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**Research Article**

## Does Managerial Decisions Affect Efficiency Profiles of Intermediary Institutions? Evidence from Emerging Economy

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### ABSTRACT

Intermediary institutions have been at the heart of financial systems in efficient allocation of resources in emerging economies and a reliable assessment of that system is a prerequisite to managerial decision-making. After more than 30 years of development, the capital market system has been basically formulated in Turkey, and the intermediary institutions have experienced a rapid development as well. However, due to the late start of intermediary institutions development in Turkish capital markets, empirical evidence on the efficiency profiles of them is quite scarce and comprehensive efficiency evaluation process has been required.

The main purpose of the research is to assess the efficiency profiles and productivity change of Turkish intermediary institutions during the years 2005 and 2016 using a comprehensive framework based on survey results, Data Envelopment Analysis (DEA) and Malmquist Total Factor Productivity Index. Based on DEA findings, that unique dataset allows to analyze that intermediary institutions in Turkey have highest efficiency scores in terms of scale efficiency. Furthermore, listed ones are significantly more technical, pure technical and scale efficient than their non-listed peers. According to Malmquist index, listed intermediary institutions have more stable in terms of total productivity change than the others during the observation period. Both for the groups, the volatility in technological change is higher than the other efficiency changes. Empirical findings evidence that, on average, the intermediary institutions operating in Turkey have not yet to enhance optimum levels of technical efficiency.

That study may provide a starting point for further investigation and validation into the efficiency of the Turkish intermediary institutions. This strand of research could provide significant information for policy makers for enhancing the level of technological efficiency as well.

### Keywords:

Intermediary Institutions, Data Envelopment Analysis, Efficiency, Malmquist Total Factor Productivity Index, Turkey



## 1. Introduction

The intermediary institutions as one of the key players in capital market, actually enables the efficient circulation in the economy, and directly have great impacts on the sustainability of the market developments one of the key players in capital market. They have direct bearing on the macro indicators which may block the economic and social development finally. Allocating resources, facilitating risk management and mobilizing savings have been the most significant functions of the intermediary institutions (Levine, 1997). Transferring credit to private industry, channelizing funds and enhancing robust information efficiency are closely related with the economic growth as well (Levine et al., 2000).

Development of capital markets development is first and foremost dependent on the existence of a strong and effective financial intermediary system. As with all economic units, intermediary institutions operating in capital markets have to carry out their activities within the framework of efficiency principles. In that context, the general aim of that study is to evaluate the efficiency profiles of Turkish intermediaries with a perspective of being listed on stock exchange or non-listed between the years 2005 and 2016 and accordingly analysing the sectorial development and the supporting factors behind during these years. For identifying the main indicators specifically for efficiency assessment in Turkish capital markets, a comprehensive survey has been structured. The top level executives has been answered that survey during the period December 2017 and March 2018. As of 2017, 65 intermediary institutions are operating in the industry (Turkey Capital Market Association - TCMA, 2018 Report).

The contribution of intermediaries to the Turkish capital markets and the overall development of Turkish intermediary institutions, depicted on Figure 1. Total assets figure has been increased by 8.9 % and reached approximately 23 billion Turkish Liras (TL) at the end of 2017. With a 19 billion TL total liabilities, only 146 million TL constituted in long-term liabilities at the end of 2017. Moreover, the related figure evidence that net income level has increased by 65 %, reaching 799 million TL.

	2016	2017	% change 2017/2016
Current Assets	20,109	21,863	8.7
Fixed Assets	1,069	1,194	11.7
Total Assets	21,178	23,057	8.9
Short term Liabilities	16,703	18,185	8.9
Long Term Liabilities	139	146	5.0
Shareholders' Equity	4,336	4,726	9.0
Operating Income	1,511	1,435	-5.0
Operating Expense	1,981	1,786	-9.8
EBIT	332	774	133.1
Net Profit	483	799	65.4

**Figure 1.** Overall development of Intermediary Institutions in Turkey (million TL)

The rest of that paper has been structured as follows. Following section is dedicated literature review on efficiency evaluation in intermediaries with discussing results. Third section proposes the survey structure, DEA model framework and Malmquist Total Factor Productivity Index. Fourth section summarizes empirical investigation and its results. Finally, fifth section provides conclusions with recommendations for policy makers.

## 2. Literature on Efficiency Evaluation in Intermediary Institutions

It is vital for the institutional authorities to establish effective strategies to deal with the unregistered economy, to promote savings, financial literacy, qualified consultancy services, to create sector-specific legal services, and to prioritize the establishment of institutional governance principles in order to bring sustainable competitive power to the system.

Fukuyama and Weber (1999) examined the activities of 57 intermediary institutions operating in Japan in 1988-1993 period and calculated the Malmquist productivity index. They also compared the effectiveness and efficiency of four large intermediary institutions. The results showed that four large intermediary institutions were more effective than other small scale institutions and technical activities of intermediary institutions tend to increase.

Worthington (1999) investigate the productivity change in 269 Australian credit unions between the years 1993 and 1997 using Malmquist productivity index. Specifically, labour number and assets figure have been found as the most significant indicators in evaluating the efficiency of that credit unions.

Garcia (2010) investigates the Portuguese pension funds management company's efficiencies between the years 1994 and 2007 using DEA-Malmquist Index. The author observes the technical inefficiencies in that period and states that inefficiency might be a consequence of principal and agent conflict (Jensen and Meckling, 1976) which shows the problem of acting managers to role on behalf of the stakeholders in order to establish a sustainable performance.

Huicken (2017) investigate 17 brokerage houses from brokerage houses active in China and reviewed their activities in 2012-2015 and calculated the Malmquist Productivity Index. This study evidence that pure technical efficiency changes were not found as important as in the differences in scale efficiency. Another study related with the Chinese securities markets belongs to Lao and Mo (2018). They investigate the growth rate of total factor and efficiency of 15 Chinese large listed security companies between the year 2009 and 2015. The results evidence that the efficiency of that firms generally showed "V" shape and during these years, there is no remarkable changes in the technical and scale efficiency of listed security firms.

Empirical research on intermediary institution efficiency in Turkey has been rather limited compared to bank efficiency. Due to the late start of intermediary institutions development in Turkish capital markets, research on that hot topic is quite scarce. Gunduz et al. (2001) were among the first to investigate the efficiency of Turkish intermediary institutions using DEA between the years 1997 and 1998. 91 intermediary institutions which were not established by banks were divided into two groups according to their total assets by taking into consideration the scale size. In the first group, 11 intermediary institutions representing 60% of the total asset size in the sector and 80 intermediary institutions having a smaller share in the sector were discussed. No significant results were found for small-scale brokerage houses, and additionally from 11 large-scale intermediaries 4 and 6 of them were found to work effectively.

Kargin and Aktas (2007) present a comprehensive study investigating efficiencies and the changes occurring in total factor productivity was measured by the Malmquist Productivity Index. 65 intermediary institutions operating during the period of 2000-2005 are taken. When the effectiveness of the scale was examined, it was seen that the most effective group was the medium-large group, while the least efficacious institutions were found to be small-scale institutions. Furthermore, Bayram (2016) has studied whether there a remarkable change in the Turkish bank-owned and non-bank owned intermediary institutions' efficiency levels between the years 2009 and 2013. The results of DEA reveal that only 7 of the institutions are efficient and bank owned institutions are found to be more efficient and technological efficient. Another recent study of Aras et al. (2018) explore the differences in terms of efficiency levels of bank-based and non-bank based Turkish intermediary institutions. DEA results reveals that the scale efficiency levels of bank-origin ones are higher than the average score of all bank-origin intermediary institutions except in the year 2008. Moreover, Aras et al. (2018a) evaluate the Turkish intermediary institutions in terms of bank origin and non-bank origin using TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method during 2005 and 2016 years. Empirical findings indicate average rank of Turkish bank origin intermediary institutions performs much more than the non-bank peers during the related period.

### 3. Research Design

Listed and non-listed intermediary institutions have been compared for exploring the disparity of efficiencies and productivity change between 2005 and 2016. The change in total productivity has been estimated in terms of technically efficient change and technological change utilizing DEA and Malmquist Total Factor Productivity Index.

The steps of this study are as follows:

- Step 1: Identifying proper criteria for intermediary institutions considering DEA CSR and DEA BSC aspects by literature review and structuring survey questions
- Step 2: Determining efficiency profiles of intermediary institutions with a perspective of being listed or non-listed by DEA
- Step 3: Determining the change in their productivity levels by utilizing Malmquist Total Productivity Index
- Step 4: Evaluating the efficiency profiles for the intermediary institutions in terms of listed and non-listed.

### 4. Data Collection and Sample

Primary and secondary sources have been used for obtaining data. Primary data has been obtained from a comprehensive survey which was replied by Turkish intermediary institutions' top managers between the December 2017 and March 2018 period for understanding the fundamental determinants for efficiency assessment. Additionally, secondary data is obtained from Turkey Capital Market Association (TSPB) public financial data are published by the brokerage firm, the Capital Markets Board (CMB) statistics and Broker of the official web page. During the

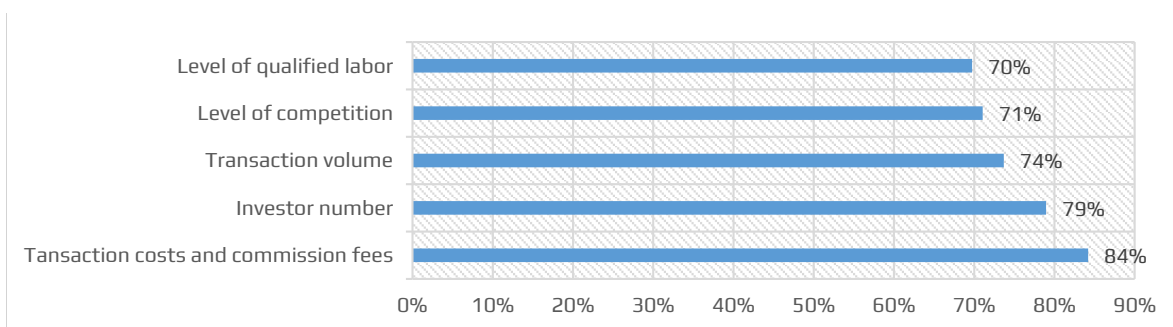
observation period of 2005 and 2016, there are fifty-five intermediary institutions in Turkish capital markets and 4 of them are listed at Borsa Istanbul (BIST).

#### 4.1. Selecting Input and Output Variables

“The production approach” and “intermediation approach” have been commonly used as to select input and output variables in the existing literature. Only physical inputs in terms of capital and labour with their costs should be incorporated under the production approach, while in the intermediation approach, input of funds with their interest costs should also be incorporated in the analysis (Berger and Humphrey, 1997). Production approach have been used in this study because intermediary institutions use capital, labour force and physical material as inputs and produce variables such as transaction volume, commission income and number of customer accounts as output (Aktaş and Kargın, 2007). Additionally, in the previous literature review considering the market structure and activities of the sector, the fixed income securities transactions volume, stock trading volume, derivatives, transactions volume and operating income realized as output while equity capital, labour number, number of branches and operating expenses were evaluated as input, by the intermediary institutions (Aktaş and Kargın, 2007; Fukuyama and Weber, 2009; Bayram, 2016; Huichen, 2017).

For identifying the main indicators specifically for Turkish intermediary institutions, a comprehensive survey has been structured. Top level executives of Turkish intermediary institutions have answered during the December 2017 - March 2018 period in order to determine the main indicators for efficiency assessment. That survey has been conducted with a five-point Likert scale (1-Low, 2-Average, 3-Good, 4-Very Good, 5-Excellent). Primary data has been obtained from a comprehensive survey which was replied by Turkish intermediary institutions’ top managers between the December 2017 and March 2018 period for understanding the fundamental determinants

The number of intermediary institutions operating in the related period was 65 and the number of participating ones in the survey was 58 whereas the number of participants was 76. The survey response rate of the survey was 89%, representing 96% of the institutions in terms of total assets. It is significant to have a high percentage in the participation rate when reflecting the current state of the intermediary institutions and comparing them with the figures of the respective years and also keeping track of their developments (see Aras et al. 2018b).



**Figure 2.** The most significant factors that affect efficiency levels of Turkish Intermediary Institutions according to survey results (Aras et al., 2018b)

According to Figure 2, the vast majority of the responding institutions (84%) agree that the level of transaction costs and commission fees are the most significant factors that affect efficiency levels of Turkish intermediary institutions. Investor number (79%), transaction volume (74%), level of competition (71%) and level of qualified labours (70%) have been found as the other significant factors by the respondents. Finally, that unique dataset allows to analyse changes in intermediaries' efficiencies with an analytical framework.

#### 4.2. Determining Number of Observations

For determining the number of Decision-Making Units (DMUs), several ways have been suggested in the existing literature. First, three DMUs for each input and output should be used in the analysis (Bowlin, 1998). Second,  $n \geq \max\{m \times s, 3(m+s)\}$  condition should be satisfied (Cooper et al., 2001). Lastly, number of DMU have to be at least  $2m \times s$  (Dyson et al., 2001).  $m$  indicates the number of inputs and  $s$  indicates the number of outputs while  $n$  represents the number of DMUs. In this study, all these assumptions regarding the number of DMUs have been satisfied.

### 5. Method

That section is dedicated to give information about the steps of the methodology and models for evaluating the efficiency profiles and productivity change of Turkish intermediary institutions. DEA and Malmquist Total Factor Productivity Index are used for determining efficiency and change in their productivity levels of the intermediary institutions.

Several financial institutions have to investigate for more efficient ways to assess their operations under the volatilities in the macro economic conditions, specifically for emerging economies. In the past a few decades, frontier efficiency approaches have been utilized within a variety of fields in the literature. In this regard, Distribution Free Approach (DFA), Stochastic Frontier Approach (SFA) and Thick Frontier Approach (TFA) are the parametric methods while DEA and the Free Disposal Hull (FDH) are the nonparametric methods used for measuring efficiency (Berger and Humphrey, 1997).

Based on Farrell's seminal paper (1957), which deals with the issue of non-parametric frontier efficiency measurement, the best performing units in a sample should be used as the benchmark for performance evaluation. DEA is a decisional approach which gives each firm's efficiency score by using a linear programming model. That non-parametric approach is first introduced by Charnes et al. (1978) and then Banker et al. (1984) extended this method by providing the addition of a convexity constraint to estimate technical efficiency. Besides, they showed that efficient measure can be regarded as the product of a technical efficiency measure and a scale efficiency measure (Banker and Thrall, 1992). In DEA, the inputs must be chosen to represent the factors of production while the outputs should represent the objectives and outcomes of the firms' operations.

As emphasized by Berger and Humphrey (1997), there are several advantages offered by DEA. This method generates a scalar value of efficiency with simultaneous inclusion and comparison of several variables in terms of inputs and outputs. It enables the determination of each DMU best practice in the evaluation of efficiency

by assigning weights to each input and output. Furthermore, the analysis is not diluted by numerous parameters as this method allows the use of a few inputs and outputs. The inputs and outputs chosen for the model do not have to be in the same unit on the condition that all of the DMUs have the same set of inputs and outputs. Therefore, the efficiency measure cannot be distorted by units and the flexibility of the model increases. One other advantage of DEA is that no priori assumptions are required by the method regarding the function form such as weights of the input and output factors. Nonetheless, DEA has some disadvantages such as its static nature and sensitivity to measurement errors (Paradi and Zhu, 2013).

DEA results represent that if a corporation is on the efficient frontier, this firm is called fully-efficient which means that efficiency score is equal to 1 whereas if a corporation is not on the efficient frontier, that corporation is called inefficient which means that efficiency score is less than 1 (Cummins et al., 2010). Based on Charnes et al (1978), efficiency of a DMU is measured with the fractional programming model that follows:

$$\begin{aligned} \max h_k &= \frac{\sum_{r=1}^s u_{rk} y_{rk}}{\sum_{i=1}^m v_{ik} x_{ik}} \\ \text{subject to} & \\ & \frac{\sum_{r=1}^s u_{rk} y_{rj}}{\sum_{i=1}^m v_{ik} x_{ij}} \leq 1, \quad j = 1, \dots, n \\ & u_{rk}, v_{ik} \geq 0, \quad r = 1, \dots, s \quad i = 1, \dots, m \end{aligned} \tag{1}$$

The  $y_{rj} \geq 0, x_{ij} \geq 0$  represent observed values of  $s$  outputs and  $m$  inputs for each of  $n$  DMUs that are to be evaluated relative to one another. The decision variables in this model are the weights assigned by  $k^{th}$  DMU to  $i^{th}$  input and  $r^{th}$  output, where the weights are denoted by  $v_{ik}$  and  $u_{rk}$  respectively. Objective function weights are selected as maximizing the value of the DMU's efficiency ratio which is lower than unity. That constraints enables the optimal weights for DMU  $k$  in the objective function cannot indicate an efficient ranking higher than unity.

In this paper, technical efficiency, pure technical efficiency and scale efficiency scores are calculated. The technical efficiency that is based on constant returns to scale and pure technical efficiency basically investigate the operational efficiency of a firm. The difference between two efficiencies is that pure technical efficiency consider scale effect and it assumes variable returns to scale. Scale efficiency is closely related with the size of a firm. The decomposition of technical efficiency into pure technical efficiency and scale efficiency find outs the sources of inefficiency (Azad et al. 2014).

In the literature, for revealing more findings, Zhou et al. (2018) proposed a multi period with a multi stage DEA model. The developed model is implemented for assessing the listed Chinese commercial banks efficiencies between the years 2014

and 2016. According to results obtained from analysis, it is found that all banks are inefficient in terms of overall efficiency and they require some improvements in their service processes. Also, Wu and Wu (2010) used DEA with Principal Component Analysis to determine efficiencies of the banks in the USA and in the UK using both non-financial and financial variables. In this study, Principal Component Analysis is employed to decrease the number of inputs and outputs and to cluster them. Moreover, by using several combinations of the variables, different models are obtained and compared with each other.

### 5.1. Malmquist Total Factor Productivity Index

Malmquist total factor productivity index can be used to decompose total productivity change between the two periods into technical efficiency change and technological change. Moreover, the previous again can be decomposed into pure technical efficiency change and scale efficiency change. If the index is greater than 1, it means that total factor productivity increases from period  $t$  to period  $t + 1$  while if it is less than 1, it reflects that total factor productivity decreases from period  $t$  to period  $t + 1$ . Following formula indicates input-orientated Malmquist productivity change index. (Worthington 1999).

$$M_I^{t+1}(y^{t+1}, x^{t+1}, y^t, x^t) = \left[ \frac{D_I^t(y^{t+1}, x^{t+1})}{D_I^t(y^t, x^t)} \times \frac{D_I^{t+1}(y^{t+1}, x^{t+1})}{D_I^{t+1}(y^t, x^t)} \right]^{1/2} \quad (2)$$

where

$y$  and  $x$  indicate outputs producing from a given level inputs respectively.  $I$  represents an input-orientation,  $M$  is the productivity of the most recent point  $(x^{t+1}, y^{t+1})$ , using period  $t + 1$  technology, relative to the earlier production point  $(x^t, y^t)$ , using period  $t$  technology,  $D$  are input distance functions. This formula can be transformed as follows:

$$M_I^{t+1}(y^{t+1}, x^{t+1}, y^t, x^t) = \frac{D_I^{t+1}(y^{t+1}, x^{t+1})}{D_I^t(y^t, x^t)} \left[ \frac{D_I^t(y^{t+1}, x^{t+1})}{D_I^{t+1}(y^{t+1}, x^{t+1})} \times \frac{D_I^t(y^t, x^t)}{D_I^{t+1}(y^t, x^t)} \right]^{1/2} \quad (3)$$

or  $M = E.P$

the efficiency of the intermediary institutions, CCR and BCC models are employed, named after Charnes et al. (1978) and Banker et al. (1984), respectively. The CC

$$E = \frac{D_I^{t+1}(y^{t+1}, x^{t+1})}{D_I^t(y^t, x^t)} \quad (4)$$

$$P = \left[ \frac{D_I^t(y^{t+1}, x^{t+1})}{D_I^{t+1}(y^{t+1}, x^{t+1})} \times \frac{D_I^t(y^t, x^t)}{D_I^{t+1}(y^t, x^t)} \right]^{1/2} \quad (5)$$

where  $M$ , Malmquist total factor productivity index, is the product of a measure of technical progress  $P$  as measured by shifts in the frontier measured at period  $t + 1$  and period  $t$  and a change in efficiency  $E$  over the same period.



In this study, an input-oriented model is employed for determining efficiencies in DEA and in Malmquist total productivity index. Input-oriented model assumes a proportional reduction in input usage with output level held constant (Fukuyama and Weber, 1999; Bibi et al. 2018, Worthington, 1999).

To estimate R model examines the technical efficiency under the constant returns to scale while the BCC model is investigates the pure technical efficiency under the variable return to scale assumption. In addition, the scale efficiency (SE) is calculated as the ratio of CCR to BCC efficiency scores, respectively. Azad et al. (2014)

## 6. Empirical Results

Table 1 gives the descriptive statistics of the employed variables. The variables used in the model are as follows. As mentioned in the previous part of the study, the inputs include: capital, number of labour, number of branch and operating expenses. The outputs are the number of total transaction volume in terms of fixed return securities, stock and derivatives, and operating income.

		Total Transaction Volume	Operating Income	Capital	Number of Labour	Number of Branch	Operating Expense
2005	mean	11,843,990,988	12,657,739	20,169,276	76	68	8,152,628
	std	16,124,881,805	17,877,180	30,490,340	75	167	9,689,974
	min	0	0	971,847	2	1	299,150
	max	72,486,267,636	98,800,060	141,362,621	332	871	48,259,218
2006	mean	11,669,063,034	12,391,763	21,919,617	77	78	9,315,651
	std	14,640,586,871	15,021,803	33,412,311	78	185	11,143,523
	min	0	-89,625	821,851	2	1	287,681
	max	71,993,347,320	61,496,319	161,380,619	350	900	52,413,941
2007	mean	15,908,622,062	16,419,999	33,545,968	79	86	11,119,392
	std	19,464,800,235	22,544,935	72,072,874	79	202	13,484,552
	min	293,272	72,890	854,266	1	1	289,669
	max	104,122,970,736	107,523,089	408,890,577	319	938	63,357,964
2008	mean	17,078,848,692	13,716,459	33,108,428	73	104	12,315,068
	std	21,023,918,452	20,802,387	69,305,640	71	243	15,780,539
	min	4,687	-446,931	881,799	0	1	515,350
	max	117,634,028,575	103,356,222	409,930,033	320	1,037	90,460,501
2009	mean	26,299,896,885	14,055,871	32,897,014	70	107	11,155,009
	std	32,584,288,957	18,864,045	58,816,197	70	252	12,803,702
	min	0	6	279,934	1	1	391,045
	max	182,100,251,290	119,339,594	316,963,853	348	1,089	76,695,187
2010	mean	33,961,505,977	17,505,952	37,786,811	73	114	12,855,390
	std	38,312,411,380	21,916,799	65,783,448	73	268	14,671,701
	min	0	889	45,676	0	1	251,929
	max	214,708,513,298	136,078,619	366,310,325	379	1,139	91,085,034
2011	mean	40,563,861,108	18,369,269	43,020,283	75	122	14,402,555
	std	58,471,592,467	23,601,835	69,469,386	77	284	17,301,691
	min	12,945,267	6,309	835,309	1	1	416,189
	max	405,831,304,458	147,139,377	370,840,427	408	1,197	111,860,292
2012	mean	62,236,716,547	17,253,011	48,476,325	76	126	15,289,849
	std	126,509,688,293	26,569,129	81,269,312	80	296	19,567,345
	min	18,742,619	95,003	1,269,063	1	1	344,000
	max	739,790,604,488	182,940,296	457,726,342	431	1,246	130,754,761
2013	mean	87,059,281,341	19,785,106	52,423,479	79	131	17,227,699
	std	143,243,739,000	26,818,269	86,884,271	78	309	20,987,569
	min	277,483,387	15,800	1,622,937	7	1	384,770
	max	828,190,028,519	174,840,660	493,365,423	402	1,304	135,589,695
2014	mean	132,186,902,605	22,407,880	57,740,132	81	133	19,675,226

		Total Transaction Volume	Operating Income	Capital	Number of Labour	Number of Branch	Operating Expense
	std	191,852,374,374	32,883,227	87,092,160	78	316	23,721,435
	min	238,767,186	295,761	1,612,049	7	1	406,399
	max	921,196,170,049	223,201,697	467,520,448	404	1,350	151,354,716
2015	mean	224,199,908,696	27,269,108	62,291,527	96	113	24,767,671
	std	360,255,427,927	35,835,767	86,279,967	97	295	28,759,947
	min	1,010,992,034	252,394	1,854,692	6	1	399,217
2016	max	1,509,986,387,515	217,954,363	470,933,426	399	1,371	175,075,744
	mean	281,918,857,169	29,949,136	66,676,901	91	99	28,622,108
	std	474,692,341,989	46,614,606	91,749,931	93	280	36,758,562
	min	0	68,931	1,266,338	4	1	347,118
	max	2,079,591,072,147	292,664,403	489,353,947	359	1,369	215,618,165

**Table 1.** Descriptive Statistics of the Employed Variables

The efficiency scores for listed, non-listed and total intermediary institutions on each of the analyses between the years 2005 and 2016 are indicated in Table 2.

	DEA-CCR			DEA-BCC			DEA-SCALE		
	listed	non-listed	overall	listed	non-listed	overall	listed	non-listed	overall
2005	0.8668	0.7205	0.7310	0.9248	0.8265	0.8340	0.9311	0.8825	0.8861
2006	0.6880	0.7465	0.7422	0.8830	0.8553	0.8573	0.7925	0.8853	0.8785
2007	0.6940	0.7385	0.7353	0.8773	0.8596	0.8609	0.8101	0.8726	0.8681
2008	0.5795	0.6721	0.6653	0.8483	0.8312	0.8324	0.7103	0.8166	0.8089
2009	0.7738	0.7607	0.7617	0.9420	0.9060	0.9087	0.8316	0.8465	0.8454
2010	0.6968	0.7324	0.7298	0.9028	0.8802	0.8819	0.7886	0.8392	0.8355
2011	0.7110	0.7440	0.7416	0.8080	0.8595	0.8558	0.9000	0.8806	0.8820
2012	0.7195	0.6680	0.6717	0.8720	0.8313	0.8342	0.8419	0.8335	0.8341
2013	0.7155	0.6697	0.6731	0.8848	0.8222	0.8267	0.8288	0.8345	0.8340
2014	0.7120	0.6887	0.6904	0.8610	0.8043	0.8084	0.8485	0.8700	0.8684
2015	0.7725	0.6662	0.6739	0.8333	0.8153	0.8166	0.9386	0.8365	0.8439
2016	0.8263	0.6557	0.6681	0.8923	0.8003	0.8070	0.9272	0.8311	0.8381
<b>mean</b>	<b>0.7296</b>	<b>0.7052</b>	<b>0.7070</b>	<b>0.8774</b>	<b>0.8410</b>	<b>0.8437</b>	<b>0.8458</b>	<b>0.8524</b>	<b>0.8519</b>

**Table 2.** DEA Efficiency Scores

The overall efficiency during these periods gives a long term view of Turkish intermediary institutions' efficiency. The efficiency scores for listed and non-listed ones in 2008 have been indicated as the worst, while the efficiency scores in 2015 has been found as the best indicating that all assessed intermediary institutions needed to improve their weak stages. Additionally, that study also highlights that mean efficiency scores of listed intermediary institutions are performing best in DEA BCC model, this indicates that the decrease in technical efficiency is due to scale effectiveness. However, non-listed ones have high efficiency scores in DEA Scale model, this shows that the decrease in technical efficiency is due to pure technical activity. Hence, listed intermediary institutions are relatively good at the scores in pure technical efficiency during the observation period. In addition, while the effectiveness of the scale of non-public intermediary institutions did not change over time, the effectiveness of the scale in listed ones, first decreased and after the 2008 global financial crisis have been increased.

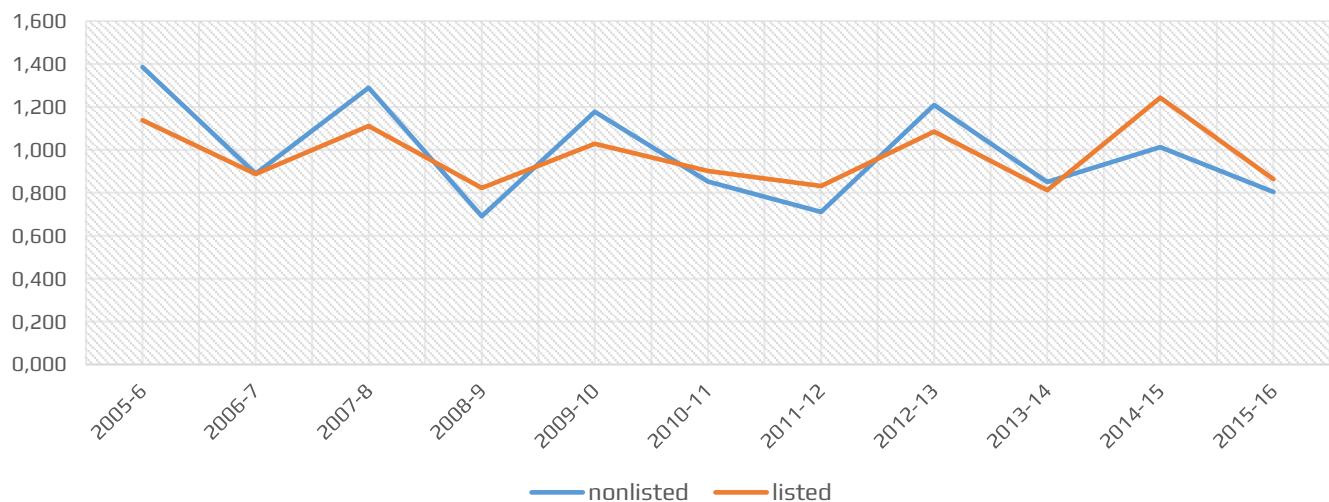
	effcht		techch		pech		sech		tfpch	
	listed	non-listed	listed	non-listed	listed	non-listed	listed	non-listed	listed	non-listed
2005-6	0.804	1.053	1.415	1.316	0.957	1.040	0.840	1.012	1.138	1.385

2006-7	1.016	0.949	0.874	0.937	0.992	1.012	1.023	0.937	0.888	0.889
2007-8	0.820	0.889	1.354	1.451	0.962	0.946	0.853	0.939	1.111	1.289
2008-9	1.361	1.181	0.604	0.584	1.122	1.116	1.214	1.058	0.822	0.691
2009-10	0.886	0.970	1.160	1.214	0.954	0.969	0.929	1.001	1.029	1.177
2010-11	1.016	0.993	0.887	0.859	0.880	0.973	1.155	1.021	0.901	0.853
2011-12	1.022	0.867	0.813	0.820	1.085	0.956	0.941	0.907	0.831	0.711
2012-13	0.991	1.040	1.096	1.161	1.005	0.990	0.986	1.051	1.085	1.208
2013-14	0.987	1.031	0.822	0.824	0.969	0.972	1.019	1.061	0.812	0.850
2014-15	1.086	0.935	1.145	1.083	0.977	1.011	1.111	0.925	1.243	1.012
2015-16	1.084	0.960	0.796	0.838	1.095	0.972	0.990	0.987	0.864	0.804
<b>mean</b>	<b>0.997</b>	<b>0.985</b>	<b>0.968</b>	<b>0.977</b>	<b>0.997</b>	<b>0.995</b>	<b>1.000</b>	<b>0.989</b>	<b>0.965</b>	<b>0.962</b>

Note: effcht, technical efficiency change; techch, technological change; pech, pure technical efficiency change; sech, scale efficiency change; tfpch, total factor productivity change

**Table 3.** Malmquist Total Factor Productivity Index Scores

DEA allows for the estimation of total factor productivity change in the form of a Malmquist index. The related index scores of listed and non-listed intermediary institutions are presented in Table 3. Total factor productivity change (tfpch), broken down into technical efficient change (effcht) and technological change (techch). Additionally, technical efficient change has been broken down into scale pure technical efficiency change (pech) and efficiency change (sech).



**Figure 3.** Malmquist Total Factor Productivity Index Scores

Figure 3 gives the total factor productivity change (tfpch) of Turkish listed and non-listed intermediary institutions. Listed intermediary institutions have more stable in terms of total productivity change than the others during the observation period. Additionally, the mean technical efficient change scores of listed ones are higher than the non-listed ones. This evidence that the diffusion or catch-up component of that intermediaries are better than the others. Empirical findings reveal, on average the intermediary institutions operating in Turkey have not yet to achieve acceptable levels in terms of technical efficient change and total factor productivity change.

## 7. Discussion

Several financial institutions have to investigate for more efficient ways to assess their operations under the volatilities in the macro economic conditions, specifically for emerging economies. That study carries out a comprehensive evaluation of the efficiency and productivity change of the Turkish intermediary institutions from 2005

to 2016, with a systematic framework based on survey results, DEA and Malmquist Total Factor Productivity Index. The overall efficiency in the related years gives a long term view of Turkish intermediary institutions' efficiency. The results reveals that first, the efficiency scores for listed and non-listed ones in 2008 has been found as the worst, while the efficiency scores in 2015 has been found as the best indicating that all assessed intermediary institutions needed to improve their weak stages. According to Malmquist productivity index results, firstly, the overall efficiency level of intermediaries went up first and then went down with a V-type trend during sample period. Additionally, listed intermediary institutions have more stable in terms of total productivity change than the others during the observation period.

That inefficiencies might be a consequence of principal and agent conflict which indicated the agency problem of acting managers to role on behalf of the shareholders in order to establish a sustainable performance. Additionally, asymmetric information may have tendency in the inefficiencies. Enhancing corporate governance principles would increase their efficiency. Intermediary institutions having the poorest performances should implement new managerial procedures for increasing their efficiency levels. So that they can catch up with the efficient frontier. That adjustment should be based on the improvement of technical efficiency, taking consideration the technological change as well.

The reliable assessment of that system is a prerequisite to managerial decision-making for comprehensively evaluating. That study may provide a starting point for further investigation and validation into the efficiency of the Turkish intermediary institutions. This strand of research can provide important information for policy makers. For determining the future development and increasing competitiveness, identifying the specific reasons for any inefficiencies is vital. Well and good developed financial markets and the sustainability of the real sector undoubtedly depend on the existence of a transparent, innovative, efficient and reliable intermediary system.

## 8. Conclusions

Based on DEA findings, intermediary institutions in Turkey have highest efficiency scores in terms of scale efficiency. Additionally, listed ones are found significantly more technical, pure technical and scale efficient than their non-listed peers. Total factor productivity Malmquist index reveal that listed intermediary institutions have more stable in terms of total productivity change than the others during the observation period. Both for the groups, the volatility in technological change is higher than the other efficiency changes. Additionally, on average, the intermediary institutions operating in Turkey have not yet to enhance optimum levels of technical efficiency. The mean technological efficient change of non-listed ones are higher than the others resulting higher innovation or frontier-shift component. Both for the groups, the volatility in technological change is better than the other efficiency changes. This situation directly affects total factor productivity change.

That study may provide a starting point for further investigation and validation into the efficiency of the Turkish intermediary institutions. This strand of research could provide significant information for policy makers for enhancing the level of technological efficiency as well.

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