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The Effectiveness of Digital Payments in Tackling Tax Evasion in Greece

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Abstract:

Purpose: *The present paper aims to provide robust answers to the research question if digital payments can contribute to a reduction in tax evasion.*
Design/Methodology/Approach: *To answer the research question, regression analysis was performed to determine if there a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and the use of electronic payment instruments. Data were collected from the Greek Independent Authority for Public Revenue (IAPR) and from the Bank of Greece.*
Findings: *The results of the research showed that the use of digital payments does not lead to an increase in tax revenues. Although over time there has been an increase in the use of electronic payment instruments and an increase in the volume of transactions, tax revenues have fluctuated significantly.*
Practical Implications: *Electronic payment methods are a modern way of making transactions and are an instrument which can be used to reduce tax evasion through transparency and better control.*
Originality/value: *This research do not link in a statistically significant way the use of electronic payment instruments and the increase of tax revenues.*

Keywords: *Tax Evasion, Tax Accounting, Digital Payments.*

JEL classification: *M41, M42, M48.*

Paper Type: *Research study.*

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1. Introduction

A phenomenon that is common in all countries - not always with the same intensity - is tax evasion. It is a phenomenon that hinders economic prosperity and growth, and therefore efforts are being made to reduce it (McGee, 2011). Particularly in the case of Greece, tax evasion is a major issue that has been plaguing the Greek economy for decades and has a significant impact on entrepreneurship and growth (Vousinas, 2017; Balios *et al.*, 2020; Kounadeas *et al.*, 2022).

Greek official authorities report that tax evasion involves amounts corresponding to 6%-9% of GDP. The main factors contributing to tax evasion in Greece are legislative and political and are linked to the complexity of the tax system and the way the public administration operates (Vlachos and Bitzenis, 2016; Vousinas, 2017; Balios *et al.*, 2020; Kounadeas *et al.*, 2022; Trigkas *et al.*, 2021). They are also technological, as the country has not yet reached the desired levels of digital transformation (Boufounou *et al.*, 2022). Finally, bureaucracy further contributes to tax evasion (Artavanis *et al.*, 2015; Williams and Horodnic, 2015).

In recent years, in the context of digital transformation, efforts have been made to organise and monitor digital payments. The purpose of this study is to investigate the phenomenon of tax evasion in Greece and, specifically, to evaluate the use of electronic payments as a means of reducing tax evasion.

In order to measure the extent to which the use of electronic transaction methods reduces tax evasion, a quantitative survey was conducted using secondary data and a regression function was developed with tax revenues as the dependent variable and independent variables being electronic payments and GDP. The data used are from 2015 to 2020 and were obtained from the Bank of Greece and the Independent Authority for Public Revenues.

2. Literature Overview

One of the reasons Electronic Means of Payment were developed was to reduce tax evasion. Payment by electronic means is recorded and it is easy to cross-check the revenues of businesses. Therefore, the more business revenues are derived from electronic payments, the more the likelihood of tax evasion is reduced (Kounadeas *et al.*, 2022).

Brockmeyer and Saenz Somarriba (2022) investigated whether the digitisation of transactions in an economy increases tax revenues and generally improves citizens' compliance with the tax system. The researchers used data from Uruguay and studied the effect on VAT of the adoption of electronic payment technology and the introduction of some related pro-active measures, such as tax deductions. More specifically, through regression functions, and using data for the years 2006-2015, the researchers concluded the following.

First, it was shown that measures such as tax rebates led to an immediate increase in credit and debit card transactions by 50%, as well as a 30% increase in the volume of transactions. In fact, in order to support their findings, the researchers show that the increase is sharp and occurs immediately after the measures are implemented. It also appears that individual consumers responded more than businesses.

Furthermore, regarding the change in government VAT revenues following the introduction of rebates, Brockmeyer and Saenz Somarriba (2022) examined the effect of the increase in card transactions on tax revenues. In fact, a distinction was made between wholesalers and retailers because it is assumed that retailers are more prone to tax evasion than wholesalers.

Moreover, it is retailers who are affected by the discounts for card transactions. The results showed that there was no statistically significant impact from the increase in transactions (due to discounts) on the VAT yield of businesses. In fact, the VAT rebates led to a loss of revenue of around 1.5%. Finally, the researchers wanted to justify the results of the survey by stating that businesses in the country have not adopted digital payments terminals to a significant extent, while card transactions in general represent a small percentage (30%) of all transactions.

Alognon *et al.* (2021), examined the effect of credit and debit card use on VAT reimbursement using data from 26 EU Member States for the years 2000 to 2016. For the purpose of the study, the researchers used the "VAT gap", i.e., the difference between expected VAT revenue and actual revenue, as the dependent variable.

More specifically, they used the variable "VAT gap" in Euros, "gap as a percentage of GDP, "gap" as a percentage of VAT. The key independent variable was the value of card transactions from all cards issued in the country as a percentage of GDP. The researchers developed a regression model and found that a 1% increase in card payments reduces the VAT gap by 0.51%.

Kitsios, Jalles, and Verdier, (2020), state that the use of digital technologies represents an important opportunity to reduce fraud and increase government revenues. The scholars used data on transactions within the EU and international transactions and concluded that cross-border tax evasion is not negligible and exists to a significant extent in many countries and that this form of fraud can be reduced by using electronic means.

The scholars also argue that the additional revenue from the extensive use of electronic transactions can exceed 1.5% of GDP in low GDP countries. Kitsios, Jalles, and Verdier, (2020), used a gravity model on import and export trade and concluded that digitization reduces inaccuracies in the values of imports and exports declared, which increases revenue.

Night and Bananuka, (2019), refer to the use of new technologies and, in particular, the existence of an electronic tax administration system. More specifically, they explore the mediating relationship between the adoption of such systems and tax evasion. While the topic may not directly refer to Electronic Means of Payment, it is nevertheless related to the issue under investigation in this paper, since the electronic filing of taxes presupposes - or at least is significantly linked to - the existence of electronic means of payment as well.

The researchers used quantitative, primary research, and their sample comprised 214 small businesses in Uganda. They used a closed-ended Likert scale questionnaire and administered it to the owners or managing directors of these businesses. According to the results of the regression analysis, the adoption of electronic tax filing "positively mediates" the relationship between entrepreneurs' perception of electronic tax management systems and the reduction of tax evasion.

Bellon *et al.* (2019), refer to the use of e-invoicing as a measure to reduce tax evasion. Through e-invoicing, it is not easy for firms to hide sales or purchase data from the tax authority. It is worth mentioning that e-invoicing also requires significant infrastructure in terms of electronic systems and therefore its adoption - once a decision has been taken by the State - is gradual. The researchers used monthly data from companies in Peru for the years 2010 to 2017.

These data reported on sales, purchases, payroll, capital, profits and taxes. First, the effect of e-invoicing on sales and tax liabilities was calculated. Indeed, an increase of 7% in sales was reported. A regression analysis was also performed, and a statistically significant, positive correlation was observed between tax yield and the adoption of e-invoicing in the case of small firms.

On the other hand, in the case of large firms, no change in tax yield was observed. Finally, it appears that e-invoicing has had a significant impact on reducing tax evasion in sectors traditionally engaged in tax evasion. Thus, trade, supply of professional services and construction seem to be more compliant.

Lovics *et al.* (2019), wanted to study whether the introduction of the use of electronic transactions had an effect on the reported income of firms in Hungary. In order to reduce tax evasion, the Hungarian government introduced the mandatory use of online transactions in some sectors of the economy.

The objectives of the government were as follows. First, to increase tax revenues by reducing the size of the underground economy. Second, to reduce the volume of sales made without relevant documents (invoices/receipts) being issued. Thus, approximately 200,000 machines were installed in 100,000 businesses. Thirdly, the improvement of competition in the market by reducing tax evasion. Finally, to support the State's structures related to the control and collection of taxes.

The researchers developed an econometric model, where they illustrated the relationship between the revenue of each enterprise and the use of electronic transactions, payroll costs and time. The results of the analysis revealed that there is an increase in the revenue of enterprises, in all sectors and of all sizes, so there is an increase in tax revenue. In general, the effect is greater in smaller enterprises.

Hondroyiannis and Papaoikonomou (2018), wanted to investigate the impact of the use of Electronic Payment Instruments on VAT revenues. It is a fact that this issue has been the subject of previous research by the researchers, but this time the research refers to European countries. More specifically, the impact on VAT of card usage in 19 eurozone countries for the period 2000 - 2016 was investigated.

The researchers developed econometric models and according to the results of the research, tax compliance is positively correlated with the use of easily controllable transaction methods, such as card payments. In other words, the use of electronic means of payment leads to an increase in VAT revenues.

Immordino and Russo (2018) developed their research to support the thesis that tax evasion is largely due to the use of cash (since the seller has the opportunity to hide the transaction) and that the use of any other means of transaction that is traceable (such as electronic payment instruments) can reduce tax evasion. The researchers used data from the European Central Bank for 25 of the 28 EU Member States for the years 2000 to 2012.

More specifically, they calculated the VAT 'gap' as follows: they calculated the difference between the amount estimated to be collected (which is the product of GDP and the VAT rate) and the actual revenue collected. This difference is then expressed as a percentage (either of GDP or of the amount estimated to be collected).

In order to provide answers to the research question, the researchers developed a regression function, where the dependent variable was tax evasion calculated with the "VAT gap" and the independent variable was the use of electronic payment instruments. Also, the unemployment rate, the Import-to-GDP ratio, the VAT rate, the age and the education level of citizens were defined as control variables.

Tax evasion varies from country to country. The average ratio of the "VAT gap" to GDP ranges from 0.36% in Sweden to 5.6% in Romania. In fact, 17 of the 25 countries in the sample have a ratio below 2%, while 8 (including Greece and Italy) have a higher ratio. Also, Luxembourg and Great Britain are the countries with the highest average per capita card payments, while Romania and Italy are the countries with the lowest.

Moreover, the researchers state that having a payment card is not necessarily an indicator of the growth of electronic payment instruments, since what really matters

is the use of cards. According to the results found by Immordino and Russo (2018), card usage is negatively correlated with tax evasion. It is also interesting that digital payments terminals are found to a significant extent even in countries that do not use cards as often as others.

Greece, for example, has the highest number of digital payments terminals (31 per 1,000 inhabitants), while at the same time being third from the bottom in terms of the number of card transactions per capita (6 transactions). An important element of the survey is the significant increase in debit and credit card transactions over time. Thus, between 2000 and 2012 in France the number of debit and credit card transactions per capita increased from 54 (on average) to 130, in Great Britain from 67 to 167, in Romania from 0.1 to 8.

Immordino and Russo (2018) developed other research in which they propose a model of negotiation between buyer and seller regarding cash transactions or electronic payment instruments. According to the researchers, evidence in Europe shows that electronic payments are associated with less tax evasion, so policies aimed at discouraging people from using cash can help to combat tax evasion.

Thus, they propose a model to study the effect of a policy that favours the use of electronic means of payment: a tax on withdrawals. They also study the effect of another similar policy, a tax rebate for those who keep their receipts for purchases. Finally, they present a bargaining game between sellers and buyers, where sellers offer discounts if buyers pay in cash.

This game is based on the fact that paying in cash prevents the existence of proof that the transaction has taken place. If a deal is struck, the customer is forced to pay in cash, which helps to cover the tracks of the transaction. If there is no agreement, the customer does not get a discount, but is free to choose between cash and electronic means of payment.

Sellers differ in how ethical they are, while customers differ on two parameters: their ethics regarding tax returns and the cost of managing electronic means of payment. The government implements both policies mentioned above before the game "starts". The results of Immordino and Russo's (2018) "game" led to multiple conclusions. If both buyers and sellers are risk-neutral, then a small tax rebate reduces tax evasion and increases government revenue.

On the other hand, a tax on withdrawals appears to increase tax evasion, particularly in economies where cash use is more common, and is an effective measure in the case of high tax. More generally, tax deductions are easier to implement, even if they are costly for the state, while electronic means of payment are the best solution to reduce cash use and tax evasion (Tzavaras *et al.*, 2021).

Hondroyiannis and Papaoikonomou (2017), investigated the effect of the use of electronic payment instruments on VAT. The researchers used quarterly data on card transactions in Greece between 2003 and 2016. Indeed, the period includes the period from July 2015 onwards, when restrictions on withdrawals led to a sharp increase in electronic payment instruments. The researchers used regression analysis and according to the results, the large increase in the use of electronic payment instruments from July 2015 onwards led to a significant increase in VAT revenues.

Madzharova (2014), investigated the relationship between payment methods and tax compliance through a study of VAT. The research is based on the assumption that the use of electronic means of payment is characterized by transparency and can be a means of preventing profit concealment and other methods of tax evasion. Data from EU countries for the period 2000 to 2010 were used. The dependent variable in the researcher's model was the VAT revenue ratio, which is calculated by dividing VAT revenue by net consumption and then dividing by the VAT rate.

The results of the research showed that the use of electronic payment instruments did not affect the efficiency of VAT collection. This is most likely due to the need to implement policies that further incentivise the use of electronic means of payment. On the other hand, card usage does not always have a statistically significant effect on VAT; however, the results reveal that cash usage has a negative effect, and these even remain the same after different controls and hypotheses.

The preceding literature review reveals that the majority of studies show a positive correlation between tax revenues and the use of electronic payment instruments. On the other hand, there are also studies that do not confirm this relationship. So, further investigation is important.

3. Research Methodology

As we have seen in the previous section, in most cases there is a positive relationship between the use of digital payments and tax revenues. In addition, this gave rise to the question; to what extent does the use of electronic payment instruments contribute to tackling tax evasion? In order to answer the research question, we sought to confirm the following hypothesis: H1: There is a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and the use of electronic payment instruments.

To investigate the above hypothesis, regression functions of the form:

$$\mathbf{Y=b+b_{01}X+b_{12}X+e_2}$$

where Y: tax revenues, X_1 is independent GDP and X_2 is payments by various types of electronic payment instruments.

For the above variables, quantitative secondary data were collected for the years 2015 to 2020. More specifically, tax revenues were calculated from the website of the Independent Authority for Public Revenue (IAPR), where the "IAPR Reports" are posted. Also, as regards GDP and card payment data, these were obtained from the website of the Bank of Greece, and more specifically from the Bank's bulletin on payment statistics (Bank of Greece, 2022).

4. Empirical Findings and Discussion

In the current section there is a presentation of the descriptive statistics of the variables, as well as the correlation analyses and regressions. Data analysis was conducted via SPSS. The following table shows the descriptive statistics of the variables GDP, tax revenue, total card payments, payments with cards that have a billing function, payments with cards that have a credit function, card payments routed to EFTPOS terminals with physical substance, payments with electronic money issued by domestic PSPs.

Table 1. *Descriptive statistics*

descriptive statistics					
	N	Minimum	Maximum	Mean	std. deviation
GDP	6	166000,00	187000,00	178500,0000	7503,33259
TAX REVENUE	6	43938,00	54778,10	51436,6000	4102,36671
TOTAL PAYMENTS	6	144,40	1117,30	581,9167	349,05200
DEBIT CARDS	6	82,50	962,50	477,1667	316,39807
CREDIT CARDS	6	60,70	152,60	102,9000	32,36721
CARDS_EFT_POS	6	122,90	996,10	517,4500	310,62651
ELECTRONIC_MONEY	6	9,20	36,20	25,4500	11,61564
Valid N (listwise)	6				

Source: *Own study.*

According to the above table, the country's GDP for the years 2015 to 2020 has a value, on average, equal to 178,500 million euros per year. The state's tax revenues, as derived from the Greek Independent Authority for Public Revenue, receive an average value equal to EUR 51,436.6 million per year. Subsequently, total card payments reach an average of EUR 581.92 million per year. As for debit card payments, for the years 2015 - 2020 these averaged 477.17 million euros per year, while the corresponding credit card payments were 102.9 million euros per year.

These results reveal the large difference in the use of the two types of cards, which was shown above. Furthermore, payments with cards routed to EFTPOS terminals with physical substance were on average EUR 517.45 million per year for the years 2015 to 2020. Finally, payments with electronic money issued by domestic Payment Service Providers are significantly lower, being on average estimated at EUR 25.45 million per year.

Furthermore, it is important to note that all variables show a significant standard deviation of the means, and this is indicative of the large variation between years.

The following section exhibits the correlation analyses between the variables (dependent and independent variables) which are presented to determine whether there is a linear relationship between them. More specifically, it is investigated whether the dependent variable (TAX_INCOME), is statistically significantly correlated with each of the independent variables (GDP, TOTAL_PAID, DEBIT_CARDS, CREDIT_CARDS,CARD_EFT_POS, ELECTRONIC_MONEY).

The results are illustrated in Table 2.

Table 2. *Correlation analysis*

Correlations								
		GDP	TAX_REVENUE	TOTAL_PAYMENTS	DEBIT_CARDS	CREDIT_CARDS	CARDS_EFT_POS	ELECTRONIC_MONEY
GDP	Pearson correlation	1	,842*	-,255	-,255	-,261	-,264	,114
	Sig. (2-tailed)		,036	,625	,626	,617	,614	,830
	N	6	6	6	6	6	6	6
TAX_REVENUE	Pearson correlation	,842*	1	-,486	-,488	-,470	-,482	-,129
	Sig. (2-tailed)	,036		,328	,326	,347	,333	,808
	N	6	6	6	6	6	6	6
TOTAL_PAYMENTS	Pearson correlation	-,255	-,486	1	1,000**	,998**	1,000**	,899*
	Sig. (2-tailed)	,625	,328		,000	,000	,000	,015
	N	6	6	6	6	6	6	6
DEBIT_CARDS	Pearson correlation	-,255	-,488	1,000**	1	,998**	,999**	,898*
	Sig. (2-tailed)	,626	,326	,000		,000	,000	,015
	N	6	6	6	6	6	6	6
CREDIT_CARDS	Pearson correlation	-,261	-,470	,998**	,998**	1	,999**	,908*
	Sig. (2-tailed)	,617	,347	,000	,000		,000	,012
	N	6	6	6	6	6	6	6
CARDS_EFT_POS	Pearson correlation	-,264	-,482	1,000**	,999**	,999**	1	,898*
	Sig. (2-tailed)	,614	,333	,000	,000	,000		,015
	N	6	6	6	6	6	6	6

ELECTRONIC_MONEY	Pearson correlation	,114	-,129	,899*	,898*	,908*	,898*	1
	Sig. (2-tailed)	,830	,808	,015	,015	,012	,015	
	N	6	6	6	6	6	6	6
*Correlation is significant at the 0.05 level (2-tailed).								
**Correlation is significant at the 0.01 level (2-tailed).								

Source: *Own study.*

According to the above table, tax revenues are not statistically significantly correlated at the 95% or 90% level with the independent variables, except for GDP. In the case of GDP, there is a statistically significant correlation at the 95% level of statistical significance. This correlation is also illustrated in the graph below. The correlation is linear and statistically significant at 95% level of statistical significance (sig. 0.036< 0.05). Also, the R Square is 0.708 which means that GDP explains 70.8% of the variability in tax revenues.

Table 3. *Linearity analysis of the GDP/tax revenue ratio*

Model Summary and Parameter Estimates							
Dependent Variable: tax_income							
Equation	Model Summary					parameter estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,708	9,711	1	4	,036	-30695,657	,460
The independent variable is GDP.							

Source: *Own study.*

The regression analyses are then presented to test the hypotheses of the study.

H1: There is a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and the use of electronic media.

In order to investigate the above hypothesis, the results of the regression are presented, where the dependent variable is TAX_PAYMENTS and the independent variables are GDP and TOTAL_PAYMENTS (Total card payments).

Table 4. *Regression analysis: the dependent variable is TAX_PAYMENTS and the independent variables are GDP and TOTAL_PAYMENTS*

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,887[a]	,787	,645	2445,16112
a. Predictors: (Constant), TOTAL_Payments, GDP				

ANOVA[a]						
Model		Sum of Squares	df	mean square	F	Sig.
1	Regression	66210624,150	2	33105312,075	5,537	,098[b]
	Residual	17936438,770	3	5978812,923		

	Total	84147062,920	5			
a. Dependent Variable: TAXATION_INCOME						
b. Predictors: (Constant), TOTAL_Payments, GDP						
Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-21486,888	27466,206		-,782	,491
	GDP	,420	,151	,768	2,784	,069
	TOTAL_PAYMENTS	-3,408	3,240	-,290	-1,052	,370
a. Dependent Variable: TAXATION_INCOME						

Source: *Own study.*

According to the above table, the regression function explains 88.7% of the variability of the dependent variable and is statistically significant at the 90% level of statistical significance (sig. 0.098). However, given that GDP explains 70.8% of the variability in tax revenues, the variable TOTAL_PAYMENTS explains a small percentage. It also appears that there is a negative, non-statistically significant correlation (sig. 0.370) between the variables TAX_RESOURCES and TOTAL_PAYMENTS. Therefore, the hypothesis is not confirmed.

Table 5. *Linearity analysis between the variables Tax revenue and Total Payments*

Model Summary and Parameter Estimates							
Dependent Variable: tax_income							
	Model Summary					parameter estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,236	1,237	1	4	,328	54760,062	-5,711
The independent variable is TOTAL_PAYMENTS.							

Source: *Own study.*

Supplementary results (Annex 1), reveal that tax revenues are not statistically significantly correlated with electronic payments, but they are statistically significantly correlated with GDP. To check that the models used are appropriate to explain the relationship between the variables under investigation, the following table shows the R Square coefficients already calculated above, and a multivariate test with the Variance Inflation Factor (VIF) criterion. The results of the multivariate tests as shown below; the VIF coefficient is less than 10, so there is no polysigram problem and the model explains the relationship between the variables very well.

Table 6. *Multigraphicity check*

Variable	R Square	VIF
GDP	70,8%	1,000
GDP + Total card payments	78,7%	1,070
GDP + Payments with cards with a billing function	78,8%	1,070
GDP + Payments by cards with a credit function	77,6%	1,073
GDP + Card payments routed to EFTPOS terminals with	88,4%	1,075

physical substance		
GDP + Payments with electronic money issued by domestic Payment Service Providers	87,1%	1,013

Source: *Own study.*

Given the above, the use of digital payments does not lead to an increase in tax revenues. Although over time there has been an increase in the use of electronic payment instruments and an increase in the volume of transactions, tax revenues have fluctuated significantly.

5. Conclusion

Tax evasion is a phenomenon that has been of concern to the governments of all countries since ancient times, because it results in both the loss of state revenues and an unequal and unfair distribution of tax burdens. However, tackling tax evasion is a particularly difficult task, mainly because it cannot be easily detected and measured. In Greece, levels of tax evasion are particularly high. It is reported that tax evasion involves amounts corresponding to 6%-9% of GDP.

The main factors contributing to tax evasion in Greece are legislative and political, which are linked to the complexity of the tax system and the way the public administration operates. They are also technological, as the country has not yet reached the desired levels of digital transformation. Finally, bureaucracy further contributes to tax evasion.

Electronic means of payment are a modern way of doing business and are also considered a tool to reduce tax evasion through transparency and more effective control. The use of electronic means of payment is increasing in Greece, although the country still lags significantly behind the European average. The value of transactions for Greece in 2021 was €948.2 billion.

There is also a continuous increase in the total number of payment cards, the number of ATMs, and especially in the number of digital payments terminals, which increased in absolute terms by 574,457 between 2015 and 2020. Furthermore, relevant legislation has been developed to make the use of electronic payment instruments more universal.

The existing literature strongly supports the positive correlation between the use of electronic payment and the reduction of tax evasion. Scholars develop regression models or use other research methods and conclude that card payments reduce the VAT gap.

At the same time, the adoption of electronic tax filing contributes positively to the reduction of tax evasion, there is a positive correlation between tax refund and the adoption of e-invoicing and electronic payments are negatively correlated with tax

evasion (Immordino and Russo, 2016; 2018; Hondroyiannis and Papaoikonomou, 2017; Lovic *et al.,* 2019; Alognon *et al.,* 2021). On the other hand, there are also studies that do not link in a statistically significant way the use of electronic payment instruments and the increase of tax revenues (Madzharova, 2014; Brockmeyer and Saenz Somarriba, 2022).

The present paper aims to provide robust answers to the research question: can the use of digital payments contribute to a reduction in tax evasion? To answer the research question, regression analysis was performed to determine if there a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and the use of electronic payment instruments.

Data were collected from the Greek Independent Authority for Public Revenue (IAPR) and from the Bank of Greece. The results of the study are in line with those of Brockmeyer and Saenz Somarriba (2022) and Madzharova (2014).

However, the results are contrary to those of the other studies included in the literature review. It is also important to mention that the present study is characterized by limitations. In particular, the data used refer to a period of significant changes (e.g., capital controls, digital transformation of the state, COVID19 pandemic). Further research is suggested to include a broader range of data and additional variables.

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Annex 1:

Multivariate control with the Variance Inflation Factor (VIF) criterion

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-21486,888	27466,206		-,782	,491		
	GDP	,420	,151	,768	2,784	,069	,935	1,070
	TOTAL_PAYMENTS	-3,408	3,240	-,290	-1,052	,370	,935	1,070

a. Dependent Variable: TAXATION_INCOME

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-21612,249	27325,220		-,791	,487		
	GDP	,419	,150	,767	2,791	,068	,935	1,070
	DEBIT_CARDS	-3,789	3,564	-,292	-1,063	,366	,935	1,070

a. Dependent Variable: TAXATION_INCOME

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-20339,957	28859,654		-,705	,532		
	GDP	,422	,155	,771	2,722	,072	,932	1,073
	CREDIT_CARDS	-34,061	35,915	-,269	-,948	,413	,932	1,073

a. Dependent Variable: TAXATION_INCOME

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-21588,818	27922,021		-,773	,496		
	GDP	,420	,153	,768	2,741	,071	,930	1,075
	CARDS_EFT_POS	-3,692	3,699	-,280	-,998	,392	,930	1,075

a. Dependent Variable: TAXATION_INCOME

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-31180,615	27665,880		-1,127	,342		
	GDP	,474	,156	,868	3,043	,056	,987	1,013
	ELECTRONIC_MONEY	-80,381	100,677	-,228	-,798	,483	,987	1,013
a. Dependent Variable: TAXATION_INCOME								

Additional hypothesis testing

H1a: There is a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and the use of debit cards.

The results of the regression are presented where the dependent variable is TAX_RESOURCES and the independent variables are GDP and BILLING_CARDS (payments with cards that have a billing function). In this way hypothesis H1a is investigated.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,888[a]	,788	,647	2437,87903
a. Predictors: (Constant), DEBIT_CARDS, GDP				

ANOVA[a]						
Model		Sum of Squares	df	mean square	F	Sig.
1	Regression	66317300,444	2	33158650,222	5,579	,098[b]
	Residual	17829762,476	3	5943254,159		
	Total	84147062,920	5			
a. Dependent Variable: TAXATION_INCOME						
b. Predictors: (Constant), DEBIT_CARDS, GDP						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-21612,249	27325,220		-,791	,487
	GDP	,419	,150	,767	2,791	,068
	DEBIT_CARDS	-3,789	3,564	-,292	-1,063	,366
a. Dependent Variable: TAXATION_INCOME						

According to the above table, the regression function explains 78.8% of the variability of the dependent variable and is statistically significant at the 90% level of statistical significance (sig. 0.098).

However, given that GDP explains 70.8% of the variability in tax revenues, the variable DEBT_CARDS explains a small percentage. It also appears that there is a negative, non-statistically significant correlation (sig. 0.366) between the variables TAX_RESOURCES and DEBT_CARDS. Hypothesis 1a is not confirmed.

Model Summary and Parameter Estimates							
Dependent Variable: tax_income							
	Model Summary					parameter estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,238	1,250	1	4	,326	54455,209	-6,326
The independent variable is CHARGEABLE_CARDS.							

H1b: There is a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and credit card usage.

Below the results of the regression are analysed, where the dependent variable is TAX_INCOME and the independent variables are GDP and CREDIT_CARDS (payments with cards with a credit function).

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,881[a]	,776	,626	2509,12239
a. Predictors: (Constant), CREDIT_CARDS, GDP				

ANOVA[a]						
Model		sum of squares	df	mean square	F	Sig.
1	Regression	65259977,471	2	32629988,736	5,183	,106[b]
	Residual	18887085,449	3	6295695,150		
	Total	84147062,920	5			
a. Dependent Variable: TAXATION_INCOME						
b. Predictors: (Constant), CREDIT_CARDS, GDP						

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	-20339,957	28859,654		-,705	,532
	GDP	,422	,155	,771	2,722	,072
	CREDIT_CARDS	-34,061	35,915	-,269	-,948	,413
a. Dependent Variable: TAXATION_INCOME						

According to the above table, the regression function explains 77.6% of the variability of the dependent variable and is marginally statistically significant at the 90% level of statistical significance (sig. 0.106). However, given that GDP explains 70.8% of the variability in tax revenues, the variable CREDIT_CARDS explains a small percentage. It also appears that there is a negative, non-statistically significant correlation (sig. 0.413) between the variables TAX_RESOURCES and CREDIT_CARDS. Hypothesis H1b was not confirmed.

Model Summary and Parameter Estimates							
Dependent Variable: tax_income							
	Model Summary					parameter estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,221	1,136	1	4	,347	57569,389	-59,600
The independent variable is CREDIT_CARDS.							

H1c: There is a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and the use of cards routed to EFTPOS terminals with physical substance.

The analysis continues with the presentation of the regression results where the dependent variable is TAX_EXES and the independent variables are GDP and CARDS_EFT_POS (card payments routed to EFTPOS terminals with physical substance). In this way, hypothesis H1c is investigated.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,884[a]	,781	,635	2478,58468

a. Predictors: (Constant), CARDS_EFT_POS, GDP

ANOVA[a]

Model		Sum of Squares	df	mean square	F	Sig.
1	Regression	65716916,849	2	32858458,425	5,349	,103[b]
	Residual	18430146,071	3	6143382,024		
	Total	84147062,920	5			

a. Dependent Variable: TAXATION_INCOME

b. Predictors: (Constant), CARDS_EFT_POS, GDP

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-21588,818	27922,021		-,773	,496
	GDP	,420	,153	,768	2,741	,071
	CARDS_EFT_POS	-3,692	3,699	-,280	-,998	,392

a. Dependent Variable: TAXATION_INCOME

According to the above table, the regression function explains 78.1% of the variability of the dependent variable and is marginally statistically significant at the 90% level of statistical significance (sig. 0.103). However, given that GDP explains 70.8% of the variability in tax revenues, the variable CREDIT_CARDS explains a small percentage. Also, it appears that there is a negative, non-statistically significant correlation (sig. 0.392) between the variables TAX_RESOURCES and CARDS_EFT_POS. The hypothesis is therefore not confirmed.

Model Summary and Parameter Estimates

Dependent Variable: tax_income

Equation	Model Summary					parameter estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,232	1,211	1	4	,333	54731,134	-6,367

The independent variable is Cards_EFT_POS.

H1d: There is a positive and statistically significant correlation between tax revenues and GDP, as well as between tax revenues and e-money payments issued by domestic PSPs.

Finally, the results of the regression are presented where the dependent variable is the TAX_RESOURCES and the independent variables are GDP and the variable ELECTRONIC_CASH (Payments with electronic money issued by domestic PSPs), in order to investigate hypothesis H1d.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,871[a]	,759	,599	2597,89300
a. Predictors: (Constant), ELECTRONIC_MONEY, GDP				

ANOVA[a]						
Model		Sum of Squares	df	mean square	F	Sig.
1	Regression	63899918,789	2	31949959,394	4,734	,118[b]
	Residual	20247144,131	3	6749048,044		
	Total	84147062,920	5			
a. Dependent Variable: TAXATION_INCOME						
b. Predictors: (Constant), ELECTRONIC_MONEY, GDP						

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	-31180,615	27665,880		-1,127	,342
	GDP	,474	,156	,868	3,043	,056
	ELECTRONIC_MONEY	-80,381	100,677	-,228	-,798	,483
a. Dependent Variable: TAXATION_INCOME						

According to the above table, the regression function explains 75.9% of the variability of the dependent variable, while it is not statistically significant at the 90% level of statistical significance (sig. 0.118). It also shows that there is a negative, non-statistically significant correlation (sig. 0.483) between the variables TAX_Payment and ELECTRONIC_CASH. Hypothesis H1d, therefore, is not confirmed.

Model Summary and Parameter Estimates							
Dependent Variable: tax_income							
	Model Summary					parameter estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,017	,067	1	4	,808	52593,912	-45,474
The independent variable is ELECTRONIC_CASH.							