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Evaluation of Efficiency in Turkish Tax Audit System after Structural Reform via Window Analysis

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Yapısal Reform Sonrası Türk Vergi Denetim Sisteminde Etkinliğin Pencere Analizi ile Değerlendirilmesi	**Evaluation of Efficiency in Turkish Tax Audit System after Structural Reform via Window Analysis**
Öz	**Abstract**
Bu çalışma, pencere analizi kullanarak yapısal reform sonrasında Türkiye'deki vergi denetim sisteminin etkinliğini değerlendirmektedir. Sistemin 2011-2022 yılları arasındaki etkinlik düzeyi, girdi değişkenleri (denetim personeli ve aktif mükellef sayısı) ve çıktı değişkenleri (denetlenen mükellef sayısı ve tahsilat/tahakkuk oranı) ile hesaplanmıştır. Sonuçlar, sistemin 2011-2015 döneminde etkin olduğunu, ancak etkinliğin 2016-2022 döneminde azaldığını göstermektedir. Daha fazla denetim personeline rağmen tahsilat/tahakkuk oranı iyileşmemiştir. Çalışma, sistemin etkinliğini artırmanın yollarını önermekte ve gelecekteki araştırmalar için içgörüler sağlamaktadır.	This study evaluates the efficiency of the tax audit system in Türkiye after the structural reform using window analysis. The efficiency level of the system from 2011 to 2022 is calculated with input variables (number of audit staff and active taxpayers) and output variables (number of taxpayers audited and collection/accrual ratio). The results show that the system was efficient in 2011-2015 but declined in 2016-2022. Despite more audit personnel, the collection/accrual ratio did not improve. The study suggests ways to increase the system's efficiency and provides insights for future research.
Anahtar Kelimeler: Etkinlik Analizi, Pencere Analizi, Vergi Denetim Sistemi, Yapısal Reform	**Keywords:** Efficiency Analysis, Window Analysis, Tax Audit System, Structural Reform
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1. Introduction

Taxes are not only a means for the state to obtain revenue, but also a way and means of directing economic and social life, sometimes even realizing political goals (Nadaroğlu, 2000). Taxes are one of the most important elements of contemporary public finance. It not only meets public needs but also serves many different purposes. Taxation, as an instrument of economic and fiscal policy, contributes to justice in income distribution, efficiency in resource allocation, economic growth, and development goals in addition to the purpose of providing revenue (Demircan Siverekli, 2003). In addition, it is known that taxation plays an important role in the formation of economic stability (Can, 2003). The success of the tax system, which has such an important place for the state, depends on the correct and effective monitoring of every step related to taxation, the collection and evaluation of information in a healthy way and the use of this information in accordance with the objectives of the tax (Akdoğan, 2011). This is only possible through the establishment of an effective tax audit system.

In its most basic form, tax audit is the examination of the compliance of taxpayer and tax administration transactions with the standards set by laws, regulations, and bylaws. In this conceptual framework, the objectives of tax audit include preventing tax losses and evasion, ensuring that the administration complies with tax laws, increasing taxpayers' awareness of tax laws and increasing voluntary tax compliance by improving tax morality (Çavdar, 2019). The fact that taxpayers calculate and declare their own tax bases reveals the need for a strong and effective tax administration. To collect taxes properly, the tax administration must find those who conceal their tax liabilities and check the accuracy of taxpayer declarations. The most effective way to achieve this in declaration-based tax systems is the establishment and operation of a successful tax audit system (Savaş, 2000).

Tax audit is one of the measures implemented to ensure that tax revenues are transferred to the administration's budget in full and on time. This mechanism, which is present in the tax systems of almost all countries, is the most important tool used in the collection of tax revenues, which is the most important source of public financing, in full and on time (Beşel, 2017; Sandalcı and Sandalcı, 2021). For this reason, it is essential to operate an effective and efficient tax audit system to accurately collect taxes, which constitute a large portion of budget revenue. As Ergen and Kılınçkaya (2014:281) state, *"a strong budget depends on a strong tax system, and a strong tax system depends on an effective and efficient tax audit system."*

Performance is a concept that expresses the gain obtained as a result of a planned activity in a quantitative or qualitative, relative or absolute way (Akal, 2005). Since there is no consensus on the concept of performance, it has been defined in connection with performance dimensions (O'Donnell and Duffy, 2002). It can be said that organizational performance has two main sub-dimensions. One of these dimensions is effectiveness, which relates outputs to objectives, and the other is efficiency, which relates outputs to inputs (Lindsay, 1982). Effectiveness is a performance dimension that shows the degree to which an organization achieves its predetermined goals, in other words, the level of achievement of the organization's objectives (Bilgin, 2004). Efficiency, on the other hand, can be defined as the ability to achieve the highest possible level of output with a given level of input or the ability to achieve a given level of output with the lowest possible level of input (Tecer, 1985).

Although efficiency and effectiveness dimensions should be considered together to get a complete picture of system performance, the levels of these dimensions should be measured and evaluated separately. Whether a system achieves its predetermined objectives is related

to the effectiveness dimension, while the ability to achieve these objectives with minimum resources is related to the efficiency dimension. While there is no absolute relationship between these two concepts, one is not a prerequisite for the other. In other words, a system may be efficient but not effective; or it may be effective but not efficient (Schermerhorn Jr and Bachrach, 2023). An efficient system that maximizes the utilization of its inputs and achieves the highest possible output level has a low level of effectiveness if it does not achieve the outputs, it has previously targeted. In this case, it is possible to increase the efficiency level of the effective system in question by increasing the amount of output obtained by increasing the quantity and/or quality of inputs used. On the other hand, if an effective system that achieves the outputs it has previously targeted cannot achieve the highest possible output level due to its inability to utilize its inputs at the maximum level and waste its resources, its efficiency level is low. In this case, it is possible to increase the efficiency level of the effective system in question by using its existing inputs more efficiently and obtaining more output. In summary, a system can do a lot with few resources but not achieve its objectives; or it can achieve its objectives but spend too many resources.

Although tax audit has fiscal, economic, social, political, and legal dimensions, its fiscal dimension, whose main purpose is to increase tax revenues to finance the state's public expenditures, comes to the fore (Beşel, 2017). This dimension is very important as it is a deterrent factor to ensure the payment of taxes, which is the main source of income of the state, as well as a means of collection with the assessments and penalties determined as a result of tax audits (Ergen and Kilinçkaya, 2014). The efficiency of tax audit is not only related to the maximization of tax revenues, but also to the minimization of the costs of obtaining these revenues. Therefore, the efficiency of the audit system should be measured by evaluating the tax revenues obtained as well as the costs incurred in obtaining these revenues. In this study, the efficiency of the tax audit system is measured based on the input-output model.

The limited availability of public resources has led to the necessity of using these resources effectively and efficiently. For this reason, countries have started to renew their public financial management systems and have made important structural reforms to allocate and use public resources economically, effectively, and efficiently. The Public Financial Management and Control Law No. 5018, which introduced the most fundamental and comprehensive revision in Türkiye's public financial management system, was adopted at the end of 2003. This law strongly emphasized the efficient and effective use of public resources (Kesik, 2005). Similarly, administrative, functional, and structural transformations were realized in the tax audit system in order to increase efficiency and effectiveness. The most recent and comprehensive regulation made by the Decree Law No. 646 issued in 2011 includes an important change regarding the Tax Audit Organization. With this regulation, the Turkish Tax Inspection Board was established directly under the Ministry of Treasury and Finance. The Presidency of the Board of Account Experts, the Presidency of the Finance Inspection Board, the Presidency of Revenue Controllers, and the Tax Inspectors' Office, which were previously operating as separate units, were merged under a single roof. On the other hand, the said Decree Law abolished the titles such as Account Expert, Finance Inspector, Revenue Controller and Tax Auditor and renamed the audit personnel authorized to conduct tax audits as "Tax Inspector". Thus, an effective and efficient audit system was aimed by eliminating coordination problems in tax audit. Therefore, the structural changes have been implemented so that the audit system

has been done more coordinately and systematically, and the use of resources has been efficient (Ceylan and Tunalı, 2011; Sandalcı, 2019).

This study will analyze the efficiency in the tax audit system of Türkiye from the years of 2011 to 2022. We used window analysis method to compare the annual efficiencies and analyze the system's developments and changes in efficiency during that period.

In this new era for Türkiye's tax audit system, we analyze the efficiency from 2011 to 2022. Window analysis gives us knowledge about the system's efficacy, emphasizing important developments and changes in efficiency during that period.

The use of window analysis allows us to track the trajectory of auditing efficiency after significant structural reforms. This method goes beyond the immediate effects of policy changes and contributes to the literature by examining the outcomes that follow. It also investigates the relationship between efficient budget performance and overall efficiency, enhancing our understanding of the fiscal consequences of the audit system. By analyzing the tax audits' efficiency at a macro level, we aim to bridge existing gaps in the literature and lay the groundwork for future research.

Furthermore, this research addresses the critical challenge of optimizing tax collection while minimizing resource use. We provide a quantitative assessment of whether the restructured tax audit system effectively meets its objectives of increasing revenue and saving resources. The findings of this study are crucial for policymakers and administrators as they develop more effective tax audit strategies and highlight the importance of continuous performance monitoring. The model we present can be applied in different settings to enhance the efficiency of tax collection mechanisms and contribute to the fiscal sustainability of the state.

The next part of the study includes a comprehensive literature review on previous research conducted on efficiency analysis in tax audits. The third section, which is methodological, offers a detailed analysis of the window analysis techniques used. After introducing the variables and the dataset used in the study, this section concludes with the analytical process. The fourth section provides a detailed explanation of the empirical results. The fifth and final section discusses the implications of these findings for the existing body of literature, proposes policy recommendations, outlines the study's limitations, and suggests avenues for future research.

2. Literature Review

Compared to other areas such as education, health and banking, efficiency analysis in taxation has been the subject of few studies in the national and international literature. The studies are generally based on comparing the efficiency of audit or tax units in a country. Thirtle *et al.,* (2000) analyzed the efficiency of 15 Indian state tax jurisdictions over a 13-year period using Data Envelopment Analysis (DEA) and Malmquist Total Factor Productivity (TFP) Index. González and Miles (2000) measured the efficiency of 15 regional audit units in Spain and Moesen and Persoon (2002) measured the efficiency of 289 regional tax offices in Belgium with DEA. Tosun and Güran (2002) examined the efficiency of 21 tax offices affiliated to the Ankara Treasurer's Office by using DEA method. Førsund *et al.,* (2005) measured the efficiency of 98 local tax offices in Norway with DEA and Malmquist TFP Index over a three-year period. Barros (2005) measured the efficiency of 41 tax offices in Lisbon, Portugal using Stochastic Frontier Analysis (SFA) and Barros (2007) measured the efficiency of the same tax offices using DEA. Katharaki and Tsakas (2010) examined the efficiency of 27 tax offices in Greece over a six-year period using DEA and Window analysis methods. Park and Ryu (2012) evaluated the efficiency

of 6 regional tax offices in Korea over an 11-year period using DEA, Window Analysis and Malmquist TFP Index. Yalçın (2012) measured the efficiency of 26 tax offices in Türkiye using DEA. Feizpour *et al.,* (2013) first categorized 30 provinces in Iran into 3 groups according to their development levels and then evaluated the tax system efficiency of these provinces with DEA. Ruy and Lee (2013) examined the efficiency of 6 tax jurisdictions in Korea over a 14-year period by using DEA and trend analysis methods. Salinas (2015) evaluated the efficiency of 15 regional directorates constituting the regional distribution of the tax administration in Paraguay over a 3-year period with DEA and Malmquist TFP Index. Fuentes and Lillo-Bañuls (2015) measured the efficiency of 30 tax offices in Alicante, Spain over a three-year period using DEA and the Malmquist TFP Index. De Carvalho Couy (2015) analyzed the efficiency of 97 federal tax offices in Brazil over a 5-year period using DEA. Askari and Charkhkar (2015) measured the efficiency of 12 tax offices in Tehran, Iran over a 4-year period with DEA. Rubio et al. (2017) evaluated the efficiency of 47 regional tax offices in Spain with two-stage DEA. Mohammadi *et al.,* (2017) examined the efficiency of tax offices in 15 underdeveloped and 15 developed provinces of Iran, excluding Tehran, within their categories and within the framework of DEA/Analytic Hierarchy Process integrated model. Huang *et al.,* (2017) analyzed the efficiency of 20 local tax offices in Taiwan using Network DEA and Russell Distance Directional Function approach. Naranjo and Jano (2017) analyzed the efficiency of tax offices in 16 Spanish Autonomous Communities over a 9-year period using DEA and Window analysis methods. Naranjo and Jano (2018) measured the efficiency of tax offices in 15 Spanish Autonomous Communities over a 9-year period using DEA and Malmquist TFP Index. Fernandes and Sousa (2018) examined the tax efficiency of 210 municipalities in the State of Paraíba, Brazil, using Multiple DEA. Ahmadi *et al.,* (2018) measured the efficiency of 31 provincial tax offices in Iran over a 4-year period with DEA. Gomes Cabello et al. (2019) examined the efficiency of tax agencies in 23 states and the federal district in Brazil over a 4-year period using SFA and three-stage DEA. Vieira et al. (2020) analyzed the tax efficiency of 767 municipalities in the State of Minas Gerais, Brazil, using DEA. Zhang and Lv (2020) measured the efficiency of the tax authorities of 28 provinces in China using three-stage DEA. Aparicio *et al.,* (2020) used the Malmquist-Luenberger and Luenberger Indices to evaluate the efficiency of 44 regional tax authorities in Spain over a 10-year period. Biswal and Rout (2021) measured the efficiency of 17 states in the general category and 11 states in the special category in India within their own categories using DEA. Jansen *et al.,* (2022) examined the tax efficiency of 8 metropolitan cities in South Africa with DEA. Yan *et al.,* (2022) measured the tax efficiency of 16 cities in Yunnan, an underdeveloped province in western China, with two-stage DEA. Pan (2022) evaluated the tax administration efficiency of 31 provinces in China over a ten-year period with DEA and Malmquist TFP Index.

There are limited number of studies in the literature comparing the tax administration efficiency of countries. Alm and Duncan (2014) examined the tax administration efficiency of 28 OECD countries with SFA and DEA. Savić et al. (2015) measured the tax administration efficiency of 13 European countries using DEA and Regression Analysis. ATAF (2021) evaluated the tax administration efficiency of 30 African countries with DEA, Window Analysis and Bilateral Analysis. Mackenzie *et al.,* (2022) evaluated the tax administration efficiency of 27 African countries with SFA and DEA. Nguyen *et al.,* (2022) measured the tax system efficiency of 88 countries over a twelve-year period with Panel DEA and Malmquist TFP Index. Martínez *et al.,* (2022) measured the tax administration efficiency of 28 OECD countries with DEA.

Anastasiou *et al.,* (2023) examined the tax administration efficiency of 26 European countries with DEA.

In the literature, there are very limited studies in which the macro-level efficiency of a country's tax system is evaluated as a whole with its own internal dimensions. Serra (2005) examined the efficiency of the Chilean tax system over a period of sixteen years using the Window Analysis method. Monjazeb and Moosavi (2015) evaluated the efficiency of the Iranian tax system over a seven-year period using the Window Analysis method. Wang (2022) examined the efficiency of the Chinese tax system over an eight-year period with three-stage DEA.

The approach used in this research for window analysis offers a view of how the audit efficiency has developed since major structural changes have occurred. This is important because it fills the gaps in literature by broadening the scope of analysis from immediate effects of policy changes to long term outcomes resulting from such reforms. It is common for studies involving tax audit efficiency in Türkiye to compare different provinces' tax offices using DEA. So far, no study has been done measuring the efficiency of the entire tax audit system at macro level. This research addresses this gap in literature and opens up further opportunities for research on this subject.

3. Method

3.1. Window Analysis

Window Analysis, also called DEA Window Analysis, developed by Charnes *et al.,* (1985), is an extension of the traditional DEA method that can process panel data and measure the efficiency of decision-making units and their changes over time.

Window analysis is a method that uses moving averages to identify trends in the performance of a decision-making unit over time. Each decision-making unit is treated as a separate unit in different periods. This lets in for a contrast of a unit's performance in a given duration with its very own past overall performance, in addition to the overall performance of other units. This approach is beneficial for small sample sizes as it increases the variety of information points, thereby increasing the discriminatory power while there are few decision-making units. The window width, which refers to the number of time periods considered in the analysis, can range from a contemporaneous analysis to an intertemporal analysis that includes observations for the entire study period (Asmild *et al.,* 2004; Tulkens and Eeckaut, 1995).

In window analysis, the dynamic nature of the data can be assessed by using windows (panels) in which trends and seasonal effects in the performance of each Decision-Making Unit (DMU) are identified (Charnes *et al.,* 1994). It is obvious that the use of panel data in window analysis allows for a more reliable evaluation of DMUs as it provides series covering more than one period (Cullinane *et al.,* 2004).

Following the formulation of Asmild *et al.,* (2004) and Kim *et al.,* (2023), assume that there are n DMUs $(n = 1, \dots, N)$ that produce s outputs using r types of inputs during period T $(t = 1, \dots, T)$. Let DMU_n^t represent an n observation in period t with the input vector (X_n^t) and output vector (Y_n^t) given below respectively.

$$X_n^t = \begin{bmatrix} x_n^{1t} \\ \vdots \\ x_n^{rt} \end{bmatrix}$$

$$Y_n^t = \begin{bmatrix} y_n^{1t} \\ \vdots \\ y_n^{st} \end{bmatrix}$$

Assuming that the window width is w $(1 \leq w \leq T)$ and the window starts at k time points $(1 \leq k \leq T - w + 1)$, the input (X_{k_w}) and output matrix (Y_{k_w}) of each window consisting of $N \times w$ observations and represented by k_w is as shown below.

$$X_{k_w} = \begin{bmatrix} x_1^k & x_2^k & \cdots & x_N^k \\ x_1^{k+1} & x_2^{k+1} & \cdots & x_N^{k+1} \\ \vdots & \vdots & \ddots & \vdots \\ x_1^{k+w-1} & x_2^{k+w-1} & \cdots & x_N^{k+w-1} \end{bmatrix}$$

$$Y_{k_w} = \begin{bmatrix} y_1^k & y_2^k & \cdots & y_N^k \\ y_1^{k+1} & y_2^{k+1} & \cdots & y_N^{k+1} \\ \vdots & \vdots & \ddots & \vdots \\ y_1^{k+w-1} & y_2^{k+w-1} & \cdots & y_N^{k+w-1} \end{bmatrix}$$

By placing the above inputs and outputs of DMU_n^t into the relevant DEA models (CCR, BCC, etc.), window analysis can be performed.

Three important methodological approaches stand out in efficiency analysis using panel data. These are contemporaneous analysis, window analysis and intertemporal analysis. In fact, contemporaneous and intertemporal analysis are two extreme cases of window analysis where the window width is equal to 1 $(w = 1)$ and T $(w = T)$ respectively (Cullinane *et al.,*2004).

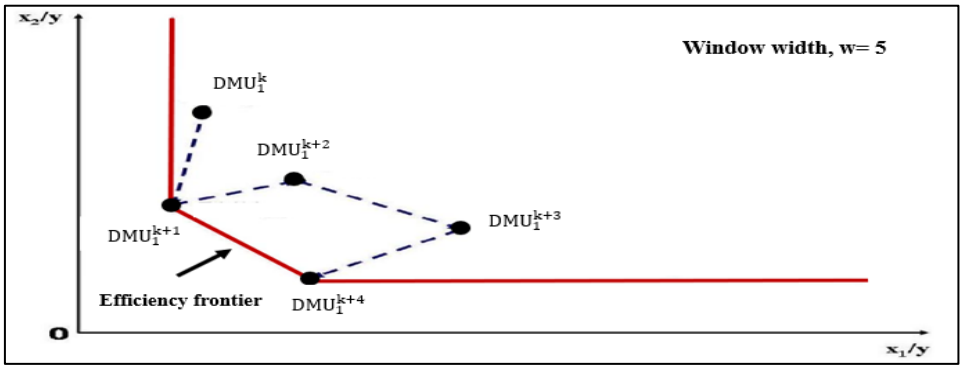
3.2. Window Analysis Model for a Single Decision-Making Unit

The window analysis model is an appropriate method for evaluating the performance of a single DMU over time (Asmild et al., 2004). A single time series consisting of several observations of a single DMU can be analyzed using window analysis (Tulkens and Eeckaut, 1995).

The Window analysis model used in this study assumes that the observations of the same tax audit system (a single DMU) for different years are different DMUs. In this case, the discriminative power of the model increases as the number of observations increases. For a period of T years $(t = 1, \dots T)$, the analysis is carried out by separately evaluating w data points (w DMUs) in a window of a single tax audit system with a window width of w $(1 \leq w \leq T)$ and starting at time point k $(1 \leq k \leq T - w + 1)$. The efficiency scores of these data points provide important information about the course of efficiency change in the tax audit system.

Figure 1, adapted from Ngo (2012), shows the efficiency frontier and the efficiency change for a five-period window ($w = 5$) between periods k and $k + 4$ for a single DMU that produces one output using two different inputs. Periods $k + 1$ and $k + 4$ constitute the efficiency frontier of DMU_1. Therefore, it is observed that in periods k , $k + 2$ and $k + 3$, DMU_1 is not efficient. It is observed that efficiency increases from period k to period $k + 1$, decreases from period $k + 1$ to period $k + 2$, remains almost unchanged from period $k + 2$ to period $k + 3$, and increases again from period $k + 3$ to period $k + 4$.

Figure 1: Efficiency Values of a Single DMU for a Five-Period Window



Source: Adapted from (Ngo, 2012).

3.3. Determination of Window Width and Input-Output Variables

As in all other systems, the tax audit system has three basic elements: input, transformation process and output. Achieving the highest potential output level provided by the available inputs is a condition for the efficiency of this system. It is most appropriate to evaluate the tax audit system with a model that can be represented by all input and output indicators. However, the degree of freedom problem does not allow the construction of this model. Therefore, it is vital for efficiency measurement to accurately determine the inputs and outputs that are most appropriate for the objectives and instruments of the tax audit system among many inputs and outputs.

In Window Analysis, which is an extension of DEA, there is a positive relationship between the number of DMUs and degrees of freedom and a negative relationship between the number of inputs and outputs and degrees of freedom. This leads to a change in the shape of the boundary that determines the efficiency of the DMUs (Cooper *et al.,*2007). An increase in the number of inputs and outputs while the number of DMUs is fixed may weaken the discrimination ability and cause many DMUs to be inefficient (Jenkins and Anderson, 2003). The main constraint equations that explain the relationship between the number of inputs and outputs and the number of DMUs in the literature on this degree of freedom problem are presented below. Assume that there are n DMUs $(n = 1, \dots N)$ that produce s outputs using r types of inputs during period T $(t = 1, \dots T)$.

- $n \geq r + s + 1$ (Boussofiane *et al.,*1991).
- $n \geq 2(r + s)$ (Golany and Roll, 1989).
- $n \geq 3(r + s)$ (Banker *et al.,* 1989; Friedman and Sinuany-Stern, 1998).
- $n \geq 2(r \times s)$ (Dyson *et al.,* 2001).

The window analysis model increases the number of observations by treating the observations of a DMU in different years as independent DMUs and thus improves the decomposition ability of the model. With this method, the degrees of freedom constraint is relaxed. Thus, for a single window of width w, the following constraint equations are obtained.

- $n \times w \geq r + s + 1$
- $n \times w \geq 2(r + s)$
- $n \times w \geq 3(r + s)$
- $n \times w \geq 2(r \times s)$

In this study, the efficiency of the tax audit system $(n = 1)$ between 2011 and 2022 $(T = 12)$ is measured by Window Analysis. In the literature, it is generally observed that in efficiency measurement studies for different periods of a single DMU, a single window with "window width equal to the total number of periods" is used (Monjazeb and Moosavi, 2015; Ngo, 2012; Serra, 2005; Wang, 2022). Similarly, in this study, the window width is set as 12 $(w = T = 12)$, the number of input types is set as two $(r = 2)$ and the number of output types is set as two $(s = 2)$ to ensure that the model has decomposition power and satisfies all the above-mentioned constraint equations. To increase the sensitivity level, the analysis with the number of inputs and outputs was repeated by choosing the smallest window width $(w = 8)$ that satisfies the constraint equations of Golany and Roll (1989) and Dyson *et al.,* (2001). To conduct our analyses, we performed two separate evaluations using distinct window widths but identical input-output variables, subsequently comparing the outcomes.

In the window analysis method, we select input and output variables with precision, ensuring they are measurable, comparable, and reflective of the system's performance. Cooper et al. (2007) emphasize that these variables must represent the system's efficiency, while Seiford and Thrall (1990) advise that input variables should indicate the resources invested in the system, and output variables should reflect the results produced.

Informed by previous studies, we chose four variables—two inputs and two outputs—aligned with the Turkish tax audit system's goals and operations. We gathered data for these variables from the Revenue Administration Annual Reports (2011-2022), the Tax Inspection Board Annual Reports (2012-2022), the 2011 Ministry of Finance Annual Report, and the Statistics of Revenue Administration. We detail the selected variables as follows:

Number of audit staff (I1): We define this input variable as the total staff count dedicated to tax audit tasks. It signifies the human resource investment necessary for conducting tax audits. An increase in this variable correlates with a rise in the cost, or resource utilization, of tax audit activities.

Number of active taxpayers (I2): This input variable represents the total number of taxpayers obligated to fulfill tax liabilities. It identifies the potential target group for tax audit endeavors. A higher value for this variable expands the scope of tax audit activities, implying a greater number of taxpayers subject to auditing.

Number of taxpayers examined (O1): This variable refers to the number of taxpayers examined within the scope of the tax audit activity. This variable, which is used as an output, is one of the products (results) obtained as a result of the tax audit activity. The higher the value of this variable, the higher the performance of the tax audit activity.

Collection/Accrual ratio (O2): Tax audit is a critical process through which the tax administration checks whether taxpayers fulfill their tax obligations. This process clarifies the taxes that taxpayers should pay, encourages tax compliance, and prevents tax evasion and avoidance. One of the most important objectives of the tax audit process is the payment of the tax by the taxpayer, that is, its collection and transfer to the budget. Tax audit contributes to the budget by increasing the revenues of the tax administration (Arslan and Biniş, 2014; Demirkol, 2020; Gez, 2011). This variable used as output is one of the products (results) obtained as a result of the tax audit activity. As the value of this variable increases, the success of the tax audit activity increases.

3.4. Data Set and Analysis

Data on the number of audit personnel, active taxpayers and taxpayers examined were obtained from the annual activity reports of the Revenue Administration (2011-2022), the Ministry of Finance (2011) and the Tax Inspection Board (2012-2022), while the Collection/Accrual ratio was obtained from the official statistics of the Revenue Administration. The data set used in the study is shown in Table 1.

Table 1: Data Set Used in the Study

Years	Inputs		Outputs	
	Number of audit staff[2]	Number of active taxpayers[3]	Number of taxpayers examined	Collection/Accrual ratio %
2011	4,725	2,367,721	28,937	85.6
2012	4,397	2,422,975	56,713	86.4
2013	4,975	2,460,281	84,276	86.8
2014	4,442	2,472,658	65,063	85.2
2015	4,591	2,527,084	68,578	84.7
2016	6,479	2,541,016	56,678	81.2
2017	6,970	2,636,370	50,398	82.3
2018	7,034	2,727,208	48,461	81.4
2019	7,070	2,813,452	45,545	81.0
2020	7,231	3,004,329	50,658	80.1
2021	6,740	3,221,894	56,429	80.7
2022	6,626	3,433,964	79,374	83.1

Source: Own elaboration using data from the 2011-2022 Revenue Administration Annual Reports[4], 2012-2022 Tax Inspection Board Annual Reports[5], 2011 Ministry of Finance Annual Report[6] and Statistics of Revenue Administration[7]

In the study, the output oriented CCR model is used since it is an approach that aims to determine the maximum level of outputs that can be obtained at fixed input levels. The results of the analysis were obtained using the Efficiency Measurement System (EMS 1.3), an Excel-based software package developed by Scheel (2000) for academic use. EMS 1.3 is a very convenient software to easily implement the Window analysis and to graphically display the results.

[2]It is composed of the sum of the number of tax inspectors actively conducting examinations and the number of tax office managers.

[3]Consists of the sum of the number of active Income Taxpayers and the number of active Corporate Taxpayers.

[4]https://www.gib.gov.tr/kurumsal/stratejik-yonetim/faaliyet-raporlari. Accessed 2 August 2023.

[5]https://vdk.hmb.gov.tr/vdk-faaliyet-raporlari. Accessed 2 August 2023.

[6]https://ms.hmb.gov.tr/uploads/2018/10/Maliye-Bakanl%C4%B1%C4%9F%C4%B1-2011-Y%C4%B1l%C4%B1-Faaliyet-Raporu.pdf. Accessed 2 August 2023.

[7]https://www.gib.gov.tr/fileadmin/user_upload/VI/GBG/Tablo_17.xls.htm. Accessed 2 August 2023.

4. Empirical Results

The results of the window analysis, in which the tax audit system is evaluated in a single window over a 12-year period, are presented in Table 2. When this table is analyzed, it is seen that the first four years after the structural transformation were efficient years (2011, 2012, 2013, 2014), 2015 was very close to the efficiency threshold, and the remaining years were inefficient, in other words, resources were not used efficiently in these years.

Furthermore, Spearman's correlation test was employed to assess the relationship between the efficiency score and the primary budget balance/GDP ratio. The results demonstrated a positive and strong correlation between these variables ($r=0.816$, $p<0.01$), indicating that as the efficiency score increases, budget performance tends to improve.

Table 2: Window Analysis Efficiency Scores (Single Window, w=12)

			Benchmark (lambda)			
Years	**Efficiency score**	**Primary budget balance/GDP**	**2011**	**2012**	**2013**	**2014**
2011	1.00	1.70	-	-	-	-
2012	1.00	1.20	-	-	-	-
2013	1.00	1.70	-	-	-	-
2014	1.00	1.30	-	-	-	-
2015	0.98	1.30	-	-	0.22	0.79
2016	0.89	0.80	0.46	-	0.59	-
2017	0.87	0.30	0.62	-	0.47	-
2018	0.83	0.03	0.68	-	0.46	-
2019	0.80	-0.60	0.76	-	0.41	-
2020	0.74	-0.80	0.67	-	0.58	-
2021	0.70	-0.30	0.58	-	0.76	-
2022	0.71	1.10	-	-	1.24	0.10
		Times as a benchmark for another year	6	0	8	2
Mean	0.88					
Range	0.30					

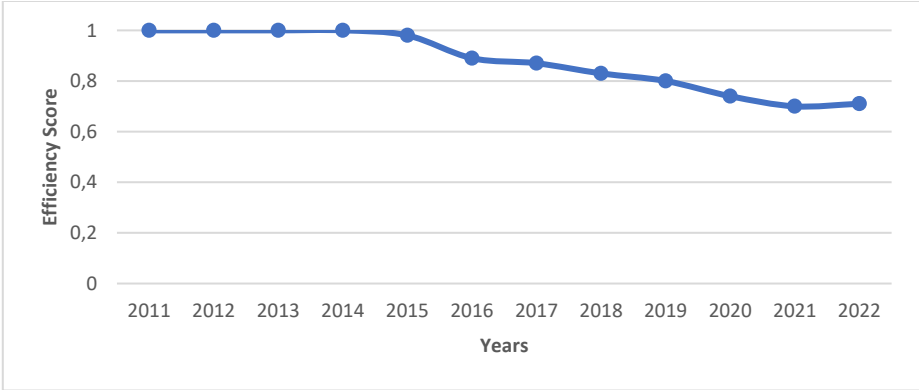
Source: The primary budget balance/GDP data was obtained from the Strategy and Budget Directorate 2024 Budget Justification Report[8].

Table 2 shows the years and benchmark rates that the inefficient years need to use to become efficient. According to this, for example, the inefficient year 2021 needs to use the year 2011 as a benchmark by 0.58 and the year 2013 as a benchmark by 0.76 to become efficient. As a result of recalculating the input and output quantities according to these rates and comparing them with the actual input and output quantities, it is necessary to reduce the excesses in the inputs and eliminate the deficiencies in the outputs to increase the efficiency. Among the efficient years, it is seen that the year 2013 was used as a benchmark 8 times, the year 2011 was used as a benchmark 6 times, the year 2014 was used as a benchmark 2 times, and the year 2012 was not used as a benchmark at all. Therefore, it can be said that the most successful years in terms of efficient use of resources among the efficient years are 2013, 2011, 2014 and 2012, respectively. It will contribute to the improvement of the efficiency of the tax audit system if the relevant managers evaluate the policies and strategies developed for resource use in these years and use them as examples.

[8] https://www.sbb.gov.tr/wp-content/uploads/2023/10/2024-Yili-Butce-Gerekcesi.pdf Accessed 5 April 2024.

The graph in Figure 2 shows the change in the efficiency of the tax audit system over the years. As can be seen from the graph, after the comprehensive transformation of the tax audit system, efficiency was achieved by using resources efficiently in the first five years, but the efficiency gradually decreased in the following seven years.

Figure 2: Change in the Efficiency of the Tax Audit System over the Years



The results of the analysis in which the tax audit system is evaluated in 5 windows of 8 successive years are shown in Table 4. In this analysis, where the trend in efficiency is evaluated more sensitively, it is understood from the efficiency averages in the windows that efficiency shows a downward trend as in the first analysis.

Table 3: Window Analysis Efficiency Scores (Five Windows, w=8)

Years	Window 1	Window 2	Window 3	Window 4	Window 5	Mean
2011	1.00					1.00
2012	1.00	1.00				1.00
2013	1.00	1.00	1.00			1.00
2014	1.00	1.00	1.00	1.00		1.00
2015	0.98	0.98	0.98	1.00	1.00	0.99
2016	0.89	0.89	0.91	0.93	0.95	0.91
2017	0.87	0.87	0.88	0.91	0.93	0.89
2018	0.83	0.83	0.85	0.87	0.89	0.85
2019		0.80	0.82	0.84	0.86	0.83
2020			0.76	0.77	0.80	0.78
2021				0.73	0.75	0.74
2022					0.85	0.85
Mean	0.95	0.92	0.90	0.88	0.88	0.91
Range	0.17	0.20	0.24	0.27	0.25	0.26

When all results are evaluated together, it is observed that in the first years after the comprehensive reform of the tax audit system in 2011, efficiency was achieved by utilizing resources at an optimum level, but especially between 2016 and 2022, resources were not utilized sufficiently and there was a downward trend in the level of efficiency.

5. Conclusion

This study, which evaluates the efficiency of the Turkish tax audit system after the structural reform over the years and as a whole, has important implications for policy makers and administrators. It is observed that the comprehensive reform, which was realized in 2011 with the aim of increasing efficiency and effectiveness in tax auditing, achieved its goal especially in the first five years, but deviated from this goal especially between 2016 and 2022. Based on the data, although the number of audit personnel increased during this inefficient period, the collection/accrual ratio did not increase; on the contrary, it decreased in some years. This situation shows that the quality of audit personnel should also be improved. Qualified audit staff improves the quality of tax audit, reduces tax disputes, and ensures tax justice. Therefore, training, competence and motivation of audit personnel are important. The knowledge and skills of audit staff should be kept up to date through continuous and up-to-date training. Their competencies should be assessed and developed according to objective criteria. To increase their motivation, attention should be paid to factors such as performance-based rewards, career planning and job satisfaction. In this way, audit staff can become more qualified, and the efficiency of the tax audit system can increase.

Our study reveals that an increase in efficiency scores actively contributes to improved budget performance. Significant enhancement of budget performance in the long term can be achieved by strategically allocating investments in key areas such as education, health, and infrastructure. These investments are crucial in building human capital and driving sustainable economic growth.

To maintain fiscal discipline and contain budget deficits, tight fiscal policies could be considered. A comprehensive review of tax policies, broadening the tax base and a strong fight against tax evasion can collectively increase government revenues and improve budget performance. In addition, our research advocates reducing unnecessary public spending and creating policies that support growth. Technology adoption to balance development financing and competitiveness is essential for socio-economic stability.

In our window analysis, we've uncovered a concerning trend: the efficiency of Türkiye's tax audit system is waning. It is evident that action must be taken decisively, with policies and strategies being crafted to halt and reverse this decline. Our analysis points to the years 2011 to 2015 as a beacon of efficiency, a time when the collection-to-accrual ratio saw an uptick even with fewer audit staff. Managers would do well to look to this period as a model, drawing from its strategies to bolster the current system. Such measures will not only align with the public interest but also fulfill organizational objectives by boosting the system's efficiency.

To ramp up efficiency, it's essential to maximize outputs using the resources at hand. Enhancing the outputs of the tax audit system is synonymous with increasing its efficiency. Here, the role of technology is crucial. The speed, quality, and reliability of tax audits can be improved by investing in tax audit technology, which includes databases, analytical tools, and artificial intelligence. This, in turn, leads to more efficient resource use and higher taxpayer satisfaction.

The performance of the tax audit is important for curtailing tax losses and evasion, and for bolstering tax revenues. Managers ought to deal with raising the nice of audit body of workers, first-rate-tuning audit plans and techniques, advancing audit generation, and preserving a keen

eye on audit overall performance. Moreover, motivating and rewarding the audit team of workers, fostering fine taxpayer relationships, and promoting tax compliance are key.

Our study isn't without its limitations. We lack data on the number of taxpayers audited before 2011, which hampers our ability to fully gauge the impact of audit reforms. This gap confines our analysis to the post-2011 era and makes it difficult to assess the long-term effects of the reforms. When considering our findings, this limitation must be kept in mind, and it underscores the need for future research with broader data sets or new methodologies.

Among the restrictions of this study is the reality that the results of tax amnesties, which can be regularly at the schedule in Türkiye, and which extensively undermine the efficiency of tax audits, are not taken under consideration. Tax amnesties may additionally negatively influence economic subject and tax justice, lessen the efficiency of audit mechanisms and harm the principle of equality among taxpayers. Since this study does no longer cope with the long-time period effects of tax amnesties on audit practices, it shows that destiny studies must observe this difficulty in a more complete manner.

Furthermore, our study doesn't consider other potential influences on the tax audit system's efficiency, such as economic conditions, tax policies, and taxpayer behavior. Future research should adopt a holistic view, employing a variety of methods and variables to gain a more nuanced understanding of the tax audit system's performance.

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