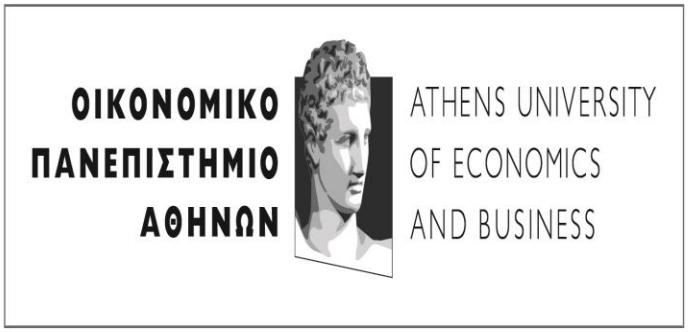

AN EXAMINATION OF THE RICARDIAN EQUIVALANCE WORLDWIDE; TESTING THE CONNECTION BETWEEN SAVING BEHAVIOR AND FISCAL POLICIES

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«Δηλώνω υπεύθυνα ότι η συγκεκριμένη πτυχιακή εργασία για τη λήψη του Μεταπτυχιακού Διπλώματος Ειδίκευσης στη Λογιστική και Χρηματοοικονομική έχει συγγραφεί από εμένα προσωπικά και δεν έχει υποβληθεί ούτε έχει εγκριθεί στο πλαίσιο κάποιου άλλου μεταπτυχιακού ή προ-πτυχιακού τίτλου σπουδών, στην Ελλάδα ή στο εξωτερικό. Η εργασία αυτή έχοντας εκπονηθεί από εμένα, αντιπροσωπεύει τις προσωπικές μου απόψεις επί του θέματος. Οι πηγές στις οποίες ανέτρεξα για την εκπόνηση της συγκεκριμένης διπλωματικής αναφέρονται στο σύνολό τους, δίνοντας πλήρεις αναφορές στους συγγραφείς, συμπεριλαμβανομένων και των πηγών που ενδεχομένως χρησιμοποιήθηκαν από το διαδίκτυο».

Νίκος Παπανδριανός

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Abstract

The present dissertation explores the existence of offsetting movements between private and public saving, in a global level, for the period 1970-2015. The study of saving behavior aims to provide evidence in favor of Ricardian Equivalence or against it. Ricardian Equivalence is a proposition, initially formulated by David Ricardo and since then it has divided the economists. The proposition suggests that, under some assumptions, an individual should be indifferent about how a government will finance its spending (by taxation or debt issuing). A detailed literature review is presented, while the main hypothesis is tested with dynamic panel data econometric methods. The empirical results provide support for the existence of partial Ricardian behavior but reject the hypothesis of pure Ricardian Equivalence. We also discuss the factors that make the existence and the examination of Ricardian Equivalence a complicated procedure.

Key words: Ricardian Equivalence, saving behavior, debt neutrality, fiscal policies.

Acknowledges

As the present dissertation and my studies in MSc of Accounting and Finance are almost completed i feel the need to thank a few people whose contribution and help was of great importance. My supervisor, Professor Kostas Drakos was especially supportive with the selection of the present subject. His spontaneous help and encouragement, as well as his willingness to answer every question of mine made the completion of my thesis feasible. I would also like to thank all the faculty members of the postgraduate program for their support and their instructions during my studies and the administrative staff for their cooperation and help. The high level of professionalism that distinguished the faculty and the students of the program was a significant motivation for me during a new academic path.

1. Introduction

There are two alternative ways for a government to finance its spending (or a mix of those). The first is to apply fiscal policies (taxation and public borrowing) and the second to apply monetary policies (altering the money supply in the economy). In this thesis we are focused on the first part, fiscal policies.

The hypothesis that public debt (government bonds) could be received by private sector as net wealth plays a crucial role in the theoretical analysis about the effect of fiscal and monetary policies in economy. The real question is if governments could succeed the stimulation of economy by selecting an increase in their debt, instead of an increase in taxation in present, in order to finance their plans. That choice would lead to increasing aggregate demand and to economic growth according to Keynesian Model. Nevertheless the above claim seems to ignore the competition of public and private debt for available funds. Less available funds for private debt would drive up interest rates and of course in long term they would diminish private investment. Apparently this is a deleterious effect for long-term growth. The final result is a decrease in private investment and thus no stimulation of economy takes place.

The alternative argument supports that households receive a possible raise in public debt as an equivalent raise of the net present value of their tax obligations. Higher public debt today means lower taxation today but also increased taxes sometime in the future. Since there is no net wealth for households they should offset any raise of public debt (future obligation) with a similar raise in their present savings. That perfect counterbalance between public debt and private savings is called *Ricardian Equivalence*. In "Essay on the Funding System" (1820), David Ricardo was the first to propose this possibility. He studied the two different ways that a government could finance a war; by increasing taxation or issuing war bonds. The conclusion, under the hypothesis of rational tax-payers, was that selection makes no difference in the present value of the obligations of a household. Finally, although Ricardo recognized a theoretical rationale in his proposition and it bears his name, he was unconvinced about its practical application.

Robert Barro (1974) repeated the question and provided arguments to support Ricardian Equivalence. In his model there are strict assumptions. First of all it considers that capital markets are perfect. Apart from that, "an operative intergenerational transfer" is

assumed. That means that although some of the remaining interest payments may be longer than the average lifetime of taxpayers, individuals display intergenerational altruism by not transferring bargains to next generations. Absence of credit constraints for all segments of population are assumed as well. Those assumptions may well be false and a lot of economists believe that Ricardian Equivalence is implausible at least to the full extent. However, it would be a facile conclusion that there are no offsetting movements in an economy, associated with private savings and tax changes. Full debt neutrality is unlikely to be realized but it is obvious that such offsetting movements are directly related with the efficiency of fiscal policies. Because of this connection their existence and their range are material issues for policy makers.

Ricardian Equivalence is an extension, applied to macroeconomics, of the Modigliani-Miller Proposition 1 (1958). The proposition states that "the market value of any firm is independent of its capital structure. That means that the value of a firm is the same either it finances its investments plans by issuing common stocks (equity) either by debt securities. Similarly to Barro's Model for Ricardian Equivalence, Modigliani-Miller Proposition is based on strict assumptions; perfect capital markets, absence of taxes, rational investors.

During the testing of Ricardian Equivalence there are various problems that can show up. We have already referred to strict assumptions that are demerits for the theory. A study of the saving behavior also consist macroeconomic factors like Public Debt, Private and Public Savings and other variables (e.g. inflation). How available are this kind of data for a lot of countries and how easily they can be measured trustworthy? Apart from that, one basic problem is even how the researcher can approach Public and Private Savings or the wealth of the households. It is obvious that with the word Savings we don't referred only to bank deposits. Wealth may include other forms such as real estate, pieces of art etc. Clearly these factors are extremely difficult to be measured and the most common approach is through raw macroeconomic data (e.g. total revenues or expenses).

The main purpose of the present thesis is to examine the possible offsetting movements between public and private savings in a worldwide level among the period 1970-2015. The main findings of similar studies end up in the existence of such offsetting movements at some extent. Of course the definition and the measurement of variables as

public and private debt isn't a simple thing. Nevertheless almost all studies seem to confirm the qualitative and partially quantitative existence or Ricardian behavior.

Since the seminal contribution of Barro, many studies have examined the existence of debt neutrality in individual countries or in groups. Results from a various range of studies are presented in Chapter 2. The studies differ not only in the range of the examined countries or period but in the econometric methods and models as well. That differentiation makes the comparison of qualitative results difficult or even meaningless. The variety of the methods highlights the difficulties of the subject. Finally there is an outline of the variables that we selected in order to form our model targeting that it would correspond with similar studies.

In Chapter 3 is included a detailed description of the selection, collection and initial transformation of the data. We develop the steps that were preceded the econometric processes, until our initial data take a panel data form. There is also a reference in the data availability and a justification of the selection of DataBank (World Bank's main database) as our source.

Chapter 4 contains all the econometric methods that were used in order to process the data and to end up with our results. We develop a model which contains Private Savings as a dependent variable, Public Savings as independent variable and a set of conventional control variables such as age dependency ratio, inflation, real interest rate, GDP annual growth and domestic credit to private sector. The Generalized Method of Moments (GMM) was judged as the most suitable for the processing of dynamic panel data. Also to check the robustness of the sample and of the method we limited the range of the examined period. For the application of the econometric method, Stata 13 was used.

In Chapter 5 are presented all the empirical results of the study. The main finding is the occurrence with statistical significance of an offsetting among private and public savings as expected. The conclusion of the results is included in Chapter 6, as well as a discussion about future research. Finally all the tables and graphs that emerged from data processing are listed in Appendixes I and II.

2. Literature Review

2.1 Theoretical Framework

Nowadays, fiscal policies and their efficiency to stabilize a national economy are on the spotlight. Of course it is not a new issue. It has divided economists for decades. A fiscal policy can be implemented by a government mainly by changing taxation levels or by increasing public debt. As it was noticed in the previous chapter, Keynesian model states that an increased public debt can create an increase in short term aggregate demand. The opposite opinion claims that households are uninterested in that choice because the present value of their wealth doesn't change. The above proposition is called Ricardian Equivalence (hereafter also as RE). The rationale behind this thesis is simple. Tax cut and increased public debt in the present is nothing more than a tax increase postponement for the future. Households react in any fiscal policy by changing the levels of their savings. As we will see bellow that helps us to test the Ricardian Equivalence.

Economic researchers consider the modern version of Ricardian Equivalence which was demonstrated by Antonio de Vitti de Marco in 1890's and Barro in 1974 as a generalization of permanent income/life cycle hypothesis. Permanent income hypothesis was introduced by Milton Friedman (1957). Permanent income is defined as average income due to the total amount of lifetime incomes and not only the present inflows. Friedman stated that an individual tries not to be based only on its current income but to estimate a lifelong inflow (with planned and unexpected components). According to that estimation individuals plan their consumption. Actually, individuals try to accommodate their consumption to their permanent income in a smooth way. Also they try to choose a stable lifestyle by spending almost similar amounts every year.

Another factor that affects the savings and the consumption in the above model is the age of the individual. During his working life an individual increases its savings while after the retirement it consumes by dissaving until assets reach to zero. The above life-cycle hypothesis was introduced by Modigliani (1966). Of course, in reality, dissaving is lower than expected probably because of bequest motives.

From this scope, it is clear that the combination of the life-cycle and permanent income hypothesis is related with Ricardian Equivalence. Individuals will try to offset any

change in their permanent income (not only in their current income) by changing their savings behaving proactively.

As almost all theories, Ricardian Equivalence is based on some strict, or even utopic, assumptions. The first assumption is that the time horizon of the government and of the households is the same. However, a government, or a state more generally, has an infinite planning horizon instead of the life-cycle finite horizon of an individual. That fact is important because a postponement of a tax obligation (due to present public debt) for a future moment, after the horizon of a household, nullify the obligation of that specific household. In that way the issuing of present public debt will be received as net wealth and will boost private consumption. Barro (1974) assumed the existence of altruistic bequests. Households' horizon can be infinite if every generation cares about the welfare of its descendants. Simple problems arise from this assumption. Obviously not all the families have descendants. Seaters (1993) estimates that these families are almost the 20% of families in the U.S.. On the other hand, to be realistic, the larger parts of the obligations which are linked with new public debt are levied in a horizon that is shorter than the lifetime of the people who lived at the time of the debt issue.

Another important prerequisite is the perfection of capital markets and the absence of liquidity constraints for the households. As we noticed, permanent life-cycle income hypothesis is related, among others, with the expected income. If a household expects higher future income but cannot borrow in the present, it cannot also modify its consumption and hypothesis doesn't hold. Same borrowing interests rate for government and households are also required. Otherwise, the issue of a bond is similar to a loan of a household with the low interest rate of the government. The difference of interest rate could be considered as net wealth because of lower tax obligations instead of interest payments of a private loan. The above is similar to an interest rate differential. Liquidity constraints can play significant role as well. Access to borrowing cannot be taken for granted, especially in developing countries. More specifically, Lopez et al. (2000) calculated that liquidity constrained individuals are 40% in OECD and 60% in developing countries.

The third requirement is to address taxes as lump sum. In reality, taxes change according to the income and are not a fixed amount. A detailed foresight of the permanent income isn't a simple case for a household. Uncertainty and risks may force an individual to

overweight its current income and do not smooth its consumption based on the permanent income. Apart from that, taxation should not be distortionary, meaning that competition and prices are not affected by taxes.

Someone may wonder how Ricardian Equivalence could hold under these assumptions. Most of them can barely exist in the most of the countries. Why we should even trouble to test a theory that may well doesn't hold at least in at full extent? Maybe the best answer that highlights the motives of this dissertation has been given by Barro (1989): "*It is easy on theoretical grounds to raise points that invalidate strict Ricardian equivalence. Nevertheless, it may still be that the Ricardian view provides a useful framework for assessing the first-order effects of fiscal policy. Furthermore, it is unclear that the standard analysis offers a more accurate guide. For this reasons it is especially important to examine empirical evidence*". A conflict about the efficiency of fiscal policies is almost as old as the economic science. However, it is prudent not to forget that year after year and as economic crises succeed each other this discussion is more apropos than ever. Finally, as we will present in the following chapter, empirical results, up to now, are mixed and don't make clear if Ricardian Equivalence holds.

2.2 Empirical Studies

During the last 40 years a lot of studies relative with Ricardian Equivalence have been published. Research is carrying out not only from academic institutions but from organizations like IMF and central banks as well due to its relevance with public finance. In this chapter are presented empirical results from such studies.

The results in the literature vary since there isn't a formal form of regression to test the hypothesis. The presence of a range of techniques, sample periods, tested countries and regions as well as the source and measurement of data, make the comparison of the empirical results a hazardous even though an interesting case. The majority of the researchers use as dependent variable the private consumption or the private savings. As independent variable normally public deficits, debt or savings are used combined with a set of control variables. Time series or panel data, specific countries or groups of them are also used commonly.

The first categorization that we cite is that between developing and developed countries. In developing countries often are implied stabilization programs of crucial

importance for growth. Important liquidity constraints, credit sectors that finance large public debts and low income are some of the characteristics of this kind of economies. Even the taxation or the issue of public debt can be complicated procedures. These common problems contradict the assumptions of RE.

Leiderman and Razin (1988) tested RE and the compliance with its assumptions for Israel. RE hypothesis could not be rejected. Khalid (1996) generalized the approach of the previous study for 17 developing countries. He similarly concluded that Ricardian Equivalence cannot be rejected in 12 of the countries. In the rest five countries of his sample debt neutrality doesn't exist because of seriously liquidity constrained households. Haque and Montel (1989), on the other hand, rejected the hypothesis due to liquidity constraints in a diverse sample of 16 developing economies. An important finding is that the main problem was the access of the households to borrowing and not the finite horizon in their plan. Dalamagas (1992) separated his sample in economies with low and high public debt and evidence supported RE for the second group.

All the above studies processed time series data. In a more recent research Giorgioni and Holden (2003) tried to clarify previous mixed results by handling panel data from 10 low-income countries. The results are mixed in that study too, while data availability is an important factor.

There is a great amount of studies assessing RE in developed countries as well. Castro and Fernandez (2009) assessed the stability of national saving account due to the offsetting between government and private saving in Spain. They concluded that total national saving was stationary during the tested period, while there was the substitution between public and private saving at some degree.

Brittle (2010) also used private and government saving to test RE in Australia. He used a set of control variables that affect private saving such as social assistance payments and unemployment. With the existence of the safety net of social assistance, households may be less precautious with saving. On the other hand, high unemployment rates mean lower disposable income and less private saving. The study concluded that although private sector acts not fully Ricardian the long run offsetting between private and public saving was -0.48. The short run estimation was -0.28. Household's disposable income, social assistance payments and terms of trade had a statistically significant affect in private saving. Brittle

concluded that fiscal policy has a reduced impact on the real economy because households are forward looking and partially behave in a Ricardian way.

Drakos (2002) tested RE for the Greek economy. Empirical results confirmed the presence of a Ricardian behavior but far from full RE. Among the conclusions was a 7% long run marginal propensity for households to save because of increased public debt. Also the mean elasticity of bank deposits was circa 17%. This metric shows the percentage of public borrowing that is received as net wealth.

Marinheiro (2001) focused in time series from Portugal. He applied a wide range of tests (ADF test, Euler equation approach, reduced form consumption functions). The results could be characterized quite ambiguous. Marinheiro noticed an excess sensitivity of consumption to current income due to liquidity constraints. Consistently with similar studies, the infinite planning horizon seems a realistic assumption. Keynesian hypothesis appears to fit in Portuguese economy but we should not overpass the fact that most of the explanatory variables were not statistically significant. Invalidation of RE in Romania stated by Belingher (2015). Feyer and Sambaugh (2009) examined the offset between public and private saving and found it around 1/3 for the United States, using OLS time series. Again it can be interpreted as evidence for a partial cancelation of fiscal policies.

In this paragraph we present the results of studies that tested the offset of private/public saving for wide groups of countries. An extended reference in the factors that affects savings follows in the next chapter. Haque et al. (1999) used a sample of 20 OECD countries for the period 1972-1993. He found out that government consumption is an important determinant for private saving. Additionally, the offset was about 0.9. De Serres and Pelgrin (2003) tested 15 OECD countries for the period 1970-2000. They used Pooled Mean Group estimator for dynamic panel data. Their empirical results didn't confirm pure RE but the degree of the offset was about 0.7. In a similar study, Ferruci and Miralles (2007) used the same method for 46 countries (OECD and emerging economies) and the period 1985-2005. The offset was particularly high in OECD countries (0.85 long-term) and about 0.3 in emerging economies. De Mello et al. (2004) deal with 21 OECD countries for the same period as De Serres (2003). They used Generalized Method of Moments with Arellano-Bond estimator. The offset was 0.58. A research with a global sample was conducted by Loayza et al. (2000). The sample contained measurements from 69 countries for the period

1966-1995. They concluded that if public saving rises by 1%, private saving will fall by 0.29% in short term (the same year) and 0.69 in long term. The p-value for testing the null of full RE was 0.10. Finally, Röhn (2010) found the long-term offset at around 42% for 16 OECD countries and 37% for G6 countries.

Summarizing, it is obvious that the empirical results of the literature do not support the presence of full RE in any kind of economy, developed or emerging. However, there is powerful evidence that indicates offsetting movements between private and public savings. We shouldn't forget that this finding as well as the investigation of which factors affects saving are not of minor importance for public finance. The research for validation of pure RE is not an end in itself; it is a tool to assess issues related with saving behavior.

2.3 Factors affecting private saving

In the most of the studies that were presented in the previous chapter authors selected a reduced-form equation of the private saving. The advantage of this method is its combination with a set of control variables which are determinants for private saving. Bellow we discuss how the factors that we adapted to our model interact with private saving.

The first control variable is a demographic variable. Old-age dependency ratio shows how many older cohorts correspond to the working-age population. According to life-cycle theory we should expect a negative sign between old-age ratio and private saving. Theory proposes that the more the older descendants are the higher the dissaving ratio will be. Of course generations are connected with each other. Bequest motives between older and younger cohorts may reverse the negative correlation.

The next control variable is the real interest rate. Real interest rate is the real cost of fund to the borrower if we subtract from nominal interest rate the inflation. That means that as a variable may take negative values in the case that inflation is larger than nominal rates. If that happens, the lender is losing money. Theoretically, a strong negative impact of interest rate on private saving is expected. Private savings increase the wealth of an individual but the higher the real interest rate the higher is the yield of a potential investment. Apparently, there is an income effect behind high real interest rate.

Similar is the approach for another variable; the domestic credit to private sector. If this variable takes high values that means, among other, a significant transfer of funds from

private savings to private investments. The mean for those transfers is the financial system either it is bank based either it is market based. On the other hand restrictions to the legalization or credit constraints give rise to saving (Jappelli and Pagano, 1994).

The fourth control variable that we adopted in our model and is commonly used in similar studies is inflation. It is clear that an increased or accelerating inflation reduces the real value of public debt. On the contrary, the private saving increases. Hüfner and Koske (2010) stated that increased inflation raises uncertainty about the future disposable income of the households. Bandiera et al. (2000), Loayza (2000) and other studies found a positive influence of inflation in private saving. It is noted that extremely high values of inflation could lead to distortions in the measurement of saving but we will return on this later.

The last control variable is the annual growth of GDP. As it is known, an increase in the GDP causes raises in the wages and in disposable income generally. This is the reason why almost every study concludes a positive relation between income rates and private saving. GDP annual growth is a way to capture the changes of disposable income. Obviously, there are other and more direct variables appropriate for that purpose. However, GDP annual growth is a very common variable and data are available for almost every country and for long periods.

The above information is the theoretical expectations and in many cases the empirical findings in panel data studies. In some studies the results differed. The signs were the opposite and mainly some variables were not statistically significant. The total conclusion it that despite the theoretical backgrounds of the expectations the empirical results are probably ambiguous.

2.4 Private and Public Saving

In literature a common proxy to catch wealth of households and corporations is private saving. On the other hand governments' spending or borrowing can be approached by public saving which is actually the result of the budget. Governments' budget run with a surplus, a deficit or it is balanced. The question is if these variables are appropriate for the testing of Ricardian Equivalence. Are they measured in a continuous and consistent way, are they available and are they express wealth? In this chapter we discuss these issues.

Private saving is income minus consumption. National accounts that measure private saving ignore the reevaluation of the stocks and the realized capital gains, although capital gains are taxed. That causes an offsetting between private and public saving, not because of Ricardian behavior but because of the way of measurement. Of course, except for capital gains a household possess other forms of wealth. Real estate, pieces of art and durable goods are characteristic examples. While durable goods are considered as consumption for households, they are treated as investment for corporations. In countries where wealth is invested in real estate or financial assets, the fluctuation of prices affects private wealth. The term 'fluctuation of prices' is referred to the change of permanent income. Gains must be sustainable and not only connected with market volatility. Unfortunately data constraints disallow an extended research of these issues.

Ferrucci and Miralles (2007) presented some recent trends in global private saving. From 1970 global private savings are stable (circa 20% of GDP). However, in local level volatility is intense. For example, in Asia, where a lot of countries are rapidly emerging economies, private saving rate has almost doubled in 40 years. In G7 economies the index is less volatile.

Conceptual problems appear in the measurement of public saving and budget balance. For example De Mello et al. (2004) notice that temporary factors, as public revenues from sale of telecommunication licenses, privatizations etc., cause problems when calculated in a cyclically adjusted basis. Even the reaction of rational individuals in the news or in the commitments of a government for its budget balance is not predictable. Sometimes there is deservedness. In other cases, in long fiscal consolidation programs for example, private expectations could be stabilized in advance.

3. Data

3.1 Data Base

The data span the period 1970-2015 and consist of yearly observations on the following variables: Gross Savings (% of GDP), Tax Revenue (% of GDP), Expense (% of GDP), Old-Age dependency ratio (% of working-age population), Real Interest Rate, Inflation (annual %), GDP growth (annual %) and (% of GDP). In this chapter and in whole dissertation it shouldn't be forgotten that data availability is a key factor in this kind of studies. It could affect the form of hypotheses and results or make the use of proxies necessary.

All the data are taken from DataBank, the analysis and visualization tool of World Bank. All the time series that have been downloaded were in the World Development Indicators Database of World Bank. World Development Indicators (WDI) is the primary World Bank collection of indicators. All its data have been compiled from officially recognized international sources. We selected as our data source the World Bank as it is considered one of the most reliable data providers, especially for macroeconomic variables. That gives the ability to take all the data from the same source. Because of the above we believe that the data set is comprehensive and of high quality as all the adjustments are made by the same organization. Also this selection aligned with our will to study Ricardian Equivalence at a global level.

An important detail is that all our variables are expressed as ratios (mainly as % of GDP). This selection reduces the huge ranges of the measurements and makes comparisons easier. Problems concerning local currencies and their exchange rates are bypassed.

At this point, it is useful to display the exact definitions of all the series that form our data set, as they presented by World Bank.

- Gross Savings: gross national income less total consumption, plus net transfers
- Tax Revenue: refers to compulsory transfers to the central government for public purposes. Certain compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue.

- Expense: cash payments for operating activities of the government in providing goods and services. It includes compensation of employees (such as wages and salaries), interest and subsidies, grants, social benefits, and other expenses such as rent and dividends.
- Old-Age dependency ratio: is the ratio of older dependents (ages > 64) to the working-age population (ages 15-64). Data are shown as the proportion of dependents per 100 working-age population.
- Real Interest Rate: is the lending interest rate adjusted for inflation as measured by the GDP deflator.
- Inflation: measured by the consumer price index. Reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.
- GDP growth: Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
- Domestic credit to private sector: refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other financial corporations are finance and leasing companies, money lenders, insurance corporations, pension funds, and foreign exchange companies.

Using DataBank we generated an Excel table with the above variables, for the period 1970-2015 for all available countries, to wit 264 countries.

3.2 Data Check and Transformation

The first change in the initial Excel file was to transform the data from time series consecutive time series to panel data. Countries are listed alphabetical and each one matched with an id number (from 1-264).

Our model includes Private and Public Savings as dependent and independent variable, respectively. Those data were not available in a raw form and we had to produce them. It is known from macroeconomic theory that the public saving equation is:

$$\text{Public Savings} = \text{Tax Revenue} - \text{Government Spending} \quad (1)$$

Public Savings can be negative (budget deficit), zero (balanced budget) or positive (budget surplus). We used as a proxy that government spending is represented by the Expense account of World Bank. That choice is justified by the description of the Expense account. It can be noticed that Expense account includes almost every government spending.

To calculate Private Savings, Gross National Savings are needed. That variable was available so it is easy to calculate Private Savings from equation 2:

$$\text{Private Savings} = \text{Gross National Savings} - \text{Public Savings} \quad (2)$$

The next step was to delete from the panel countries whose data quantity was poor. In some cases, especially small island states, no data were available. In other countries, extremely sparse measures or the lack of measures for one variable made us to delete it as well from the sample. After that procedure, 139 countries remained in the panel.

Panel data in our case is heavily unbalanced. This means that measures are missing in one or another variable from year to year. In a lot of cases unbalance is caused by historical events. For instance, it's not possible to find data for the countries of former Soviet Union before 1992 as they were not exist as states. War conflicts and political changes with non-democratic governments also affect the density of the data, mainly in developing countries. It is a common difficulty in similar studies and data availability drives the research and the choice of econometric method. We will discuss further in the next chapter.

Before the application of any econometric method a few more controls are required. The first one is a qualitative control. Our target was to locate any abnormal prices in the sample by filtering the data. For example some variables cannot have negative values. Those are Old-age dependency ratio, expenses, tax revenue and domestic credit to private sector. Apart from that we checked our sample for mistyped values, e.g. character instead of numbers. No errors of this nature were located. The last step with Excel was to replace any blank or mistyped cell with a dot (.) so it can be recognized by Stata as blank.

After the qualitative controls our sample was inserted in Stata software for further processing. One important step to make our sample more consistent and reliable is to move from it any outliers. Values that were above 99^{th} percentile and bellow 1^{st} percentile were deleted. That means 2% of the values of each variable. That remove is necessary as these extreme values maybe are mistyped and passed the qualitative control. Even if they are responding to reality they are caused by unusual events, are temporal and may affect our results. Apparently, there is always a tradeoff between a bigger sample (always better in econometrics) and a homogeneous sample.

3.3 Descriptive statistics

Since the remove of outliers bellow all the descriptive statistics and histograms are presented for each variable. The correlation matrix of the variables is also cited.

Totally 125 outliers removed from old-age dependency ratio. In Table 1 we observe the descriptive statistics for the ratio after the remove of outliers and in Graph 1 its histogram. The total amount of observations is 6088 and the mean value is 11.44%. That means that in our global sample there are 11.44 older dependents per 100 working-age population. In Graph we can see that the histogram is skewed right. Usually the countries with a small old-age dependency ratio are developing economies and the opposite happens to developed countries. For instance all European countries have observed with age ratio more than 15. Apparently this is a measure of demographic problem which is intense in more developed countries. Apart from that in developed countries it seems that the ratio is increasing through time while in developing countries it is steady or even decreasing. The smallest value observed in Bahrain and the highest in France.

[Insert Table 1]

[Insert Graph 1]

In Table 2 we observe the descriptive statistics for the real interest rate after the remove of 76 outliers and in Graph 2 its histogram. Totally 3777 observations have mean value of 5.96%. The histogram has a symmetrical enough shape and we can see that extreme low or high values (less or more than 20%) are rare. That is confirmed if we check the percentiles for real interest rate. Only 1% of observations is less than 21% and 10% more than 21%. The lowest real interest rate is in Serbia in 2000, a year of serious political instability. Prices below 30% are observed in similar cases in African countries (e.g Ghana) or in Latin America (e.g. Peru, Costa Rica) for a couple of years in each case. Very high real interest rate values are noticed among others in Brazil and Uruguay in the 2000's and in Ecuador and Bolivia in the late 80's and early 90's. Real interest rate is a variable that is affected directly from the economic and political situations.

[Insert Table 2]

[Insert Graph 2]

Descriptive statistics and histogram of inflation are displayed in Table 3 and Graph 3 respectively. 5103 Observations remained since 104 removed as outliers. The mean inflation is 13% but the histogram is significantly right skewed. Even after the remove of 1% of observations from both sides, a 10% of them have a value greater than 24% which are extremely high values of inflation. Very negative values in the sample were few and removed as outliers. The rest negative values are observed in countries of Eurozone during the economic crisis after 2008. Deflation existed also in Argentina and Japan in 2000's. Deflation existed in isolation for a couple of years in a lot of developing economies. High values of inflation are observed in countries that were formed after the dissolution of Soviet Union, in Argentina from middle 70's to late 80's. The rest extreme values are noticed in developing countries for small periods.

[Insert Table 3]

[Insert Graph 3]

The next variable which is examined is the annual growth percentage of GDP. Table 4 and Graph 4 contain the statistics. 111 observations were removed. GDP annual growth is almost normally distributed, as its Skewness is almost 0 (-0.4) and kurtosis 4.3 (close to 3). The shape also is similar to normal distribution. The mean value is 2.09% in a sample of 5392 observations. The variable spans between -14.99 – 15.22 percent. Serious reduction of the GDP we can observe in Argentina in the period of large deflation and in Russian Federation in 90's. Important reduction has also faced Greece after 2009. A lot of countries from Africa, Asia and Latin America had negative rate of GDP growth for periods larger than 3 years in a row. Economies with high rates of growth (>10%) were those of countries of former Soviet Union in 2000's, Republic of Korea in 80's and Iran in 70's.

[Insert Table 4]

[Insert Graph 4]

In Table 5 we observe the descriptive statistics for the domestic credit to private sector (as % of GDP), after the remove of 108 outliers and in Graph 5 its histogram. Histogram is right skewed while the mean value is 41.56%. The range of the values is between 1.99 – 179.06 percent. Almost all the countries with the lowest values of domestic credit to private sector for large periods are in Africa and a few of former Soviet Union. On the other hand the highest values are observed in the countries with the most developed financial sectors (e.g. European Union, United States, United Kingdom, Singapore, New Zealand, Malaysia, Republic of Korea, Japan, Canada and Australia). Those countries have healthy bank system, are trusted by investors and characterized by political and economic stability.

[Insert Table 5]

[Insert Graph 5]

Descriptive statistics and histogram of private savings are displayed in Table 6 and Graph 6 respectively. 2918 Observations remained since 58 removed as outliers. Private Savings are normally distributed with mean value of 30.53% of GDP (Skewness=0.19 Kurtosis=3.11). The shape of histogram confirms the normality. Private Savings differ from -

0.35 to 77.71%. Also notice that almost all the observations are positive. The lowest observations belong to African countries or small island states. On the contrary high private savings there are in European countries, Singapore, Philippines, Oman, Kuwait and Azerbaijan.

[Insert Table 6]

[Insert Graph 6]

The last variable which is examined is the Public Savings as % of GDP. Table 7 and Graph 7 present the statistics. 69 observations were removed and 3351 remained. Almost 90% of measures are negative and their mean value is -8.65%. Public Savings span between -6.95 – 7.02 percent. Histogram is slightly left skewed. Very negative values of public savings indicate rising debt. There are countries that public savings are less than -20% for more than 20 years of the examined period (e.g. France, Netherlands, Greece). On the other hand positive public savings are observed in a lot of African and Asian countries for 5 or more years in a row.

[Insert Table 7]

[Insert Graph 7]

Table 8 is the correlation matrix of the variables. None of the variables is significant correlated with any other (more than ±0.8). That means that our sample faces no multicollinearity problems. The correlation between private and public saving is negative as expected with a value of -0.41. Negative correlated is also private saving with real interest rate (expected) and inflation (not expected). The positive correlation of private saving with GDP growth and domestic credit to private sector is consistent with the theory. Positively are correlated private saving and old-age ratio, which may suggests strong bequest motives.

[Insert Graph 8]

Those were the descriptive statistics for the data that will be used in all econometric methods. In most of the cases the remove of the outliers helped to have more normal or less

skewed histograms. Also extreme values were noticed in specific countries or geographical regions as it was expected.

It is obvious that the range of each variable is really big even if the whole study is carried out with the usage of ratios. This fact is logical and expected since the sample includes 139 countries from all over the world and for a period of more than four decades. Countries with very different backgrounds, historical evolutions and circumstances, with various stances on economic issues, developing or developed economies, even new states that were not existed during the examined period.

All the above, certainly affect the sample and the form of the data (outliers, missing values etc.). But it is that extended sample, which gives us the opportunity to test Ricardian Equivalence in a global level and to compare the results with other studies. Ricardian Equivalence is based on assumptions that are difficult to be fulfilled in all the countries of the world. We already know that perfectly efficient markets cannot exist even in developed countries. Finally, the rationale behind Ricardian Equivalence points out a general economic behavior that should be followed in a worldwide level, at least qualitatively, despite any of the above differences.

4. Econometric Method

4.1 Econometric Introduction

The model that was created for this dissertation is the following:

$$prsa_{it} = a + b_1 pusa_{it} + b_2 age_{it} + b_3 rir_{it} + b_4 inf_{it} + b_5 gdppcag_{it} + b_6 dctps_{it} + e_{it} \quad (3)$$

$$e_{it} = \mu_i + u_{it} \quad (4)$$

where:

prsa: private savings (% of GDP)

pusa: public savings (% of GDP)

age: old-age dependency ratio

rir: real interest rate

inf: inflation

gdppcag: GDP annual growth

dctps: domestic credit to private sector (% of GDP)

The key factor in our analysis is the coefficient b_1. In the case of a perfect Ricardian Equivalence it should be -1 and statistically significant. In the case of a partial offsetting movement between private and public saving it should be negative (between 0 and -1) and statistically significant.

One problem in our model (equation 3) is the possible causal connections between the variables. Until now we assumed that a change in public savings will cause a change in private savings. Who can assure that may well the opposite movement could happen? Such a bi-directional causality between dependent and independent variable is called endogeneity and can reduce the reliance on the parametric estimation. Eventually it is not a problem that can be ignored. Endogeneity appears when an explanatory variable is correlated with the error term.

In equation (4) the error term is analyzed in two components. The first one, μ_i, is an individual specific effect fixed over time. It is possible that there will be attributes fixed across time (captured by μ_i) like the geographical region of any country etc. The second one, u_{it}, is a time varying random part that captures everything that has not explained for the dependent variable (prsa) by the rest variables.

Finally, due to the form of our dataset, methods that are appropriate for panel data processing will be used. In this thesis, for the sake of completeness, the hypothesis was tested with four models. Those are fixed effects model, random effects model and two variants of the generalized method of moments; Arellano-Bond estimation and Arellano-Bover estimation. In this chapter theoretical elements and properties of each methodology are presented.

4.2 Fixed Effects Model

The basic idea of fixed effects model is the following. The component μ_i is correlated with independent variables. Fixed effects model could be considered as a generalized least squares technique. For the sake of brevity equation (3) can be rewritten as bellow:

$$prsa_{it} = a + b\,X_{it} + \mu_i + u_{it} \quad (5)$$

where X_{it} is the regressor matrix, b is a vector of parameters that we want to estimate, μ_i, is an individual specific effect fixed over time and u_{it} is the residual error term.

The components of X matrix are variables that can be observed and measured with accuracy across time. But in economics we cannot observe, measure or even recognize every component that affects a phenomenon. The present study is related with countries and households. There are numerous historical, institutional, habitual etc. factors unobserved, fixed across time and are still contributing cross-sectionally to the results. Those are captured by μ_i.

Fixed effects model is based in the creation of demeaned variables using the *within transformation*. With this transformation the time-mean of its variable is subtracted from the values of the variable. By working with differences μ_i, which is time-invariant factor will be canceled out. The time-means and the new model are:

$$\bar{X}_\iota = \frac{1}{T}\sum_{t=1}^{T} X_{it} \;\; , \overline{prsa_\iota} = \frac{1}{T}\sum_{t=1}^{T} prsa_{it} \;\; , \bar{u}_\iota = \frac{1}{T}\sum_{t=1}^{T} u_{it} \;\; , \bar{\mu}_\iota = \frac{1}{T}\sum_{t=1}^{T} \mu_i \quad (6)$$

$$prsa_{it} - \overline{prsa_\iota} = b_{FE}\,(X_{it} - \bar{X}_\iota) + \;\; (\mu_i - \bar{\mu}_\iota) + (u_{it} - \bar{u}_\iota) \Rightarrow$$

$$\ddot{y_{\iota t}} = \; b_{FE}\ddot{X_{\iota t}} + \ddot{u_{\iota t}} \quad (7)$$

Notice that the intercept has been omitted since as the equation (7) constructed its dependent variable has zero mean. The μ_i that was correlated with the X matrix now has been canceled out. The estimator b_{FE} is obtained with a simple OLS regression. The disadvantage of fixed effects method is obvious. The influences, of any factor that affect private savings but is time invariant, are not taken into consideration. Also the method requires exogeneity of the u_{it} error term with the independent variables.

4.2 Random Effects Model

Random Effects Model also begins with the assumption that the error term of equation (3) is analyzed in the two terms of equation (4). That means that there are time constant factors that affect the dependent variable. The difference from fixed effects model is that this time those factors are not correlated with the X regressor matrix.

Even without the endogeneity the estimators in equation (5) are consistent but inefficient by OLS regression. That happens because of the cross-correlations between error terms for a given cross-sectional unit at different points in time. Random effect method is also a Generalized Least Squares technique. In contrast with fixed effects method, we subtract a weighted mean from the measurements and not the whole mean. The variables will now be transformed like this:

$$y_{it}^{'} = y_{iy} - \theta \overline{y_i} \quad (8)$$

where $\overline{y_i}$ is the same mean value as in equation (6). θ coefficient is the following function:

$$\theta = 1 - \frac{\sigma_u}{\sqrt{T\sigma_\mu^2 + \sigma_u^2}} \quad (9)$$

The weight of the transformation, as we can see, is a function of the variances of the two components of the error term. With this transformation the cross-correlations between error terms have eliminated.

4.3 Generalized Method of Moments (GMM) Estimators

We already have referred to possible endogeneity problems in our econometric model. Apart from this inertia and persistence of saving behavior is also expected. A variety of Generalized Method of Moments (GMM hereafter) estimators are probably the most

appropriate econometric tool to deal with these problems. GMM is a relatively new but revolutionary econometric method that developed by Peter Hansen in 1982. Jaganathan et al. (2002) point out some of the strong advantages of GMM. No severe assumptions about the distribution are necessary. GMM estimators are consistent, efficient and asymptotically normal. These advantages make GMM the more convenient and general method for dynamic panel data.

In this point it is useful to make a reference to dynamic panel data. Until now we considered that our model is static. That means a contemporaneous relationship between dependent and independent variables. We can extend our analysis to the case where private savings depend on private savings of the previous period. Equations (3) & (5) can be rewritten as follows:

$$prsa_{it} = a + b_1 pusa_{it} + b_2 prsa_{it-1} + b_3 age_{it} + b_4 rir_{it} + b_5 inf_{it} + b_6 gdppcag_{it} + b_7 dctps_{it} + e_{it} \Rightarrow$$

$$prsa_{it} = a + b_1 pusa_{it} + b_2 prsa_{it-1} + bX_{it} + \mu_i + u_{it} \quad (10)$$

where X_{it} is a vector that contains all the control variables

Due to the usage of a lag of the dependent variable as regressor our panel data can be characterized as dynamic. Lags are often used in econometric studies when there are indications for inertia on the dependent variable. Because of the lag term in equation (10) the implication of fixed and random effects models is not appropriate. The estimators from the above methods will be inconsistent as the exogeneity assumption is violated. The error term u_{it} will be correlated a priori with the lag term. One GMM version which solves this problem is the Arellano-Bond method.

The specific method uses first difference of equation (10) and ends with consistent and efficient estimators. By taking the first difference:

$$\Delta(prsa_{it}) = b_1 \Delta(pusa_{it}) + b_2 \Delta(prsa_{it-1}) + b\Delta(X_{it}) + \Delta(u_{it}) \quad (11)$$

Now the μ_i term has been eliminated. Δ operator takes the difference between it and it-1 measure. Namely the observations are reduced by 1 but our results are more reliable.

Arellano-Bond method has possible weaknesses. When variables resemble with a random walk the lagged levels that Arellano-Bond method creates are poor instruments. Now both lagged levels and lagged differences are used for the estimation. Soto (2009) found that,

if there is persistency in the data, Arellano-Bover estimator is more efficient and has lower bias than Arellano-Bond estimator. Arellano-Bover is termed also System GMM estimator.

GMM estimators are instrumental variable methods. To test the liability of the results it is important to make some commonly used test in dynamic panel data. The first test is called Sargan-Hansen test. The second test that we applied is the AR for the autocorrelation of the residuals. As the equation of the model uses first differences, its residuals ($\Delta(u_{it})$) are expected to be autocorrelated. Also we have assumed that the initial residuals u_{it}, are independent. If the above are correct AR(2) behavior of ($\Delta(u_{it})$) should not be exhibited. If AR(2) is statistically significant, more lags of the endogenous variable must be used as instruments.

5. Empirical Results

In the present chapter all the empirical results of our study are presented as generated by Stata13. It should be noticed that in order to check the robustness of our analysis we processed the data for the period 1992-2015 apart from 1970-2015. By scanning the dataset we noted that data availability is improved since the early 90's. In reality in some cases a group of countries started to exists after early 90's because of the dissolution of the Soviet Union.

5.1 Fixed Effects

In Table 9 are presented the results of the fixed effects regression. From our initial sample data availability allowed the regression to run for 117 countries with 1753 observations. The crucial result for the testing of RE is the coefficient of pusa variable. In the case of full RE it should be -1 and statistically significant. If there is an offset between private and public savings the coefficient should be between 0 and -1 and statistically significant. We notice that with the fixed effects method it calculated -0.4247 with a t-value of 11.16. It is statistically significant but of course there is a great departure from unity. The 95% confidence interval spans between -0.4993 and -0.3500534.

Also we notice that 4 of 6 explanatory variables are significant in a level of significance of 95% and 5 of 6 in a level of significance of 90%. Even domestic credit to private sector is marginally insignificant in 90% level. That means that our model fits the

data set sufficiently. Age ratio is positive with value of 0.1943 but significant in 90% level. Real interest rate is negative also as expected. The signs meet the expectations in GDP annual growth and in domestic credit to private sector, although the last is marginally insignificant in 90% level. The sign of inflation is negative, which is contradictory with the main findings in literature. According to our results if inflation rises by 1%, private saving will fall by 0.035%. Maybe this result is due to extremely abnormal values of inflation that remained even after the remove of 2% of outliers. Qualitatively the biggest change from control variables is due to age ratio and GDP growth. If age-ratio and GDP rises by 1%, private savings will fall rise by 0.19% and 0.14% respectively. The correlation of the idiosyncratic error with the vector of independent variable is relatively small, 0.14. Finally, R^2 parameter is 0.2417.

[Insert Table 9]

In our data the mean value of observations per country is 15. That means that for each country the software used in average 15 yearly measurements. However there is a great range between the minimum yearly measurements for a country (2) and the maximum value (38). In Table 10 we can see the results when the fixed effects method applied in the period 1992-2015. Only 300 out of 1753 of the observations were in the first 22 years of our sample. The signs are similar with those of full sample. The coefficients that differ from previous results are age-ratio (0.22), real interest rate (-0.079), GDP growth (0.081) and domestic credit to private sector (-0.023). R^2 parameter is lower as expected due to the reduction of the observations.

[Insert Table 10]

5.2 Random effects

Table 11 contains the results of the random effects regression. Obviously the observations and the countries are the same with the previous method. The coefficient of public saving is -0.4202 and statistically significant with a 95% confidence interval between -0.4919356 and -0.348547. Apparently the null hypothesis of full RE is rejected. This time all explanatory variables are significant in a 90% level of significance, while all except domestic credit in a 95% level.

The signs of the coefficients are the same with the fixed effects method. The values suggest that if age-ratio, real interest rate, inflation, GDP growth and domestic credit rises by 1%, private savings will alter by 0.31%,-0.088%,-0.032, 0.0146 and -0.014, respectively. R^2 parameter is 0.2484.

[Insert Table 11]

In Table 12 we can see the results when the random effects method applied in the period 1992-2015. The coefficient of public saving is -0.4212 and statistically significant. Inflation is marginally insignificant in 90% level of significance, while the rest of variables are significant in 90% level. After the robustness analysis no qualitative and no important qualitative changes are noticed.

[Insert Table 12]

5.3 Generalized Method of Moments Estimations

In table 13 are presented the empirical results generated by Arellano-Bond estimation. First of all, observations are less than previous methods, 1466, since that method is using first differences to form the final equation. The coefficient of public savings is statistically significant and takes a value of -0.349. The 95% confidence significance level varies between -0.385 and -0.313. The null hypothesis of unity in the offsetting coefficient is rejected again. Another important finding is the autocorrelation of private saving with its lag value (0.466). That indicates sufficient evidence for inertia in private saving as expected.

All the control variables are statistical significant even in a 99% level of significance, indicating a good fit of our model to data. The signs are the same with the previous methods. According to the results, if age ratio, real interest rate, inflation, GDP growth and domestic credit rise by 1%, private saving will change by 0.199, -0.048 and -0.019, 0.051 and -0.011 respectively.

[Insert Table 13]

As we can see in Tables 14 and 15 are presented the diagnostic tests that we applied to test the reliance of Arellano-Bond estimation. The first is the Arellano-Bond test with the autocorrelations. We reject the null of no autocorrelation between the differenced residuals of

order 2 as we expected from the theory. The Sargan-Hansen test is also successful. The null that over-identifying restrictions of the method are valid is not rejected. That means that the instruments that used the software were appropriate and our results are reliable.

[Insert Table 14]

[Insert Table 15]

In the robustness analysis, no qualitative differences are noticed. The results are presented in Table 16. Again all the control variables are statistically significant even in 99% level of significance. Age-old ratio (with coefficient 0.0147), real interest rate (with coefficient –0.077), inflation (with coefficient –0.018), GDP growth (with coefficient 0.017) and domestic credit (with coefficient –0.022). The coefficients of the first order lag of private saving (0.421) and of public saving (-0.328) are similar with those of full sample. Again both diagnostic tests validate the results.

[Insert Table 16]

[Insert Table 17]

[Insert Table 18]

The Table 19 contains the results from Arellano-Bover estimation. The coefficient of public savings is statistically significant and takes a value of -0.304. The 95% confidence significance level varies between -0.343 and -0.266. With this method all variables are statistically significant in 99% level of significance, except old-age ratio whose p-value is 0.076 (90% level of significance). The strong persistence of private savings is confirmed by the coefficient of its lag (0.538). The rest coefficients are: real interest rate: 0.066, inflation:-0.038, GDP growth: 0.038 and domestic credit to private sector: -0.016. Both diagnostic tests are successful. Null hypothesis of no autocorrelation of 2^{nd} order cannot be rejected as expected. Also we cannot reject the null of Sargan test about valid over-identifying restrictions (Table 21)

[Insert Table 19]

[Insert Table 20]

[Insert Table 21]

The robustness analysis with Arellano-Bover estimation has small differences from this of the full sample. One control variable, old-age ratio is statistically insignificant, while inflation is significant in 90% level of significance. All the rest values are similar with those of the full sample. Finally, Arellano-Bond autocorrelation test and Sargan-Hansen test have the expected results, as presented in Table X.

[Insert Table 22]

[Insert Table 23]

[Insert Table 24]

The main conclusions from the empirical results are summarized in this paragraph. In all the econometric methods that we applied, an offsetting movement between public and private savings has emerged. Our preferred methods (GMM) calculated the offset coefficient around 1/3 and statistical significant. Another important finding is the inertia in the private savings. The contribution of control variables is ambiguous as in the most similar studies. The real interest rate and the annual GDP growth are statistical significant in every method and their signs are as we expected. It is not clear if the other control variables play a crucial role in private saving behavior, of course according to our dataset. Robustness analysis hasn't indicated at least qualitative differences between the period 1990-2015 and 1970-2015.

6. Conclusions

The purpose of this dissertation was to test the Ricardian Equivalence in a global level. The main way to achieve this in modern literature is through a study of the private saving behavior. An offsetting movement between private and public saving can be considered as evidence of Ricardian behavior of individuals.

An overview of literature indicates that the discussion about pure Ricardian Equivalence in any economy is probably unfruitful. RE holds under a set of very strict assumptions. It is obvious that these assumptions cannot be fulfilled even in developed countries. However, the straight connection of saving behavior with consumption, aggregate demand and fiscal policies gathers interest not only in the proof of perfect crowding out

effect among private and public saving. A partial offsetting movement could reduce at some extend the efficiency of fiscal policies and should be considered by policy makers.

We tried to detect offset movements, in a global level, as we considered Ricardian behavior a universal inherent human trend. We followed the path of similar panel data studies by using econometric methods mainly appropriate for dynamic panels. Our target was to catch any inertia or endogeneity effects in our sample. The most well-known method for this is Generalized Method of Moments. By shaping a model which was consisted by a set of commonly used control variables, we tried to study the private saving behavior for a period of 46 years. The selection of the variables was driven by data availability and literature review. It is possible that some variables present conceptual problems. For example, households' wealth should capture real estate and realized capital gains except for savings. One of our targets was to shape a parsimonious model. Apart from that, a basic factor is the data availability. Measurements for our selected variables were available for a large group of countries and for satisfactory time periods. Also all the data were downloaded from one reliable database of World Bank and we didn't mixed measurements from different sources.

We concluded in the existence of an offsetting movement between public and private saving (around 1/3), a result consistent with the most similar researches. The null hypothesis of pure RE is rejected from all methods. Our results are in line with those of literature review. Their reliance is proved by the success of both diagnostic tests that were applied. Autocorrelation and Sargan-Hansen tests are the most commonly used for dynamic panel data and GMM methods.

Our model seems to fit with the dataset as almost all control variables were statistically significant within all econometric methods. We concluded the expected signs with only exception the inflation. A possible interpretation is that even if inflation should increase private savings, it also increases the uncertainty for the economy and the future disposable income of the households. Maybe this uncertainty is responsible for the negative relationship between inflation and private saving.

For a further study of Ricardian Equivalence, a few improvements in the used model may contribute to more precise results. For example, a new index instead of private saving could capture more wealth effects (we have already referred to real estate and capital gains). The main problem is that it is not easy to construct a new index and even if that happens

there will be poor data available. Another idea would be to add more variables in our model (e.g. terms of trade). As in every econometric model, the usage of many explanatory variables makes the model to fit only to the applied dataset (not parsimonious). Finally, it would be interesting to include in the research the effect of indebtedness of a national economy in the Ricardian behavior.

Under the above findings we can claim that a significant crowding out effect between private and public saving exists. It may deviates from perfect Ricardian Equivalence but it can make fiscal decisions and policies less efficient. The Keynesian multipliers therefore will be smaller than those that have been predicted by the Keynesian model. It seems that households are at some extend indifferent about the way that a government will finance its spending. Perhaps the most effective long term policy would be a partial reduction of public expenditures.

On the other hand, maybe the reject of pure Ricardian Equivalence is caused not only because of a violation of its strict assumptions. Behavioral economics highlight emotional factors which affect the economic decisions of individuals. It is possible that some households act myopic, ignoring the general picture of the factors (permanent income, economic indexes etc.) ending up with irrational decisions about their expenditures and savings. This behavior is irrelevant with the case of descendants' absence. It is due to an inherent tendency of human beings to put more weight to recent information and needs.

Further research is needed about the factors that affect private saving and households' decisions. However, it has crucial importance, the findings of that field of research to be taken into account by policy makers, especially in a continuously changing economic environment, where recession crises are becoming more frequent.

Appendix I: Tables

Table 1: Descriptive Statistics for Old-age dependency ratio

Old- Age Dependency Ratio (%)				
	Percentiles	Smallest		
1%	4.20086	3.436889		
5%	4.860339	3.459745		
10%	5.254724	3.470025	Observations	6088
25%	6.163736	3.477257	Sum of Wgt.	6088
50%	8.713729		Mean	11.44232
		Largest	Std. Dev.	6.40888
75%	16.41927	28.61786		
90%	21.6344	28.65143	Variance	41.07375
95%	23.95337	28.71048	Skewness	0.831068
99%	27.09111	28.72239	Kurtosis	2.437226

Table 2: Descriptive Statistics for real interest rate

Real Interest Rate				
	Percentiles	Smallest		
1%	-21.2578	-40.4744		
5%	-6.53717	-39.6826		
10%	-2.24315	-39.5336	Observations	3777
25%	2.21823	-37.3464	Sum of Wgt.	3777
50%	5.521569		Mean	5.956173
		Largest	Std. Dev.	8.692779
75%	9.458821	44.02031		
90%	15.14604	44.11316	Variance	75.56441
95%	20.08825	44.40763	Skewness	-0.02223
99%	33.41575	44.63512	Kurtosis	7.697226

Table 3: Descriptive Statistics for inflation

Inflation				
	Percentiles	Smallest		
1%	-0.74006	-1.27929		
5%	0.465391	-1.27003		
10%	1.23835	-1.26889	Observations	5103
25%	2.808332	-1.22498	Sum of Wgt.	5103
50%	6.308527		Mean	13.00152
		Largest	Std. Dev.	28.38994
75%	12.01542	359.9366		
90%	24.22535	368.4781	Variance	805.9886
95%	42.72788	373.8205	Skewness	7.061687
99%	147.1422	374.7354	Kurtosis	66.68816

Table 4 Descriptive Statistics for GDP annual growth

GDP Annual Growth (%)				
	Percentiles	Smallest		
1%	-10.06166	-14.19542		
5%	-5.290809	-13.93017		
10%	-2.834867	-13.86304	Observations	5392
25%	0.044082	-13.76223	Sum of Wgt.	5392
50%	2.2485		Mean	2.088985
		Largest	Std. Dev.	4.093335
75%	4.457904	14.80423		
90%	6.861143	14.8908	Variance	16.75539
95%	8.549824	15.1852	Skewness	-0.404656
99%	11.87348	15.21528	Kurtosis	4.32778

Table 5: Descriptive Statistics for domestic credit to private sector

	Domestic credit to private sector (% of GDP)			
	Percentiles	Smallest		
1%	3.053376	1.986518		
5%	5.759317	1.997825		
10%	8.927275	2.013644	Observations	5220
25%	16.54908	2.023813	Sum of Wgt.	5220
50%	30.79848		Mean	41.56438
		Largest	Std. Dev.	34.35079
75%	56.66713	177.0154		
90%	90.48151	177.7554	Variance	1179.977
95%	115.1782	177.8536	Skewness	1.465211
99%	157.5438	179.0649	Kurtosis	4.999137

Table 6: Descriptive Statistics for private savings

Private Savings (% of GDP)				
	Percentiles	Smallest		
1%	4.697908	-1.05054		
5%	11.61031	-0.35298		
10%	14.90497	0.019813	Observations	2918
25%	22.34821	0.124489	Sum of Wgt.	2918
50%	30.01921		Mean	30.52732
		Largest	Std. Dev.	11.88536
75%	38.82722	75.355		
90%	45.32589	75.48871	Variance	141.2617
95%	48.71154	76.67945	Skewness	0.185467
99%	60.96942	77.71497	Kurtosis	3.113411

Table 7: Descriptive Statistics for public savings

Public Savings (% of GDP)				
	Percentiles	Smallest		
1%	-31.63786	-36.94825		
5%	-23.4799	-36.64126		
10%	-20.03872	-36.58334	Observations	3351
25%	-13.85826	-36.51873	Sum of Wgt.	3351
50%	-6.892352		Mean	-8.6533
		Largest	Std. Dev.	8.001176
75%	-2.59384	6.496447		
90%	-0.0233304	6.717973	Variance	64.01882
95%	1.436003	6.873363	Skewness	-0.78175
99%	4.900362	7.016306	Kurtosis	3.212962

Table 8: Correlation Matrix

	age	rir	inf	gdppcag	dctps	prsa	pusa
age	1						
rir	-0.1441	1					
inf	-0.063	-0.1094	1				
gdppcag	0.0044	-0.0137	-0.051	1			
dctps	0.4341	-0.1477	-0.2782	-0.1617	1		
prsa	0.3751	-0.2173	-0.109	0.0604	0.2038	1	
pusa	-0.3909	0.0291	0.0006	0.116	-0.1982	-0.4066	1

Table 9: Fixed effects – Full sample (1970-2015)

Fixed-effects	**(within) regression**		Number of	Obs.	1753	
Group variable: id			Number of	groups	117	
R-sq: within =	0.0865		Observations per	group:	min=2	
between=0.2022					avg=15	
overall=0.2417					max=38	
			F(6,1630)=25.72			
corr(u_i,Xb)=	0.1893		Prob>F=0			
prsa	**Coefficient**	**Std. Err.**	**t**	**P>t**	**[95% Conf.**	**Interval]**
pusa	-0.424689	0.038052	-11.16	0	-0.4993	-0.3500534
age	0.1943365	0.107903	1.8	0.072	-0.0173	0.4059796
rir	-0.084467	0.022128	-3.82	0	-0.1279	-0.0410652
inf	-0.034902	0.014599	-2.39	0.017	-0.0635	-0.006268
gdppcag	0.1385938	0.042982	3.22	0.001	0.05429	0.2228986
dctps	-0.01408	0.008753	-1.61	0.108	-0.0312	0.003089
_cons	25.03569	1.436028	17.43	0	22.219	27.85234
sigma_u	9.8651834					
sigma_e	5.4713859					
rho	0.7647607	(fraction of variance due to u_i)				
F test that all u_i=0:			F(116,1630) =	36.12		Prob>F=0

Table 10: Fixed effects – Robustness (1992-2015)

Fixed-effects	**(within)**	**regressio n**	**Number of**	**Obs**	**1453**	
Group variable id			Number of	groups	116	
R-sq: within =	0.0727		Obs. Per group:	min = 2		
between=	0.1892			avg = 12.5		
overall=	0.2082			Max = 23		
			F(6,1331) =17.38		17.38	
corr(u_i,Xb)=0.1 4			Prob>F=0			
prsa	**Coefficient**	**Std. Err.**	**t**	**P>t**	**[95% Conf.**	**Interval]**
pusa	-0.4215247	0.045067	-9.35	0	-0.5099353	-0.33311
age	0.2216368	0.14086	1.57	0.116	-0.0546955	0.497969
rir	-0.0785341	0.025156	-3.12	0.002	-0.1278833	-0.02918
inf	-0.0327563	0.019165	-1.71	0.088	-0.0703534	0.004841
gdppcag	0.081068	0.049353	1.64	0.101	-0.0157498	0.177886
dctps	-0.0230094	0.010724	-2.15	0.032	-0.0440461	-0.00197
_cons	25.26632	1.929992	13.09	0	21.48017	29.05248
sigma_u	10.088026					
sigma_e	5.4638139					
rho	0.7731886 2	(fraction	of variance	due	to u_i)	
F test that all u_i=0:	F(116,1630)=	35.59				Prob>F= 0

Table 11: Random effects – Full sample (1970-2015)

Random-effects	**GLS regression**		Number of	obs. =	1753	
Group variable: id			Number of	group =	117	
R-sq: within =	0.0857		Obs per group: min=	2		
between =	0.2245		avg=	15		
overall =	0.2484		max=	38		
			Wald chi2(6)=	185.67		
corr(u_i, X) = 0	(assumed)		Prob > chi2=	0		
prsa	**Coefficient**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf.**	**Interval]**
pusa	-0.4202413	0.0365794	-11.49	0	-0.4919356	-0.348547
age	0.3074365	0.0848893	3.62	0	0.1410565	0.4738166
rir	-0.0881835	0.0218984	-4.03	0	-0.1311036	-0.0452634
inf	-0.0315495	0.0142737	-2.21	0.027	-0.0595254	-0.0035736
gdppcag	0.1459815	0.0427595	3.41	0.001	0.0621744	0.2297885
dctps	-0.013824	0.0082579	-1.67	0.094	-0.0300092	0.0023612
_cons	22.83053	1.375765	16.59	0	20.13408	25.52698
sigma_u	9.3966309					
sigma_e	5.4713859					
rho	0.74680394	(fraction	of variance	due	to u_i)	

Table 12: Random effects – Robustness (1992-2015)

Random-effects	**GLS regression**		Number of	Obs =	1453	
Group variable: id			Number of	Grou ps=	116	
R-sq: within =	0.0716	=	Obs per group:	Grou p:	Min = 2	
between =	0.2158				Avg = 12.5	
overall =	0.2193				Max = 23	
			Wald	chi2=	134.35	
corr(u_i, X) = 0	(assumed)		Prob >	chi2=	0	
prsa	**Coefficient**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf.**	**Interval]**
pusa	-0.4212487	0.042616	-9.88	0	-0.5047738	-0.33772
age	0.3566943	0.09791	3.64	0	0.1647944	0.548594
rir	-0.0816793	0.024739	-3.3	0.001	-0.1301665	-0.03319
inf	-0.030154	0.018782	-1.61	0.108	-0.0669667	0.006659
gdppcag	0.0936541	0.048872	1.92	0.055	-0.0021337	0.189442
dctps	-0.0204009	0.009849	-2.07	0.038	-0.0397052	-0.0011
_cons	22.71536	1.564202	14.52	0	19.64958	25.78114
sigma_u	9.5964104					
sigma_e	5.4638139					
rho	0.75518947	(fraction	of variance due	to	u_i)	

Table 13: Arellano Bond estimation – Full sample (1970-2015)

Arellano-Bond	**dynamic**	**panel-data**	**estimation**	**Number**	**of obs =**	**1466**
Group	variable:	id		Number	of groups =	116
Time	variable:	year				
				Obs per	group:	min = 1
						avg = 12.64
						max = 36
Number of	instruments =	1.40E+03		Wald chi2 (7)	5575.05	
				Prob>chi2 =	0	
Two-step	results					

prsa	**Coefficient**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
prsa						
L1.	0.4660536	0.012035	38.72	0	0.442466	0.4896417
pusa	-0.3489943	0.018425	-18.94	0.00000	-0.38511	-0.312882
age	0.1987829	0.049236	4.04	0.00000	0.102281	0.2952844
rir	-0.0483896	0.005041	-9.6	0.00000	-0.05827	-0.038509
inf	-0.0186908	0.004602	-4.06	0.00000	-0.02771	-0.009672
gdppcag	0.0511803	0.007939	6.45	0.00000	0.035621	0.0667398
dctps	-0.0107982	0.001264	-8.54	0.00000	-0.01328	-0.008321
_cons	11.11948	0.941673	11.81	0.00000	9.273834	12.96513

Table 14

Arellano-Bond test for zero autocorrelation in first-differenced errors		
Order	**z**	**Prob>z**
1	-4.2533	0
2	-0.91271	0.3614
H0:	No autocorrelation	

Table 15: Sargan-Hansen test for Arellano-Bond full sample estimation

H0: overidentifying restrictions are valid	
chi2(1424)=	103.9067
Prob>chi2=	1.0000

Table 16: Arellano-Bond estimations – Robustness (1992-2015)

Arellano-Bond	**dynamic**	**panel-data**	**estimation**	**Number**	**of obs =**	**1238**
Group	variable:	id		Number	of groups =	115
Time	variable:	year				
				Obs per	group:	min = 1
						avg = 10.77
						max = 23
Number of	instruments =	1.20E+03		Wald chi2 (7)	3925.14	
				Prob>chi2 =	0.000	
Two-step	results					

prsa	**Coefficient**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
prsa						
L1.	0.4207427	0.011211	37.53	0	0.39877	0.4427154
pusa	-0.3281498	0.016259	-20.18	0	-0.36002	-0.296284
age	0.1469675	0.049795	2.95	0.003	0.049371	0.2445644
rir	-0.077254	0.00762	-10.14	0	-0.09219	-0.062319
inf	-0.0183563	0.003894	-4.71	0	-0.02599	-0.010725
gdppcag	0.0170115	0.006397	2.66	0.008	0.004474	0.029549
dctps	-0.0222211	0.003238	-6.86	0	-0.02857	-0.015874
_cons	14.29641	0.788749	18.13	0	12.75049	15.84233

Table 17

Arellano-Bond test for zero autocorrelation in first-differenced errors		
Order	**z**	**Prob>z**
1	-4.0735	0.0000
2	-0.91271	0.3964
H0:	No autocorrelation	

Table 18: Sargan-Hansen test for Arellano-Bond estimation (1992-2015)

H0: overidentifying restrictions are valid	
chi2(1424)=	105.0678
Prob>chi2=	1.0000

Table 19: Arellano-Bover estimation – Full sample (1970-2015)

System	**dynamic**	**panel-data**	**estimation**	Number	of obs =	1656
Group	variable:	id	Number	Number	of groups =	116
Time	variable:	year				
				Obs per	group:	min= 2
						avg = 14.276
						max = 38
Number of	instruments =	1.50E+03		Wald chi2 (7)	= 5122.65	
				Prob>chi2 =	0.000	
Two-step	results					

prsa	**Coefficient**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
prsa						
L1.	0.537522	0.013588	39.56	0	0.51089	0.564153
pusa	-0.30429	0.019614	-15.51	0	-0.34273	-0.26584
age	0.090276	0.050795	1.78	0.076	-0.00928	0.189833
rir	-0.06643	0.004994	-13.3	0	-0.07621	-0.05664
inf	-0.03142	0.006192	-5.07	0	-0.04355	-0.01928
gdppcag	0.037955	0.009476	4.01	0	0.019382	0.056528
dctps	-0.01576	0.002279	-6.92	0	-0.02023	-0.0113
_cons	11.30739	0.813593	13.9	0	9.712772	12.902

Table 20

Arellano-Bond test for zero autocorrelation in first-differenced errors		
Order	**z**	**Prob>z**
1	-4.2815	0.0000
2	-0.7587	0.4480
H0:	No autocorrelation	

Table 21: Sargan-Hansen test

H0: overidentifying restrictions are valid	
chi2(1424)=	103.9112
Prob>chi2=	1.0000

Table 22: Arellano-Bover estimation – Robustness (1992-2015)

System	**dynamic**	**panel-data**	**estimation**	Number	of obs =	1383
Group	variable:	id	Number	Number	of groups =	115
Time	variable:	year				
				Obs per	group:	min= 2
						avg = 12.026
						max = 23
Number of	instruments =	1.30E+03		Wald chi2 (7)	9725.31	
				Prob>chi2 =	0.000	
Two-step	results					

prsa	**Coefficient**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
prsa						
L1.	0.513938	0.007769	66.15	0	0.498711	0.529164
pusa	-0.28917	0.027614	-10.47	0	-0.3433	-0.23505
age	0.046029	0.03275	1.41	0.16	-0.01816	0.110218
rir	-0.08271	0.007434	-11.13	0	-0.09728	-0.06814
inf	-0.00729	0.004056	-1.8	0.072	-0.01524	0.000661
gdppcag	0.029888	0.009541	3.13	0.002	0.011188	0.048587
dctps	-0.01944	0.003671	-5.3	0	-0.02663	-0.01224
_cons	12.99928	0.583987	22.26	0	11.85469	14.14388

Table 23

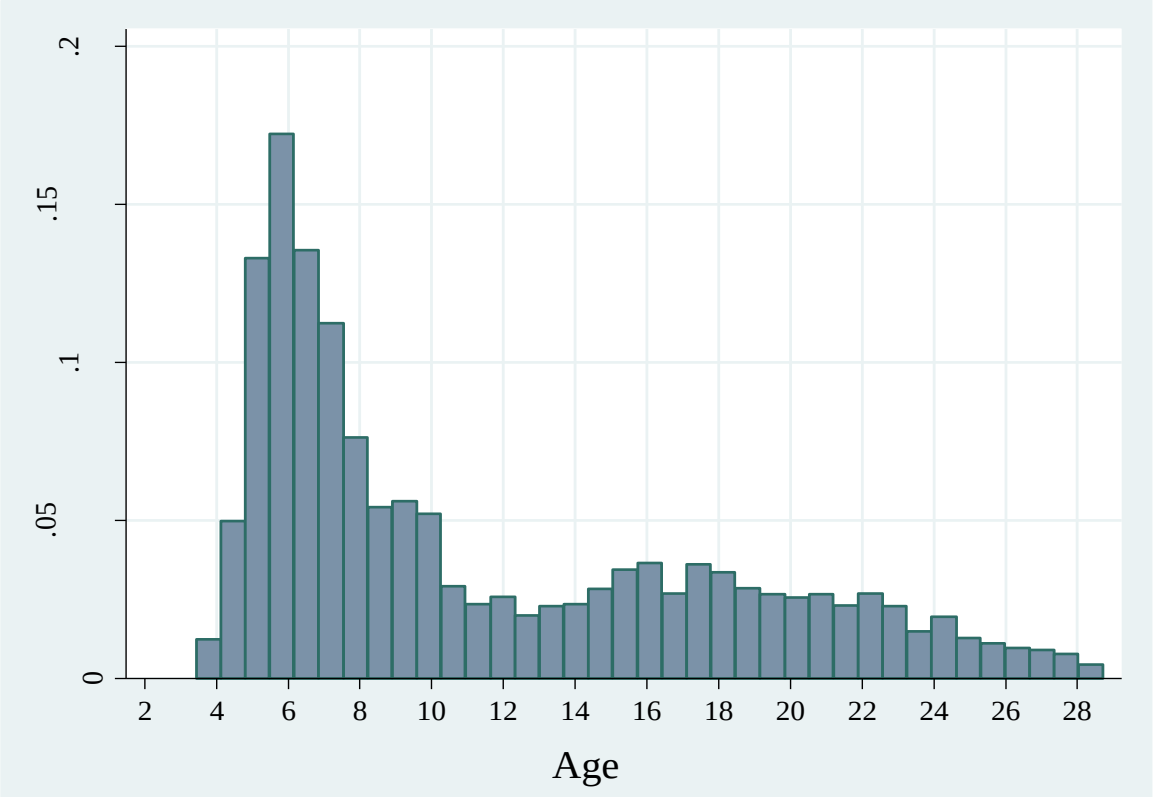
Arellano-Bond test for zero autocorrelation in first-differenced errors		
Order	**z**	**Prob>z**
1	-4.0967	0.0000
2	-0.62011	0.5352
H0:	No autocorrelation	

Table 24: Sargan-Hansen test

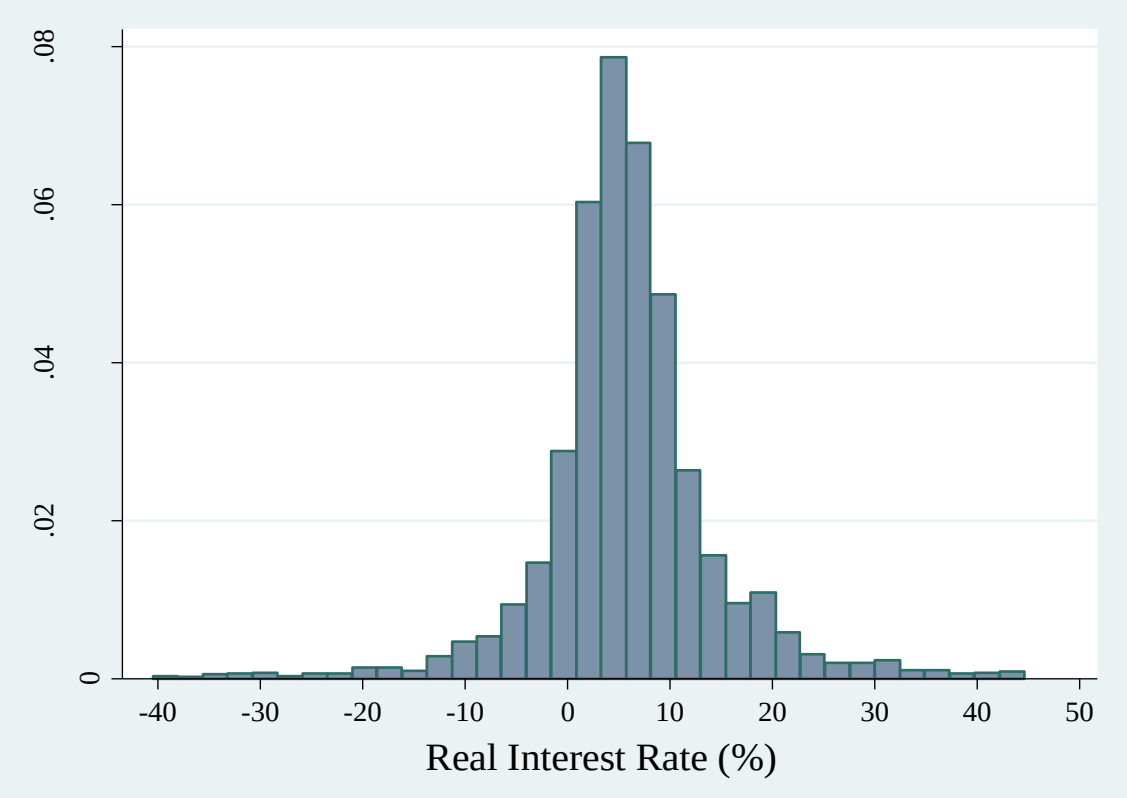
H0: overidentifying restrictions are valid	
chi2(1424)=	105.5919
Prob>chi2=	1.0000

Appendix II: Graphs

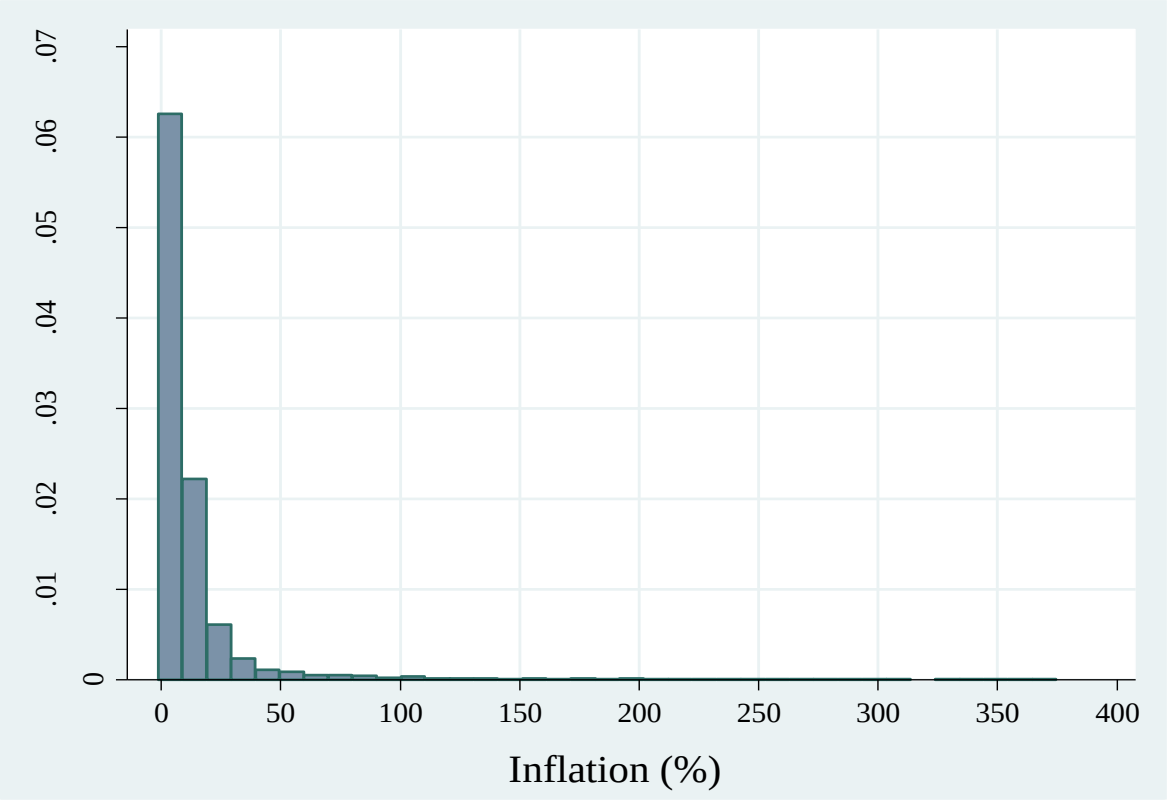
Graph 1: Histogram of Age-Old Dependency Ratio



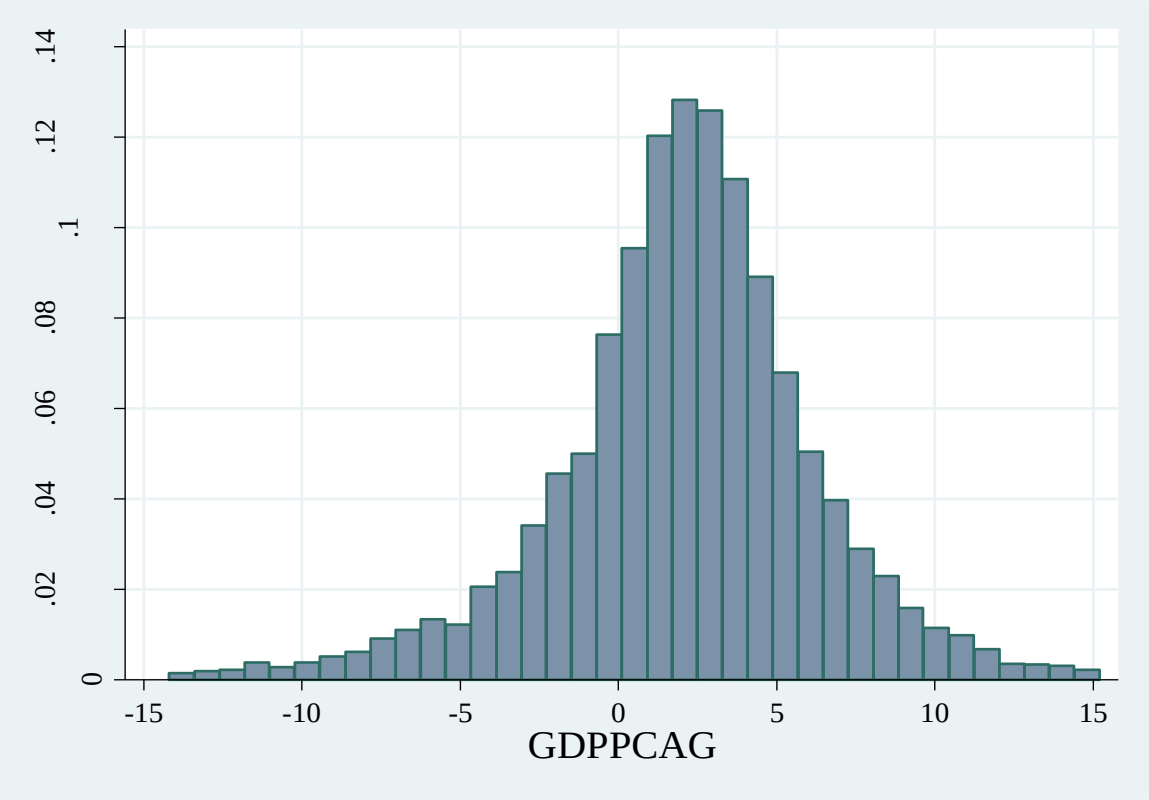
Graph 2: Histogram of the Real Interest Rate



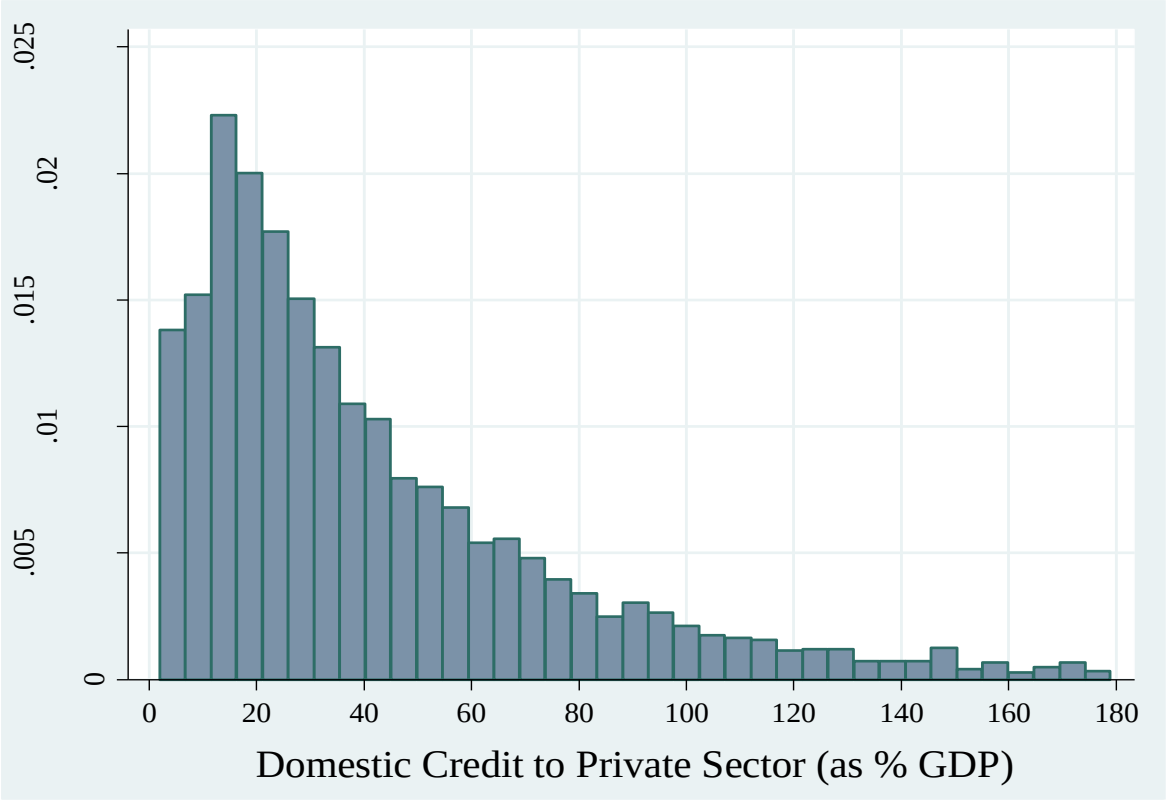
Graph 3: Histogram of Inflation



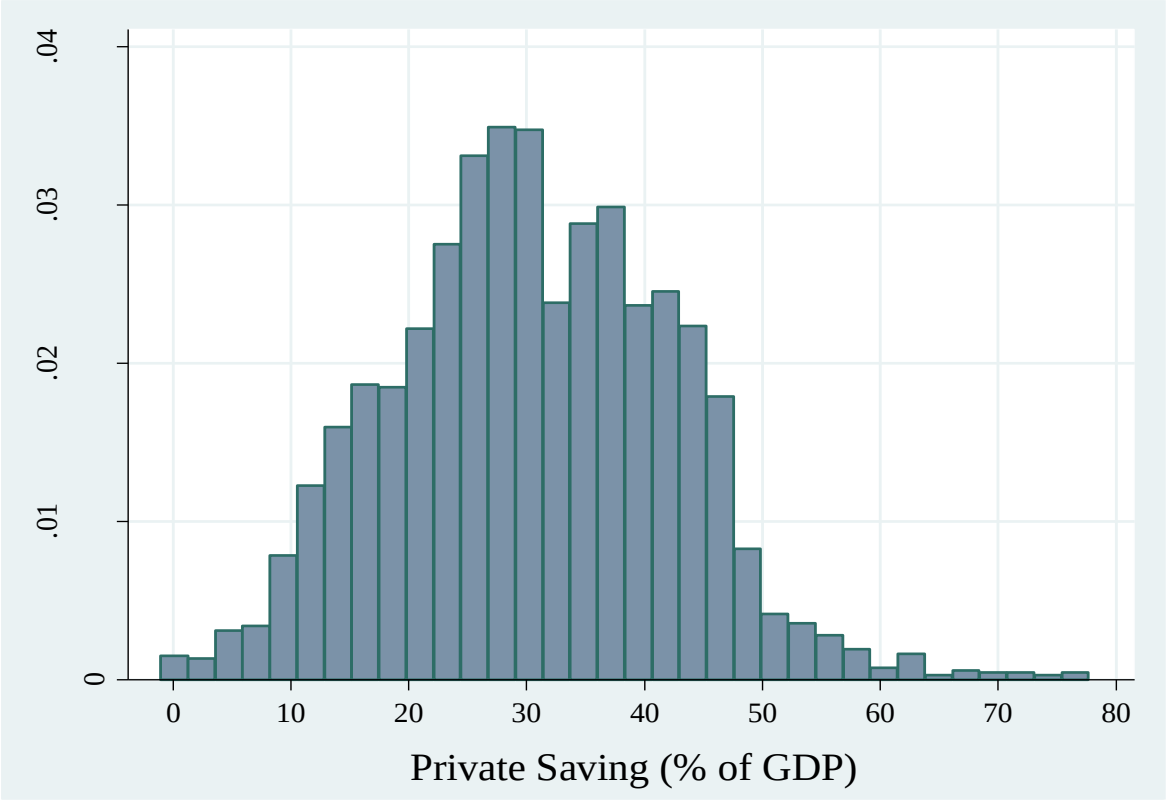
Graph 4: Histogram of the annual growth of GDP



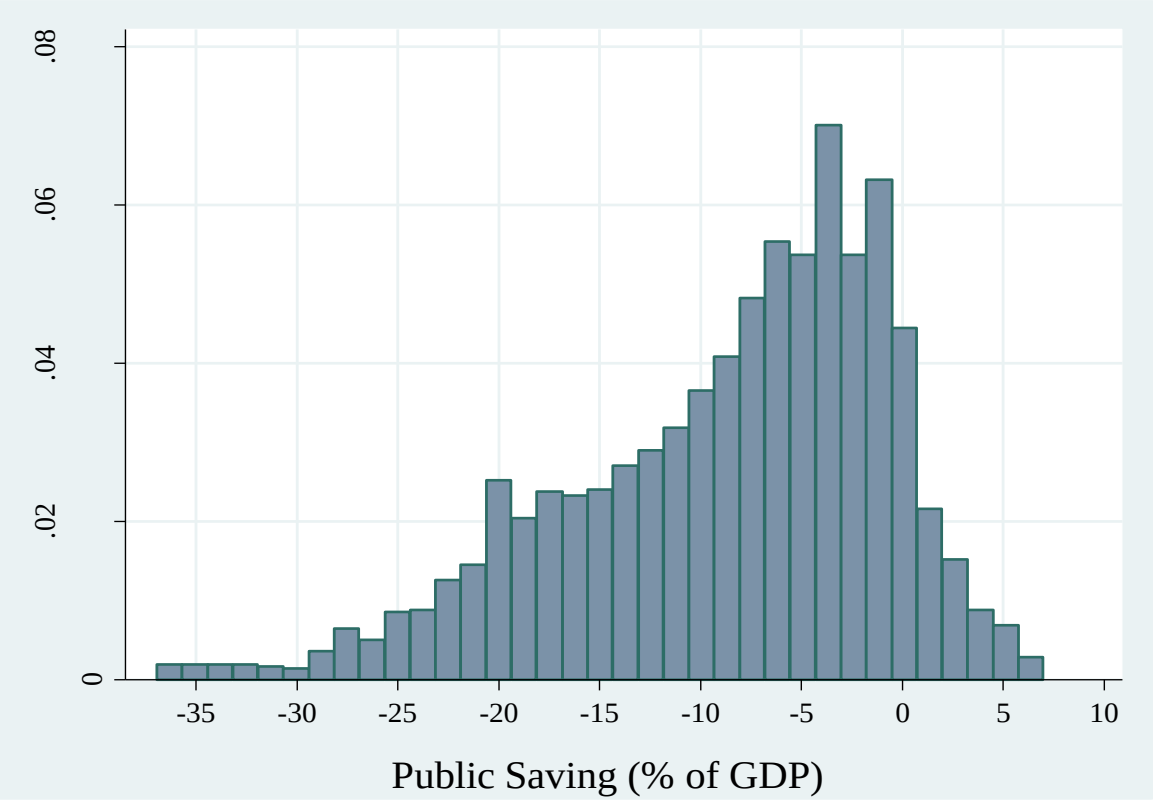
Graph 5: Histogram of Domestic Credit to Private Sector (as % of GDP)



Graph 6: Histogram of Private Saving (% of GDP)



Graph 7: Histogram of Public Saving (% of GDP)



References

Bandiera O., Caprio G., Honohan P., Schiantarelli F., 2000, Does financial reform raise or reduce saving?, Review of Economics and Statistics 82, 239-263.

Barro R., 1974, Are government bonds net wealth?, Journal of Political Economy 82:6, 1095-1117.

Barro R., 1974, The Ricardian Approach to Budget Deficits, Journal of Economic Perspectives 3:2, 37-54.

Belingher D., 2015, Empirical evidence on the Ricardian equivalence in Romania, Theoretical and Applied Economics XXII, 163-170.

Blejer M., Leiderman L., Modeling and Testing Ricardian Equivalence: A Survey, IMF Economic Review 35:1, 1-35.

Brealey R., Myers S., Allen F., 2017, Principles of Corporate Finance, McGraw Hill, 12th edition.

Brittle S., 2010, Ricardian Equivalence and the Efficacy of Fiscal Policy in Australia, Australian Economic Review 43, 254–269.

Brooks H., 2008, Introductory Econometrics for Finance, Cambridge University Press, 2nd edition.

Castro F., Fernández JL, 2009, The Relationship between Public and Private Saving in Spain: Does Ricardian Equivalence Hold?, Bank of Spain, Working Paper No. 0923

Dalamagas B., 1992, Testing Ricardian Equivalence: a reconsideration, Journal of Applied Economics, 24:1, 59-68.

Dalamagas B., 1992, How Rival are the Ricardian Equivalence Proposition and the Fiscal Policy Potency View, Scottish Journal of Political Economy.

David Ricardo, 1888, Essay in the Funding System, The Works of David Ricardo; With a Notice of the Life and Writings of the Author, by J.R. McCulloch.

De Mello L., Kongsrud P., Price R., 2004, Saving Behavior and the Effectiveness of Fiscal Policy, OECD Economics Department Working Papers, No. 397, OECD Publishing.

Dornbush R., Fischer S., Startz R., 2011, Macroeconomics, McGraw Hill, 11th edition.

Drakos K., 2002, Testing the Ricardian Equivalence Theorem: Time Series Evidence from Greece, Journal of Economic Development, 26:1.

Feyrer J., Shambaugh J.C., 2009, Global Savings and Global Investment: The Transmission of Identified Fiscal Shocks, National Bureau of Economic Research (NBER), Working Papers, No. 15113.

Friedman M., 1957, A Theory of the Consumption Function, Princeton University Press.

Giorgioni G., Holden K., 2003, Does the Ricardian Equivalence Proposition Hold in Less Developed Countries?, International Review of Applied Economics, 17:2, 209-2.

Haque, Nadeem U. and Peter Montiel, 1989, Consumption in Developing Countries: Tests for Liquidity Constraints and Finite Horizons, The Review of Economics and Statistics 71:3, 408–415.

Hüfner, F., Koske I., 2010, Explaining Household Saving Rates in G7 Countries: Implications for Germany, OECD Economics Department Working Papers, No. 754, OECD.

Humberto L.J., Schmidt-Hebbel K., Servén L., 2000, How effective is the fiscal policy in raising national saving, The Review of Economics and Statistics 82:2, 226-238.

Jappelli T., Pagano M., 1994, Saving, Growth and Liquidity Constraints, The Quarterly Journal of Economics, 109:1, 83-109.

Khalid A, 1996, Ricardian Equivalence: Empirical Evidence from Developing Economies, Journal of Development Economics 51:2, 413-432.

Leiderman L., Razin A., Testing Ricardian Neutrality with an Intertemporal Stochastic Model, Journal of Money, Credit and Banking, 20:1.

Loayza N., Schmidt-Hebbel K., Servén L., 2000, What Drives Private Saving across the World?, Review of Economics and Statistics 82:2, 165-181.

Marinheiro C., 2001, Ricardian Equivalence: An Empirical Application to the Portuguese Economy, Catholic University of Leuven, CES Discussion Paper Series No. 01.12.

Modigliani F., 1966, The Life Cycle Hypothesis of Saving, the Demand for Wealth and the Supply of Capital, Social Research 33:2, 160-217.

Ricciuti R., 2003, Assessing Ricardian Equivalence, Journal of Economic Surveys 17, 55-78.

Röhn O., 2010, New Evidence on the Private Saving Offset and Ricardian Equivalence, OECD Economics Department Working Papers, No. 762, OECD Publishing.

Seater J., 1993, Ricardian Equivalence, Journal of Economic Literature 31:1, 142-190.

Serres A. de, Pelgrin F., 2003, The Decline in Private Saving Rates in the 1990s in OECD Countries: How Much Can be Explained by Non-Wealth Determinants?, OECD Economics Studies, No. 36, OECD.

Soto M., 2009, System GMM estimation with a small sample, Universitat Autònoma de Barcelona, Unitat de Fonaments de l'Anàlisi Econòmica.