output-oriented and hyper-oriented are so close fluctuated together. This show that Turkish banking sector was focused output efficiency more than input efficiency. The efficiency score of the Turkish banking sector are moderate for the period covered ($0.6 \geq \alpha \geq 0.4$).

Key Words: Banking; Technical Efficiency; Robust Nonparametric Quantile; Partial Frontier Approach; Turkish Banking Sector; Production Function

JEL Code: G21, G20, D2

TÜRK BANKACILIK SEKTÖRÜNÜN ETKİNLİK ANALİZİ: PARAMETRİK OLMAYAN KISMİ SINIR YAKLAŞIMI BAĞLAMINDA

Öz

Çalışmada, parametrik olmayan Parçalı Sınır yöntemi kullanılmıştır. Bu yöntem parametrik olmayan yöntemler içinde güçlü tutarlılık ve asimptotik normallik içermektedir. Bu bağlamda, 1999 ile 2016 yılları arasını kapsayan 17 banka ile Türk bankacılık sistemi incelenmiştir. Özetle, analiz sonuçları göstermektedir ki 1999 ile 2016 yılları arasında çıktı yönlü etkinlik görülmektedir. Bu durumu m-order ve süper etkinlik değerleri firma bazında desteklemektedir. Çıktı ve aşırı (hyper) etkinlik değerleri ele alınan dönem içinde birlikte seyretmektedir. Bu durumda, girdi yönlü etkinlikten çok sektörün çıktı yönlü etkinliğe odaklandığını desteklemektedir.

Anahtar Kelimeler: Bankacılık; Teknik Etkinlik; Parçalı Sınır Yöntemi; Türk Bankacılık Sistemi; Üretim Fonksiyonu

JEL Kodu: G21, G20, D2

1. INTRODUCTİON

After the 2000 and 2001 financial crises, the structure dynamics of Turkish banking sector changed so quickly. Especially, the new banking law played a big role in this. On the other hand, the main aim of this paper is how changed efficiency score of this sector in this period. So, the paper analysed 17 different banks with 1999 to 2016 period in the Turkish banking sector. This paper focuses on nonparametric efficiency analysis based on robust estimation of

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Partial Frontiers (PF). The PF is proposed achieving strong consistency and asymptotic normality.

As regards theoretical work, Both DEA (Data Envelopment Analysis) and FDH (Free Disposal Hull) estimators of *P* fully envelop all of the sample observations; for this reason, they are called "full-envelopment estimators." Full-envelopment estimators are especially responsive to outliers or extreme observations. Alternatively, one can use robust, partial frontier estimators, which also offer other advantages. Recent papers by (Cazals et al.; 2002), (Aragon et al.; 2005), and (Daouia and Simar; 2005, 2007), (Wheelock and Wilson; 2008), (Simar and Wilson; 2011), (Simar and Vanhems; 2012), and (Simar et al.; 2012) have developed robust alternatives to the traditional FDH and DEA estimators.

2. DATA AND METHODOLOGY

The paper analysed 17 different banks with 1999 to 2016 period in the Turkish banking sector. In the present study I use of one output indicators and three input indicator. As output indicator, I take mean the total value of output for Banks. As input indicators, I take mean deposit, equity and labour expenditure for Banks. I estimated production function in this analysis. Table.1 is descripted indicators mean, max., min. and standard deviation values (in below).

Table.1 Descriptive statistics

	Mean	**Max**	**Min**	**Stand. Dev.**
The total value of *output* (in TL) for Banks involved	21095547	5831	1.62E+08	32930252
The total value of *deposit* (in TL) for Banks involved	14370228	212	1.26E+08	22852317
The total value of *equity* (in TL) for Banks involved	2306079	283	17921364	3539053
Total value of *labor expenditure* (in TL) for Banks	257358.3	15	1819222	329895

In the present study I have used three variants of model orientation: input, output and Graph Hyperbolic. In the input oriented approach, I compare the actual input usage with benchmark input usage while in the output oriented approach, I compare the actual output with benchmark output. In the Graph Hyperbolic approach I assume as if the fund tries simultaneously output and minimize input (Sinha; 2015).

Order-m Partial Frontiers

(Cazals et al.; 2002) acquaint a notion of a 'partial' frontier (as facing to the 'full' frontier ψ^{ϑ}) that ensures a less-heavy benchmark than the aid of the random variable (X,Y) and has its possess economic interpretation.

As described by (Cazals et al.; 2002), the order-m frontier can then be calculated as

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$$\varphi_m(y) = \int_0^\infty \left[1 - F_{X/Y}(x/y)\right]^m dx$$

Thus, the benchmark for a unit (x,y) fertiling a level y of outputs is the looked minimum input level among m firms drawn at random from the population of firms producing *at least* output level y. The order-m input efficiency score, as the expectation of this random variable, was defined by (Cazals et al.;2002), that is,

$$\widetilde{\theta_m}(x,y)=\mathbb{E}\left[\widetilde{\theta_m}(x,y)/Y \geq y\right]=\int_0^\infty \left[1 - F_{\overline{Y}}^{X}(\eta x/y)\right]^m d\eta.$$

a simple Monte Carlo method can calculate easily this.(Simar and Wilson; 2015).

Order-α Quantile Frontiers

An different partial frontier notion for describing a less-heavy benchmark than the full frontier is depended to the notion of conditional quantiles, even though varied from the regular conditional quantile. The resulting efficiency evaluate is described by (Simar and Wilson; 2015).

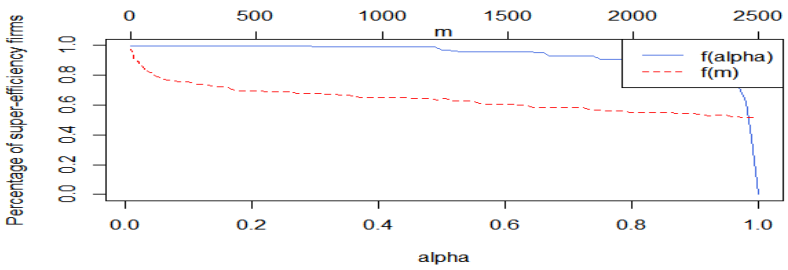
$$\theta_\alpha(x,y) = inf\left\{\theta / F_{\overline{Y}}^{X}(\theta x/y) > 1-\alpha\right\},$$

3. EMPİRİCAL RESULTS

In this chapter, I calculated statistics of technical efficiency scores. These scores have order-m, order-alpha and bootstrap order-m efficiency score. I found graphs of technical efficiency. These graphs have order-m, order-alpha and Super efficiency firms graphs.

Choice of m and α:

Figure.1 Parameter-Outlier Relationship



In the diagram [Figure.1], I present the relationship between the value of m and alpha with the percentage of super-efficient firms included in the construction of the frontier. When alpha=1 the frontier is a full frontier where all super-efficient firms are included. Similarly, form m ≥ 2500, the order-m frontier also converges with the half frontier. On the basis of the relationship exhibited in [Figure.1], the following values are selected: m=8 and alpha=0.67.The values correspond to a partial frontier where almost 7 % of the funds are dropped.

Table.5 Super-efficiency-partial frontier parameter relationship

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Percentage of funds declared as super-efficient	Value of m	Percentage of funds declared as super-efficient	Value of α
93	8	93	0.67
75	196	75	0.96
61	1380	61	0.98
51	2500	0	1

Sourced: Calculated.

Descriptive Statistics of Technical Efficiency Scores:

[Tables.2] presents the descriptive statistics of technical efficiency scores corresponding to alpha-order Frontier using three orientations- input oriented, output oriented and graph hyperbolic.

Table.2 Descriptive Statistics of Efficiency Scores (Order-m)

Percentage of firms included	Mean Technical Efficicency		
	Output Oriented Approach	Input Oriented Approach	Graph Hyperbolic Approach
12.5	0.69	0.76	0.98
25	0.38	0.64	0.88
50	0.90	0.28	0.94
75	0.63	0.51	0.83
100	1.12	0.67	1.09

Sourced: Calculated.

On the other hand, [Table.3] presents the descriptive statistics of technical efficiency scores corresponding to alpha-order Frontier using three orientations- input oriented, output oriented and graph hyperbolic.

Table.3 Descriptive Statistics of Efficiency Scores (Order-alpha)

Percentage of firms included	Mean Technical Efficicency		
	İnput Oriented Approach	Output Oriented Approach	Graph Hyperbolic Approach
12.5	0.99	0.48	0.65
25	0.13	0.81	0.90
50	0.55	0.29	0.87
75	0.32	0.65	0.91
100	0.99	1.20	0.93

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Sourced: Calculated.

Bootstrap Estimates:

Computation procedure for bootstrap estimates of efficiency in case of Order- α is yet to be developed. Under the circumstances, we consider the bootstrap estimates in case of order-m. It is generally agreed that in case of order-m, re-sampling of data for 200 times provides robust bootstrap estimates. [Table 4] provides the descriptive statistics of bootstrap estimates for different values of m.

Table.4 Bootstrap Estimates of Mean Technical Efficiency (Order-m)

Value of m	**Percentage of funds included in the frontier**	**Input Oriented Approach**	**Output Oriented Approach**	**Graph Hyperbolic Approach**
21	10	0.74	0.30	0.47
42	20	0.50	0.52	0.38
110	50	0.36	0.40	0.14
150	75	0.30	0.45	0.28
220	100	0.23	0.38	0.22

Sourced: Calculated.

4. CONCLUSİON

Our estimation results based on hyperbolic α and m-quantiles indicate that Turkish banking sector generally became more efficient between the years 1999 and 2013. The results of the α-quantile approach in a relationship the total assets and others (Deposit, Equity and Salary). Hyper direction and output direction are close to each wave in the database. It does show us that the Turkish banking sector focused on output-oriented efficiency from 1999 to 2016. According to the m-quantile approach in a relationship the total assets and others (Deposit, Equity and Salary). Hyper direction and output direction are close to each wave in the database. It does show us that the Turkish banking sector focused on output-oriented efficiency from 1999 to 2016. In the diagram [Figure.1], I present the relationship between the value of m and alpha with the percentage of super-efficient firms included in the construction of the frontier. When alpha=1 the frontier is a full frontier where all super-efficient firms are included. Similarly, form m ≥ 2500, the order-m frontier also converges with the half frontier. On the basis of the relationship exhibited in [Figure.1], the following values are selected: m=8 and alpha=0.67 [Table.5].The values correspond to a partial frontier where almost 7 % of the funds are dropped. The efficiency score of the Turkish banking sector are moderate for the period covered (0.6≥α≥0.4) [Figure.1]. This result is supported by m-order and super-efficiency firms scores. Then, input-orianted and hyper-orianted are so close fluctuated together. This show that Turkish banking sector was focused input efficiency more than output efficiency. Indeed, our study shows that robust performance evaluation is attained both in case of point and bootstrap estimates only considering 50 % of the sample observation. Since, in a partial frontier approach, the entire data set is not considered, the estimates are less likely to affect by extreme data.

Overall, our results are thus consistent with the view of (Berger and Mester; 2003) that in the face of increased competition among banks as well as banks and other financial intermediaries, advances in information-processing and financial technologies have not increased productivity of banks, but have rather been "given away" at a large extent to bank customers in the form of improved service quality and lower prices.

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