Ricardians in the European Union: The Role of Fiscal Rules

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Abstract

The presented paper deals with the concept of Ricardian equivalence in the European Union. The debt crisis has drawn the attention of professionals and the general public to the sustainability of public finance. The growing government debts of countries also affect the consumer behavior of households. The main objective of the paper is to determine the role of government debt and compliance with fiscal rules on household consumer behavior in the European Union and the Eurozone. The results of the empirical study confirmed the validity of the Ricardian equivalence in the European union during the time period 1995-2020, where the year-on-year change in the amount of government debt and the distance from compliance with fiscal rules dampens the growth of household expenditures.

1. Introduction

The concept of Ricardian equivalence has attracted the attention of economists since its formulation by Buchanan in 1976, which linked the ideas of Barro and David Ricardo. The essence of the Ricardian equivalence is the fact that increasing public spending through deficit financing does not affect the level of aggregate demand. The reason is the rational consumption behavior of households, which assumes that they or their children will have to repay the growing government debt in the future. Based on these facts, households will reduce current consumption and leave most of their income in the form of savings. Thus, the level of aggregate demand will not change and only its structure will change, when the share of government consumption in total consumption will increase. The Keynesian concept of economic policy therefore becomes ineffective as households begin to generate savings to compensate for the reduction in disposable income due to the expected increased tax burden in the future.

Several member states of the European Union are struggling with growing government debt, which has exceeded the limits set by Stability and Growth Pact. The debt crisis as a consequence of the financial crises of 2008 and 2009 and the crisis caused by the COVID-19 pandemic have exacerbated the situation. In addition to undermining the long-term sustainability of public finances, excessive government debt affects a whole range of macroeconomic and microeconomic variables.

Economic policy-makers need to be aware of these consequences when designing practical fiscal policy. The present article therefore estimates the impact of increasing government debt on the shaing of household consumption behavior. Our main hypothesis is that household consumer behavior is determined not only by the current level of government debt, but also by expectations regarding the growth of government debt in the upcoming year. We further examine the role of supranational fiscal rules and compliance with them within the framework of the Ricardian equivalence, assuming that they provide some warning signals to households in the event that the government fails to meet its obligations. The greater the distance from compliance with fiscal rules, the greater dampening of household expenditure growth. Based on the foregoing, our main objective is to confirm the validity of the Ricardian equivalence in the European Union, also with regard to the expected level of government debt, and to highlight the role of compliance with supranational fiscal rules.

The structure of the article is as follows, the first part deals with a review of the literature and a theoretical definition of the problem. The second section discusses the working procedure and methodology, through which we test our assumptions and hypothesis. The last section presents the achieved results of empirical research, which are then conceived into conclusions and recommendations.

2. Literature Review

The origins of Ricardian equivalence can be traced back to Barro (1974), who addressed the question of whether Treasury bonds are a source of pure wealth. If not, debt financing of government activities does not inherently affect private consumption of households and hence government debt becomes neutral with respect to it. In other words, taxes and government debt have a similar effect on private consumption. Buchanan (1976) pointed out the interconnectedness between the work of Barro and Ricardo, who in the 18th century discussed the possibilities of financing war through debt or tax increases, concluding that an increase in government debt is only a postponement of a tax increase in the future. Contemporary economic analysis of the impact of government debt and the budget deficit shows that an increase in the budget deficit leads to an increase in the disposable income of the population and to an increase in aggregate demand in the short run. In the Ricardian equivalence case, on the other hand, the rational consumer perceives an increase in the budget deficit in the present as a tax increase in the future and thus will not increase private consumption and will leave it at the current level or reduce it to compensate for the tax increase in the future. Dvořák and Mandel (1995) dealt with the theoretical connection between the Ricardian equivalence and the budget deficit from the point of view of its origin. The authors of the present study argue that the Ricardian equivalence refers to a BB-type deficit[1] in contrast to the classical Keynesian analysis, which is based on an AX-type deficit[2]. The authors also summarized the theoretical basis of the Ricardian equivalence: a) with a fixed volume of public

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[1] This type of deficit reflects the fact that it is caused by a reduction in tax collections for the same level of government spending.
[2] The main cause of the AX-type deficit growth is seen to be rising government spending, while tax revenues remain flat.

expenditure, the reduction of taxes covered by government debt does not affect private consumption because it is offset by increased private savings, b) if household and government consumption does not change, aggregate demand does not increase; (c) the increase in private sector disposable income caused by tax cuts will be reflected in an increase in private savings but not in consumption, as future tax increases are expected to be needed to repay government debt and interest thereon; (d) the increase in private savings offsets the decline in public savings , and there is no increase in the interest rate, e) if the interest rate does not change, there is no decline in domestic investment assets in a closed economy and no inflow of foreign capital affecting the appreciation of the national currency, and in the open economy there is no current account deficit.

Among the theoretical contradictions we can include the question of the temporal validity of the Ricardian equivalence. Ricardian equivalence is not valid, because consumers are aware that the government debt will not be repaid until after their death and thus they increase spending (Diamond, 1965). This concept is based on neo-classical point of view of government debt. On the other hand, Gumus (2003) considers the time horizon to be infinite, provided that parents take into account their children, they take into account their children and still around. Based on his claims, the model of intergenerational altruism is accepted. Although parents are aware that deferred taxes will not be collected until after their death, they will not increase their consumption despite the increased disposable income. The reason is that parents care about the well-being of their children and know that their children will have to pay higher taxes in the future to compensate for the budget deficits created in the past. Therefore, parents save more and let more to their children to help them pay higher taxes in the future. The planning period of each generation is extended indefinitely if each generation cares for the well-being of its next generation and each generation leaves its children with an altruistic legacy. (Barro, 1974)

However, the altruistic reference to intergenerational justice has been criticized. Feldstein (1976) doubts that there is a connection between families, as he also takes into account the existence of childless families. Childless families have little interest in future-generation taxes and change their consumer behavior when the government exchanges debt for taxes (Tobin, Buiter, 1980). On the contrary, families with children are realizing that decisions about the consumption of childless families increase the tax burden on future generations and thus try to balance the decisions of childless families by leaving more savings for their children. (Barro, 1989)

However, it is very likely that the compensation will not be sufficient and thus the Ricardian equivalence will be invalid. There is insufficient evidence to reject the Ricardian equivalence despite the existence of childless families. One of the reasons is that we cannot unambiguously estimate the decisions of childless families and also the decisions of families with children regarding compensation. Empirical research has not confirmed whether the existence of childless families would be an acceptable source of rejection of the Ricardian equivalence. Some studies are consistent with altruism (Seater, 1993), others contradict altruism (Bernheim, 1987). Altruism is an important concept of Ricardian equivalence, because if parents are not altruistic in the infinite horizon model, they will change their economic behavior and not leave their children with enough savings to help them pay higher taxes in the future. (Barro, 1989)

A certain shortcoming of the validity of the Ricardian equivalence is the assumption that economic agents enter the capital market without any time limits if they need to borrow money. Opponents of the Ricardian equivalence take a different view, arguing that most microeconomic evidence suggests that the liquidity of some households is not unlimited.

The topic of Ricardian equivalence has been very popular for several decades among many economists (especially from developing and emerging markets) who have tried to empirically prove or disprove it using a variety of methods. In the following section, we provide a chronological overview of empirical studies dealing with Ricardian equivalence in different countries or country groupings.

Khalid (1996) has shown that an increase in government spending can have an expansionary effect on aggregate demand in the short-run in developing countries, thus confirming to some extent the validity of Ricardian equivalence. Marinheiro (2001) used the example of the Portuguese economy to show that it is not possible to meet all the assumptions of Ricardian equivalence in practice. The results of tests based on consumption functions using the Euler equation did not show clear validity of Ricardian equivalence in Portugal.

Based on empirical results, Hadiwibowo (2008) showed that Ricardian equivalence cannot be rejected in the short-run because government spending and tax burden cannot affect private consumption and investment in the short run in Indonesia. On the other hand, Adji and Alm (2016) did not confirm the validity of Ricardian equivalence in Indonesia, focusing on three mainly variable effects on consumption, on interest rates, and on the current account balance. But in 2019, Wardhono, Ferdianto, Nasir, and Qori'ah published a study that investigated fiscal policy during the Soeharto regime in Indonesia, where they proved the validity of Ricardian equivalence during two periods (1969-2013, 1982-2013).

Grennes and Strazds (2013) confirmed the validity of the Ricardian equivalence based on cross-sectional data from 2007 in the European Union. Household net financial assets (% GDP) and Government debt (% GDP) were the variables in the regression analysis.

Sunge and Matsvai (2015) empirically tested the validity of Ricardian equivalence using bound testing approach to cointegration and error Correction model within the context of the Auto-Regressive-Distributed-Lag (ARDL), they investigated whether a long-run equilibrium relationship exists between private consumption and GDP, government expenditure, tax revenue, total public debt and interest payments. They confirmed strong evidence against the Ricardian equivalency in Zimbabwe and support for Keynesian debt non-neutrality.

In Romania, the validity of the Ricardian equivalence was not confirmed during the period 1993-2014 via Vector Autoregression with two variables (gross national savings rate and budget balance) by Belingher (2015).

Meissner and Afschar (2017), using the tools of experimental economics under laboratory conditions, did not confirm the validity of Ricardian equivalence. Up to 56% of the subjects behaved contrary to the assumptions of Ricardian equivalence, and multiple repetitions of the experiment did not confirm the fact that consumers also take into account previous experiences.

Mosikari and Eita (2017) estimate the validity of Riccardian equivalence based on time series in Lesotho during the two periods 1980-2014 and 1988-2014.

With the implementation of several variables, they have shown that an increase in public expenditure or government debt will lead to a reduction in personal expenditure of household per capita. At the same time, the authors confirmed the ineffectiveness of fiscal policy in stabilizing the economy.

In the case of Germany as a developed country, a questionnaire survey was conducted in 2013 by Hayo and Neumeier (2017), which identified changes in consumer behavior with regard to changes in the amount of government debt and public expenditure. However, the results did not confirm the validity of the Ricardian equivalence.

Banday and Aneja (2019) provide an empirical study to analyze the validity of the Ricardian equivalence theorem for China using time series data over the period 1990 to 2016. Authors reject the validity of Ricardian equivalence for China due to liquidity constraint, uncertainty which offsets consumption, and finite time horizons

Haug (2019) does not confirm the validity of Ricardian equivalence in the U.S. using narrative measures of U.S. tax shocks because these tax shocks increase economic activity with time lags.

Okwan and Kovacs (2020) did not confirm the presence of the Ricardian equivalence in Ghana during the period 1990-2017. Fiscal policy did not affect the level of household expenditure, which is in line with the Keynesian concept of economic policy.

Ikechukwu and Omojolaibi (2020) examined the validity of Ricardian Equivalence in Nigeria over 48 years through vector autoregression (VAR). The results reveal that government fiscal deficit exerts negative effects on gross domestic savings and investment, which is further affirmed by the impulse response function

Sardoni (2020) is a critic of Ricardian equivalence and brings a different approach based on the idea that an appropriate structure of government spending can ensure a stable government debt ratio even if the government runs a primary deficit. As another critic of Ricardian equivalence, Podkaminer (2020) criticizes the use of the public debt-to-GDP ratio to estimate the validity of Ricardian equivalence because Granger non-causality tests applied to data for a large set of countries do not establish the fact that the private sector should follow Ricardian equivalence on the basis of prior facts.

The validity of Ricardian equivalence in country clustering is addressed by Hameed, Ahmed, and Salman (2020) who chose SAARC countries as a representative sample of countries during the period 1990-2018. The results of their study reject the validity of Ricardian equivalence in SAARC because along with the increase in government debt, private consumption increases and people do not postpone current consumption despite the increasing government debt and expected taxes that may be collected in the future to repay debt obligations. On the other hand, Agarwal and Gangal (2020) have shown with the example of India that fiscal deficit does not affect GDP and does not have adverse effect on GDP, thus confirming the validity of Ricardian equivalence in this country.

The validity of the Ricardian equivalence was also confirmed in Turkey during the period 1980-2017. Ikiz (2020) confirmed the existence of rational households, which by increasing savings respond to the increase in public spending over several time periods.

Beyene and Kotosz (2020) using autoregressive distributed lag cointegration approach demonstrated the partial validity of Ricardian equivalence in Ethiopia during the period 1990-2011. The results of their study showed that increases in budget deficit and government consumption spending satisfy the Ricardian equivalence assumptions, but in the case of public debt, these assumptions were not satisfied.

As we can see from the previous review of empirical studies, Ricardian equivalence is particularly popular among academics coming from developing and emerging markets. The validity of Ricardian equivalence cannot be generalized to all countries or clusters of countries, and the level of economic maturity of the observed country as well as the methods employed need to be taken into account.

3. Data and Methodology

To confirm the theoretical assumptions of the Ricardian equivalence in the member states of the European Union and the Eurozone, we used the method of regression analysis based on panel data via OLS, random and fixed effects or Prais-Winsten regression, correlated panels corrected standard errors (PCSEs), if the problem with cross-sectional dependence occurs.

A representative sample consists of 28 member states of the European Union, respectively countries of the Eurozone, and in some cases we used a narrower selection of countries, where membership in both the European Union and the OECD was a condition. The original time period represents the range of the years 1995-2020, while in certain cases it is shortened due to the conversion of individual indicators to percentage changes between specific years. The Ricardian equivalence is based on the assumption that there is a negative correlation between household expenditures and the amount of government debt, respectively a positive correlation between household savings and government debt. Thus, the level of government debt becomes one of the determinants of household expenditure. We used a different approach to the correlation between the level of household expenditure and the level of government debt compared to previous empirical studies. Instead of estimating the correlation relationship through nominal quantities, we decided to use variables describing the increase and dynamics of individual factors over time.. We consider the most important factor determining the level of household expenditures to be the level of labor income and therefore we decided to incorporate this variable in our regression analysis. The growth of income is captured in three ways: a) GDP growth, b) GDP p.c. growth, c) Household disposable income (% annual growth). The dependent variable in the regression analysis is the percentage change in the amount of household expenditure (HouseEXPgrowth), which reflects the dynamics of growth in household expenditure over time.

Following the research of Arapova (2018) and Varlamova and Larionova (2015), we decided to divide and incorporate the following variables and determinants into the regression analysis: a) macroeconomic variables (government debt, financial/debt/COVID-19 crisis, compliance with fiscal rules) b) demographic variable (population growth) and c) time dummies variables (particular years).

The role of fiscal rules within the Ricardian equivalence is to warn households about the uneconomical way in which the government uses public funds. Thus, fiscal

rules represent guardians of public finance and alerts for households to increase prudence in making budgetary decisions. Based on these facts, we decided to incorporate into the regression analysis the variable FRgap, which expresses the "distance" from the compliance with fiscal rules (negative values represent the compliance with fiscal rules, positive values express the deviation from the compliance with fiscal rules, while the higher the value, the greater the distance). In addition, this variable also reflects the amount of government debt inderectly. Our assumption is that the further a country is from complying with debt fiscal rules, the more cautious households become when it comes to increasing their spending. In the regression analysis, we assume that households make financial consumption decisions based on future assumptions about the evolution of a number of variables, and therefore we decided to include a variable expressing the expected compliance with debt fiscal rules in the following year (FRgapFuture).

In Table 1 we provide a more detailed description and specification of the variables and data used. Despite the availability of several specific indicators from statistical databases, we must state that our statistical database is unbalanced due to the absence of certain data for specific countries and for a specific year, which, however, does not have a negative effect on the results achieved.

Table 1 Description and Data Used

variable	expression	description	source/database
Growth of household expenditure	HouseEXPgrowth	Households and NPISHs Final consumption expenditure (annual % growth)	World Bank / World Development Indicators
Household expenditure	HouseEXP	Households and NPISHs Final consumption expenditure (%GDP)	World Bank / World Development Indicators
Government debt	GOVdebt	Government consolidated gross debt (%GDP)	Eurostat/ Government deficit/surplus, debt and associated data IMF/World economic Outlook
Household income a)	Income	Household disposable income (% annual growth)	OECD/ Households accounts
Household income b)	Growth	GDP growth (annual %)	World bank / World Development Indicators
Household income c)	GROWTHpc	GDP p.c. growth (annual %)	World Bank / World Development Indicators
Distance from compliance with EU debt fiscal rules	FRgap(Future)	Expected Government consolidated gross debt (%GDP) – required Government consolidated gross debt (%GDP)	Eurostat/ Government deficit/surplus, debt and associated data IMF/World economic Outlook
Population growth	POPgrowth	Population growth (annual %)	World Bank / World Development Indicators
Financial crisis (2008-2009)	FINcrisis	Dummy time variable	
Debt crisis (2010-2013)	DEBTcrisis	Dummy time variable	
COVID crisis (2020)	COVIDcrisis	Dummy time variable	
Specif year	t_year	Dummy time variable	

Source: own proceeding

To meet the basic assumptions of the linear regression model, we examined the stationarity of time series, respectively on what difference and shift are the time series stationary. For our purpose, we chose the Im-Peasaran-Shin panel unit-root test because it also works with unbalanced data. The null hypothesis in that test is the assumption that all panels contain unit roots and, conversely, the alternative hypothesis assumes that some panels are stationary. (Im, Pesaran and Shin, 2003)

In the case of detecting heteroskedasticity of independent variables, we used Modified Wald test for groupwise heteroskedasticity in fixed effect regression model (Greene (2000)). The null hypothesis assume that homoscedasticity or constant variance is presented in the data. If the heteroscedasticity occurs, we can use option "robust" in Stata to control it both in random or fixed effects model.

To determine the appropriate type of regression model among the trinity OLS, Fixed, Random we used Breusch-Pagan Lagrange Multiplier (Breusch and Pagan (1980)) and Hausman test. The first of these tests detects the presence of significant differences across countries and compares suitability of OLS against Random effects. Conversely, Hausman determines the goodness of fit of the model with fixed or random effects.

To ensure robust estimations, we report the results of regression analysis of all models. We then further test for the presence of serial correlation via Wooldridge test for autocorrelation in panel data and estimate if the data does not have first-order autocorrelation Wooldridge (2002), Drukker (2003).Because we use macroeconomic data, it is also necessary to test for the presence of cross-sectional dependence via Pesaran's test Pesaran (2004) and thus whether residuals are not correlated.

If cross-sectional dependence is confirmed, the use of classical models may lead to bias in the test results. To avoid bias, we therefore decided to use Prais-Winsten regression, correlated panels corrected standard errors (PCSEs), which is feasibile with N>T Greene (2012).

In addition to using panel regression, we estimated the relationship between Households and NPISHs final consumption expenditure (% of GDP) and the level of government consolidated gross debt (% of GDP) using the linear regression method separately for the European Union (2000- 2019) and the Eurozone (1995-2019) as a whole. The results are presented through the use of scatter plot.

4. Results

We used regression analysis with panel data to verify the validity of the Ricardian equivalence in the countries of the European Union. First of all, it is necessary to verify the stationarity of individual time series. Table 2 shows the results of the Im-Pesaran-Shin unit-root test.

The results of the unit-root test confirmed that some time series are stationary. As the first regression model, we estimated the one in which household income is expressed as GDP growth (annual %). To verify the presence of heteroskedasticity, we used the Modified Wald test for groupwise heteroskedasticity in a fixed effect regression model, rejecting the null hypothesis of homoskedasticity and confirming the presence of heteroskedasticity in our data (chi2 (28) = 3658.64, Prob>chi2 = 0.0000). To control heteroskedasticity we used option "robust" in fixed and random effects in STATA.

Table 2 Results of Im-Pesaran-Shin Unit-Root Test

	H_o: All panels contain unit roots	
	H_a: Some panels are stationary	
Variable	Z-t-tilde-bar/ W-t-bar	p-value
HouseEXPgrowth	-4.2213	0.0000
Income	-7.2132	0.0000
Growth	-6.4342	0.0000
GROWTHpc	-6.2876	0.0000
FRgap[3]	-1.9642	0.0248
POPgrowth[4]	-4.7916	0.0000

Source: own calculations in STATA

Table 3 Diagnostic Tests – Regression Analysis with GDP Growth (Annual %)

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model
  chi2 (28) = 3658.64
  Prob>chi2 = 0.0000

  Presence of heteroscedasticity confirmed

Breusch and Pagan Lagrangian multiplier test for random effects
  chibar2(01) = 27.71
  Prob > chibar2 = 0.0000

  A Model´with random effect is more appropriate than OLS regression.

Hausman test
  Prob>chi2 =   0.1503

  Model with random effects is more appropriate than model with fixed effects

Pesaran's test of cross sectional independence = 3.587, Pr = 0.0003

  Cross sectional dependence confirmed

Wooldridge test for autocorrelation in panel data
  F(1, 27) = 16.088
  Prob > F = 0.0004

  Serial autocorrelation in the data confirmed

Source: own calculations in STATA

To determine the most suitable model we used Breusch and Pagan Lagrangian multiplier test for random effects a Hausmanov test. The former selects a more suitable model from the pair OLS and random effects and Hausman test between random or fixed effects. Results of Breusch and Pagan Lagrangian multiplier test reject the null hypothesis and conclude that random effects is appropriate (chibar2(01) = 27.71, Prob > chibar2 = 0.0000). This is evidence of significant differences across countries; therefore, we cannot run a simple OLS regression.

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[3] ADF regressions: 1.36 lags average (chosen by AIC)
[4] ADF regressions: 0.64 lags average (chosen by AIC)

Hausman test indicates the use of a random effects model (Prob>chi2 = 0.1503 is > 0.05). The results of the diagnostic tests are reported in the Table 3.

The following table presents the results of regression models to provide robust estimates.

Table 4 Regression Analysis with GDP Growth (Annual %)

	(1)	(2)	(3)	(4)
VARIABLES	OLS	FE	RE	PCSEs
FRgapFuture	-0.0112***	-0.0211***	-0.0131***	-0.0121***
	(0.00293)	(0.00697)	(0.00491)	(0.00301)
Growth	0.759***	0.772***	0.769***	0.731***
	(0.0303)	(0.106)	(0.108)	(0.0369)
DEBTcrisis	-0.0103***	-0.00846***	-0.00975***	-0.0103***
	(0.00269)	(0.00256)	(0.00253)	(0.00243)
COVIDcrisis	-0.0260***	-0.0233**	-0.0252**	-0.0282***
	(0.00549)	(0.0112)	(0.0117)	(0.00491)
Constant	0.00613***	0.00527*	0.00573**	0.00688***
	(0.00138)	(0.00305)	(0.00256)	(0.00138)
Observations	722	722	722	722
R-squared	0.626	0.630		0.593
Number of Countries		28	28	28

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: own proceeding based on data retrieved from World Bank, IMF, OECD and Eurostat

Although the Hausman test indicated the most suitable model with random effects among the three models, it is still necessary to test the existence of cross-sectional dependence called also contemporaneous correlation. Based on the results from Pesaran's test of cross-sectional independence = 3.587, Pr = 0.0003) we reject the null hypothesis, that residuals are not correlated and so for cross-sectional dependence is presented.

Finally, we used Wooldridge test for autocorrelation in panel data to test for the presence of autocorrelation. Based on the results of this test (F(1, 27) = 16.088; Prob > F = 0.0004) we reject the null hypothesis (no serial correlation – no first-order autocorrelation) and confirm the presence of serial autocorrelation.

Based on previous diagnostic tests that revealed the presence of heteroskedasticity, cross-sectional dependence and serial autocorrelation it is necessary to use Prais-Winsten regression, correlated panels corrected standard errors (PCSEs), to avoid bias in the results and this method is feasibile with N>T (28>26 in our case). The results of the Prais-Winsten regression are presented in the summary table in column (4) of the PCSE.

Among the statistically significant factors influencing the growth of household expenditure we can include the expected "distance" from compliance with fiscal rules stemming from the Stability and Growth Pact and GDP growth reflecting growth in household income. All variables dampen the growth of household expenditure except already mentioned GDP growth. As we can see, households adjust their consumer behavior not only on the basis of the change in income in the current year, but also on the expected change of government debt in the following

year (e.g. on the basis of forecasts by various institutions) in terms of compliance with fiscal rules. The role of fiscal rules in this case is to send warning signals to the households about irresponsible government management. At the same time, the greater the distance from compliance with fiscal rules, the more growth of household expenditures is dampened. Growth of household expenditure is also sensitive to the impact of ongoing crises, as evidenced by statistically significant time dummies variables reflecting the Debt crisis and COVID-19 crisis.

To ensure that correlation between dependent variable and independent variables is not caused by common time variation we included time dummies (specific years) which would prevent from this issue. In the following table can be found the results, where time-specific effects have been included.[5] with the statistically significant years, which influenced the growth of household expenditures.

Table 5 Regression Analysis with GDP Growth (annual %) and Time Dummies

	(1)	(2)	(3)	(4)
VARIABLES	*OLS*	*FE*	*RE*	*PCSE*
FRgapFuture	-0.00997***	-0.0189***	-0.0115***	-0.0109***
	(0.00298)	(0.00649)	(0.00440)	(0.00317)
Growth	0.771***	0.790***	0.784***	0.741***
	(0.0315)	(0.106)	(0.110)	(0.0353)
Constant	0.00571***	0.00529*	0.00547**	0.00618***
	(0.00203)	(0.00293)	(0.00255)	(0.000698)
Observations	722	722	722	722
R-squared	0.638	0.643		0.599
Number of Country		28	28	28

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: own proceeding based on data retrieved from World Bank, IMF, OECD and Eurostat

As the results from the previous table showed, the inclusion of time dummies caused the influence of the other independent variables to weaken, but their statistical significance was maintained.

We achieved similar results even when we used GDP p.c. growth (annual %). In this regression analysis, we also included demographic variable such as population growth (POPgrowth), which turns to be statistically significant. The following table presents the results of diagnostic tests together with the conclusions.

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[5] statistically significant years, which influenced the growth of household expenditures are: 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2007, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2020

Table 6 Diagnostic Tests – Regression Analysis with GDP p.c. Growth (Annual %)

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model
chi2 (28) = 3500.73
Prob>chi2 = 0.0000

Presence of heteroscedasticity confirmed

Breusch and Pagan Lagrangian multiplier test for random effects
chibar2(01) = 16.05
Prob > chibar2 = 0.0000

A Model´with random effect is more appropriate than OLS regression.

Hausman test
Prob>chi2 = 0.0596

Model with random effects is more appropriate than model with fixed effects

Pesaran's test of cross sectional independence = 3.413, Pr = 0.0006

Cross sectional dependence confirmed

Wooldridge test for autocorrelation in panel data
F(1, 27) = 16.988
Prob > F = 0.0003

Serial autocorrelation in the data confirmed

Source: own calculations in STATA

Based on the results of diagnostic tests, the Prais-Winsten regression model, correlated panels corrected standard errors (PCSEs), seems to be the most appropriate, because heteroskedasticity, cross-sectional dependence and serial autocorrelation occur again in our time series. The results of all regression models are presented in the following table, while the most relevant results can be found in column (4).

Table 7 Regression Analysis with GDP p.c. Growth (Annual %)

	(1)	*(2)*	*(3)*	*(4)*
VARIABLES	OLS	FE	RE	PCSE
POPgrowth	0.515***	0.864***	0.623***	0.530***
	(0.121)	(0.198)	(0.239)	(0.188)
FRgapFuture	-0.0106***	-0.0208***	-0.0130***	-0.0117***
	(0.00292)	(0.00608)	(0.00476)	(0.00287)
GROWTHpc	0.762***	0.773***	0.768***	0.734***
	(0.0300)	(0.101)	(0.105)	(0.0360)
DEBTcrisis	-0.0104***	-0.00825***	-0.00978***	-0.0104***
	(0.00268)	(0.00259)	(0.00257)	(0.00240)
COVIDcrisis	-0.0258***	-0.0233**	-0.0251**	-0.0280***
	(0.00545)	(0.0113)	(0.0116)	(0.00487)
Constant	0.00666***	0.00506*	0.00611**	0.00731***
	(0.00139)	(0.00276)	(0.00262)	(0.00145)
Observations	722	722	722	722
R-squared	0.631	0.633		0.598
Number of Countries		28	28	28

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: own proceeding based on data retrieved from World Bank, IMF, OECD and Eurostat

In the following table, we re-use dummy variables for specific years to remove potential time variation in the determinants and factors.[6]

Table 8 Regression Analysis with GDP p.c. Growth (Annual %) and Time Dummies

	(1)	(2)	(3)	(4)
VARIABLES	OLS	FE	RE	PCSE
POPgrowth	0.521***	0.876***	0.637***	0.548***
	(0.120)	(0.213)	(0.235)	(0.192)
FRgapFuture	-0.00949***	-0.0190***	-0.0117***	-0.0107***
	(0.00297)	(0.00542)	(0.00445)	(0.00299)
GROWTHpc	0.779***	0.792***	0.787***	0.751***
	(0.0306)	(0.0988)	(0.104)	(0.0338)
Constant	0.00745***	0.00573**	0.00685***	0.00801***
	(0.00177)	(0.00252)	(0.00259)	(0.00102)
Observations	722	722	722	722
R-squared	0.643	0.645		0.605
Number of Countries		28	28	28

Notes: Standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: own proceeding based on data retrieved from World Bank, IMF, OECD and Eurostat

As we can see from the results in the table above, the expected increase in government debt next year and its distance from the permissible limit set by the fiscal rules affects the consumption behaviour of households. The more the government moves away from complying with the fiscal rules, the more restrained households are in increasing consumption.

In the following regression model, there will be a change in a representative sample of countries and an expression of the variable reflecting household income. A representative sample of countries reflects the member countries of the European Union, which are also members of the OECD.[7] In the case of the variable household income, it is expressed using Household disposable income (% annual growth). The results of diagnostic tests are presented in the following table.

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[6] Statistically significant years, which influenced the growth of household expenditures are: 1996, 1997, 1998, 1999, 2000, 2002, 2003, 2004, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2020
[7] For 2020, data for only 9 EU Member States were available: Czechia, Denmark, Germany, Italy, Netherlands, Portugal, Slovakia, Finland and Sweden

Table 9 Diagnostic Tests – Regression Analysis with Household Disposable Income (% Annual Growth)

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model
> chi2 (23) = 774.15
> Prob>chi2 = 0.0000

Presence of heteroscedasticity confirmed

Breusch and Pagan Lagrangian multiplier test for random effects
> chibar2(01) = 16.05
> Prob > chibar2 = 0.0000

There is evidence of significant differences across countries; therefore we cannot run a simple OLS regression.

Hausman test
> Prob>chi2 = 0.0000

Model with fixed effects is more appropriate than model with random effects

Pesaran's test of cross sectional independence = 7.168, Pr = 0.0000

Cross sectional dependence confirmed

Wooldridge test for autocorrelation in panel data
> F(1, 22) = 39.807
> Prob > F = 0.0000

Serial autocorrelation in the data confirmed

Source: own calculations in STATA

The occurrence of heteroskedasticity, cross-sectional dependence and serial autocorrelation was confirmed again. For this reason, we again used Prais-Winsten regression, correlated panels corrected standard errors (PCSEs). The results of regression coefficients within individual models can be found in the following table.

Table 10 Regression Analysis with Household Disposable Income (% Annual Growth)

	(1)	(2)	(3)	(4)
VARIABLES	OLS	FE	RE	PCSE
FRgapFuture	-0.0108***	-0.0273***	-0.0108***	-0.0139***
	(0.00265)	(0.00427)	(0.00262)	(0.00436)
INCOME	0.653***	0.607***	0.653***	0.584***
	(0.0305)	(0.0382)	(0.0362)	(0.0540)
FINcrisis	-0.0285***	-0.0288***	-0.0285***	-0.0300***
	(0.00312)	(0.00707)	(0.00701)	(0.00468)
COVIDcrisis	-0.0617***	-0.0580***	-0.0617***	-0.0617***
	(0.00680)	(0.00818)	(0.00806)	(0.00827)
Constant	0.0114***	0.0124***	0.0114***	0.0131***
	(0.00115)	(0.000822)	(0.00128)	(0.00194)
Observations	559	559	559	559
R-squared	0.633	0.604		0.584
Number of Countries		23	23	23

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: own proceeding based on data retrieved from World Bank, IMF, OECD and Eurostat

Apart from the variable Income, all other variables have a negative effect on the growth of household expenditure and results are similar to the previous cases. We can see that the financial crisis in 2008-2009 and COVID-19 crisis (2020) negatively affected the growth rate of household expenditure. An interesting finding is that the debt crisis does not play a significant role in this case, as this variable did not show statistical significance and was excluded from the econometric model.

The following table shows results of regression analysis with time dummies representing particular years, which were statistically significant.[8]

Table 11 Regression Analysis with Household Disposable Income (% Annual Growth) and Time Dummies

	(1)	(2)	(3)	(4)
VARIABLES	OLS	FE	RE	PCSE
FRgapFuture	-0.0107***	-0.0257***	-0.0107***	-0.0141***
	(0.00265)	(0.00412)	(0.00274)	(0.00430)
INCOME	0.639***	0.594***	0.639***	0.564***
	(0.0307)	(0.0381)	(0.0368)	(0.0546)
Constant	0.0106***	0.0116***	0.0106***	0.0121***
	(0.00115)	(0.000802)	(0.00124)	(0.00184)
Observations	559	559	559	559
R-squared	0.635	0.605		0.587
Number of countries		23	23	23

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
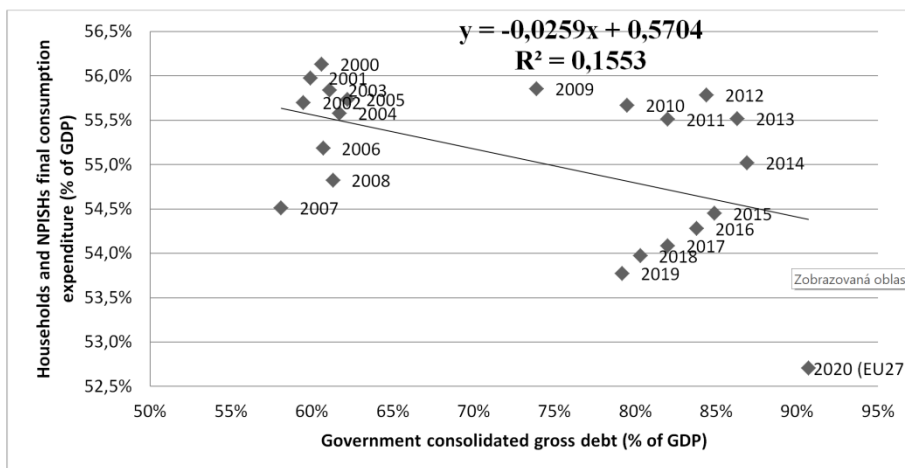
Source: own proceeding based on data retrieved from World Bank, IMF, OECD and Eurostat

As we can see, in 2007 (the pre-crisis year) the growth rate of household spending was increasing, while in 2009 (when the financial crisis peaked) and 2020 (the beginning of the crisis triggered by the COVID-19 pandemic) the growth rate of household spending was slowing down.

In the following section, we estimate the relationship between household expenditure (Households and NPISHs final consumption expenditure (% of GDP)) and government consolidated gross debt (% of GDP) separately in the European Union and the Eurozone in particular. The following figure shows this relationship for the whole of the European Union during the period 2000-2020.

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[8] statistically significant years, which influenced the growth of household expenditures are: 2007, 2009 and 2020

Figure 1 Household Expenditure and Government Debt in the European Union

$$y = -0{,}0259x + 0{,}5704$$
$$R^2 = 0{,}1553$$

Source: own proceeding based on data retrieved from World Bank and Eurostat

As we can see from the previous figure, there is a negative correlation between household expenditure and the level of government debt. The year 2020 represents an outlier, as the COVID-19 crisis hits the world economy, when the household's expenditure decreases and on the other hand government debt increase. The correlation coefficient in this case reaches the value -0.3941, which represents a slight tightness.

The Figure 1 shows the existence of two clusters of observations based on time periods (2000-2008; 2009-2019). The following Figure 2 represents the regression analysis separately for each of these periods.

Figure 2 Household Expenditure and Government Debt in the European Union (Two Time Periods)

$$y = 0{,}164x + 0{,}4556$$
$$R^2 = 0{,}1407$$

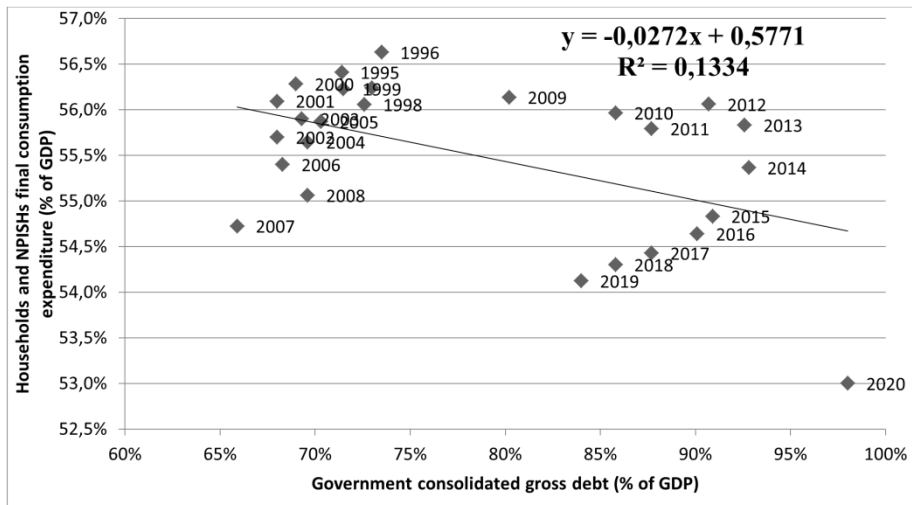$$y = -0{,}0138x + 0{,}5603$$
$$R^2 = 0{,}0042$$
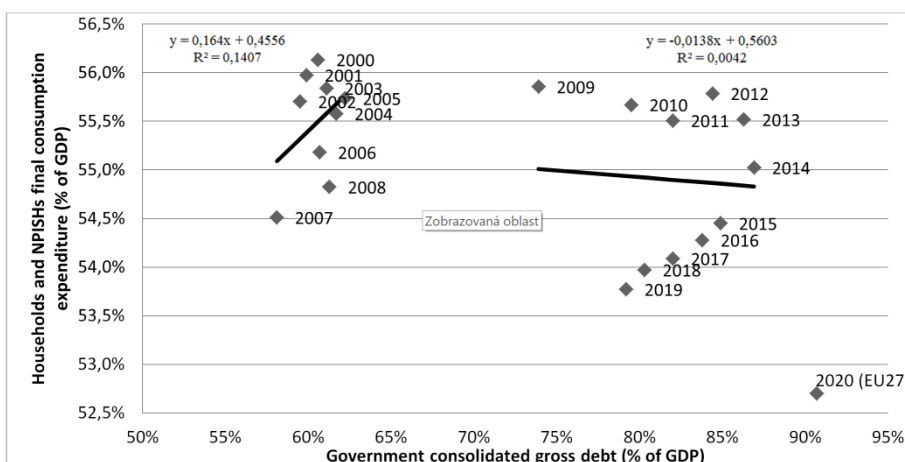
Source: own proceeding based on data retrieved from World Bank and Eurostat

After splitting the time period into two periods, we can see that there is a change between the correlation of these two variables. In the pre-crisis period, the increase in the growth of government debt did not cause a decrease in the household spending. The turning point came only with the beginning of the debt crisis, when we can already see that the growth of government debt caused a reduction in household spending. Pandemic year 2020 represents new turning point as for now it is look like an outlier to the time series.

We used a similar procedure to estimate the linear relationship between household expenditure and government debt in the Eurozone countries during the period 1995-2020. The results of this regression relationship are shown in the following figure. Again, we do not consider pandemic year 2020 in a regression analysis as we assume that it is an outlier.

**Figure 3 Household Expenditure and Government Debt in the Eurozone**

Source: own proceeding based on data retrieved from World Bank and Eurostat

We reaffirmed the existence of a negative correlation, with the correlation coefficient becoming -0.3653, which is a slight dependence. Compared to the results achieved for the European Union, this is a weaker form of correlation now.

If we split the time period into two shorter time periods again (without considering year 2020 as we assume that it is a new turning point), we get different results compared to the previous cases, which is recorded in Figure 4.

Figure 4 Household Expenditure and Government Debt in the Eurozone (Two Time Periods)
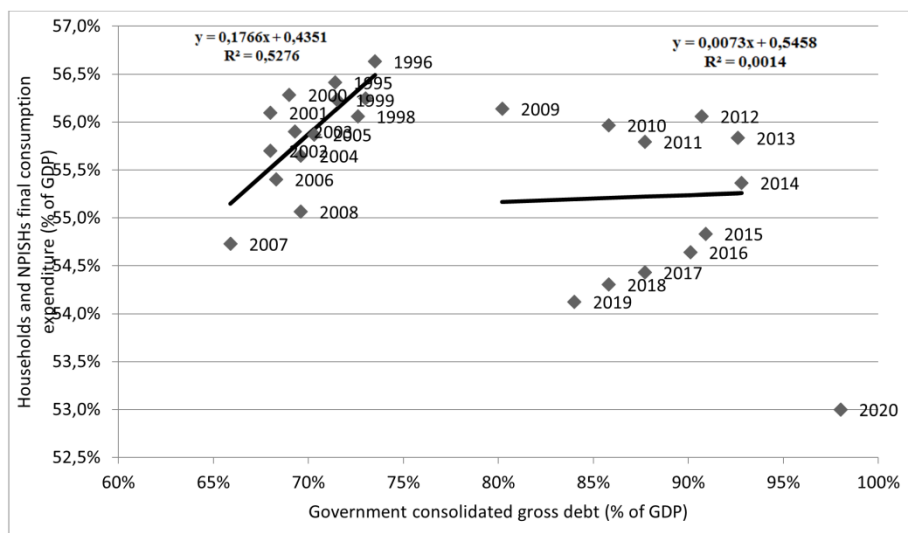
$y = 0{,}1766x + 0{,}4351$
$R^2 = 0{,}5276$

$y = 0{,}0073x + 0{,}5458$
$R^2 = 0{,}0014$

Source: own proceeding based on data retrieved from World Bank and Eurostat

As we can see from the regression analysis, the situation is different after 2009 in the Eurozone compared to the situation in the European Union as a whole. In contrast to the post-crisis situation in the European Union, households in the countries of Eurozone did not reduce their spending during the debt crisis, despite an increase in government debt.

5. Conclusions

The article deals with the validity of the Ricardian equivalence in the member states of the European Union. As many countries in the European Union are struggling with rising government debt due to the impact of the Covid-19 pandemic, the aim of the article was to examine the impact of government debt on household consumer behavior. We consider our main contribution to be the confirmation of the validity of the Ricardian equivalence in the member states of the European Union, where we have shown that the amount of government debt has a negative effect on household expenditure growth, respectively dampens their growth rate. An equally important finding is that households in the European Union base their family budgets on expected level of government debt in interaction with fiscal rules. The government's compliance with fiscal rules plays a crucial role, as the expected"distance" from complying with fiscal rules can negatively affect the growth rate of household expenditure. Households will start to behave more conservatively and, despite income growth, they will start to dampen expenditure growth.

We have demonstrated a negative linear correlation between the level of household expenditure and government debt in the European Union as a whole and also in Eurozone as well, with a slight dependence between the two variables already mentioned. However, differences can be seen if we divide the time period into pre-

crisis, crisis or post-crisis in the context of the financial and debt crisis. In the pre-crisis period in both the EU and the Eurozone, as government debt rises, household expenditure also rises. Since 2009, however, the situation in the EU has been changing, with household expenditure falling as government debt rises. By contrast, in the Eurozone, household expenditure continues to grow despite the rise in government debt, albeit at a slower pace than in the pre-crisis period.

Despite the empirical results obtained through regression analysis, we have to take into account the possible existence of a cofounding variable that affects both the independent (household expenditure) and dependent variables (government debt), but the regression analysis does not include it. The existence of this variable may lead to spurious regression and misleading results. One such cofounding variable may be government expenditure. Rising government expenditure may increase government debt especially if financed by borrowing. Through the multiplier effect of government expenditure, the income of the population and consequently the amount of household's consumption expenditure will increase. Another such variable is world trade and openness of the economy. Marchand (2017) has shown that increasing level of world trade and openness of the economy leads to changes in the prices of goods and services in the context of the validity of Engel's law and also affects household income through the unequal distribution of income in the society between skilled and unskilled workers. On the other hand, higher openness of the economy based on the study of Rodrik (1998) leads to an increase in government expenditure (financed, for example, by debt) due to the government's attempt to mitigate external shocks and their impact on the population. Other variables we can include the price level, rescpetively inflation rate and interest rate. As the inflation rate and the price level rise, both household and government spending increase because both entities act as consumers in the economy. When interest rates are low, household consumption increases because it is not profitable to build up savings and it is easier to borrow money. This also applies to the government, where it is easier for it to borrow money to finance government expenditure. Based on these facts, it is important to continue research on this issue and take these variables into account in future research.

However, our results are significant despite some open issues and are particularly helpful for economic policy makers, especially as the Keynesian concept of fiscal policy becomes ineffective if the Ricardian equivalence is in place. Fiscal policy will thus not be able to mitigate cyclical fluctuations in the national economy, as it cannot increase aggregate demand by increasing debt-financed public expenditure. The situation is becoming more complicated in the Eurozone countries as they have relinquished their competence to formulate independent monetary policy, so that the only stabilizing tool has become fiscal policy, which can have limited options due to the validity of the Ricardian equivalence in particular cases.

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