BANK OF GREECE
EUROSYSTEM

Working Paper

The determinants of VAT revenue efficiency: recent evidence from Greece

Athanasios O. Tagkalakis

181

MAY 2014

BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

Printed in Athens, Greece
at the Bank of Greece Printing Works.

ISSN 1109-6691

THE DETERMINANTS OF VAT REVENUE EFFICIENCY: RECENT EVIDENCE FROM GREECE

Athanasios O. Tagkalakis
Bank of Greece

Abstract

This paper examines the relationship between VAT revenue and economic activity in Greece by estimating the relationship between tax revenue efficiency and real GDP growth rate. We find a positive and significant relationship between these variables, and show that the responsiveness of tax revenue efficiency to economic activity fluctuations has increased in the recent years. Tax efficiency is affected by changes in the ability to curb tax evasion**.**

JEL classification: C32; E32; H20; O52

Keywords: VAT; GDP; tax evasion; Greece.

Acknowledgements: I would like to thank Jim Alm, Heather Gibson, George Hondroyiannis, Dimitris Malliaropulos and Basil Manesiotis for their very helpful comments. The views of the paper are my own and do not necessarily reflect those of the Bank of Greece. All remaining errors are mine.

Correspondence:
Athanasios O. Tagkalakis
Economic Research Department, Bank of Greece,
21 El. Venizelos Av. 10250 Athens, Greece
Email: atagkalakis@bankofgreece.gr
Tel.:0030-210-3202442
Fax: 0030-210-3232025

1. Introduction

The success of the on-going fiscal consolidation effort is one of the prerequisites for the recovery of the Greek economy. This implies that all possible interactions between fiscal consolidation and economic activity have to be fully understood.

However, an issue that has not yet received appropriate attention relates to the fact that since the start of the implementation of the Economic Adjustment Programme (EAP) for Greece in May 2010 there have been recurrent revenue shortfalls, in particular as regards VAT and indirect tax revenue in general. Successive increases in VAT rates and excise taxes since the start of the EAP did not bring about a higher VAT and indirect tax ratio to GDP (IMF, 2012; 2013). This could be related to behavioral changes by consumers (a shift in demand towards low VAT (necessity) goods), as well as a worsening in tax compliance (IMF, 2013) which is particularly relevant during recessions (see e.g. Poghosyan 2011; Brondolo 2009; Sansac et al. 2010). All in all these developments contributed to a deteriorating VAT revenue collection efficiency in recent years (see Figure 1).

Building on the aforementioned studies we examine the VAT revenue performance as a way of understanding the recent revenue shortfalls. We estimate the relationship between VAT revenue efficiency and real GDP growth rate. While doing that we control for the ability to curb tax evasion, as well as shifts in consumption patterns towards necessity goods.

Our findings show that an improvement (deterioration) in economic conditions increases (reduces) VAT efficiency. A 1 percent increase in the rate of growth of real GDP raises VAT efficiency by about 0.63 p.p. We find evidence that VAT efficiency tends to be lower on average when economic conditions are bad. According to our findings VAT efficiency has become more responsive to economic activity developments since the start of 2009 (when the economic crisis deepened).

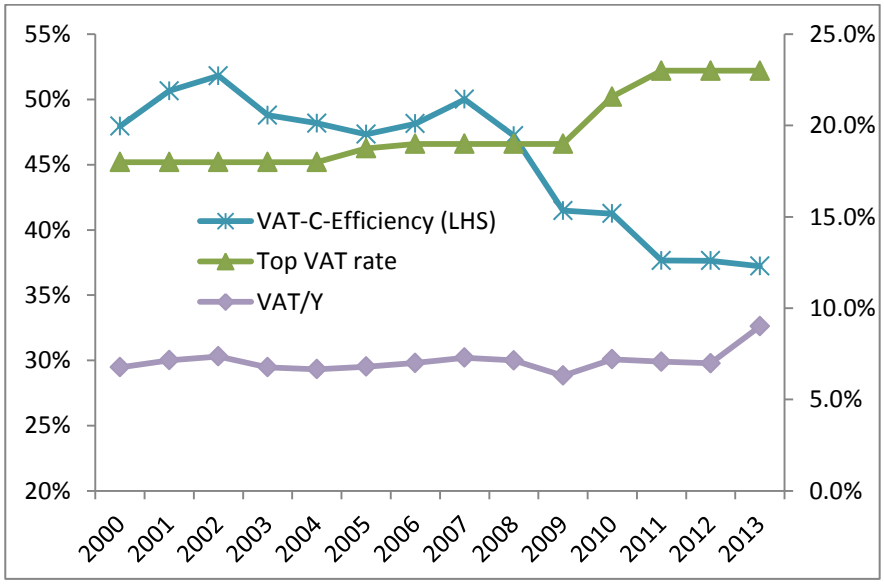
Additionally, we show the deterioration in the ability to fight tax evasion (that usually takes place in economic downturns) reduces VAT efficiency. Shifts towards necessity goods (that are usually taxed at a lower VAT rate) are associated negatively

with VAT efficiency, thought the results are not statistically significant. Building on Sansac et al. (2010), we show that the increase in tax evasion is a significant and relevant channel through which the real GDP growth rate impacts on VAT efficiency.

The key implication of our analysis is that policy makers should take into account in their forecasts that revenue performance varies significantly through the cycle. This requires strengthening the tax enforcement mechanism to combat tax evasion, as well as recognizing that further increasing tax obligations will not necessarily translate into increased revenue in recession periods that both individuals and firms face binding financing and liquidity pressures.

In the remainder we consider the following: Section 2 discusses data issues, methodology and discusses issues related to VAT collection efficiency. Section 3 summarizes and concludes.

Figure 1: VAT collections and efficiency



Notes: Top VAT rate is standard VAT rate; VAT/Y is VAT collections as a % of GDP.We define VAT –C-Efficiency as the share of VAT revenues in the private consumption, normalized by the standard tax rate: VAT revenue efficiency ratio = (VAT revenue/private consumption)/standard tax rate*100.

2. Data, methodology and findings

We use quarterly data on VAT revenue, private consumption and GDP over the period 2000:Q1-2012:Q3. Data are transformed in real terms by means of the GDP deflator.[1] Following earlier IMF studies, like Sansac et al. (2010), we investigate the effect of cyclical economic activity developments on VAT revenue efficiency.[2] Using data over the period 2000:Q1 – 2012:Q3 we regress by means of OLS (with robust standard errors) equation (1)[3]:

$$VAT\ C\text{-}efficiency_t = \alpha + \beta^{*}\Delta log(Real\ GDP)_t + Elections_t + EAP_t + EDP_t + time\ trend_t + EAP^{*}\ time\ trend_t + \varepsilon_t \quad (1)$$

The economic activity variable used is: $\Delta log(Real\ GDP)_t = log\ Real\ GDP_{t} - log\ Real\ GDP_{t-4}$.[4] The "election" dummy captures election periods; there is anecdotal evidence that revenue collection and budgetary performance deteriorates in election periods.[5] The EDP dummy variable captures the period that Greece was in excessive deficit procedure, i.e. 2004:Q3-2007:Q2 and from 2009: Q1 -2010:Q1; controlling for (tax) policy changes that occurred in that period.

Greece continues to be in EDP in the post 2010:Q2 period, however, we differentiate between the pre- and post-EAP era because in the period that Greece receives EU-IMF funding (from 2010:Q2 onwards) surveillance procedures are stricter and much more intense relative to the pre-EAP EDP surveillance. Hence, the "EAP"

[1] Data are seasonally adjusted by means of the census X12 procedure.

[2] We define VAT (indirect tax) revenue efficiency as the share of VAT (indirect tax) revenues in the tax base (private consumption), normalized by the standard tax rate, e.g. in case of VAT: VAT revenue efficiency ratio = (VAT revenue/private consumption)/standard tax rate*100. This is called VAT Consumption (C) efficiency. Data on VAT rates were taken from Bank of Greece (2009-2013).

[3] We have also considered OLS with Newey-West standard errors, i.e., the error structure is assumed to be heteroskedastic and autocorrelated up to lag one. Moreover, we have also considered a generalized least-squares method to estimate the parameters in a linear regression model in which the errors are assumed to follow a first-order autoregressive process.

[4] Due to data availability issues we consider real GDP growth and not the output gap (as in Sancak et al (2010)) as our cyclical economic activity variable. There is no quarterly output gap indicator based on the production function approach, therefore we would have had to rely on a purely statistical procedure, such as the HP filter, to extract the cyclical component of real GDP. Instead of doing that we preferred relying on real GDP growth rate as our cyclical economic activity variable.

[5] The election dummy takes value 1 in the quarters that national elections were held (2002 Q2, 2004 Q1, 2007 Q3, and 2009 Q4, 2012 Q2) and zero otherwise.

dummy captures the period that Greece is under joint EU-IMF surveillance (since May 2010); during that period Greece had to take several measures to improve revenue administration and to fight tax evasion. Moreover, tougher consolidation measures were implemented in this period. The time trend captures time related effects that affect the relationship between VAT and GDP. The interaction term "EAP*time trend" captures trend related effects in the EAP era.

Alternatively, and building on specification (1) we investigate the behavior of VAT efficiency in bad and good economic times. In bad economic times the real GDP growth rate takes negative values, while in good economic times takes positive values. The findings are reported in Table 1.

As shown in column 1 in Table 1 a 1 percent increase in real GDP growth improves VAT efficiency by about 0.63 p.p. Turning to the behavior of VAT efficiency in bad and good economic times we find evidence that there is positive (and in most cases) significant relationship between revenue efficiency and the real GDP growth rate in both bad and good economic times (see columns 2, 3 and 4 in Table 1). However, as shown by the coefficient of the bad time variable in column 5 (in Table 1) VAT efficiency tends to be lower on average when the economy is in recession, as the estimated bad times variable coefficient is negative and significant. Nevertheless, in terms of the slope, there is no significant difference between good and bad times, as the coefficient of the bad time dummy interacted with the real GDP growth rate is not particularly significant (in Table 1).

Table 1: VAT-C-efficiency in good and bad times

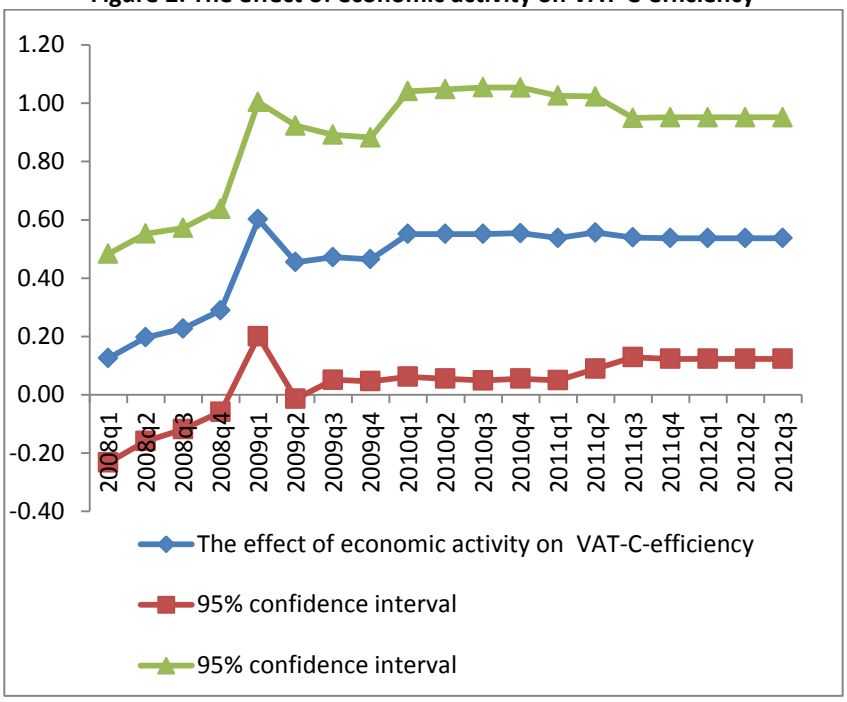
	1	2	3	4	5
	Full sample	Full sample	Good times	Bad times	Interactions
Growth rate of real GDP	0.629 (3.01)***	-	0.099 (0.51)	0.553 (1.84)*	0.105 (0.56)
Bad times	-	1.039 (2.51)**	-	-	-0.038 (-3.74)***
Good times	-	0.358 (1.96)*	-	-	-
Bad times* Growth rate of real GDP	-	-	-	-	0.671 (1.65)
Elections	-0.004 (-0.54)	-0.003 (-0.45)	-0.012 (-1.25)	0.005 (0.60)	-0.005 (-0.68)
EAP	0.783 (2.97)***	0.689 (2.23)**	-	2.008 (0.96)	0.857 (3.02)***
EDP	-0.021 (-2.68)***	-0.017 (-2.36)**	-0.021 (-2.47)**	-0.060 (-1.00)	-0.022 (-3.24)***
Time trend	-0.0003 (-0.82)	-0.0005 (-1.43)	0.0001 (0.37)	0.006 (0.53)	0.0002 (0.45)
EAP*time trend	-0.004 (-3.10)***	-0.003 (-2.20)**	-	-0.010 (-0.95)	-
constant	0.575 (7.87)***	0.624 (8.81)***	0.515 (6.90)***	-0.563 (-0.28)	0.511 (7.11)***
R-sq	0.845	0.857	0.251	0.755	0.878
No. of obs.	47	47	29	18	47
F-test (p-value)	F(6, 40) : 62.53 (0.000)	F(7, 39) : 54.15 (0.000)	F(4, 24) : 1.90 (0.1438)	F(6, 11) : 16.79 (0.0001)	F(8, 38) : 59.03 (0.0000)
F-test: Bad=Good (p-value)	-	F(1, 39) : 2.42 (0.1279)	-	-	-

Notes: OLS estimation, robust standard errors in parenthesis; ***, **, *statistically significant at 1%, 5% and 10%, respectively.

Last but not least, in Figure 2 and we report evidence that VAT efficiency has become more responsive to economic activity developments since the start of 2009 (when the contraction in economic activity became more pronounced). [6]

[6] This evidence is based on the recursive estimation of specification (2) that incorporates additional control variables. There is a "spike" in the efficiency figures in 2009 Q1. This is linked to the collapse of the tax collecting mechanism, which is related to changes in tax-revenue administration and Ministry of Finance officials in 2009 Q1. However, it should be recalled that since 2009 Q1 Greece has been in EDP procedure in view of the deterioration of public finances.

Figure 2: The effect of economic activity on VAT-C-efficiency



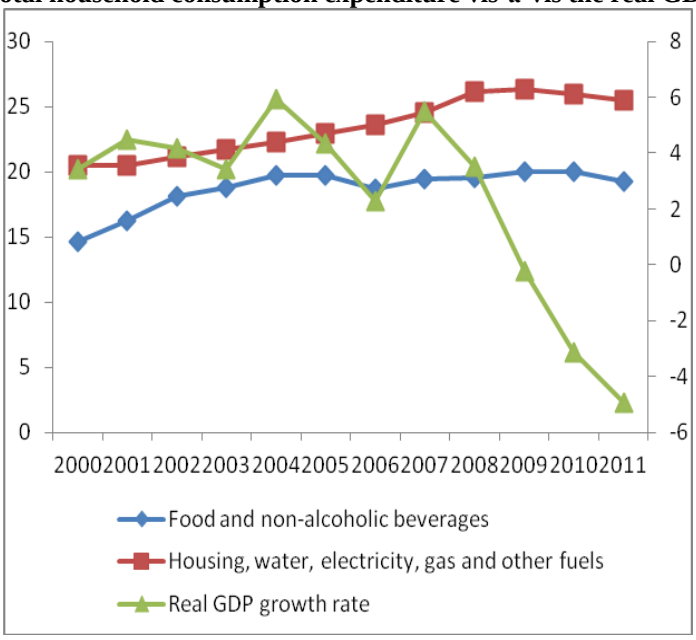
2.1. Shifts in consumption patterns and tax evasion

Building on the work of Sansac et al. (2010) we now investigate the effect of possible shifts in consumption patterns, as well as the effect of the ability to control tax evasion.

As pointed out by Sancac et al (2010) "*during a downturn (upswing), it is reasonable for rational consumers to increase (decrease) the share of necessity goods and services in total consumption.*" In addition as pointed out by Sancac et al (2010) "*shifts in consumption patterns can have a significant impact on revenue collections, as necessity items are either zero-rated or taxed at a lower than standard rate in many countries*." Figure 3 shows that there is a negative correlation between the share of food and non-alcoholic beverages in total household consumption and real GDP growth. In addition, there is a significant negative correlation between real GDP growth and the share of housing, water, electricity, gas and other fuels in total household consumption.[7]

[7] The correlation between real GDP and food and non-alcoholic beverages is -0.27, whereas that between real GDP and housing, water, electricity, gas and other fuels is -0.60. Data on consumption shares are

Figure 3: The share of food and non-alcoholic beverages and housing, water, electricity, gas and other fuels in total household consumption expenditure vis-à-vis the real GDP growth rate

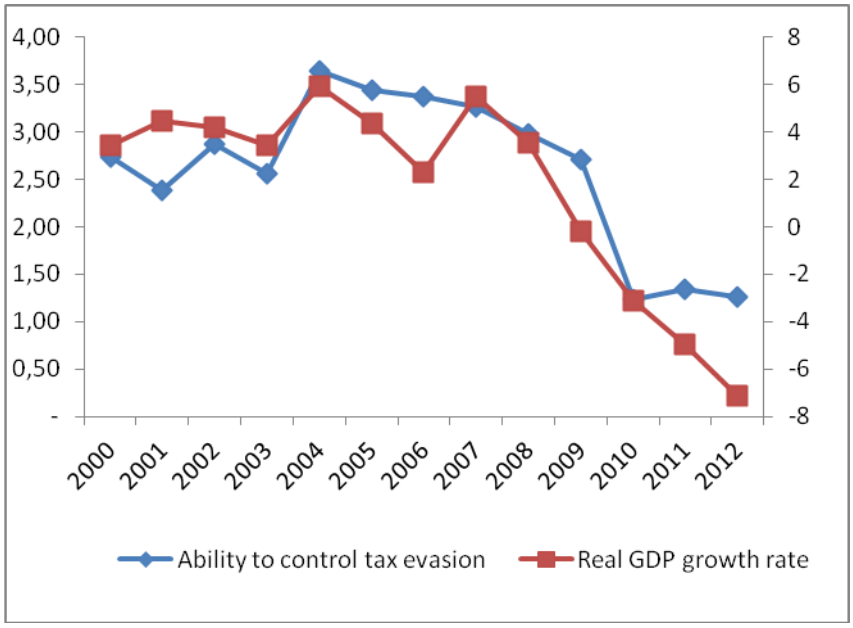


As reported by Poghosyan (2011), Brondolo (2009), Sansac et al. (2010) firms and households are more likely to evade taxes in bad economic times, i.e., when they are credit constrained and face financial pressures. Following Sansac et al. (2010) and given the absence of hard data on tax evasion, we rely on a qualitative indicator provided by the IMD's World Competitiveness Online database. This indicator is based on IMD's company executives' surveys, ranking tax evasion issues on a scale from 0 to 10 (with higher values imply improved ability to control tax evasion). As shown in Figure 4, declining economic activity goes hand-in-hand with a deterioration in the ability to fight tax evasion (i.e. an increase in (the perceived) tax evasion).[8] Based on this evidence we expect that an increase in the ability to control tax evasion will translate into an increase in VAT revenue efficiency.

taken from Eurostat. See Eurostat, Statistics in focus, 2/2013, Analysis of EU-27 household final consumption expenditure.

[8] Real GDP growth and the ability to control tax evasion have a significant positive correlation of 0.88.

Figure 4: Ability to control tax evasion vis-à-vis real GDP growth rate



Using data over the period 2000:Q1 – 2012:Q3 we regress by means of OLS (with robust standard errors) specification (2) in order to study the effect of the shift in consumption patterns and the ability to control tax evasion on VAT C-efficiency[9]:

$$VAT\ C\text{-}efficiency_t = \alpha + \beta^{*}\Delta log(Real\ GDP)_t + Shift\ in\ consumption\ patterns_t + Control\ of\ Tax\ Evasion_t + Elections_t + EAP_t + EDP_t + time\ trend_t + EAP^{*}\ time\ trend_t + \varepsilon_t \quad (2)$$

According to the evidence presented in Table 2, the shift in consumption patterns towards necessity goods exerts a negative but insignificant effect on VAT C-efficiency (see columns 1-2).

[9] We have also considered OLS with Newey-West standard errors, i.e., the error structure is assumed to be heteroskedastic and autocorrelated up to lag one. Moreover, we have also considered a generalized least-squares method to estimate the parameters in a linear regression model in which the errors are assumed to follow a first-order autoregressive process. Both the tax evasion measures and the share of necessity goods in consumption are available in annual frequency and have been transformed by the authors to quarterly frequency.

Table 2: VAT-C-efficiency, share of necessity goods and control of tax evasion

	1	2	3	4	5
Growth rate of real GDP	0.621 (2.90)***	0.617 (2.94)***	0.571 (2.73)***	0.537 (2.54)***	0.510 (2.53)**
Consumption share of food and non alcoholic beverages	-0.136 (-0.37)	-	-	-0.650 (-1.43)	-
Consumption share of food and housing, water, electricity, gas and other fuels	-	-0.043 (-0.12)	-	-	-0.521 (-1.09)
Control of tax evasion	-	-	0.011 (1.89)*	0.017 (1.99)*	0.016 (2.06)**
Elections	-0.005 (-0.58)	-0.005 (-0.62)	-0.006 (-0.74)	-0.008 (-0.89)	-0.009 (-1.03)
EAP	1.383 (2.76)***	1.368 2.22)**	0.781 (2.73)***	1.758 (3.23)***	2.018 (2.74)***
EDP	-0.021 (-2.55)**	-0.0216 (-2.64)**	-0.025 (-3.17)***	-0.025 (-3.15)***	-0.027 (-3.33)***
Time trend	-0.0002 (-0.43)	-0.0002 (-0.19)	-0.0004 (-0.92)	0.00008 (0.14)	0.0009 (0.69)
EAP*time trend	-0.007 (-2.79)***	-0.007 (-2.24)**	-0.004 (-2.81)***	-0.009 (-3.26)***	-0.010 (-2.77)***
constant	0.584 (8.25)***	0.575 (7.08)***	0.555 (7.46)***	0.579 (8.38)***	0.521 (5.75)***
R-sq	0.818	0.818	0.852	0.834	0.832
No. of obs.	44	44	47	44	44
F-test (p-value)	F(7, 36) : 63.60 (0.000)	F(7, 36) : 61.28 (0.000)	F(7, 39) : 55.99 (0.000)	F(8, 35) : 53.25 (0.0000)	F(8, 35) : 50.76 (0.000)

Notes: OLS estimation, robust standard errors in parenthesis; ***, **, *statistically significant at 1%, 5% and 10%, respectively.

Adding the variable for the control of tax evasion reveals that an increase in the ability to control tax evasion improves VAT revenue efficiency (see column 3, Table 2). The fact that the coefficient on real GDP growth declines (compared to that in Table 1-column 1 where we do not control for tax evasion) implies that tax evasion is a relevant channel through which the real GDP growth rate has an impact on VAT revenue efficiency (see Sansac et al., 2010).

Incorporating both the shift in consumption patterns and the tax evasion proxy reduces substantially the coefficient estimate of real GDP growth, however it remains statistically significant.. Specifically, in Table 2- columns 4-5 it declines to 0.510-0.537 from 0.629 in Table 1-column 1 where neither of the control variables under discussion is included. This indicates, as pointed out by Sansac et al. (2010), that the increase in tax evasion and to a much lesser extent the shift in consumption patterns are relevant channels through which the real GDP growth rate impacts on VAT tax efficiency.[10]

3. Summary and conclusions

The above analysis provides empirical evidence that the VAT revenue efficiency is positively associated with economic activity. A 1 percent increase in real GDP growth improves VAT efficiency by about 0.63 p.p. We find evidence that in contractions revenue efficiency declines compared to periods of expansion. In addition, VAT efficiency has become more responsive to economic activity developments since the start of 2009 when the contraction of the Greek economy accelerated.

Building on the work of Sansac et al. (2010) we then investigated the effect of possible shifts in consumption patterns towards necessity goods, as well as the effect of the ability to control tax evasion. Both the shift in consumption patterns towards necessity goods and reduced tax compliance are more likely to occur in periods of economic decline and financial stress. Our estimates reveal it is primarily the control of tax evasion that impacts on tax efficiency. There is limited but not significant evidence that the shift towards necessity goods (that are usually taxed at a lower VAT rate) has reduced VAT efficiency.

At the same time we find that when incorporating both the shift in consumption patterns and the tax evasion proxy in our specifications, the coefficient estimate of real

[10] Turning to the other control variables we see that under the EDP, VAT efficiency deteriorated, while VAT efficiency improved with the measures adopted in the period under joint EU-IMF surveillance (EAP dummy). This could be also explained by the recent evidence that the intensification of tax audits in 2012 reduced VAT tax offenders (Tagkalakis, 2013). The interaction term between the time trend and the EAP dummy reveals a trend deterioration in VAT efficiency in more recent years. The elections dummy has a negative but insignificant effect on efficiency.

GDP growth declines by up to 19-21% but it remains statistically significant. This indicates, as pointed out by Sansac et al. (2010), the increase in tax evasion is a significant and relevant channels through which the real GDP growth rate impacts on VAT efficiency. As pointed above the evidence is weak and not significant as regards the shift toward necessity goods.

The most important implication of the analysis is that policy makers should take into account the effects of the economic cycle on revenue performance. VAT efficiency shows increased responsiveness to economic activity changes in particular in recent years. Part of this could possibly be explained by increased incentives to tax evade (there is no significant evidence regarding the shift in consumption patterns towards necessity goods taxed with lower VAT rates). This requires strengthening the tax enforcement mechanism to combat tax evasion. At the same time further increasing tax obligations will not necessarily translate into increased revenue in recession periods that both individuals and firms face binding financing and liquidity pressures.

References

Bank of Greece (2009) “Governor’s Annual Report for 2008”. Annex to Chapter VIII: Tax policy changes April, Bank of Greece.

Bank of Greece (2010) “ Governor’s Annual Report for 2008”. Annex to Chapter VIII: Tax policy changes, April, Bank of Greece.

Bank of Greece (2011) “Governor’s Annual Report for 2010”. Annex to Chapter IX: Tax policy changes, April, Bank of Greece.

Bank of Greece (2012) “Governor’s Annual Report for 2011”. Annex to Chapter IX: Tax policy changes, April, Bank of Greece.

Bank of Greece (2013) “Governor’s Annual Report for 2012”. Annex to Chapter IX: Tax policy changes, February, Bank of Greece.

Brondolo, J., (2009). Collecting Taxes During an Economic Crisis: Challenges and Policy Options, IMF Staff Position Note 09/17 (Washington: International Monetary Fund).

IMF, (2012). Greece: Request for Extended Arrangement Under the Extended Fund Facility, IMF Country Report No. 12/57.

IMF, (2013). Greece: Third Review Under the Extended Arrangement Under the Extended Fund Facility, IMF Country Report No. 13/20.

Poghosyan T., (2011). Assessing the variability of tax elasticities in Lithuania, IMF WP 11/270.

Sancak, C., Velloso, R., and Xing, J., (2010). Tax Revenue Response to the Business Cycle, IMF Working Paper 10/71 (Washington: International Monetary Fund).

Tagkalakis, A., (2013). Audits and tax offenders: recent evidence from Greece. Economic Letters, 118(3), pp.519-522.

BANK OF GREECE WORKING PAPERS

171. Tagkalakis, O. A., "Assessing the Variability of Indirect Tax Elasticity in Greece", January 2014.

172. Koukouritakis, M., A.P. Papadopoulos and A.Yannopoulos, "Transmission Effects In The Presence of Structural Breaks: Evidence from South-Eastern European Countries", January 2014.

173. Du Caju, P., T. Kosma, M. Lawless, J. Messina, T. Rõõm, Why Firms Avoid Cutting Wages: Survey Evidence From European Firms", January 2014.

174. Mitrakos, T., "Inequality, Poverty and Social Welfare in Greece: Distributional Effects of Austerity", February 2014.

175. Lazaretou, S., "Η Έξυπνη Οικονομία: «Πολιτιστικές» και «Δημιουργικές» Βιομηχανίες Στην Ελλάδα Μπορούν Να Αποτελέσουν Προοπτική Εξόδου Από Την Κρίση", February 2014.

176. Chouliarakis, G., and S. Lazaretou, "Déjà Vu? The Greek Crisis Experience, the 2010s Versus the 1930s. Lessons From History", February 2014.

177. Tavlas, G.S., "In Old Chicago: Simons, Friedman and The Development of Monetary-Policy Rules", March 2014.

178. Bardakas, C. I., "Financing Exports of Goods: a Constraint on Greek Economic Growth, March 2014.

179. Tagkalakis, O., "Financial Stability Indicators and Public Debt Developments", May 2014.

180. Kaplanoglou, G., V. T., Rapanos , and I.C, Bardakas, "Does Fairness Matter for the Success of Fiscal Consolidation?", May 2014.