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The direct and indirect effects of audits on the tax revenue in Greece

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Abstract

This paper uses recently unveiled monthly information from the Hellenic Ministry of Finance on tax audits targeted to large enterprises, high wealth individuals and VAT non-filers and finds evidence that an increase in the number of audits can boost revenue performance. A 1 percent increase in the number of tax audits increases the direct revenue yield of audits by about 0.4 percent. The indirect tax revenue effect of an intensification of tax audits is estimated to be 0.1 percent. The intensification of targeted audits, as well as improvements in the collection of taxes and fines can tackle tax evasion and boost revenue performance, contributing, thus, to the fiscal consolidation effort.

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1. Introduction

Greece is currently implementing an ambitious, EU-IMF financed, fiscal adjustment programme, the so-called Economic Adjustment Programme (EAP) for Greece. One of the goals of the EAP is to boost revenue performance by tackling tax evasion through improvements in tax administration. As part of this effort several specialized tax units have been set up since the start of EU-IMF programme in 2010. Their main goals are to employ risk-based auditing techniques targeting individuals and firms more liable to tax evade. In order to monitor progress as regards the reform of tax administration, bi-annual structural benchmarks (or quantified targets) have been set up and have to be met by the Greek authorities (see European Commission, 2013; IMF, 2013).

These structural benchmarks involve meeting specific targets as regards the number of tax audits that have to be conducted in case of large enterprises (full scope or regular and temporary audits), high wealth individuals/self-employed[1], and VAT non-filers. In addition, these structural benchmarks involve the achievement of specific targets as regards the collection rates of audits as a percent of the assessed taxes and penalties. Finally, structural benchmarks have been set up regarding internal control assessment and human resource integrity (audits on assets of managers of local tax offices and on assets of auditors themselves). Emphasis has also been placed on the re-training of personnel and the modernization of tax revenue administration structures. According to European Commission (2013) all these improvements in tax administration are expected to yield additional revenues of about 1.5% of GDP in the period 2014-2016.

The economics-of-crime methodology pioneer by Becker (1968) and various papers that relied on it such as Allingham and Sandmo (1972), Srinivasan (1973), Yitzhaki (1974) have shown that tax compliance depends upon enforcement i.e. on the fear of detection and punishment. Several international studies like Andreoni et al. (1998), Alm (1999), Dubin *et al.* (1990), Ratto et al. (2013), Slemrod and Yitzhaki (2002) and Tagkalakis (2013) have shown that an intensification of targeted tax audits, as well as forceful implementation of penalties and fines can induce tax compliance and reduce tax evasion. Based on this evidence, and driven by the availability of newly released monthly data by the Hellenic Ministry of Finance (MoF, 2014) on completed risk based-audits and their revenue yield in terms of collected taxes and fines over the period January 2012 to December 2013, we investigate the effect of an intensification of audits on tax revenue performance.

Following studies like Dubin et al (1990), Dubin (2007), Plumley (1996), and Kleven et al. (2011) we examine both the direct effect of tax audits on revenue performance, i.e., the revenue yield of tax audits in terms of taxes and fines collected, as well as the indirect effect of the intensification of audits on tax compliance and on tax revenue performance (the deterrence effect of tax audits). [2]

Our findings indicate that a 1% increase in the number of targeted tax audits increases the revenue yield of audits by about 0.4% (direct effect). Tax revenues (excluding the revenue proceed of tax audits) increase by about 0.1% (indirect effect). Hence, the intensification of audits can fight tax evasion and increase tax revenue collection.

[1] Based on Artavanis *et al.* (2012) there is evidence of tax evasion by self-employed professionals (e.g. doctors, lawyers etc) in Greece.
[2] See discussion in Andreoni *et al.* (1998) and more recently in Kleven *et al.* (2011) for a tax audit experiment in Denmark.

Based on the tax proceeds in the period 2012-2013 and the total number of audits conducted the abovementioned estimates imply that, on average, on a yearly basis: a 10% increase in the number of tax audits will increase the direct revenue yield of audits by about 11.1 million euro, while the indirect effect amounts to about 250.7 million euro, with the total effect being about 262 million euro or 0.14% of 2013 GDP. In line with the evidence presented in Dubin *et al.* (1990), Dubin (2007), Plumley (1996) the indirect effect of tax audits outweighs the direct effect, with the former one being about 23 times bigger than the latter.

In addition, we show that improvements in tax enforcement, and in particular in the collection rates of taxes and fines imposed in the context of tax audits, can induce tax compliance. Therefore, tax administration reforms aiming in improving tax collection will have positive effects on the continuation and eventual success of fiscal consolidation, while ensuring a fair burden sharing of the adjustment effort.[3] Improved economic prospects induce tax compliance or provide fewer incentives to tax evade, thus, reducing the direct revenue yield of tax audits and at the same time boosting the overall tax revenue performance.

The remainder of the paper proceeds as follows. Section 2 provides data information and discusses the empirical methodology. Section 3 presents the main findings, while in Section 4 we conduct additional robustness checks. Section 5 concludes.

2. Data information and methodology

We use a newly released data set from the MoF (MoF, 2014). The monthly dataset covers the period from January 2012 to December 2013 and includes information on the number of conducted tax audits and their revenue yield in terms of taxes and fines paid. The tax audits were targeted and involved the following three categories/groups: (full scope or regular and temporary audits of) large enterprises, high wealth individuals/self-employed, and VAT non-filers.

The monthly dataset includes in total 72 observations (24 months times 3 audit categories/groups). Based on this information we want to make a first assessment of the tax revenue administration reforms in Greece in recent years. In particular, we investigate the direct and indirect effect of the intensification of tax audits on tax revenue performance.

We study the direct effect of tax audits (controlling for other relevant factors) by regressing the number of conducted audits on the direct revenue yield of audits, i.e., the taxes and fines collected from large enterprises, high wealth individuals/self-employed and VAT non-fillers.

In order to investigate the indirect effect of audits (controlling for other relevant factors) we regress the number of conducted audits on the aggregate tax revenue data that correspond to each audit group. In the case of large enterprises the tax revenue variable used is corporate income tax (CIT). In the case of high wealth individuals the tax revenue variable corresponds to personal income tax (PIT), while in the case of VAT non-filers we use VAT revenue. Therefore, we link the number of risk-based audits that were targeted to specific enterprises and individuals with aggregate CIT, PIT and VAT revenue at monthly frequency. Implicitly, we assume that a tax compliance effect is at play here, i.e., the intensification of tax audits

[3] According to the data released by the MoF during the period from January 2012 to December 2013 33,404 tax audits were completed with a total yield in terms of taxes and fines of 553.7 million euro, i.e., about 0.30% of 2013 GDP. Although this might seem small it should be contrasted with the following: pension cuts to high pension earners will yield 1,080.4 million euro, while the increase in statutory retirement age from 65 to 67 will yield 631 million euro in 2013. Moreover, cuts in social benefits will yield only 68.3 million euro in the period 2013-2016, while creating social tensions (See MoF, 2013).

(which is known to the public) induces all enterprises and individuals (even if not audited) to be more candid about their tax obligations.

Unfortunately, due to the limited sample size and the absence of individual level data we cannot infer this tax compliance effect through (voluntary) tax statements as in Kleven et al. (2011). Nevertheless, aggregate tax revenue data on CIT, PIT and VAT revenue will still capture any indirect effect of increased tax audits.[4] It has to be stressed that these monthly CIT, PIT and VAT revenue data that are used as dependent variable when trying to extract the indirect effect of audits correspond to current year tax obligations and do not incorporate the revenue yield of tax audits. The taxes and fines collected from audit activity that are used as dependent variable when estimating the direct effect of audits are registered under different tax codes, i.e., direct and indirect tax revenues from past years' tax obligations and other direct tax revenues.

Hence, the tax proceeds from increased audits (the direct effect) are registered separately from the tax proceeds related to current year economic activity. This allows the identification of the indirect effect of audits on tax revenue, because it implies that the intensification of tax audits (whose progress becomes publicly available on a monthly basis) will be sufficient to deter tax evasion and induce tax compliance on the part of enterprises and individuals.

Using data for the 3 audit groups from January 2012 to December 2013 we estimate equation (1) that examines the direct effect and equation (2) that examines the indirect effect of audits. Index i (i=1,2,3) stands for audit group (large enterprises, high wealth individuals/self-employed, VAT non-filers) and index t (t=1…24) stands for months:

$$\textit{log(taxes and fines collected)}_{it} = \alpha_{1*}\,\textit{log(taxes and fines collected)}_{it-1} + \alpha_{2*}\,\textit{log(number of tax audits)}_{it} + \alpha_{3*}\,\textit{collection rate of audits}_{it} + \alpha_{4*}\,\textit{log (economic confidence)}_{it} + \textit{time dummies} + \varepsilon_{it} \qquad (1)$$

$$\textit{log(tax revenue)}_{it} = \beta_{1*}\,\textit{log(tax revenue)}_{it-1} + \beta_{2*}\,\textit{log(number of tax audits)}_{it} + \beta_{3*}\,\textit{collection rate of audits}_{it} + \beta_{4*}\,\textit{log(economic confidence)}_{it} + \textit{time dummies} + u_{it} \qquad (2)^{5}$$

Equations (1)-(2) incorporate additional control variables: we control for the collection rate of audits, i.e., the revenue yield of audits as a percent of assessed taxes and penalties. An increase in the number of conducted audits might not lead to a 1-1 increase in revenues and fines collected if the collection rates are low. Given the monthly frequency of our dataset and the fact that no enterprise or individual data are published by the MoF, we cannot link the taxes and fines paid by these specific enterprises and firms to their financial or income data. Hence, driven by these constraints we use as proxy for the economic conditions of each audit group aggregate economic confidence data that are available on a monthly frequency.

[4] Dubin *et al.* (1990) used individual tax data aggregated at the US state level.

[5] The variable $\textit{log(tax revenue)}_{it}$ = $\textit{log}$ { Corporate income tax $_{i=1,t}$; Personal income tax $_{i=2,t}$; VAT $_{i=3,t}$ }

Specifically, in the case of VAT non-filers and high wealth individuals we use the economic sentiment indicator (published by European Commission). In the case of large enterprises we use the PMI index (published by Markit). The economic sentiment indicator and the PMI index proxy current and expected economic conditions and can be associated with the ability of each audit group to pay taxes.[6]

Improved economic prospects are expected to increase tax revenue, while the effect on the direct revenue yield of tax audits might be ambiguous. For example, improved economic conditions could provide fewer incentives for tax evasion (Brondolo, 2009; Sancak et al. 2010). Hence, it is likely that the economic confidence variable will be associated negatively with the taxes and fines yield of audits (as the number of tax evaders diminishes). On the other hand, tax evaders that are caught are more likely to be able to pay their debts in good economic times.

A lagged dependent variable is incorporated in specifications (1) and (2) in order to control for features not captured by our parsimonious specification. *Time dummies* were included to capture time effects and events occurred in each particular month, i.e., like tax policy changes, EU-IMF "troika" visits etc. ε_{it} and u_{it} are the random components satisfying the usual properties.

We allowed for unobserved fixed effects (λ_i).[7] However, in fixed-effects (within) regressions and in fixed-effects (within) IV regressions we cannot reject the null hypothesis that fixed effects are jointly zero.[8] This implies that there is no evidence that individual or fixed effects are relevant in the analysis. To this end we just pool the data when estimating equations (1)-(2).[9] Given the nature and time span of the data we cannot use additional control variables. The MoF dataset does not incorporate other time varying characteristics for the 3 different audit categories/groups.

3. Findings

Given that fixed effects are not relevant we estimate equations (1)-(2) with the Prais-Winsten estimator allowing for panel (i.e., audit group) corrected standard errors for heteroskedasticity and first order autocorrelation. The findings for the indirect and direct effects of tax audits are presented in Tables 1-2 and 3-4, respectively. In column 1 of Tables 1-2 we allow for

[6] The variable log(Economic *Confidence)* $_{it}$ =

$$\log \begin{vmatrix} \text{PMI index}_{\,i=1,t} \\ \text{Economic sentiment}_{\,i=2,t} \\ \text{Economic sentiment}_{\,i=3,t} \end{vmatrix}$$

We have also considered an alternative specification where we use the industrial, consumer and retail sector confidence to capture confidence effects, respectively, in each audit group i.e., large enterprises, high wealth individuals/self-employed, and VAT non-filers.

[7] We also considered variants of specifications (1)-(2) without the inclusion of a lagged dependent variable (and with fixed effects).

[8] In case of fixed-effects (within) IV regression, in equation (1) we want to control for endogeneity issues related to tax audits and the taxes and fines collected. Hence, we instrument the number of tax audits with its lagged values and the collection rate of audits. In equation (2) we control for likely endogeneity issues between tax revenue and economic confidence. To this end, we instrument the economic confidence variable with its lagged values.

[9] Nickell (1981) has shown that in the context of one-way fixed effects dynamic panel data models there is a serious bias in the estimate of the coefficient of the lagged dependent variable when the number of panels N is large and the number of time periods T is small (usual fixed effects estimator is inconsistent when the time span is small). In such cases, the instrumental variable (IV) estimator (Anderson and Hsiao, 1981) and the generalized method of moments (difference and system GMM) estimator (see Arellano and Bond (1991) and Blundell and Bond (1998)) have been proposed. The use of difference and system GMM techniques are considered in cases where N is large and T is small. However, in our case T=24>N=3, so the above is not applicable.

correlated panel corrected standard errors (no heteroskedasticity is assumed), while in all remaining columns of Tables 1-2 (apart from first order aurocorrelation within panels) we allow for heteroskedastic panel corrected standard errors. According to the evidence presented in Tables 1-2 (columns 1-3 in Table 1 present a version of (1) without a lagged dependent variable) a 1% increase in the number of audits leads a 0.24% increase in tax revenues, which declines to about 0.08-0.11% when a lagged dependent variable is accounted for (see columns 1-3; Table 2). This is the so-called indirect effect of tax audits. The direct effect of tax audits is estimated to be 0.48-49% (see Table 3, columns 1-3), but diminishes to 0.35-0.38% in the specifications with a lagged dependent variable (see columns 1-3, Table 4).

In addition, we find significant evidence that improvements tax administration that increase the collection rate of the revenue yield of audits contribute to raising tax revenue (Tables 1-2, column 3). A 1 percentage point (p.p.) increase in the collection rate lead to a 0.13-0.15% increase in tax revenue. This is the indirect effect due to the fact that taxes and fines related to tax audits are not incorporated in the tax revenue variable. Therefore, improvements in tax procedures that increase the collectability of fines imposed induce tax compliance, thus, raising tax revenue.

Turning to the direct effect, we find evidence that a 1 p.p. increase in the collection rate increases the taxes and fines collected by about 0.09-0.13% (Tables 3-4, column 3), with the coefficient estimates being smaller and less significant compared to those in Tables 1-2. This implies that the indirect effect of the collection rate of penalties and fines in terms of deterring tax evasion and increasing tax revenue outweighs its direct contribution in terms of raising the revenue yield of tax audits.

The statistically significant coefficient estimate of the lagged dependent variable implies that persistence effects are relevant in specifications (1) and (2). Finally, improvements in economic conditions and prospects as captured by the economic confidence variable are associated with increased tax revenue (see Tables 1-2). On the other hand, improvements in economic confidence are associated negatively with the direct revenue yield of tax audits (see Tables 3-4). These two findings imply that improved economic prospects induce tax compliance or provide fewer incentives to tax evade (in line with Sancak et al (2010) and Brondolo, (2009)), thus reducing the direct revenue yield of audits and, at the same time, boosting the overall tax revenue performance.

4. Robustness checks

As robustness test and building on Judson and Owen (1999) and Buddelmeyer et al. (2008) we estimate specifications (1) and (2) with a corrected Least Squares Dummy Variable estimator which was found to perform best in balanced panels. The results are presented in Table 5; columns 1-2 capture the indirect effect and columns 3-4 the direct effect of audits. The indirect effect of audits is estimated to be 0.09% (column 1), but is reduced to 0.08% (column 2) if we use the lagged rather than the contemporaneous value of the economic confidence variable. However, in both cases the coefficient estimates are not statistically significant. The direct effect of tax audits is estimated to be 0.29% (column 3), while it is reduced to around 0.24% (column 4) if we use the lagged rather than the contemporaneous tax audit variable.

The justification for considering variants of specification (1) and (2) in Table 5 (in column 2 we used the first lag of economic confidence and in column 4 we used the first lag of tax

audits) relate to endogeneity issues. First, it is likely that there is a contemporaneous feedback effect between tax revenue and economic confidence in specification (1). Second, endogeneity issues might be prevalent also in specification (2) where we examine the relationship between the number of tax audits and the direct revenue yield of tax audits.

To address these concerns in Table 6 we consider an IV-GMM estimator. Moreover, given that we have several observations for each audit group (corresponding to each monthly observation), we want to control for clustering on each tax audit group, i.e., we account for arbitrary correlation among observations within audit groups. In columns 1-2 we examine the indirect effect of tax audits and we instrument the economic confidence variable with its first lag, while in column 2 we add also its second lagged value. Our findings indicate that a 1% increase in the number of tax audits increases tax revenue by about 0.06-0.09% (the indirect effect of tax audits). In columns 3-5 we examine the direct effect of audits and we instrument the tax audit variable with its first lag, while in column 4 (5) we add also the collection rate (lagged value of the collection rate). We find that a 1% increase in tax audits raises the direct revenue yield of audits by about 0.34-0.40% (see columns 3-5).

The collection rate is positively associated with tax revenue, but its coefficient estimate is not statistically significant (columns 1-2). However, its coefficient estimate is positive and statistically significant in the taxes and fines specification (2). Specifically, a 1 p.p. increase in the collection rate increases the direct revenue yield of audits by about 0.1% (column 3). Finally, economic confidence is positively associated with tax revenue and negatively associated with the taxes and fines yield of tax audits.

In Tables 7-8 we consider two additional robustness tests. In columns 1-2 of Table 7 and 1-4 of Table 8 we consider seemingly unrelated regressions; while in column 3 of Table 7 and in columns 5-6 of Table 8 we use a three stage least square estimator (3SLS). Seemingly unrelated regressions (SUREG) can be applied to small N (cross section), large T (time) panels as an alternative to fixed effects (in our case $N=3<T=24$). In columns 1-2 of Table 7 the first equation corresponds to specification (1) and is shown at the upper part of Table 7 (panel A), while the second equation involves regressing the economic confidence variable on various determinants (e.g. its first and second lagged value) and is shown at the lower part of Table 7 (panel B). In columns 1-4 of Table 8 the first equation corresponds to specification (2) and is shown at the upper part of Table 8, while the second equation involves regressing the tax audit variable on various determinants (i.e. its first and second lagged value, the collection rate, the first lag of the collection rate) and is shown at the lower part of Table 8.

In addition, in column 3 of Table 7 (corresponding to specification (1)) and in columns 5-6 of Table 8 (corresponding to specification (2)) we consider a 3SLS procedure. In this case, in column 3 (Table 7), tax revenue and economic confidence are treated as endogenous variables, while in columns 5-6 (Table 8) taxes and fines collected and tax audits are consider as endogenous variables. The second equation that is estimated is shown at the lower part of Tables 7-8 (see panel B; columns 3 and 5-6 in Tables 7 and 8, respectively).

According to the findings a 1 percent increase in the number of tax audits increases tax revenues by about 0.08-0.09% (the indirect effect –see Table 7; columns 1-3; panel A). The direct effect of tax audits ranges from 0.36% to 0.44% (see Table 8; columns 1-6; panel A).

The collection rate is positively associated with tax revenue, but its coefficient estimate is not significant (Table 7; columns 1-3; panel A). On the other hand, there is evidence that a 1 p.p.

in the collection rate raises the direct revenue yield of audits by about 0.09-0.1% (Table 8; columns 1, 4, 6; panel A). The findings for the economic confidence variable are qualitatively similar to those reported before.

As an additional robustness check we estimate specifications (1) and (2) as a system of equations. The findings are reported in Tables 9-10. In column 1 (Table 9; Panel A-B) we examine a seemingly unrelated regression estimation involving specifications (1) and (2); in column 2 (Table 9; Panel A-B) we consider the 3SLS variant, i.e., tax revenue and taxes and fines collected are treated as endogenous variables. In column 3 (Table 9; Panel A-B), which is a variant of the specification considered in column 2, economic confidence is treated as endogenous variable.

Furthermore, in Table 10 (columns 1-2; Panels A-C) we examine a system of 4 equations, i.e., we treat tax revenue, taxes and fines, economic confidence and tax audits as endogenous variables. Hence, on top of the specifications (1) and (2) that are presented, respectively, in panel A and B of Table 10, we employ two additional parsimonious specifications determining the evolution of economic sentiment and tax audits. Economic sentiment is determined by its past values (1 lag in column 1; 1-2 lags in column 3; panel C). Similarly, tax audits are determined by their lagged values (1 lag in column 3; 1-2 lags in column 4; panel C).

The direct and the indirect effect of tax audits are estimated to be about 0.086% and 0.361%, respectively, when tax revenue and taxes and fines collected are treated as endogenous variables (see Table 9, column 2; panels A-B). The estimated direct and the indirect effect of tax audits increases to 0.092% and 0.0389%, respectively, when economic confidence is assumed to be endogenous (see Table 9, column 3; panels A-B). Finally, when tax revenue, taxes and fines collected, economic confidence and tax audits are all treated as endogenous variables the indirect effect of tax audits is reduced in size (to about 0.04-0.06%) and in terms of statistical significance, while the indirect effect increases to about 0.427-0.46% (see Table 10, columns 1-2; panels A-B).

The collection rate is positively associated with tax revenue and taxes and fines collected, but its coefficient estimate is, in most cases, statistically insignificant. However, we do find evidence that an increase in the collection rate raises the direct revenue yield of audits by about 0.1% when all 4 variables of interest are treated as endogenous (see Table 10, columns 1-2; panel B).[10]

5. Conclusion

This paper uses recently unveiled information from the Hellenic Ministry of Finance on tax audits and taxes and fines collected from large enterprises, high wealth individuals and VAT non-filers collected in the context of the EU-IMF financed Economic Adjustment Programme. Building on earlier empirical work such as Dubin *et al.* (1990) and Kleven *et al.* (2011), we have found strong evidence that a 1% increase in tax audits can boost revenue performance by about 0.4%, through the direct effect of higher collected taxes and fines. In addition, we found evidence that tax revenues increase by about 0.1% due to the indirect effect of tax audits.

In the period from January 2012 to December 2013 33,404 tax audits were conducted, with a total proceed of 533.7 million euro (or 0.3% of 2013 GDP); while over the same period tax

[10] The findings for the economic confidence variables are qualitatively similar to those reported above.

revenues (CIT, PIT and VAT revenue) amounted to 50.1 billion euro. Based on the abovementioned figures our estimates (0.4% and 0.1%, respectively, for the direct and indirect effect) imply that, on average, on a yearly basis: a 10% increase in tax audits (i.e., about 1670 more audits)[11] will increase the direct revenue yield of audits by about 11.1 million euro. The indirect effect amounts to about 250.7 million euro, with the total effect being about 262 million euro or 0.14% of 2013 GDP.

In line with the evidence presented in Dubin *et al*. (1990), Dubin (2007), Plumley (1996) we find that the indirect effect of tax audits outweighs the direct effect, with the former one being about 23 times bigger than the latter. Our findings, coupled with the study of Artavanis et al (2012) that report evidence of extensive under-reporting of income and tax evasion in case of self-employed individuals in Greece, imply that the intensification of tax audits can lead to significant spill-over effects and increased tax compliance.

Therefore, in accord with the findings of Galbiati and Zanella (2012) and Ratto *et al*. (2013), a substantial increase in the number of tax audits (by mobilizing more resources and better targeting groups more inclined to tax evade) could lead, ceteris paribus, to additional tax revenues from both the direct and indirect effect of tax audits. These revenue proceeds could exactly match or even outweigh the expenditure saving from various painful fiscal consolidation measures undertaken in recent years, such as the increase in the statutory retirement age from 65 to 67 (with expected yield 264 million euro in 2014), cuts in supplementary pension allowance (with expected yield 114 million euro in 2014), and the abolishment of personal income tax deductions (with expected yield 237 million euro in 2014; see MoF, 2013).

Furthermore, we have found evidence that an improvement in tax enforcement mechanism and in particular in the collection rate of taxes and fines associated with auditing activity can induce tax compliance. There is a positive association between collection rates and tax revenue indicating the presence of an indirect tax compliance effect. However, the coefficient estimates were in most cases insignificant. Nevertheless, there is strong evidence that a 1 p.p. increase in the collection rates of taxes and fines can increase the direct revenue yield of tax audits by about 0.1%. Finally, we have shown that improved economic prospects induce tax compliance or provide fewer incentives to tax evade, thus, reducing the direct revenue yield of tax audits, while at the same time boosting the overall tax revenue performance.

The findings of this study indicate that tax administration reforms aiming at enhancing tax enforcement and tax compliance can make a difference in Greece, boosting tax revenue performance and improving the chances for a successful conclusion of the fiscal consolidation effort. Moreover, curtailing tax evasion and punishing tax evaders through strict enforcement of penalties and fines can avoid further spending cuts. At the same time it contributes to a fair burden sharing of the adjustment effort, thus, increasing the support of the public to the fiscal consolidation programme.

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Table 1: The indirect effect of tax audits, Prais-Winsten regressions (autocor. and heterosk. corrected panels)

	1	2	3
Estimation:	Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)	Prais-Winsten regression, heteroskedastic panels corrected standard errors	Prais-Winsten regression, heteroskedastic panels corrected standard errors
Dependent variable:	**(log) Tax revenue**		
Dependent variable (t-1)	-	-	-
(log) Tax audits (t)	***0.239 (3.73)******	***0.239 (3.99)******	***0.243 (4.25)******
(log)Economic Confidence (t)	3.313 (5.69)***	3.313 (7.47)***	3.306 (7.70)***
Collection rate (t)	-	-	0.149 (2.30)**
Time dummies	Yes		
Panel categories	*correlated (balanced)*	*heteroskedastic (balanced)*	*heteroskedastic (balanced)*
Correlation	panel-specific AR(1)		
No. obs	72	72	72
R^2	0.958	0.958	0.949
Wald chi2(df) (p-value)	Wald chi2(25) = 5158.63 (0.000)	Wald chi2(25) = 125.23 (0.000)	Wald chi2(26) = 133.01 (0.000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.

Table 2: The indirect effect of tax audits, Prais-Winsten regressions (autocor. and heterosk. corrected panels)

	1	2	3
Estimation:	Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)	Prais-Winsten regression, heteroskedastic panels corrected standard errors	Prais-Winsten regression, heteroskedastic panels corrected standard errors
Dependent variable:	**(log) Tax revenue**		
Dependent variable (t-1)	0.468 (3.08)***	0.468 (4.21)***	0.417 3.81)***
(log) Tax audits (t)	***0.085 (2.38)****	***0.085(2.37)****	***0.109(2.85)******
(log)Economic Confidence (t)	1.615 (2.66)**	1.615 (3.60)***	1.789 (4.00)***
Collection rate (t)	-	-	0.135 (1.93)*
Time dummies	Yes		
Panel categories	*correlated (balanced)*	*heteroskedastic (balanced)*	*heteroskedastic (balanced)*
Correlation	panel-specific AR(1)		
No. obs	69	69	69
R^2	0.967	0.967	0.943
Wald chi2(df) (p-value)	Wald chi2(26) = 1.55e+07 (0.000)	Wald chi2(26) = 154616.69 (0.002)	Wald chi2(26) = 315.58 (0.003)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.

Table 3: The direct effect of tax audits, Prais-Winsten regressions (autocor. and heterosk. corrected panels)

	1	**2**	**3**
Estimation:	Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)	Prais-Winsten regression, heteroskedastic panels corrected standard errors	Prais-Winsten regression, heteroskedastic panels corrected standard errors
Dependent variable:	**(log) Taxes and fines collected**		
Dependent variable (t-1)	-	-	-
(log) Tax audits (t)	***0 .477 (10.62)******	***0 .477 (12.61)******	***0.489 (13.08)******
(log) Economic Confidence (t)	-2.891 (-11.27)***	-2.891 (-14.51)***	-2.873 (-13.76)***
Collection rate (t)	-	-	0 .131 (2.16)**
Time dummies	Yes		
Panel categories	*correlated (balanced)*	*heteroskedastic (balanced)*	*heteroskedastic (balanced)*
Correlation	panel-specific AR(1)		
No. obs	72	72	72
R^2	0.945	0.945	0.904
Wald chi2(df) (p-value)	Wald chi2(25) = 2913.16 (0.000)	Wald chi2(25) = 354.75 (0.000)	Wald chi2(26) = 348.95 (0.000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.

Table 4: The direct effect of tax audits, Prais-Winsten regressions (autocor. and heterosk. corrected panels)

	1	**2**	**3**
Estimation:	Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)	Prais-Winsten regression, heteroskedastic panels corrected standard errors	Prais-Winsten regression, heteroskedastic panels corrected standard errors
Dependent variable:			
Dependent variable (t-1)	0 .295(2.78)***	0 .295(3.45)***	0 .259(3.05)***
(log) Tax audits (t)	***0.349 (5.94)******	***0.349 (7.32)******	***0 .376 (7.79)******
(log) Economic Confidence (t)	-2.164 (-6.39)***	-2.164 (-7.98)***	-2.254 (-8.24)***
Collection rate (t)	-	-	***0 .091(1.59)***
Time dummies	*Yes*		
Panel categories	*correlated (balanced)*	*heteroskedastic (balanced)*	*heteroskedastic (balanced)*
Correlation	panel-specific AR(1)		
No. obs	69	69	69
R^2	0.959	0.959	0.917
Wald chi2(df) (p-value)	Wald chi2(25) = 3552.1 (0.000)	Wald chi2(25) = 739.89 (0.000)	Wald chi2(26) = 642.75 (0.000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.

Table 5: The direct and indirect effects of tax audits- LSDVC dynamic regression

	1	2	3	4
Estimation:	**LSDVC dynamic regression**			
Dependent variable:	**(log) Tax revenue**		**(log) Taxes and fines collected**	
Dependent variable (t-1)	0 .536 (3.76)***	0.557 (3.86)***	0 .181 (1.41)	0 .107 (0.70)
(log) Tax audits (t)	***0 .092 (0.69)***	***0.080 (0.61)***	***0 .292(3.06)******	**-**
log) tax audits (t-1)	**-**	**-**	-	0 235 (2.20)**
(log) Economic Confidence (t)	7.335 (1.53)	-	2.166(0.66)	1.771 (0.44)
(log) Economic Confidence (t-1)	-	8.787 (1.61)	-	-
Collection rate (t)	0 .104 (1.13)	0.075 (0.81)	0 .091 (1.49)	0.101 (1.29)
Time dummies	Yes			
No. obs	66			

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.Bias correction initialized by Anderson and Hsiao estimator up to order O(1/NT^2)

Table 6: The direct and indirect effects of tax audits -Instrumental variables (GMM) regressions

	1	2	3	4	5
Estimation:	**Instrumental variables (GMM) regression**				
Dependent variable:	**(log) Tax revenue**		**(log) Taxes and fines collected**		
Dependent variable (t-1)	*0 .499 (5.36)****	*0 .564 (5.56)****	*0 .238 (2.77)****	*0 .253 (2.94)****	*0 .303 (3.87)****
(log) Tax audits (t)	*0 .090 (2.41)***	*0 .064 (1.92)**	*0 .397 (7.03)****	*0 .382 (6.79)****	*0 .343 (6.50)****
(log) Economic confidence (t)	*1.521 (3.87)****	*1.156 (3.72)****	*-2.327 (-7.96)****	*-2.307 (-7.82)****	*-2.050 (-8.09)****
Collection rate (t)	*0 .119 (1.44)*	*0 .099 (1.12)*	*0 .097 (3.26)****	-	-
Time dummies	Yes				
No. obs	69	66	69	69	69
R^2	0.8892	0.8765	0.9052	0.9007	0.9015
Wald chi2(df) (p-value)	Wald chi2(26) = 582.83 (0.000)	Wald chi2(25) = 805.89 (0.000)	Wald chi2(26) = 1364.69 (0.000)	Wald chi2(25) = 1324.65 (0.000)	Wald chi2(25) = 1122.27 (0.000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis. In columns 1-2 we have used as instrument of the economic confidence variable its first lag, while in column 2 we also add its second lag. In columns 3-5 we instrument the tax audits variable with its first lag; in column 4 we also add the collection rate, while in column 5 we consider the lagged value of the collection rate. In all columns we control for clustering on each audit group.

Table 7: The direct and indirect effects of tax audits- seemingly unrelated regressions and 3SLS

Panel A	**1**	**2**	**3**
Estimation:	**Seemingly unrelated regression**		**3SLS (2 equation system; endogenous: tax revenue, economic confidence)**
Dependent variable:	**(log) Tax revenue**		
Dependent variable (t-1)	0.505 (5.52)***	0 .525 (5.24)***	0.529 (5.26)***
(log) Tax audits (t)	***0.089 (2.24)****	***0.083 (1.96)****	***0.082 (1.95)****
(log) Economic Confidence (t)	1.497 (4.06)***	1.453 (3.77)***	1.43 (3.70)***
Collection rate (t)	0.116 (1.53)	0 .113 (1.45)	0.112 (1.44)
Time dummies	Yes		
No. obs	69	66	66
R^2	0.8891	0.8823	0.8823
chi2(df) (p-value)	Chi2 (27): 127581.56 (0.000)	Chi2 (26): 117637.09 0.0000	Chi2 (25): 495.66 (0.0000)
Panel B			
Dependent variable:	**(log) Economic Confidence**		
(log) Economic Confidence (t-1)	0.994 (91.28)***	0.621 (5.97)***	0.620 (5.97)***
(log) Economic Confidence (t-2)	-	0.368 (3.54)***	0.368 (3.55)***
(log) Tax audits (t-1)	-	-	-
(log) Tax audits (t-2)	-	-	-
Collection rate (t)	-	-	-
Collection rate (t-1)	-	-	-
constant	0.032 (0.69)	0.058 (1.44)	0.058 (1.44)
No. obs	69	66	66
R^2	0.9918	0.9938	0.9938
Wald chi2(df) (p-value)	Chi2 (1): 8331.52 (0.0000)	Chi2 (2): 10597.61 (0.0000)	Chi2 (2): 10597.37 (0.0000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.

Table 8: The direct and indirect effects of tax audits- seemingly unrelated regressions and 3SLS

Panel A	**1**	**2**	**3**	**4**	**5**	**6**
Estimation:	**Seemingly unrelated regression**				**3SLS (2 equation system; endogenous: taxes and fines, tax audits)**	
Dependent variable:	**(log) Taxes and fines collected**					
Dependent variable (t-1)	0.263 (3.18)***	0.279 (3.31)***	0.272 (3.23)***	0.232 (2.36)**	0.254 (2.57)**	0.166 (1.44)
(log) Tax audits (t)	***0.379 (8.08)****	***0.359 (7.63)*****	***0.364 (7.74)*****	***0.397 (7.18)*****	***0.377 (6.35)*****	***0.443 (6.45)*****
(log) Economic Confidence (t)	-2.247 (-8.55)***	-2.206 (-8.24)***	-2.227 (-8.32)***	-2.352 (-7.30)***	-2.284 (-7.29)***	-2.568 (-6.80)***
Collection rate (t)	0.093 (1.65)*	-	-	0.094 (1.62)		0.101 (1.72)*
Time dummies	Yes					
No. obs	69	69	69	66	69	66
R^2	0.9055	0.9022	0.9021	0.9018	0.9018	0.8989
chi2(df) (p-value)	Chi2 (26): 670.58 (0.0000)	chi2(26) = 128886.76 0.0000	Chi2 (25) :643.08 (0.0000)	Chi2 (26): 122298.38 (0.0000)	Chi2 (25) 622.52 0.0000	Chi2(26) : 119619.42 0.0000
Panel B						
Dependent variable:	**(log) Tax audits**					
(log) Economic Confidence (t-1)	-	-	-	-	-	-
(log) Economic Confidence (t-2)	-	-	-	-	-	-
(log) Tax audits (t-1)	0.875 (17.50)	0.870 (17.10)***	0.870 (17.06)***	0.592 (5.72)***	0.870 (17.11)***	0.584 (5.66)***
(log) Tax audits (t-2)	-	-	-	0.331 (3.29)***	-	0.339 (3.38)***
Collection rate (t)	-	-0.045 (-0.46)	-	-	-0.041 (-0.42)	-
Collection rate (t-1)	-		-0.047 (-0.48)	-	-	-
constant	0.597 (2.35)**	0.648 (2.35)**	0.650 (2.35)**	0.323 (1.41)	0.644 (2.33)**	0.331 (1.44)
No. obs	69	69	69	66	69	66
R^2	0.8166	0.8166	0.8163	0.8638	0.8166	0.8638
Wald chi2(df) (p-value)	Chi2(1) 306.29 (0.0000)	Chi2(2): 307.34 (0.0000)	Chi2 (2): 306.96 (0.0000)	Chi2(2): 420.64 (0.0000)	Chi2(2) : 307.19 0.0000	Chi2(2): 419.02 (0.0000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.

Table 9: The direct and indirect effects of tax audits- seemingly unrelated regressions and 3SLS

	1	2	3
Estimation:	**Seemingly unrelated regression (2 equations)**	**3SLS (2-equation system; endogenous: tax revenue, taxes and fines)**	**3SLS (2 equation system; endogenous: tax revenue, tax and fines, economic confidence)**
Panel A			
Dependent variable:	**(log) Tax revenue**		
Dependent variable (t-1)	0.528 (6.06)***	0.528 (6.06)***	0.471 (4.21)***
(log) Tax audits (t)	***0.086*** ***(2.18)****	***0.086*** ***(2.18)****	***0.092*** ***(2.29)****
(log) Economic Confidence (t)	1.414 (3.97)***	1.414 (3.97)***	1.655 (3.49)***
Collection rate (t)	0.115 (1.51)	0.115 (1.51)	0.123 (1.60)
Time dummies	Yes		
No. obs	69	69	69
R^2	0.8891	0.8891	0.8889
Chi2(df) (p-value)	Chi2(27): 127587.41 0.0000	Chi2(27): 127587.41 0.0000	Chi2(26): 547.89 0.0000
Panel B			
Dependent variable:	**(log) Taxes and fines collected**		
Dependent variable (t-1)	0.294 (3.74)***	0.294 (3.74)***	0.239 (2.45)**
(log) tax audits (t)	0.361 (7.92)***	0.361 (7.92)***	0.389 (7.16)***
(log) Economic Confidence (t)	-2.157 (-8.49)***	-2.157 (-8.49)***	-2.348 (-7.18)***
Collection rate (t)	0.091 (1.59)	0.091 (1.59)	0.092 (1.62)
Time dummies	Yes		
No. obs	69	69	69
R^2	0.9057	0.9057	0.9053
Wald chi2(df) (p-value)	Chi2(26): 665.45 (0.0000)	Chi2(26): 665.45 (0.0000)	Chi2(27): 133063.59 (0.0000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.

Table 10: The direct and indirect effects of tax audits- seemingly unrelated regressions and 3SLS

	1	**2**
Estimation:	**3SLS (4 equation system; endogenous: tax revenue, tax and fines collected , economic confidence, tax audits)**	
Panel A		
Dependent variable:	**(log) Tax revenue**	
Dependent variable (t-1)	0.558 (6.46)***	0.555 (5.87)***
(log) Tax audits (t)	***0.043*** ***(1.02)***	***0.059*** ***(1.34)***
(log) Economic Confidence (t)	1.375 (3.91)***	1.375 (3.73)***
Collection rate (t)	0.094 (1.25)	0.104 (1.34)
Time dummies	Yes	
No. obs	69	66
R^2	0.8849	0.8808
Chi2(df) (p-value)	Chi2(27): 126105.44 0.0000	Chi2(25) : 505.15 0.0000
Panel B		
Dependent variable:	**(log) Taxes and fines collected**	
Dependent variable (t-1)	0.186 (1.96)*	0.131 (1.20)
(log) tax audits (t)	0.427 (7.20)***	0.460 (6.99)***
(log) Economic Confidence (t)	-2.483 (-8.09)***	-2.686 (-7.41)***
Collection rate (t)	0.103 (1.81)*	0.103 (1.76)*_
Time dummies	Yes	
No. obs	69	66
R^2	0.9030	0.8966
Wald chi2(df) (p-value)	Chi2(27): 132285.41 (0.0000)	Chi2(26): 118618.63 (0.000)

Panel C				
	1	**2**	**3**	**4**
Dependent variable:	(log) Economic sentiment	(log) Tax audits	(log) Economic sentiment	(log) Tax audits
Dependent variable (t-1)	0.994(93.04)***	0.882 (17.98)***	0.607 (5.87)***	0.609 (5.98)***
Dependent variable (t-2)	-	-	0.381 (3.69)***	0.314 (3.18)***
Constant	0.031 (0.70)	0.563 (2.25)**	0.058 (1.44)	0 .325 (1.42)
Nobs	69		66	
R^2	0.9918	0.8159	0.9938	0.8639
Wald chi2(df) (p-value)	Chi2(1) : 8656.51 (0.0000)	Chi2(1):323.40 (0.0000)	Chi2(2): 10637.90 (0.0000)	Chi2(2): 421.62 (0.0000)

Notes: ***,**, * statistically significant at 1%, 5%, and 10% respectively; t-statistics in parenthesis.