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The Impact of Balance Sheet Cleaning on the Relationship Between Non-Performing Loans and Cost Efficiency: Bad Luck or Bad Management? A Case Study of Türkiye

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ABSTRACT

This study investigates the impact of balance sheet cleaning on the cost-effectiveness of banks, focusing on the "bad luck" and "bad management" hypotheses developed by Berger and DeYoung (1997). These hypotheses posit a negative relationship between increasing non-performing loans (NPLs) and cost efficiency. Analyzing quarterly data from 10 deposit banks in Türkiye from 2012 to 2021, the study utilizes Stochastic Frontier Analysis (Battese & Coelli, 1995) to evaluate cost efficiency and the Dumitrescu-Hurlin Panel Causality Test (Dumitrescu & Hurlin, 2012) to explore causality. The findings reveal that prior to balance sheet cleaning, the "bad management" hypothesis holds, and the "bad luck" hypothesis is more applicable post-cleaning. This shift suggests that balance sheet cleaning can mitigate the detrimental effects of poor management on bank performance. The findings suggest that banks should prioritize balance sheet cleaning to improve cost-effectiveness. As a pioneering effort, this research is the first to explore the effect of balance sheet cleaning on bank cost efficiency under the "bad luck" and "bad management" hypotheses, and it uniquely contributes to the literature by employing the Dumitrescu-Hurlin Panel Causality Test in this analysis.

Keywords: Balance Sheet Cleaning, NPL, Cost-Efficiency, Bad Luck Hypothesis, Bad Management Hypothesis.

JEL Classification Codes: G21, G28, G29, G32

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INTRODUCTION

Banks primarily encounter credit risk, market risk, and operational risk in their operations. When the Basel Regulations were first introduced, the calculation of capital adequacy centered mainly on credit risk. However, as it became evident that market and operational risks could have substantial negative effects on both individual banks and the wider financial system, these risks were later incorporated into the regulatory framework (Bodellini, 2019). This study specifically examines the relationship between credit risk and cost.

Loans inherently carry the risk of non-repayment from the moment they are issued. To mitigate this risk, banks develop and implement credit risk management systems. These systems, governed by regulations established by supervisory authorities and internal bank management, are rigorously monitored and audited to ensure adherence to both legal requirements and internal policies.

Credit losses are an integral part of the lending process, affecting every business unit within banks (Aiyar et al., 2015). In countries with advanced risk management practices, a range of statistical tools is employed to minimize these losses (Babuşcu et al., 2018). Banks carefully assess risk levels, potential losses, required capital reserves, and necessary loan provisions, ensuring compliance with regulations at every stage of the loan process—prior to issuance, throughout the loan's duration, and after any risks have materialized.

This study examines the effect of removing non-performing loans from the balance sheet on a bank's cost-effectiveness. The results are expected to be crucial in evaluating the benefits of balance sheet cleaning for the banking sector.

The existing literature does not contain any studies that examine the relationship between bank cost efficiency and non-performing loans (post-balance sheet cleaning) under the "bad management" and "bad luck" hypotheses. This study is the first to investigate this relationship in this specific context. Furthermore, it is also the first to test the "bad luck" and "bad management" hypotheses using the Dumitrescu-Hurlin Panel Causality Test (2012).

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The study starts by detailing the core processes of credit risk management. It then introduces the concepts of balance sheet cleaning and the "bad luck" and "bad management" hypotheses. This is followed by a review of relevant literature and a presentation of the analysis results. The study concludes with a discussion of the findings.

Processes Related to Credit Risk

Credit risk management processes for banks in Türkiye are guided by both international standards and national regulations. Furthermore, detailed directives from the Central Bank of the Republic of Türkiye and the Banking Regulation and Supervision Agency (BDDK) provide banks with specific guidance in this area.

This study seeks to offer a fresh perspective on the relationship between non-performing loans and costs. In Türkiye, bank loans are categorized into three main groups—standard quality, closely monitored, and non-performing—in accordance with legal regulations. These classifications are based on the risk levels and the delays in principal and interest payments.

The study's data covers 40 quarters over a 10-year period. In the last 8 quarters, measures were implemented to mitigate the effects of the global COVID-19 pandemic, including the extension of loan repayment periods in Türkiye. These measures distorted the distribution of loan categories, as non-performing credit risk, which should have been classified as non-performing loans, was instead categorized under standard and closely monitored loans. As a result, when interpreting the study's findings, it is important to consider that the reported volume of non-performing loans may not accurately reflect the true situation.

Balance Sheet Cleaning

The asset quality of banks is critical, impacting everything from the efficient use of equity to the costs associated with various borrowings, particularly in maintaining a well-diversified asset portfolio. The NPL ratio (Non-performing loan / Total loan) is a key financial indicator that directly influences borrowing costs, especially from international institutions and through securities issuance. Banks typically manage non-performing loans using two primary methods: the first involves keeping the loans on the balance sheet and attempting to liquidate them through administrative or legal means; the second method entails removing the loans from the balance sheet, either by selling them or writing them off entirely (Bunda, 2021).

In Türkiye, the common practice for handling non-performing loans involves either selling them to Asset Management Companies or removing them from the balance sheet. In the Turkish banking sector, private banks primarily conducted sales to Portfolio Management Companies until 2017. That year, a regulation by the Banking Regulation and Supervision Agency (BRSA) permitted public banks to engage in such sales. However, audit reports indicate that public banks did not make any sales until the end of 2021. Notably, Ziraat Bank, one of the three major public banks analyzed, did not perform any loan deletions during this period. The other two public banks, Halkbank and Vakıfbank, only began deleting non-performing loans in 2021.

Conceptual Framework

This study investigates whether balance sheet cleaning in banks enhances cost-effectiveness. The analysis is grounded in the "bad luck" and "bad management" hypotheses. Drawing on the framework developed by Berger and DeYoung (1997), the study explores the causal relationship between non-performing loans and banks' operational cost-effectiveness. The hypotheses, which posit a negative relationship between the increase in non-performing loans and operational cost-effectiveness, are formulated as follows:

The Bad Luck Hypothesis suggests that an increase in non-performing loans leads to higher operating costs for banks as they address these challenges, ultimately resulting in decreased efficiency. According to this hypothesis, negative external factors initially manifest as an increase in non-performing loans, which in turn erodes the banks' efficiency. Under the Bad Luck Hypothesis, a causal relationship is expected from non-performing loans to reduced bank cost-effectiveness (Berger & DeYoung, 1997).

The Bad Management Hypothesis posits that ineffective management practices lead to an increase in non-performing loans. When bank managers fail to properly oversee loan allocation and monitoring, and do not support personnel and operational resources with sound loan management policies, the bank's cost efficiency declines. This inefficiency is then followed by a rise in non-performing loans as a result of poor loan policies. Under the Bad Management Hypothesis, a causal relationship is expected, with declining bank cost efficiency leading to an increase in non-performing loans (Berger & DeYoung, 1997).

REVIEW OF LITERATURE

Our study falls under two main categories in the literature. The first category includes articles that investigate the relationship between non-performing loans and bank costs, specifically discussing the "bad luck" and "bad management" hypotheses. The second category comprises studies that address the issue of balance sheet cleaning in banks.

The Relationship Between Non-Performing Loans and Bank Costs Under the "Bad Luck" and "Bad Management" Hypotheses

The first study to explore the relationship between non-performing loans and bank costs while testing the "bad luck" and "bad management" hypotheses was conducted by Berger and DeYoung (1997). In their research, they developed four hypotheses to analyze the dynamic relationships between cost-effectiveness, capital, and risk: the "bad luck," "bad management," "stinginess," and "moral hazard" hypotheses. The "bad luck" hypothesis suggests that external events lead to increased loan defaults, thereby raising operating costs for banks. The "bad management" hypothesis asserts that poor management performance results in higher levels of non-performing loans. The "stinginess" hypothesis posits that banks may initially boost efficiency by under-investing in loan allocation and monitoring; however, this strategy eventually leads to an increase in non-performing loans. The "moral hazard" hypothesis links the rise in non-performing loans to a weak capital structure. In our study, we did not employ the "stinginess" and "moral hazard" hypotheses as they were not relevant to our research question.

Williams (2004) extended the causality framework developed by Berger and DeYoung (1997) for American banks to European deposit banks. His analysis provided evidence supporting the "bad management" hypothesis for European banks. In the case of German banks, the results supported both the "bad management" and "bad luck" hypotheses. However, this study did not address the topic of balance sheet cleaning.

Podpiera and Weill (2008) studied banks in the Czech Republic, a region that saw numerous bankruptcies in the 1990s and early 2000s. Their research investigated the causality between non-performing loans and cost-effectiveness, aiming to pinpoint the key factors behind these bank failures. By extending the Granger-causality model from Berger and DeYoung (1997), they analyzed data from Czech banks between 1994 and 2005, uncovering evidence that supports the "bad management" hypothesis. However, their study is limited to the bankruptcy period and does not consider the issue of balance sheet cleaning.

Setiawan et al. (2017) examined banks within the Organization of Islamic Cooperation, investigating the causality between non-performing loans and bank efficiency. Their findings supported the "bad luck" hypothesis for banks in Asia and the "bad management" hypothesis for banks in Türkiye and the Middle East. However, the study did not address the topic of balance sheet cleaning.

Ghosh (2018) conducted a study involving a sample of approximately 100 banks, including a quarter that are Islamic, operating in 12 MENA countries during the 2001-2012 period. The findings supported the "bad luck" hypothesis for both conventional and Islamic banks. However, the study did not consider the issue of balance sheet cleaning.

Balance sheet cleaning literature

Garrido et al. (2016) analyzed non-performing loans in the Italian banking system, arguing that this issue can be effectively addressed through a comprehensive approach that includes economic, supervisory, and legal measures. The study highlights the importance of strengthening corporate governance within banks, expediting bankruptcy and enforcement proceedings, and supporting reforms to facilitate balance sheet cleaning as key strategies for reducing NPLs. However, the study does not investigate the "bad luck" and "bad management" hypotheses.

Jonbst and Weber (2016) analyzed the profitability of the 15 largest Italian banks, finding that while the banking system was generally profitable, it displayed significant heterogeneity. The study underscored the critical role of resolving non-performing loans in enhancing bank profitability, suggesting that increased profitability would allow banks to strengthen capital buffers and expedite balance sheet cleaning. However, it was also observed that some smaller banks still face profitability pressures, highlighting the need for decisive action in clearing their balance sheets. The study ultimately emphasized the importance of encouraging all banks, regardless of their profitability, to pursue balance sheet cleaning. It is important to note that the analysis focused exclusively on profitability, without incorporating a cost-effectiveness assessment or examining the "bad luck" and "bad management" hypotheses.

Manz et al. (2019) explored the effects of disposing of non-performing loans (balance sheet cleaning) on financing costs in the European banking sector. The study analyzed data from 180 NPL sales, providing evidence that selling non-performing loans can reduce financing costs for European banks. However, the study primarily focuses on financing costs and does not examine bank cost-effectiveness or the "bad luck" and "bad management" hypotheses.

Bunda et al. (2021) explored the issue of NPLs in banks operating in African countries and discussed strategies for reducing the financial damage caused by NPLs. The study focused on assessing the impact of removing NPLs from the balance sheet (balance sheet cleaning) on capital adjustment and loan capacity. However, it did not investigate the effect of balance sheet cleaning on the bank's cost-effectiveness.

DATA AND METHODOLOGY

Data

The analysis focused on a single country due to challenges in obtaining comparable data from different countries. The data for this study were sourced from independent audit reports of banks available on the BDDK (Banking Regulatory and Supervisory Agency) website, with information on the number of bank employees drawn from the statistical data section of the TBB (Turkish Banks Association) website. The dataset comprises 8 variables—non-performing credit risk, total credit risk, non-performing credit risk sold to VYS (Asset Management Company), non-performing credit risk removed from the balance sheet, personnel expenses, number of personnel, tangible fixed assets, and property, plant, and equipment depreciation expenses—across 40 periods (2011/Q4 – 2021/Q4) for 10 deposit banks operating during this timeframe. In total, 3,200 data points were analyzed. The sample of 10 banks, which represents 83% of the total asset size of banks operating in Türkiye (as shown in Appendix 1), indicates that the sample set has a strong capacity to represent the Turkish Banking Sector.

In the study, the actual non-performing loan rate (actual follow-up), cost efficiency score, and clean non-performing loan rate (clean follow-up) were calculated for each bank for the relevant period, following balance sheet cleaning.

Real NPL ratio = (NPL in financial statement + NPL written off balance sheet in the same year)/ Total loans (1)

Clean NPL ratio = Non-performing loans in financial statement/Total loans (2)

The NPL ratios calculated using formulas (1) and (2) before and after balance sheet cleaning for the banks included in the analysis are presented in Appendix 2 and 3. Additionally, Appendix 4 provides information on the differences between NPL ratios before and after cleaning. The analysis shows that the three banks with the largest differences in balance sheet cleaning and NPL ratios are medium-sized banks.

Methodology

In this study, Stochastic Frontier Analysis (Battese & Coelli, 1995) was used to evaluate cost-effectiveness, and the Dumitrescu-Hurlin Panel Causality Test (Dumitrescu & Hurlin, 2012) was applied for causality analysis. We opted for the Dumitrescu-Hurlin Panel Causality Test, a more recent method, because it is particularly suited to our dataset, which is stationary and exhibits cross-sectional dependency between variables.

Several methodologies can be used to estimate banks' cost-effectiveness. In our study, we adopted the production approach, which emphasizes operational costs. According to this approach, operational costs are defined solely as non-interest expenses. The inputs for estimating these costs include labor and physical capital, with loans incorporated into the output vector (Berger & DeYoung, 1997).

In the production approach, banks utilize inputs such as labor and capital to produce outputs like deposits and loans. From an input perspective, only operating costs are considered, excluding interest-related costs. Since our study focuses on the credit aspect of banks, only non-interest costs are taken into account. Therefore, the production approach has been deemed more appropriate for this study.

According to the production approach adopted in this study, banks use labor and capital to produce loans and deposits. The input variables are defined as follows.

Cost of labor: 3-month average of personnel expenses / number of personnel at the end of the quarter

Cost of physical capital: 3-month average of property, plant and equipment depreciation expenses / quarter-end property, plant and equipment (Podpiera & Weill, 2008).

Stochastic Frontier Analysis, one of the most widely used approaches, was employed in our cost-effectiveness

analysis. The primary goal of Stochastic Frontier Analysis is to maximize output while minimizing input across all production areas, thereby achieving the highest possible efficiency. In this study, we utilized the Cobb-Douglas production function, developed by Battese and Coelli (1995), as the basis for our Stochastic Frontier Analysis.

$ln\,(Qi,t) = \beta 0 + \sum \beta j\ N\ j=1\ ln(xj,i,t) + vi,t - ui,t$

Qi,t : Output of bank i in period t

xj,i,t : an input vector

β : vector of unknown parameters to predict

ln(Qi,t) : Logarithmic state of production for bank i and period t

xj,i,t : Input vector for bank i and period t

βi :Parameters (i=1…n)

vi,t : random error term for bank i and period t

ui,t : Technical inefficiency error term for bank i and period t

N : Number of inputs

The model used in the analysis, developed in alignment with our data structure and within the framework of the specified theoretical approach, is presented below (Coelli, 1996):

$ln\,(Qi) = \beta 0 + \beta 1 ln(\mathrm{Ki}) + \beta 2\ ln(\mathrm{Li}) + (\mathrm{V}i - \mathrm{U}i)$

Q: output variable (credit)

K: input variable (physical capital)

L: input variable (personnel expense)

i: 1…..40

β : unknown parameters to predict

Vi – Ui: random error terms

For the causality analysis, the Dumitrescu-Hurlin Panel Causality Test (Dumitrescu & Hurlin, 2012), based on Granger causality analysis, was employed. The study utilizes the following linear model within this framework.

$$y_{i,t=}\ \alpha_i + \sum_{k=1}^{K=} \gamma_i^k\ y_{i,t-k} + \sum_k^K \beta_i^{(k)}\ x_{i,t-k} + \epsilon_{i,t}$$

K ∈ N ve βi= (βi (1),…,βi (K), (Dumitrescu & Hurlin, 2012)

In the model, x_1, x_2 and y represent the variables that were previously determined to be stationary: the actual NPL rate, clean NPL rate, and cost score, respectively. The dependent variable is cost (y), while the independent variables are actual NPL (x_1) and clean NPL (x_2).

N: number of banks, i=1…..10

T: 2012/Q1-2021/Q4 periods in the range, t=1…..40

The null hypothesis , which investigates whether the variables and Granger-cause the dependent variable, is formulated as follows.

H_0: βi= 0 ∀i =1,…N,

βi=(βi (1),…,βi (K))′

The alternative hypothesis is as follows.

H_1: βi ≠0 ∀i = 1,……N_1

βi ≠ 0 ∀i = N1+1, N2+2,…….N

ANALYSIS and RESULTS

Cost-effectiveness scores for 10 banks operating in Türkiye were calculated across 40 quarters. In estimating cost-effectiveness, labor and physical capital were used as input variables, with the loan amount as the output variable. The resulting cost-effectiveness scores are detailed in Appendix 5. The causality between Real NPL, Clean NPL, and cost-effectiveness was analyzed in three stages.

In the first stage of the analysis, the Breusch and Pagan (1980), Pesaran (2004), and Baltagi, Feng, and Kao (2012) tests were applied to the cross-sectional panel data of the banks. These tests examined whether there is cross-sectional dependency among the variables (cost, real NPL, clean NPL) and whether changes in one bank's variables influence those of other banks. The following hypotheses were tested for each variable (Breusch & Pagan, 1980; Pesaran, 2004; Baltagi, Feng, & Kao, 2012).

H_0: The variables are independent/no cross-sectional dependence between them.

H_1: The variables are not independent/ there is cross-sectional dependence between them.

The test results are presented in Table 1.

The test results revealed cross-sectional dependence between the variables (Table 1), resulting in the rejection of the null hypothesis that the variables were independent or showed no cross-sectional dependence across all tests. This indicates that a shock affecting

Table 1. Cross-sectional dependence table

	Cost/Efficiency	Real NPL	Clean NPL
Breusch-Pagan LM	1374.624 [0.0000]	820.9465* [0.0000]	704.7358 [0.0000]
Pesaran scaled LM	140.1547 [0.0000]	81.79194* [0.0000]	69.54226 [0.0000]
Bias-corrected scaled LM	140.0265 [0.0000]	81.66374* [0.0000]	69.41406 [0.0000]
Pesaran CD	36.74261 [0.0000]	25.58162* [0.0000]	24.39387 [0.0000]

* Significant at 1% confidence level. The square brackets are the probability values.

one bank in the analysis also influences the others. Subsequently, the stationarity of the variables (real NPL rate, cost score, clean NPL rate) was assessed using the Pesaran-CIPS (2007) panel unit root test, which accounts for cross-sectional dependence (Table 2) (Pesaran, 2007).

The test findings indicate that the cost series is stationary at the logarithmic level with a 1% confidence level, the real NPL series is stationary at a 10% confidence level, and the clean NPL series is stationary at a 1% confidence level (Table 2).

In the analyses conducted thus far, it has been determined that there is cross-sectional dependence between the variables and that they are stationary. In the final stage of the study, the causality between the cost/efficiency, real NPL, and clean NPL variables was explored. To this end, the Dumitrescu and Hurlin causality test, which accounts for cross-sectional dependence in stationary series, was applied (Dumitrescu & Hurlin, 2012). The causality test was conducted on pairs of real NPL and clean NPL variables.

All the results obtained are summarized in Table 3.

Table 2. Stationarity Test

	Test Statistic	*p*-value
Cost/Efficiency		
CIPS	-3.6071	<0.01
Real NPL		
CIPS	-2.28094	<0.10
Clear NPL		
CIPS	-2.71728	<0.01
Critical Values		
%1	-2.56	
%5	-2.33	
%10	-2.21	

Table 3. Dumitrescu-Hurlin Panel Causality Test

Variables	***Wbar-statistics***	***Zbar*-statistics**	***p*-value**	**Result**
Real NPL is not homogeneously the cause of Cost/Efficiency	6.1157	-1.0312	0.3025	***Cost/Efficiency*** ⇨ ***Real NPL***
Cost/Efficiency is not homogeneously the cause of Real NPL	11.2231	1.9624*	0.0497	
Clean NPL is not homogeneously the cause of Cost/Efficiency	2.2004	-1.9541*	0.0507	***Clean NPL*** ⇨ ***Cost /Efficiency***
Cost/Efficiency is not homogeneously the cause of Clean NPL	4.99615	0.62336	0.5330	

Probability values belong to *Zbar*-statistics.

As summarized in Table 3, there is a one-way causality from Real NPL to cost/efficiency at the 5% confidence level, as well as from Clean NPL to cost/efficiency. The results suggest that before balance sheet cleaning, cost/efficiency influenced Real NPL, with no evidence of a reverse relationship, thus supporting the "bad management" hypothesis. However, after balance sheet cleaning, the direction of the relationship between NPL and cost/efficiency reversed, providing evidence in favor of the "bad luck" hypothesis.

CONCLUSION and RECOMMENDATIONS

Conclusion and Summary of Findings

This study aimed to determine whether balance sheet cleaning improves the cost-effectiveness of banks. The analysis utilized quarterly data from 10 deposit banks operating in Türkiye between 2012 and 2021. Cost-effectiveness was evaluated using Stochastic Frontier Analysis (Battese & Coelli, 1995), while the Dumitrescu-Hurlin Panel Causality Test (Dumitrescu & Hurlin, 2012) was applied to explore causality.

The analysis supports the "bad management" hypothesis, highlighting managerial weaknesses in banks operating in Türkiye. This finding is consistent with the study by Berger and DeYoung (1997), which examined American banks. Similarly, studies by Williams (2004) and Podpiera and Weill (2008) also provided evidence supporting the bad management hypothesis. Setiawan et al. (2017) found results that support the "bad luck" hypothesis for banks in Asia and the "bad management" hypothesis for banks in Türkiye and the Middle East. Conversely, Rossi et al. (2005) found evidence supporting the "bad luck" hypothesis. Ghosh (2018) also reported findings that support the "bad luck" hypothesis for Islamic banks.

The findings after balance sheet cleaning support the "bad luck" hypothesis. This is because, post-cleaning, the dependency of NPL figures on managerial weaknesses diminishes, with external factors, likely driven by market dynamics, playing a more significant role. Additionally, balance sheet cleaning contributes to an increase in cost efficiency.

In summary, balance sheet cleaning reduces the costs associated with non-performing loans and enables banks to operate more cost-effectively. Therefore, banks should be encouraged to pursue balance sheet cleaning. This conclusion is consistent with the findings of Garrido et al. (2016) and the studies by Jonbst and Weber (2016). Similarly, Manz et al. (2019) supported the hypothesis that the sale of non-performing loans by European banks reduces financing costs.

Recommendations

The results indicate that banks in Türkiye achieve cost efficiency through balance sheet cleaning, assuming healthy loan processes. To enhance the performance of the Turkish banking sector, we recommend prioritizing and encouraging balance sheet cleaning.

During the data collection process, it was observed that balance sheet cleaning was conducted exclusively by private deposit banks in Türkiye. Public banks, apart from a small amount of balance sheet deletion by Vakıfbank and Halkbank in 2021, did not engage in this practice. It is estimated that if public banks also undertook balance sheet cleaning, the impact of managerial weaknesses on the rise of non-performing loans would be further mitigated. Therefore, we recommend that public banks implement balance sheet cleaning as well. Additionally, for future research, we suggest focusing on the effects of balance sheet cleaning using data solely from private deposit banks.

Another point to consider is the influence of the 4-quarter period in 2020 and 2021, during which flexibility in the classification of non-performing loans was introduced to mitigate the economic impact of the pandemic. While necessary, this adjustment undoubtedly affected the dataset and should be acknowledged as a limitation of the study.

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Appendix 1. Banks Included in the Sample (31.12.2021)

	Bank	**Total Assets (Billion TL)**	**Sector Share %**
Bank1	Akbank	709	7.7
Bank2	Denizbank	309	3.35
Bank3	Garanti BBVA	758	8.23
Bank4	Halkbank	901	9.78
Bank5	İş Bankası	927	10.06
Bank6	QNB Finansbank	371	4.03
Bank7	Türk Ekonomi Bankası	194	2.76
Bank8	Vakıfbank	1.007	10.93
Bank9	Yapı Kredi	737	8
Bank10	Ziraat Bankası	1.371	14.88
	TOTAL	**7.284**	**82.72**

Appendix 2. NPL before balance sheet cleaning/Total Loans (%) (Real NPL Ratio)

Period	Bank1	Bank2	Bank3	Bank4	Bank5	Bank6	Bank7	Bank8	Bank9	Bank10
2012/1	1.72	3.31	1.88	2.77	2.17	5.97	2.79	3.44	3.03	1.26
2012/2	1.64	3.32	1.89	2.74	1.97	5.98	2.28	3.43	3.14	1.37
2012/3	1.62	4.24	1.93	2.83	2.16	6.14	2.52	3.68	3.38	2.55
2012/4	1.24	4.06	2.18	2.78	1.9	6.43	2.14	3.8	3.01	2.77
2013/1	1.39	3.98	2.23	2.71	2	6.75	2.19	4.1	3.22	2.68
2013/2	1.21	3.92	1.88	2.62	1.66	5.96	1.96	3.95	3.35	2.38
2013/3	1.3	3.91	1.9	2.48	1.66	6.13	2.09	3.87	3.62	2.25
2013/4	1.47	3.39	2.02	2.46	1.55	6.53	2.19	3.86	3.44	2.1
2014/1	1.56	3.57	2.09	2.55	1.67	6.25	2.3	3.88	3.43	2.0
2014/2	1.63	3.81	2.1	2.53	1.52	5.22	2.46	3.89	3.4	1.94
2014/3	1.81	3.97	2.18	3.64	1.53	5.29	2.19	3.95	3.25	1.92
2014/4	1.78	3.68	2.34	3.46	1.45	5.06	2.38	3.61	3.3	1.85
2015/1	1.78	3.96	2.23	3.29	1.45	5.32	2.03	3.51	3.47	1.73
2015/2	1.97	4.26	2.33	3.04	1.53	5.55	2.14	3.44	3.5	1.68
2015/3	2.12	4.48	2.65	2.9	1.63	5.72	2.34	3.61	3.69	1.6
2015/4	2.26	4.84	2.6	2.96	1.9	6.04	2.24	3.73	3.99	1.62
2016/1	2.12	4.94	2.56	3.07	2.09	6.36	2.49	3.87	4.05	1.65
2016/2	2.24	4.64	2.7	2.93	2.3	5.91	2.42	3.99	4.37	1.65
2016/3	2.37	4.93	2.9	2.99	2.45	6.21	2.89	3.99	4.8	1.78
2016/4	2.49	4.81	2.65	3.03	2.26	6.19	2.99	4.13	4.88	1.75
2017/1	2.48	4.42	2.56	3.06	2.24	5.32	3.06	4.15	4.44	1.69
2017/2	2.17	4.25	2.47	2.98	2.3	5.27	3.07	3.98	4.2	1.58
2017/3	2.19	4.34	2.54	2.87	2.3	5.18	3.12	3.92	4.18	1.57
2017/4	2.24	4.26	2.42	2.82	2.09	4.79	2.93	3.96	4.29	1.55
2018/1	1.99	4.73	2.43	2.79	2.26	4.93	2.92	3.86	4.12	1.73
2018/2	2.73	5.02	3.22	2.64	2.71	4.82	2.9	3.85	3.84	1.85
2018/3	3.43	5.88	4.4	2.29	3.36	4.71	3.22	3.86	3.78	2.02
2018/4	4.21	6.38	4.96	3.29	4.12	6.04	4.15	4.63	5.45	2.4
2019/1	4.75	6.58	5.18	3.27	5.02	6.11	4.81	4.78	5.49	1.94
2019/2	5.36	7.67	5.58	4.02	5.76	6.38	5.24	4.73	5.84	2.02
2019/3	7.17	8.66	6.72	4.57	6.69	6.25	5.58	5.22	6.82	2.28
2019/4	7.86	10.45	6.89	5.15	6.49	6.86	5.99	5.92	7.54	2.8
2020/1	7.44	10.34	6.51	4.75	5.98	6.32	5.07	5.3	7.03	2.66
2020/2	6.79	9.44	5.97	3.9	5.63	6.46	5.14	4.29	6.62	2.3

2020/3	6.37	9.32	5.96	3.57	5.21	5.53	4.77	3.72	6.05	2.1
2020/4	6.83	8.86	4.56	3.76	5.54	5.98	4.22	3.96	6.38	2.29
2021/1	6.41	8.44	4.47	3.49	5.26	5.65	3.93	3.64	5.4	2.14
2021/2	6.25	8.29	4.1	3.41	4.89	5.29	3.61	3.66	5.22	2.17
2021/3	5.75	8.22	3.96	3.4	4.79	4.42	3.27	3.46	4.94	2.18
2021/4	5.29	8.04	3.78	3.02	4.12	4.15	3.08	3.09	4.62	1.93

Source: bddk.gov.tr./ Calculated by the authors considering the data in the Independent Audit Reports

Appendix 3. NPL after balance sheet cleaning/Total Loans (%) (Clean NPL Ratio)

	Bank1	Bank2	Bank3	Bank4	Bank5	Bank6	Bank7	Bank8	Bank9	Bank10
2012/1	1.63	3.14	1.88	2.77	2.17	5.97	2.79	3.44	3.03	1.26
2012/2	1.54	2.85	1.69	2.74	1.72	5.98	1.84	3.43	3.14	1.37
2012/3	1.49	3.52	1.75	2.83	1.91	6.14	2.09	3.68	3.38	2.55
2012/4	0.53	3.39	2.01	2.78	1.17	6.43	1.09	3.8	2.31	2.77
2013/1	1.38	3.98	2.23	2.71	2.0	6.75	2.19	4.1	3.22	2.68
2013/2	0.93	3.92	1.6	2.62	1.58	4.67	1.63	3.95	3.35	2.38
2013/3	1.03	3.91	1.63	2.48	1.59	4.89	1.78	3.87	3.62	2.25
2013/4	1.18	2.94	1.77	2.46	1.27	5.32	1.89	3.86	3.24	2.1
2014/1	1.56	3.57	2.09	2.55	1.67	6.25	2.3	3.88	3.43	2
2014/2	1.41	3.81	1.99	2.53	1.18	3.55	2.46	3.89	3.27	1.94
2014/3	1.57	3.95	1.97	3.64	1.21	3.74	1.8	3.95	2.87	1.92
2014/4	1.33	2.88	2.14	3.46	0.91	2.9	2	3.61	2.89	1.85
2015/1	1.59	3.96	2.18	3.29	1.24	5.32	1.52	3.51	3.47	1.73
2015/2	1.76	4.26	2.28	3.04	1.34	5.55	1.64	3.44	3.49	1.68
2015/3	1.9	4.48	2.51	2.9	1.44	5.72	1.86	3.61	3.67	1.6
2015/4	2.03	4.83	2.49	2.96	1.71	6.04	1.29	3.73	3.97	1.62
2016/1	1.82	4.94	2.37	3.07	2.09	6.36	2.49	3.87	4.05	1.65
2016/2	1.94	4.15	2.37	2.93	2.3	5.18	2.07	3.99	4.37	1.65
2016/3	2.08	4.1	2.54	2.99	2.44	5.5	2.55	3.99	4.8	1.78
2016/4	2.21	4.0	2.11	3.03	1.89	4.47	2.12	4.13	4.88	1.75
2017/1	2.48	4.07	2.51	3.06	2.24	5.32	2.89	4.15	4.17	1.69
2017/2	1.78	3.6	2.31	2.98	2.3	5.26	2.78	3.98	3.48	1.58
2017/3	1.81	3.7	2.38	2.87	2.3	5.18	2.65	3.92	3.36	1.57
2017/4	1.88	3.47	2.01	2.82	1.81	3.95	2.1	3.96	3.51	1.55
2018/1	1.61	4.73	2.43	2.79	2.26	4.93	2.72	3.86	3.81	1.73
2018/2	2.35	4.7	3.22	2.64	2.7	4.82	2.59	3.85	3.1	1.85
2018/3	3.06	5.56	4.4	2.29	3.36	4.71	2.68	3.86	2.97	2.02
2018/4	1.79	5.03	3.94	3.29	3.77	5.93	3.4	4.63	4.34	2.4
2019/1	4.75	6.39	5.18	3.27	5.02	6.11	4.67	4.78	5.32	1.94
2019/2	5.36	7.48	5.58	4.02	5.6	6.38	4.89	4.73	4.95	2.02
2019/3	7.17	8.48	6.72	4.57	6.11	6.25	4.91	5.22	5.7	2.28
2019/4	6.93	8.66	6.22	5.15	5.95	6.07	5.07	5.92	6.12	2.8
2020/1	7.44	10.34	6.51	4.75	5.98	6.32	4.91	5.3	6.7	2.66
2020/2	6.78	8.73	5.97	3.9	5.63	6.46	4.79	4.29	6.3	2.3
2020/3	6.37	8.66	5.96	3.57	5.21	5.53	4.3	3.72	5.73	2.1
2020/4	6.55	7.49	3.29	3.76	5.53	5.97	3.59	3.96	6.06	2.29
2021/1	6.4	8.44	4.46	3.49	5.06	5.65	3.77	3.64	5.08	2.14
2021/2	6.23	8.28	3.77	3.41	4.48	5.29	3.37	3.66	4.9	2.17
2021/3	5.72	7.71	3.63	3.4	4.31	3.84	2.92	3.3	4.63	2.18
2021/4	4.84	7.6	2.87	3.02	3.72	3.67	2.72	2.95	4.37	1.93

Source: bddk.gov.tr./ Calculated by the authors considering the data in the Independent Audit Reports

Appendix 4. Difference Between NPL Ratios Before and After Balance Sheet Cleaning

Period	Bank1	Bank2	Bank3	Bank4	Bank5	Bank6	Bank7	Bank8	Bank9	Bank10
2012/1	0.09	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012/2	0.10	0.47	0.20	0.00	0.25	0.00	0.44	0.00	0.00	0.00
2012/3	0.13	0.72	0.18	0.00	0.25	0.00	0.43	0.00	0.00	0.00
2012/4	0.71	0.67	0.17	0.00	0.73	0.00	1.05	0.00	0.70	0.00
2013/1	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013/2	0.28	0.00	0.28	0.00	0.08	1.29	0.33	0.00	0.00	0.00
2013/3	0.27	0.00	0.27	0.00	0.07	1.24	0.31	0.00	0.00	0.00
2013/4	0.29	0.45	0.25	0.00	0.28	1.21	0.30	0.00	0.20	0.00
2014/1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014/2	0.22	0.00	0.11	0.00	0.34	1.67	0.00	0.00	0.13	0.00
2014/3	0.24	0.02	0.21	0.00	0.32	1.55	0.39	0.00	0.38	0.00
2014/4	0.45	0.80	0.20	0.00	0.54	2.16	0.38	0.00	0.41	0.00
2015/1	0.19	0.00	0.05	0.00	0.21	0.00	0.51	0.00	0.00	0.00
2015/2	0.21	0.00	0.05	0.00	0.19	0.00	0.50	0.00	0.01	0.00
2015/3	0.22	0.00	0.14	0.00	0.19	0.00	0.48	0.00	0.02	0.00
2015/4	0.23	0.01	0.11	0.00	0.19	0.00	0.95	0.00	0.02	0.00
2016/1	0.30	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016/2	0.30	0.49	0.33	0.00	0.00	0.73	0.35	0.00	0.00	0.00
2016/3	0.29	0.83	0.36	0.00	0.01	0.71	0.34	0.00	0.00	0.00
2016/4	0.28	0.81	0.54	0.00	0.37	1.72	0.87	0.00	0.00	0.00
2017/1	0.00	0.35	0.05	0.00	0.00	0.00	0.17	0.00	0.27	0.00
2017/2	0.39	0.65	0.16	0.00	0.00	0.01	0.29	0.00	0.72	0.00
2017/3	0.38	0.64	0.16	0.00	0.00	0.00	0.47	0.00	0.82	0.00
2017/4	0.36	0.79	0.41	0.00	0.28	0.84	0.83	0.00	0.78	0.00
2018/1	0.38	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.31	0.00
2018/2	0.38	0.32	0.00	0.00	0.01	0.00	0.31	0.00	0.74	0.00
2018/3	0.37	0.32	0.00	0.00	0.00	0.00	0.54	0.00	0.81	0.00
2018/4	2.42	1.35	1.02	0.00	0.35	0.11	0.75	0.00	1.11	0.00
2019/1	0.00	0.19	0.00	0.00	0.00	0.00	0.14	0.00	0.17	0.00
2019/2	0.00	0.19	0.00	0.00	0.16	0.00	0.35	0.00	0.89	0.00
2019/3	0.00	0.18	0.00	0.00	0.58	0.00	0.67	0.00	1.12	0.00
2019/4	0.93	1.79	0.67	0.00	0.54	0.79	0.92	0.00	1.42	0.00
2020/1	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.33	0.00
2020/2	0.01	0.71	0.00	0.00	0.00	0.00	0.35	0.00	0.32	0.00
2020/3	0.00	0.66	0.00	0.00	0.00	0.00	0.47	0.00	0.32	0.00
2020/4	0.28	1.37	1.27	0.00	0.01	0.01	0.63	0.00	0.32	0.00
2021/1	0.01	0.00	0.01	0.00	0.20	0.00	0.16	0.00	0.32	0.00
2021/2	0.02	0.01	0.33	0.00	0.41	0.00	0.24	0.00	0.32	0.00
2021/3	0.03	0.51	0.33	0.00	0.48	0.58	0.35	0.16	0.31	0.00
2021/4	0.45	0.44	0.91	0.00	0.40	0.48	0.36	0.14	0.25	0.00
Mean	0.28	0.40	0.22	0.00	0.19	0.38	0.40	0.01	0.34	0.00
Order	5	2	6	9	7	3	1	8	4	10

Appendix 5. Cost Efficiency Scores of Banks

Period	Bank1	Bank2	Bank3	Bank4	Bank5	Bank6	Bank7	Bank8	Bank9	Bank10
2012/1	0.90	0.89	0.91	0.89	0.88	0.91	0.89	0.89	0.90	0.92
2012/2	0.90	0.90	0.89	0.91	0.89	0.91	0.89	0.89	0.90	0.92
2012/3	0.89	0.90	0.89	0.90	0.89	0.91	0.89	0.89	0.90	0.91
2012/4	0.89	0.89	0.89	0.91	0.89	0.91	0.89	0.89	0.90	0.91
2013/1	0.85	0.81	0.67	0.78	0.70	0.87	0.76	0.55	0.81	0.89
2013/2	0.79	0.79	0.74	0.82	0.65	0.83	0.76	0.76	0.81	0.88
2013/3	0.71	0.66	0.68	0.83	0.53	0.80	0.72	0.74	0.74	0.85
2013/4	0.67	0.71	0.70	0.84	0.51	0.81	0.68	0.83	0.71	0.82
2014/1	0.46	0.50	0.39	0.64	0.18	0.84	0.58	0.34	0.51	0.52
2014/2	0.35	0.55	0.36	0.81	0.19	0.99	0.68	0.74	0.52	0.43
2014/3	0.25	0.58	0.76	0.86	0.15	0.93	0.46	0.80	0.49	0.42
2014/4	0.21	0.64	0.56	0.99	0.14	0.97	0.18	0.63	0.38	0.46
2015/1	0.84	0.37	0.54	0.59	0.33	0.77	0.56	0.61	0.57	0.66
2015/2	0.75	0.66	0.68	0.66	0.33	0.76	0.58	0.69	0.50	0.61
2015/3	0.71	0.63	0.64	0.70	0.26	0.85	0.56	0.66	0.59	0.66
2015/4	0.61	0.68	0.68	0.74	0.21	0.83	0.59	0.67	0.60	0.69
2016/1	0.92	0.26	0.28	0.65	0.36	0.85	0.64	0.31	0.26	0.44
2016/2	0.86	0.49	0.28	0.63	0.82	0.82	0.57	0.71	0.24	0.43
2016/3	0.73	0.65	0.71	0.74	0.72	0.78	0.51	0.64	0.21	0.40
2016/4	0.60	0.61	0.69	0.61	0.29	0.64	0.41	0.50	0.18	0.80
2017/1	0.70	0.12	0.18	0.26	0.20	0.81	0.14	0.18	0.16	0.28
2017/2	0.66	0.11	0.43	0.59	0.39	0.53	0.12	0.44	0.50	0.28
2017/3	0.59	0.11	0.42	0.60	0.14	0.80	0.10	0.41	0.12	0.60
2017/4	0.49	0.28	0.39	0.64	0.12	0.78	0.91	0.36	0.11	0.55
2018/1	0.82	0.78	0.78	0.78	0.77	0.81	0.78	0.80	0.79	0.79
2018/2	0.82	0.78	0.78	0.81	0.77	0.82	0.78	0.81	0.79	0.81
2018/3	0.81	0.78	0.78	0.81	0.77	0.82	0.77	0.81	0.79	0.81
2018/4	0.82	0.79	0.79	0.81	0.77	0.83	0.79	0.80	0.77	0.82
2019/1	0.73	0.68	0.67	0.71	0.68	0.73	0.70	0.71	0.72	0.71
2019/2	0.75	0.69	0.67	0.71	0.69	0.73	0.66	0.73	0.71	0.73
2019/3	0.75	0.69	0.68	0.71	0.69	0.73	0.66	0.73	0.72	0.73
2019/4	0.76	0.70	0.69	0.71	0.70	0.73	0.70	0,73	0.72	0.74
2020/1	0.73	0.65	0.66	0.68	0.64	0.68	0.68	0.75	0.68	0.69
2020/2	0.72	0.66	0.66	0.69	0.68	0.68	0.68	0.72	0.69	0.69
2020/3	0.72	0.65	0.66	0.69	0.67	0.68	0.67	0.71	0.69	0.69
2020/4	0.72	0.66	0.66	0.68	0.65	0.72	0.66	0.70	0.68	0.71
2021/1	0.69	0.62	0.63	0.66	0.62	0.67	0.65	0.69	0.67	0.68
2021/2	0.70	0.63	0.64	0.67	0.63	0.68	0.64	0.69	0.66	0.69
2021/3	0.70	0.63	0.64	0.67	0.63	0.69	0.65	0.69	0.66	0.69
2021/4	0.70	0.64	0.66	0.68	0.64	0.71	0.65	0.71	0.67	0.72