THE IMPACT OF THE SOVEREIGN DEBT CRISIS ON THE EFFICIENCY OF FOREIGN BANKS IN TURKEY

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Abstract

The aim of this paper is to investigate the impact of Euro-zone sovereign debt crisis on the efficiency of foreign banks in Turkey. Results of the maximum likelihood estimates of the stochastic frontier production and cost functions illustrate that except one bank with capital from one of the GIIPS countries, the efficiencies of foreign banks have not been affected from the sovereign debt crisis. Results suggest that if the banking industry is strong in a country than the effects of crises do not have considerable impact on the banking sector in general, foreign banks in particular.

Keywords: *Foreign Banks; Financial Crisis, Bank Efficiency, Stochastic Frontier Analysis*

AVRUPA BORÇ KRİZİNİN TÜRKİYE'DEKİ YABANCI BANKALARIN ETKİNLİĞİ ÜZERİNDEKİ ETKİSİ

Öz

Bu çalışmanın amacı Avro bölgesi borç krizinin Türkiye'deki yabancı bankaların etkinliği üzerindeki etkisini incelemektir. Stokastik Sınır üretim ve maliyet analizlerinin Maksimum Olabilirlik Yöntemi ile hesaplanan sonuçlarına göre GIIPS ülkelerinden birinin sermayesine sahip yabancı bir banka dışında diğer yabancı bankalar borç krizinden etkilenmemişlerdir. Sonuçlar göstermektedir ki eğer bir ülkede bankacılık sektörü güçlüyse, krizler genel

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olarak bankacılık sektörü, özel olarak da yabancı bankalar üzerinde önemli bir etki yaratmamaktadır.

Anahtar Kelimeler: *Yabancı Bankalar, Finansal Krizler, Banka Etkinliği, Stokastik Sınır Analizi*

Introduction

The Euro-zone sovereign debt crisis which started by the ends of 2009 was mainly due to the competitiveness loss of the GIIPS [1] countries due to international trade imbalances and high labor costs compared to the core Eurozone members. The current account deficits of the periphery are financed by the current account surplus of the core countries. The easy credit conditions stimulated consumption related and property related borrowing. The sudden stop of the financial flows caused doubts about not only the viability of the banks but also of the governments due to the doom loop between banks and governments as in the case of Greece. Global Financial Crisis, the real estate bubble, contagion, the highly leveraged banking sector problems coupled with the ineffective use of the borrowed funds caused an asymmetric crisis in the euro-zone. The sovereign debt was already at very high levels at the onset of the crisis in Greece. However, real estate crisis resulted in weak banks in Ireland and Spain and when the government intervened, the sovereign debt increased to unsustainable levels also in these countries. Except Italy all the GIIPS countries ended in bailout programs. The Outright Monetary Transactions (OMT) of the ECB by 2012 ended the financial crisis although the economic crisis continued.

The Turkish banking system is liberalized after 1980s and lived through two devastating crisis, one in 1994 and the other in 2001. After the 2001 crisis, a comprehensive restructuring program is started in the Turkish banking industry by the Banking Regulation and Supervision Agency. The impact of the global crises was rather limited due to the strength of the banking sector after restructuring in Turkey. The Turkish banking industry was also exposed to the sovereign debt crisis. The foreign bank branches and foreign bank subsidiaries especially with European capital in Turkey are the ones which are assumed to be more exposed to the euro-zone crisis.

The aim of this paper is to investigate if the sovereign debt crisis affected the efficiencies of foreign bank branches and subsidiaries in Turkey. The paper

[1] Greece, Portugal, Spain, Italy, Ireland which are the so-called GIIPS countries.

is motivated by the fact that it investigates for the first time the impact of the sovereign debt crisis on the efficiencies of foreign bank branches and subsidiaries in Turkey.

Literature Review

There are several studies about the impacts of financial crises on the efficiency of banks in the literature. There are also some papers which used frontier models to measure bank efficiency for European Union (EU) members. However, literature concerning the effects of crises on the efficiency of foreign banks including the euro-zone debt crisis is still rather scarce.

Andries and Ursu (2016) performed two comparisons when they were researching the effects of 2008 global crisis on the efficiency of 783 commercial banks in 27 EU member states in their studies. Therefore, the authors comparatively examined the banking systems of old EU members and the banking systems of new EU members and also the banking systems of Eurozone countries and the banking systems from non-members of the Eurozone. Stochastic Frontier Approach (SFA) was used for 2004-2010 period in the paper. The authors classified the banks as large and small banks or private and public banks. As the result of the paper, it reveals that the banks of old EU member states, public banks and the large banks were the most affected banks from the crisis in terms of cost efficiency, and the public banks and the large banks were less affected from the crisis in terms of profit inefficiency.

Ngan (2014), in his study, grounds on the fact that the factors which effects risk and asset quality in the banking sector lead to cost and profit inefficiency. The author assumed that there is a strong connection between the bank concentration, bank mergers and bank ownership with cost inefficiency. The author measured cost and profit efficiency by using SFA for 45 Vietnamese commercial banks for the years of 2007-2012. It is concluded that public commercial banks are more efficient than national, commercial and foreign banks in terms of profit efficiency. Furthermore, international banks have more cost inefficiency compared to the national banks.

Chortareas, Girardone and Ventouri (2012), searched the effects of bank regulatory and supervisory policies on the efficiency and performance of the banks for 22 EU members during 2000-2008 period by employing Data Envelopment Analysis (DEA). It is revealed that the large scale banks that operate in countries with less concentrated and less developed systems have higher efficiency levels. In addition, the paper concluded that the structure of

auditing in the banking sector and restriction of banking activities related to the private sector lead to more inefficiency in the banking sector.

Andries (2012) employed SFA and DEA to examine the efficiency and productivity of the banking systems of seven Central and East European Countries from 2004 to 2008. The results indicate that banks' efficiency increased during the analyzed period. Evidence also reveals that unlike the Slovenian banking system, the banking systems of Romania and the Czech Republic have the highest level of technical efficiency. The efficiency of banks increased due to technological modification during the analyzed period.

Ferreira (2011) examined bank efficiency for different European Union Members from 1994 to 2008 by employing SFA and DEA. The paper concluded that the bank efficiency of EU members increased in 2000-2008 period with the implementation of European Monetary Union, however there was a slight decrease in the bank efficiency due to the EU enlargement process during 2004-2008 period. It is clearly seen that during the EU enlargement process, the new EU members' banking efficiency scores were low. The old EU members were faced with problems because of the new market conditions such as competition due to the difficulties of the adaptation process.

Manlagnit (2011), examined the cost efficiency of Philippines commercial banks based on risk and asset quality during 1990-2006 period using SFA. In the paper, the decrease in the risk and asset quality among the national banks in Philippines is handled in terms of financial crises, bank reforms and restructuring of the banks. Especially after the 1998 financial crisis, the bank reforms and restructuring process which were implemented to increase the economic stability caused cost inefficiency in the banks. It is observed that, except for increased inefficiency of the banks after the 1998 financial crisis, the banking performance increased during the analyzed period.

Andries and Cocris (2010) analyzed the efficiency of the large banks in Romania, Czech Republic and Hungary by using SFA and DEA during 2000-2006 period. According to the analysis results, it has been understood that the asset quality, bank size, annual inflation rate, banking reform and ownership types in the banking sector of all three countries are effective on the cost and technical efficiency levels of these banks. Moreover, the banks in all three countries have low efficiency levels and Romanian banks have lower technical efficiency levels compared to other banks.

Staikouras, Mamatzakis and Koutsomanoli-Filippaki (2008) analyzed the cost efficiency in the banking sector of six South Eastern European members

from 1998 to 2003 by using SFA. The study results indicate that there is a low cost efficiency level with significant inefficiency differences among sample countries. The analysis reveals that some medium-sized banks with foreign capital are cost efficient credit institutions. In addition, there is also a negative correlation of cost inefficiency with bank capitalization and firm market share during the analyzed period.

Mamatzakis, Staikouras and Koutsomanoli-Filippaki (2008) investigated cost and profit efficiency of the new ten European Union members' banking systems between 1998 and 2003 by employing the SFA. In the paper, it is observed that there are low level of cost and lower level of profit efficiency. Although foreign banks outperform both state-owned and domestic private-owned banks in terms of profit efficiency, it is obvious that results are not strong for cost efficiency.

Bonin, Hasan and Wachtel (2005) examined the ownership effects of 225 banks, including strategic foreign owner banks, in eleven transition countries during the 1996-2000 period by using SFA. Strategic foreign-owned banks in transitional countries have achieved better service as well as more efficient banks compared to other banks. It has also been achieved that state banks have on average the same level of efficiency as national private banks.

Christopoulos, Lolos and Tsionas (2002) aimed to examine the cost efficiency of the Greek banking sector from 1993 to 1998 using a Heteroscedastic Frontier Model. The results indicate that large banks are more efficient than small ones. In addition, economic performance, bank loans and investments have a positive relationship with the cost efficiency of the Greek commercial banking sector. During the analysis period, some of the major Greek banks had a very low cost efficiency due to inefficient management of large-scale public banks, inadequate staff motivation, and so on.

Lang and Welzel (1999) analyzed the causes and cost effects of small-scale mergers between 283 Bavarian cooperative banks representing the subgroup of the German cooperative banking sector between 1989-1997 by using SFA. The analysis represents that the efficiency differences are balanced after the mergers take place. In addition, size effects are one of the most important issues in pre-merger cost incentives when acquiring another bank.

There are some papers which used frontier methodology to measure bank efficiency in Turkey.

Güneş and Yıldırım (2016), in their study which includes 2003-2015 period analyzed 22 Turkish commercial banks in terms of scales in order to examine

the cost efficiency on the restructuring process of Turkish Banking System (TBS) which coincided with the 2008 financial crisis and 2010 European debt crisis. According to the results of the study, even though the effects of 2008 financial and 2010 European debt crises were limited in Turkey, the efficiency level depends on the bank size and ownership structure. When examining the efficiency scores according to the ownership structures; it is determined that in average, foreign banks have almost same efficiency levels with national private banks and both groups are more effective compared to the public banks. It is understood that small scale banks have the tendency to have less cost efficiency compared to the middle and large scale banks.

Çelik, (2012) examined the efficiency of Turkish Commercial Banks between 2005 and 2010 by employing DEA and SFA and the findings obtained from these different models were compared. As a result, if the efficiency of the banking sector is to be used for different purposes such as taking regulatory policy decisions or improving management performance, these methods give similar results. The findings are important for banks, creditors and investors as well as economy.

Aysan, Karakaya and Uyanık (2011) aimed to examine the relationship between efficiency and profitability in TBS by using the Panel SFA in the period of 2002-2007 after the 2001 crisis. According to the analysis results, new applications which increase the productivity in TBS are easily accepted and new incoming banks in the sector are imitated in many respects including technology. It has been observed that public banks have a higher efficiency level than foreign banks and banks newly entering to the sector. It has also been found out that some banks which were bought by foreign banks in Turkey are inefficient. On the other hand, there is no significant relationship between efficiency and profitability in TBS and bank size is very important factor for profitability.

Isık and Hassan (2002) searched the effects of bank size, corporate governance and ownership structure on cost and alternative profit efficiency for Turkish commercial banks by employing SFA (modern stochastic cost and alternative profit efficiency techniques) between 1988 and 1996. The results of the analysis presented that the degree of connection between cost and profit efficiency in Turkish commercial banks is very low. In addition, it is seen that there is no need for greater cost efficiency for high profit activity in Turkey.

The rest of the paper unfolds as follows: The following section describes the methodology and the data of the empirical investigation. The succeeding section depicts and discusses the results. Finally, the paper concludes.

Methodology and Data

Farell (1957) developed the efficiency concept. Stochastic Frontier Analysis (SFA) which is a parametric frontier efficiency measurement approach is developed independently from each other by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). SFA estimates the best practice frontier of the optimal input mix for maximized outputs and predicts the firm level efficiencies by comparing the efficiency of the firm with that frontier.

In order to estimate the impact of the sovereign debt crisis on the foreign banks in Turkey, the frontier of all the commercial banks is estimated and the production and cost efficiencies of foreign bank subsidiaries and branches are measured by their distance from the estimated frontier. To this end, Cobb-Douglas SFA is employed both for the production and cost functions.

For the production function, the mean technical efficiency scores of the banks and the bank specific determinants of technical inefficiencies are estimated by a single equation model of Batesse and Coelli (1995) which may be expressed as follows:

$$\ln(Q_{i,t})=\beta_0 + \sum_j \beta_j \ln\left(x_{j,i,t}\right) + v_{i,t} - u_{i,t} \quad (1)$$

where $Q_{i,t}$ is the output of bank i in period t; $x_{j,i,t}$is a vector of inputs; β is a vector of unknown parameters to be estimated.

For the cost function, again the mean technical efficiency scores of the banks and the bank specific determinants of cost inefficiencies are estimated by employing Batesse and Coelli (1995) which may be expressed as follows:

$$\ln(c_{i,t})=C(y_{i,t}, w_{i,t}; \beta) + v_{i,t} + u_{i,t} \quad (2)$$

where c_i is the cost of production of bank i at period t; C(.) is a functional form such as Cobb Douglas in our case; $y_i$is the logarithm of output quantity of bank i at period t; $w_{i,t}$ is the logarithm of vector of input prices of bank i at period t and β is a vector of unknown parameters to be estimated.[2]

In both of the equations $v_{i,t}$ are random variables which are assumed to be iid and independent of the $u_{i,t}$. $u_{i,t}$ are non-negative random variables which are assumed to account of technical inefficiency in production function and cost

[2] $ln\left(\frac{TC_i}{PL}\right) = \beta_0 + \beta_1 \ln(Loans) + \beta_2 \ln(Securities) + \beta_2 \ln\left(\frac{PC}{PL}\right) + \beta_4 \ln(\frac{PF}{PL}) + (v_i + u_i)$ (4)
where total cost(TC) and the two input prices of price of capital (PC) and price of funds (PF) are scaled by the price of labor (PL) to guarantee linear homogeneity of the cost function.

inefficiency in cost function. They are assumed to be independently distributed as truncations at zero of the N(μ, σ_u^2) distribution which may be expressed as follows:

$$\mu_{i,t} = \delta_0 + \sum_n \delta_{n,i,t}\, z_{n,i,t} \quad (3)$$

The z in the above equation represents the vector of n variables that drive the inefficiency μ of bank i at time t and the δs represent the coefficients to be estimated. Maximum Likelihood Estimation (MLE) Method is used to estimate the parameters of the two equations simultaneously both for the stochastic frontier production and cost functions[3]. For the stochastic frontier production and cost functions, generalized truncated normal distribution is used.

Intermediary approach is used both for the stochastic frontier production and cost functions. For production (and cost) functions, loans and receivables as well as securities are considered as outputs; whereas (the prices of) deposits and other borrowings as well as capital and labor are employed as inputs. On the other hand, in the stochastic frontier production function loans over assets and in the stochastic frontier cost function total assets as a representation of size are used as the z variables. The negative coefficient for loans over assets (L/A) indicates that the larger the L/A ratio, the smaller the values of inefficiency effects will be. In the cost function, the positive coefficient for total assets (TA) indicates an increase in cost inefficiency.

The paper employs data covering the period of 2009 to 2015 for stochastic frontier production and cost functions. There are two reasons behind the choice of period of analysis. The first reason is that the paper searches for the impact of sovereign debt crisis on the efficiency of foreign banks in Turkey. The second reason is that the 2002-2008 period is already analyzed in two previous papers[4]. There are 34 commercial banks[5] in Turkey as of end of 2015. The

[3] For further information on stochastic frontier cost and production functions see Coelli (1996) and Coelli et al. (1998)

[4] Ersoy (2010) uses data covering the period of 2002-2008 and employs Stochastic Frontier Production Function and Ersoy (2012) uses again data covering the period of 2002-2008 and employs Stochastic Frontier Cost Function.

[5] Out of 34, 3 are state owned banks, 1 bank belongs to Saving Deposit Insurance Fund (SDIF), there are 9 privately owned Turkish deposit banks, 15 foreign banks founded in Turkey and 6 foreign bank branches.

source of database for the balanced panel data of 26 commercial banks[6] analyzed is the Banks Association of Turkey (2015).

Table 1 and Table 2 illustrate the descriptive statistics of the variables of the Stochastic Frontier Production Function and the Stochastic Frontier Cost Function. Table 3, on the other hand, displays the description of variables for the Stochastic Frontier Cost Function.

Table 1: Descriptive Statistics of Variables of the SFPF

	Output	Labour	Capital	Deposits	$Z_{L/A}$
Mean	4.20E+10	6851.835	5.84E+09	3.56E+10	48.18637
Median	8.62E+09	2859.000	1.31E+09	8.11E+09	57.3850
Maximum	2.52E+11	25697.00	3.20E+10	2.06E+11	76.69000
Minimum	1794000	15.00000	22635000	11188000	0.000000
Std. Dev.	5.93E+10	7809.001	8.08E+09	4.88E+10	22.07204
Observations	182	182	182	182	182

Note: The descriptive statistics for the variables are expressed in Turkish Liras.
Source: Authors' calculations

Table 2: Descriptive Statistics of Variables of the Stochastic Frontier Cost Function

	C	Y_{LOAN}	Y_{SEC}	W_{PL}	W_{PC}	W_{PF}	Z_{TA}
Mean	3.24E+09	3.05E+10	1.16E+10	105682.0	0.234567	0.056681	5.13E+10
Median	8.91E+08	6.91E+09	1.70E+09	81295.48	0.205993	0.047766	1.08E+10
Maximum	1.67E+10	1.87E+11	7.64E+10	488456.0	3.092784	0.867036	3.03E+11
Minimum	2859000	0.000000	772000.0	50247.50	0.000000	0.002084	73025000
Std. Dev.	4.18E+09	4.34E+10	1.82E+10	67981.22	0.258104	0.080473	7.15E+10
Observations	182	182	182	182	182	182	182

Note: The descriptive statistics for the variables are expressed in Turkish Liras.
Source: Authors' calculations

[6] In our database there are three state-owned banks and one bank belonging to SDIF. Out of 9 privately owned Turkish commercial banks there is data problem with Adabank. Fibabank was a foreign bank and became privately owned Turkish bank and Garantibank became foreign only as of 2015. Hence in our database there are 8 privately owned Turkish deposit banks. Out of 15 foreign banks Alternatifbank became foreign in the course of time, ICBC, Odeabank and Rabobank do not have continuous data for the concerned period, Bank of Tokyo Mitsubishi has missing data. Hence in our database there are 9 foreign banks founded in Turkey. Out of 6 foreign bank branches in our database there are 5 since Intesa Sanpaolo S.p.A. does not have continuous data for the concerned period.

Table 3: Description of Variables for the Stochastic Frontier Cost Function

Abbreviation	Variable name	Explanation
C	Total Cost	Total interest and non-interest expenses
Y_{LOAN}	Output	Total Loans + Receivables
Y_{SEC}	Output	Total Securities
W_{PL}	Price of Labour	Total Expenditures on employees /number of employees
W_{PC}	Price of Capital	Total Expenditures on fixed assets /physical capital
W_{PF}	Price of Funds	Total Interest Expenditures on deposits and non-deposit/those funds
Z_{TA}	Total Assets	Sum of all assets of the commercial banks

Source: Authors' calculations

Results and Discussions

Table 4 demonstrates that the maximum likelihood estimates of the parameters for the Stochastic Frontier Production Function are all statistically significant. The impact of capital is the highest with a coefficient of 0.65 and it is followed by deposits and labor. The coefficient for $\delta_{L/A}$ is negative which illustrates that the larger the L/A ratio, the smaller the value of inefficiency effects will be.

Table 4: MLE of the TE Effects of the SFPF Model

Variable	Coefficient	Standard –error	t-ratio
β_0	0.47E+00	0.19E+00	-0.24E+01**
β_L	0.12E+00	0.37E-01	0.31E+01*
β_C	0.65E+00	0.33E-01	0.20E+02*
β_D	0.33E+00	0.32E-01	0.10E+02*
δ_0	0.61E+00	0.15E+00	0.39E+01*
$\delta_{L/A}$	-0.60E-01	0.22E-01	-0.28E+01*
σ^2	0.24E+00	0.85E-01	0.28E+01*
γ	0.97E+00	0.10E-01	0.96E+02*

Note: * significance at 1%; **significance at 5%
Source: Authors' calculations

To test the model, Ho:$\beta_{i,j} \neq 0$ for all i$\leq j = 1, 2, 3$ is tested to find out if Cobb-Douglas production function is the appropriate model and is rejected.[7] Ho: γ=0

[7] LL_{C-D}= 0.10501087E+03 and $LL_{TRANSLOG}$=0.18511534E+03

is tested to find out if there is no Technical Inefficiency Effect (TIE) in the model and is rejected.[8] γ = 0.97096515E+00 (0.10104055E-01) indicates that the vast majority of residual variation is due to the inefficiency effect. The MLE of $\delta_{L/A}$is larger than its standard error, hence $\delta_{L/A}$ should not be deleted from the model.

Table 5 demonstrates that the maximum likelihood estimates of the parameters for the Stochastic Frontier Cost Function are also all statistically significant. The coefficient for δ_{TA} is positive which indicates that size increases cost inefficiency.

Table 5: MLE Results of the Stochastic Frontier Cost Function

Variable	Coefficient	Standard –error	t-ratio
β_0	0.67E+01	0.45E+00	0.15E+02*
β_{LOAN}	0.93E-01	0.39E-01	0.24E+01**
β_{SEC}	0.25E-01	0.82E-02	0.30E+01*
$\beta_{\frac{PC}{PL}}$	0.39E-01	0.19E-01	0.21E+01**
$\beta_{\frac{PF}{PL}}$	0.50E-00	0.32E-01	1.57E+02*
δ_0	-0.91E+01	0.50E+00	-0.18E+02*
δ_{TA}	0.86E+00	0.47E-01	0.18E+02*
σ^2	0.20E-01	0.25E-02	0.82E+01*
γ	0.21E-04	0.49E-05	0.43E+01*

Note: * significance at 1%, ** significance at 5%
Source: Authors' calculations

To test the model, Ho:$\beta_{i,j} \neq 0$ for all i$\leq j = 1,2,3$ is tested to find out if Cobb-Douglas production function is the appropriate model and is rejected.[9] Ho: γ =0 is tested to find out if there is no Technical Inefficiency Effect (TIE) in the model and is rejected.[10] The MLE of $\delta_{TA}$is larger than its standard error, hence δ_{TA} should not be deleted from the model.

-2((0.10501087E+03)- (0.18511534E+03)) = 160.210306
160.210306 > upper 5% point for the x_3^2 distribution which is 7.045 according to table 1 of Kodde and Palm (1986)

[8] LR test of one the one-sided error = 0.15291629E+03

[9] LL_{C-D}= 0.96593732E+02 and $LL_{TRANSLOG}$= 0.10795362E+03
-2((0.96593732E+02) - (0.10795362E+03) = 22.719776
22.719776 > upper 5% point for the x_3^2 distribution which is 7.045 according to table 1 of Kodde and Palm (1986)

[10] LR test of one the one-sided error = 0.96593732+02

Table 6 below discloses technical efficiencies of banking groups in Turkey as the commercial banks are used as the frontier for the efficiency estimation of foreign banks in Turkey.

Table 6: Technical Efficiencies of SFPF of Banking Groups in Turkey

Banking Groups	2009	2010	2011	2012	2013	2014	2015	Group Eff.
State-owned	0.95	0.95	0.96	0.94	0.95	0.95	0.96	**0.95**
SDIF	0.76	0.61	0.78	0.80	0.90	0.98	0.96	**0.82**
Private Comm.	0.90	0.92	0.92	0.92	0.95	0.95	0.95	**0.93**
For. Subsidiary	0.91	0.88	0.92	0.90	0.93	0.91	0.93	**0.91**
Foreign Branch	0.75	0.82	0.82	0.67	0.60	0.58	0.56	**0.69**
Mean Efficiency	**0.85**	**0.84**	**0.88**	**0.85**	**0.87**	**0.87**	**0.87**	**0.86**

Source: Authors' calculations

As can be seen from the table, group technical efficiency score of state owned banks is 0.95 and that of Turkish private commercial banks is 0.93. Foreign subsidiaries have quite close efficiency scores to Turkish banks with an efficiency score of 0.91 whereas the group efficiency of foreign bank branches is at the level of 0.69. The mean efficiency which shows the industry average is 0.86. The efficiencies of all the banking groups have- although marginally- increased except the foreign bank branches. The efficiencies of foreign bank branches which have always been very volatile, have decreased quite considerably after 2012. When compared with Ersoy (2010), the analyses of technical efficiencies of banks for the period of 2002-2008 reveal that the technical efficiency ranking is unchanged. Yet the comparison shows that the efficiencies of banks have quite considerably increased.

On the other hand, as can be seen from table 7 below, the cost efficiencies of banking groups in Turkey disclose that the cost efficiency of state-owned banks is 0.68 and decreasing and that of Turkish private commercial banks is 0.81 and decreasing. In line with the high impact of total assets on the cost efficiency of banks, the cost efficiency of SDIF, foreign banks are 1.00 and foreign subsidiaries is 0.98.

Table 7: Cost Efficiencies of Banking Groups in Turkey

Banking Groups	2009	2010	2011	2012	2013	2014	2015	Group Eff.
State-owned	0.81	0.76	0.72	0.69	0.62	0.59	0.55	**0.68**
SDIF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
Private Comm.	0.88	0.85	0.83	0.82	0.79	0.76	0.74	**0.81**
For. Subsidiary	1.00	1.00	1.00	0.99	0.97	0.96	0.95	**0.98**
Foreign Branch	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
Mean Efficiency	**0.94**	**0.92**	**0.91**	**0.87**	**0.86**	**0.85**	**0.87**	**0.89**

Source: Authors' calculations

The technical efficiencies of foreign bank subsidiaries and branches in Turkey are illustrated below in table 8.

Table 8: Technical Efficiencies of SFPF of Foreign Banks in Turkey

Banks	2009	2010	2011	2012	2013	2014	2015	Bank Eff.
F.B.Subsidiary1	0.89	0.88	0.82	0.74	0.87	0.82	0.81	0.81
F.B.Subsidiary2	0.95	0.95	0.95	0.94	0.98	0.97	0.97	0.96
F.B.Subsidiary3	0.86	0.82	0.86	0.84	0.80	0.74	0.88	0.83
F.B.Subsidiary4	0.94	0.95	0.94	0.95	0.96	0.95	0.95	0.87
F.B.Subsidiary5	0.84	0.56	0.96	0.85	0.94	0.89	0.94	0.85
F.B.Subsidiary6	0.94	0.94	0.95	0.94	0.95	0.95	0.95	0.94
F.B.Subsidiary7	0.88	0.89	0.92	0.93	0.94	0.93	0.96	0.87
F.B.Subsidiary8	0.95	0.95	0.96	0.95	0.96	0.96	0.96	0.87
F.B.Subsidiary9	0.93	0.96	0.95	0.96	0.96	0.96	0.96	0.95
Foreign Branch1	0.96	0.99	0.81	0.50	0.66	0.63	0.63	0.87
Foreign Branch2	0.58	0.61	0.67	0.71	0.74	0.69	0.72	0.67
Foreign Branch3	0.68	0.91	0.97	0.54	0.23	0.20	0.16	0.53
Foreign Branch4	0.97	0.93	0.91	0.93	0.73	0.83	0.84	0.88
Foreign Branch5	0.55	0.69	0.71	0.69	0.66	0.55	0.45	0.61

Source: Authors' calculations

Table 8 shows that the technical efficiencies of foreign bank subsidiaries have not been affected from the sovereign debt crisis. The volatility of efficiency scores of foreign bank branches is high but seems to be unaffected from the sovereign debt crisis. This result is contrary to our expectations especially for the foreign bank subsidiaries and branches that belong to the European countries.

Table 9 illustrates the cost efficiencies of the foreign bank subsidiaries and foreign bank branches in Turkey.

Table 9: Cost Efficiencies of Foreign Banks in Turkey

Banks	2009	2010	2011	2012	2013	2014	2015	Bank Eff.
F.B.Subsidiary1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F.B.Subsidiary2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F.B.Subsidiary3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F.B.Subsidiary4	1.00	1.00	1.00	1.00	0.90	0.84	0.79	0.93
F.B.Subsidiary5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F.B.Subsidiary6	1.00	1.00	0.98	0.93	0.86	0.82	0.78	0.91
F.B.Subsidiary7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F.B.Subsidiary8	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.99
F.B.Subsidiary9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign Branch1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign Branch2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign Branch3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign Branch4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign Branch5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Authors' calculations

The cost efficiencies of foreign bank subsidiaries show that the cost efficiency of two[11] subsidiaries decreased. One of these subsidiaries belongs to a bank that has been severely affected from the sovereign debt crisis due to capital from one of the GIIPS countries. On the other hand, the foreign bank branches have all high cost efficiencies which are in line with the high impact of TAs on cost efficiencies of banks and the fact that all the commercial banks are used as the frontier.

Concluding Remarks

The study investigates the impact of sovereign debt crisis of the euro-zone countries on the efficiencies of the foreign banks subsidiaries and branches in Turkey. The results of the maximum likelihood estimates of the stochastic frontier production and cost functions reveal that only the cost efficiency of one foreign bank subsidiary with capital from one of the GIIPS countries is affected from the sovereign debt crisis. However, the production and cost efficiencies of

[11] The decrease in the cost efficiency of the second subsidiary takes place after the sovereign debt crisis.

foreign bank subsidiaries and branches are not affected from the sovereign debt crisis. This result is in line with Güneş and Yıldırım (2016) who suggest that Euro-zone crisis did not have a noticeable impact on the Turkish banking system overall in terms of cost efficiency. The banking sector production efficiency on the other hand has increased in Turkey for all the banking groups during the period of 2009-2015 when compared with the results of the analysis of Ersoy (2010) for the period of 2002-2008. Results suggest that if the banking industry is strong in a country than the effects of crises do not have considerable impact on the banking sector in general, foreign banks in particular.

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