MASTER OF SCIENCE IN FINANCE

MASTERS FINAL WORK

DISSERTATION

DOES SOCIAL SECURITY REDUCE PRIVATE SAVING? A TIME-SERIES ANALYSIS TO THE PORTUGUESE CASE.

PEDRO NUNO LOURO SILVESTRE RODRIGUES

OCTOBER – 2015

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Abstract

Despite many studies aiming to find a relation between social security and private savings, the true effect is still uncertain. From a theoretical perspective, social security may increase, decrease or not affect savings, although the last two are more plausible. The empirical studies have presented mixed results, using very different methodologies, with some finding statistical evidence of a negative impact, whilst others claim no influence at all. Applied work in this field in Portugal has been non-existent for a long time. Using Portuguese time-series data from 1983 to 2012, we built a Social Security wealth algorithm, under the context of a life-cycle savings model, according to the existing literature, and perform sensitivity analysis to alternative assumptions and perceptions individuals may have when they save for retirement. We did not find statistical evidence against the presence of unit roots on our main variables, but we also found them to be cointegrated, and, as a result, we present our final results using the FMOLS estimator. We conclude that, in Portugal, during our period of analysis, there is no statistical evidence that social security has affected private savings, either positive or negatively.

Jel Classification: C22, D91, H55

Keywords: Private Saving, Social Security, Time-Series analysis

Resumo

Apesar de muitos estudos tentarem encontrar uma relação entre segurança social e poupança privada, o verdadeiro efeito é ainda incerto. Dum ponto de vista teórico, a segurança social pode aumentar, reduzir ou não afetar a poupança, embora os dois últimos sejam mais plausíveis. Os estudos empíricos têm apresentado resultados inconclusivos, usando metodologias muito distintas, com alguns a encontrar evidência estatística de um impacto negativo, enquanto outros defendem que não existe qualquer influência. Trabalho aplicado desenvolvido em Portugal, nesta área, tem sido nulo há bastante tempo. Utilizando séries temporais portuguesas, de 1983 a 2012, construímos um algoritmo que representa a riqueza proporcionada pela Segurança Social, no contexto dum modelo de poupança de ciclo de vida, de acordo com a literatura existente, e realizámos análise de sensibilidade a hipóteses e perceções alternativas que os indivíduos podem ter na sua decisão de poupar para a reforma. Não encontrámos evidência estatística de que as nossas variáveis principais não tenham uma raiz unitária, mas também encontrámos evidência de que são cointegradas, e, consequentemente, apresentámos os nossos resultados finais usando o estimador FMOLS. Concluímos que, em Portugal, durante o nosso período de análise, não há evidência estatística de que a segurança social tem afetado a poupança privada, quer positiva quer negativamente.

Jel Classificação: C22, D91, H55

Palavras-Chave: Poupança privada, Segurança Social, Análise de Séries Temporais

Acknowledgements

This dissertation is something I am really proud of. It is the result of will and dedication to produce a work that could bring something new and useful to the scientific community, especially the Portuguese one, and to provide a fully independent work related to a field I hold interest in: social security.

However, there was a period some months ago that I started to fear for its feasibility without severe handicaps due to data problems. Fortunately, those problems were surpassed, but by then there was one person that withstood with me, showing solidarity and comprehension with the delicate technical position I was in, Professor Teresa Garcia, a person to whom I am most thankful for trusting and believing me even in the worst moments.

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Table of Contents

List of Tables

List of Figures

1. Introduction

Social security in Portugal is a topic that lately has received a lot of attention because of its sustainability. Whilst such issue is extremely important, there are other aspects of social security that deserve to be studied, such as its impact on private savings.

The extreme importance of private savings is undeniable to achieve a healthy economy. It generates investment, growth, more investment, more growth, creating a virtuous circle, and, consequently, it is relevant for policy makers to have available a solid literature on topics related to private savings, including social security, so that their policy decisions can be based on serious and rigorous research works.

One of the challenges with the topic was how to include a variable representing the present value of the future cash flows an individual expects to receive from social security during retirement, into a consumer expenditure function. Feldstein (1974) came up with an algorithm that aimed to model such wealth pool, and concluded, using USA time series data, that social security had depressed private savings by a very considerable amount. Other authors followed, such as Leimer and Lesnoy (1982), who argued against some of Feldstein's assumptions and developed enhanced versions of the algorithm and corrections that dramatically changed the results and conclusions, although Feldstein never endorsed such changes. A lot of literature followed, with ambiguous results, using either time series or panels. In Portugal, besides Garcia and Silva (1994), there are no studies on the relation between social security and private savings, and since that work was done when the Portuguese social security system was still an infant, it is important to re-launch this topic and study what is the relation in today's environment.

This particular paper will make use of the conceptual tools found, mainly, in the work of Feldstein (1974) and Leimer and Lesnoy (1982), with some econometric applications and improvements that were not available at the time those original authors produced their papers and its main objectives are to provide a Portuguese social security wealth variable to researchers, since no variable exists at the moment and its construction is too much time consuming to be built from scratch in every investigation that may follow, and also to estimate, using appropriate and modern econometric technics, the effect that social security has had in private savings, in Portugal.

Chapter 2 gives basic insights on the Portuguese social security system. Chapter 3 presents some of the literature covering the importance of private savings in the economy, the motives for saving, how social security can affect private savings and the main empirical findings about the topic. Chapter 4 focuses on the data we use to build the social security algorithm, the building process itself and sensitivity analysis on some hypothesis. Chapter 5 explains the econometric methodology we use, the tests we perform and the statistical quality of our results. Chapter 6 reports our conclusions from producing this work, its main limitations and comments on potential future researches related to the theme.

2. Social security in Portugal

In 1984 the First Social Security Act was published (Law no. 28/84), designing the Portuguese social security system with both a general social security, featuring a contributive and a non-contributive regime, and a social action schemes. The contributive covered employees and self-employed people, formerly scattered through the different social insurance schemes, and was fully financed by employee and employer contributions, granting access to benefits in kind or cash in event of illness, maternity, work-related accidents and occupational diseases, unemployment, old age, death and family expenses. The non-contributive regime had the objective of protecting poor individuals not covered by the contributive system. The access to benefits in kind or cash in incapacity, old age, death and family expenses' situations was means-tested, with the respective financing dependent on State transfers. Social action had the purpose of preventing deprivation, dysfunction and social exclusion. Similarly to the non-contributive regime, social action financing came, mostly, from State transfers.

The following table summarizes the most relevant legislation that followed:

TABLE I - LEGISLATIVE SUMMARY 1986-1999

Decree-Law no. 140-D/86	Single Social Tax (SST), unification of unemployment fund and social security contributions.
Decree-Law no. 259/89	Social Security Financial Stability Fund creation, to face the financial pressure experienced by social security.
Decree no. 514/90	Extension of pension benefits to a 14^{th} month (holiday subsidy).
Law no. 19A/96	Introduction of the Minimum Guaranteed Income, an automatically renewed cash means-tested benefit.
Decree-Law no. 9/99	Allowance of conditional early retirement.

Despite the publication of a Second and Third Social Security Acts in 2000 (Law no. 17/2000) and 2002 (Law no. 32/2002), the system barely changed at all until 2005, when Council of Ministers Resolution no. 110/2005 was approved, starting the convergence process of the Civil Servants Fund to the general Social Security system.

In 2007 was published the Forth Social Security Act (Law no. 4/2007), which is the one in force at the time this study is being produced. It created a new arrangement for the system: citizenship social protection, social welfare and complementary[1].

One important change this last Social Security Act brought was the introduction of the sustainability factor related to the increasing life expectancy. Detailed in Decree-Law no. 187/2007, the sustainability factor essentially reduces the pension benefit if life expectancy increases, promoting long-term sustainability for the system. It was aggravated in 2013 (Decree-Law no. 167-E/2013).

The following table summarizes the 2013 situation of the public sector pensions':

TABLE II - MACRO DATA OF PUBLIC PENSIONS

Single Social Tax (rate)	11% employees; 23.75% employers
Single Social Tax (tax collected)	13,422,863.7*
Total pension expenditure	15,831,958.8*
Contributive system pension expenditure	11,582,741.3*
Old age pension expenditure	8,920,044.2*
Old age pension beneficiaries	2,092 **

Source: Social Security Financial Management Institute (2015). Values in thousands of Euros*/individuals**

This gives a clear picture that, at least in 2013, the contributive social security system was financially solid, since Single Social Tax revenues more than cover contributive pension expenditure by a significant margin, yet an attentive analysis is required as usually people tend to compare the Single Social Tax revenues to the total pension expenditure and conclude that the system is not financially sustainable. Accessing its future sustainability is another question that needs to be further studied because of its massive possible consequences for the country as a whole.

[1] Proteção Social de Cidadania, Previdencial e Complementar

3. Literature Review

Private saving is the difference between disposable income and private consumption. In a closed economy, with no relations with the outside world, all these savings are transformed, directly or indirectly, into real investment. In an open economy, though, private savings do not necessarily turn into real investment; that will depend on the degree of capital mobility (Romer, 2006). Theoretically, if there is full capital mobility, all internal savings will flow to the country that offers the highest expected return on invested capital, which means that if a country offers a lower expected return than others, it does not matter if that country has high levels of private savings compared to GDP, it will all be invested elsewhere. See, for example, Feldstein and Horioka (1980), Blanchard (2006) and Abel *et al.* (2014). In practice, there are neither closed economies nor full capital mobility. There are mixed economies, meaning that a portion of a country's private savings will be invested in that same country while the other portion will be invested elsewhere, as noted by Feldstein and Horioka (1980).

The importance of investment for economic growth and development has been studied for many years. Harrod became well known with his 1939 paper, creating an economic growth model, whose main positive determinant for growth was savings (investment). Solow (1956) innovated the subject with neoclassical reasoning, allowing for replaceable production factors, physical capital and labor; however savings (investment) kept a limited role since, according to Solow's model neoclassical assumptions, the marginal productivity of capital is decreasing, therefore the economy will converge to a stationary state. Still, the stationary state will represent a higher output if saving rates are higher (Blanchard, 2006). Following the argument, the only way to increase GDP permanently is through technical progress, as explained in Barro (1998). Later on, Romer (1986) abandoned some neoclassic assumptions, allowing, for instance, increasing per capita returns. This was the first of a new class of models called *endogenous* growth models, because capital accumulation itself, either physical or human, creates innovations and technical progress, therefore there are no limits to economic growth, as explained by Stern (1991). Further details are presented in, for example, Romer (1986; 1994), Rebelo (1991) and Caballé and Santos (1993). Summarizing, *endogenous* growth models stress that because investment itself leads to technical progress, indirectly it increases *per capita* growth rate. Due to the close relation between investment and savings (Dooley *et al*., 1987), an increase in the latter promotes economic growth. For recent empirical evidence on this relation see, for example, Kuijs (2005), which analyses the Chinese case. Even in open economies, whose local savings importance could be lessened due to direct foreign investment and capital movements, Aghion *et al*. (2006) showed that local savings allows local banks to cofinance local investments, attracting more foreign investment.

We can therefore conclude that savings create a virtuous cycle of investment and growth, whether if we consider closed or open economies, at the aggregate level. As Feldstein claims, “The saving rate of an economy is one of the most important parameters governing its long-run performance. A higher saving rate means greater capital intensity, higher productivity and a better standard of living” (Feldstein, 1979, p.1).

Other important issues are the motivations for saving (Sturm, 1983), such as income for retirement. In 1948, Roy Harrod[2] described the life-path of savings as a "hump". The reasoning for such hump shape is very intuitive: During working years, individuals' consumption is lower than their income; when retired, they earn less income and as a result use their respective accumulated savings to finance a stable consumption pattern. This is known as the life-cycle hypothesis and draws one main conclusion: the main reason for saving while working is retirement. One of the reasons for the creation of social security systems was to overcome myopic behavior and to provide lifetime income security in retirement as long as the retiree lives (Bodie, 1990), through a pension. Therefore, a pension has two essential purposes. The first is *consumption smoothing* over an individual's lifecycle. The second is *insurance,* in respect to longevity risk (Barr, 2012).

According to Blake (2006), there are only two ways of paying for a pension. One is the *unfunded* or *pay-as-you-go* (PAYG) pension scheme, where workers pay a contribution (out of their labor income) that intends to pay for the pensions of retired people, in return of a promise that the next generation will do the same. The other is the *funded* pension plan; in that case workers save (out of their labor income) for their future pensions in a fund, that can be managed and invested in many different ways according to individual risk profiles. Usually, PAYG pension schemes are associated with state pension plans (social security), while funded ones are most common on private pension plans, either personal or occupational.

Both pensions and social security are late 19th century inventions, which started precisely with Bismarck, 1880, in Germany. Before the invention of social security and state pensions, people used to work as long as they could, often dying very

[2] In Feldstein (1974)

shortly after stop working and ended their lives poorly (Blake, 2006). In the 20th century, state and occupational pension schemes expanded to other European countries and developed economies, such as USA and Australia. Nevertheless, even today some countries do not know what retirement is, namely in Africa, Asia and Latin America.

Concerning today's state pensions in developed countries, included in the social security schemes, there are two main types, the Beveridgean and the Bismarckian. According to Blake (2006), a *Beveridgean system* provides a low retirement benefit, just enough to keep retirees above the breadline; if people want to enjoy higher living standards in old age, they are expected to make their own alternative arrangements, as it is the UK or USA. A *Bismarckian system* provides higher pension benefits, so that many times individuals do not have to make additional arrangements to have reasonable living standards. Germany, Italy, France and Portugal have Bismarckian social security schemes. Due to logical reasons, the social security tax is lower in Beveridgean systems than in Bismarckian ones.

A more detailed criteria for social security schemes in Europe is presented in Boeri (2002), distinguishing between four different models: the *Nordic*, with the highest social protection expenditure and universal welfare provision, the *Anglo-Saxon*, offering a lower social protection and more last-resort solutions, the *Continental European,* similar to the *Nordic*, yet less generous, with old age pensions being the priority and the *Mediterranean*, heavily old age pensions-oriented, being the only one with this portion of social protection representing more than 50% of all social protection expenditures. See Figure 2 for a general picture of this categorisation.

The debate about the impact of social security on saving is not recent. Cagan (1965) argued that social security may actually increase savings. He argued that social security can increase savings due to a recognition/educational effect. The argument can be summarized as follows: when an individual is forced to participate in a pension plan, he recognizes for the first time the importance of saving for his old age.

Contrarily, Friedman (1971) recognized a theoretical adverse effect of social security on private savings, but did not include it on his analysis. Other subsequent studies about the life-cycle hypothesis, such as Ando and Modigliani (1963), ignored social security as well.

Feldstein (1974) recognizes two opposing forces concerning the social security effect on savings, although rejects Cagan's (1965) arguments. One of the effects is that social security reduces personal savings because it substitutes for other household assets. At first glance, this reasoning may seem fallacious, since workers may save less, but retirees dissave less as well. It is rational, however, if the economy is growing; in that situation, current workers are richer than retirees, therefore, in absence of social security, the formers' savings would surpass the latters' dissavings. The net effect on savings would be, then, positive. In the presence of a PAYG (unfunded) social security system, though, all contributions are used to pay current benefits, not allowing for a positive net effect on savings, resulting in less capital accumulation. If social security were to be funded, today's workers would accumulate assets mandatorily and retirees deccumulate, leading to a positive net effect. Therefore in terms of asset accumulation, personal savings and social security would be perfect substitutes and the possible jeopardize of economic growth caused by unfunded social security would not apply, as pointed by Leimer and Lesnoy (1985).

The other effect is that social security may increase savings due to earlier retirement inducement. Basically the argument is the following: since individuals only have access to social security pensions when they retire, for those individuals that would otherwise work until they died (extreme case), they will retire earlier to benefit from the pensions; but since it is assumed that individuals want to maintain a stable consumption pattern, they will save more during working years because they have a longer period to dissave. This means that some individuals will live a longer period without working, therefore they need to save more while they work so that they can maintain their living standards during that longer retirement period. This second effect is very complex. It is true that the individuals that would otherwise retire later save more during their working years, but on the other hand, once they retire, they dissave more each year (Leimer and Lesnoy, 1985).

Due to the lack of definitive theoretical conclusions, Feldstein (1974) presented an empirical study using USA time series data, on which he introduced a very important innovation: the creation of a social security wealth (*SSW*) variable with fitness into the life-cycle empirical regressions.

Actually Feldstein (1974) presented not only one *SSW* variable, but two. The first was the gross *SSW*, defined as the present value, in year *t,* of the retirement benefits which could eventually be claimed by all those who are either in the labor force or already retired at year *t*. The second was net *SSW*, equaling gross social security wealth minus the present value of the social security taxes to be paid by those who are currently in the labor force. Despite creating both variables, Feldstein

(1982) concluded that Net *SSW* was inappropriate and, as a result, did not use it again in any subsequent study.

His results were striking, yet not unreasonable. He found statistical evidence that social security reduced aggregate savings in the United States; the reduction amount varies with the used *SSW* variable. Feldstein (1974) justifies this result arguing that for low and middle income families, social security is a complete substitute of private savings, therefore the asset-substitution effect is very prominent. His estimate is that, in the absence of social security, personal savings would be at least 50% higher than they were in 1974. Capital accumulation was lower than otherwise would have been, jeopardizing economic growth.

However, individuals are, in general, shortsighted, not making the necessary arrangements for retirement while working. That led to inadequate resources to face retirement consumption needs. This was one of the main reasons for the introduction of social security, as Leimer and Lesnoy (1985) summarize. So, if individuals did not save for retirement previously, social security did not reduce savings, since they never existed in the first place.

Another issue not covered by Feldstein (1974) was intergenerational transfers. As pointed out in Darby (1979) and Leimer and Lesnoy (1985), prior to social security systems, workers did not save for retirement because they believed their children would provide for them when time demanded it. So, there were private voluntary intergenerational transfers for the elderly. Following this logic, social security just substitutes private voluntary transfers by public mandatory ones, as argued in Barro (1978)[3]. The effect of such change on savings is null.

[3] In Leimer and Lesnoy (1981)

One very important assumption of the simple life-cycle model is that financing retirement expenditure is the primary/main reason for private saving, as Feldstein (1974) assumed. Other researchers believe other motives, as precautionary savings to meet contingencies and leaving bequests to heirs, are also very strong determinants, as stressed by Leimer and Lesnoy (1985). Menchick and David (1983) argue that as people age, the bequest motive becomes stronger. They also explain that ageing makes people more risk averse, increasing the importance of precautionary savings. Darby (1979) concludes that the life-cycle model without bequests is not suitable to explain aggregate savings. Modigliani (1988) recognizes the relevance of the precautionary motive but does not for the bequest, arguing that such is only important in the highest wealth brackets. David and Menchick (1985) found evidence not compatible with the life-cycle model of savings without bequests. In a more recent study, Dynan *et al.* (2002), using a 1998 survey of Consumer Finances, found that 45% of included households claims to save for retirement purposes, 30% to precautionary/emergency reasons and just 8% to leave a bequest. If the sample is restricted to retired households only, the retirement motive drops to less than 30% while precautionary and bequest increase to 40 and 12%, respectively. Concerning bequests, it is also important to have an idea if social security has an influence on savings for that purpose. Leimer and Lesnoy (1985) argue that since social security wealth is not possible to be bequeathed, if one wants to leave an estate it must specifically save for that purpose, therefore, following the argument, social security would increase bequest savings. Their reasoning diverges with Darby's (1979), which states that bequest savings may be reduced by social security. David and Menchik (1985) conclude that the effect of social security on bequest savings is dependent on age. They found that for retirees aged 65 and 71 years old, a 1$ increase in social security benefits raises bequests by 47 and 27 cents, respectively; however after age 79 it will decrease them. Empirical evidence suggests that the effect of social security on bequest savings is ambiguous.

Another key assumption of life-cycle model for savings is the deccumulation of wealth by the elderly. Some authors criticize this assumption. Some of Menchick and David's (1983) results failed to show a decrease in wealth for the old aged, while other results even indicated an increase in wealth. The authors justify their results with a possible large reduction in consumption in old age. Triantis (1997) provides some reasons for the elderly to continue to save after retirement, such as non-labor income being unaffected, tax alleviation, elimination of work related expenses (transportation, meals, clothes), reduction in tourism and entertainment expenses, conservativism when buying durable goods and lack of interest by new innovative products.

The author also criticizes the assumption inherent to the life-cycle theory that in a growing economy the new generations will be richer than the previous. The author defends that retirees own a significant portion of private capital; consequently, if the economy is growing, returns shall increase and capital appreciate. This way, retirees' income increases with economic growth, and because this author believes the aged save, that increase in income implies an increase in savings by the elderly.

Apart from the theoretical issues raised by other authors concerning Feldstein's (1974) assumptions, there was controversy with some technical aspects of his work as well. A few years after Feldstein published his paper in 1974, a computer programming error was detected in his work (Leimer and Lesnoy, 1981; 1982; 1985). Using a corrected *SSW* variable, the effect of social security on savings becomes statistically insignificant. If only post-war data is used, the coefficient of *SSW* becomes negative and statistically significant, indicating that social security decreases consumption (increases savings), as estimated by Leimer and Lesnoy (1985).

Other post-1974 major studies were published, such as Munnell (1974)[4], Barro (1978)[5] and Darby (1979). As summarized in Leimer and Lesnoy (1985), these studies differ Feldstein's in the consumer-expenditure function specification. Munnell (1974) uses private savings as the dependent variable and concludes that social security appears to reduce savings, but less than estimated by Feldstein (1974). Barro (1978) adds explanatory variables but did not find statistical evidence that social security depresses saving. Darby (1979) estimates that social security reduced private savings by 20% (much less than Feldstein). Yet, all these studies use *SSW* as presented by Feldstein, including its computer error, which implies the unreliability of their results, as stressed by Leimer and Lesnoy (1985).

Other controversy with Feldstein's (1974) paper is the *SSW* variable itself. Leimer and Lesnoy (1981; 1982) present a different algorithm, which, according to the authors, incorporates more sophisticated actuarial estimates. Feldstein (1982) defends his original conception arguing that what matters are the actual *perceptions* by the individuals and not the actuarial sophistication, when building a *SSW* variable.

Leimer and Lesnoy (1981, 1982) also raise doubts upon Feldstein's choice of concentrating on the entire period 1929-1971 and 1930-1974 (Feldstein, 1982).

[4] In Leimer and Lesnoy (1981; 1985)
[5] In Leimer and Lesnoy (1981; 1985)

Feldstein (1974), claims that using post-War data leads to multicollinearity[6]. Leimer and Lesnoy (1985) do not agree with Feldstein. They argue that the resulting imprecise estimates were performed prior to the detection of the computer error and that if one accounts for it, the estimate becomes negative (implying that social security increases savings) and statistically significant. Furthermore, Leimer and Lesnoy (1981) believe that the post-War data should be preferred over the whole period because only in 1935 the Social Security Act was passed and tax collections began in 1937 (Leimer and Lesnoy, 1985), therefore it is impossible to know if individuals started to make perceptions of social security wealth in 1935 or 1937, for instance.

Leimer and Lesnoy (1981; 1982) also criticized Feldstein's (1974) assumption regarding the benefit to per capita disposable income. Feldstein argues that historical variation is mild, with no perceivable trend, around a mean of 0.41. Leimer and Lesnoy (1982) explain that it is not possible to know individuals' perceptions about the benefit to income ratio, which justifies using a variety of possible scenarios to have a broader idea of the impact of this component on the *SSW* variable. They present, apart from the original Feldstein's constant ratio (0.41), the current ratio, reflecting the possibility of individuals being myopic, assuming the current benefit to income ratio to endure forever; the adaptive expectations perception, assuming that individuals use the last observed benefit to income ratio and the previous ones to adapt their forecasts; the best information perception, which uses the best actuarial published studies; and finally the perfect forecast perception, assuming individuals were able to know exactly the changes on the

[6] Multicollinearity is a statistical problem that occurs when an explanatory variable in a multiple linear regression model is explained at a large scale by other explanatory variables (Introductory Econometrics for Finance, 2008, p.170 to 172). One of its consequences is estimation biasness.

benefit to income ratio that would occur, which is, in methodological terms, in accordance to Feldstein's algorithm for the present value of all future social security taxes paid by covered workers, used in his Net *SSW* formulation. As Leimer and Lesnoy (1985) summarize, for the period 1930-1976, excluding World War II years, using all perceptions, social security reduced private savings much less than Feldstein estimated, yet the results are not statistically significant in any case, so the null hypothesis of social security having no impact on savings cannot be rejected.

Besides Feldstein's 1974 famous paper, using U.S. time series, and respective replies to feedback, the author presented other studies using different data type. One example is his 1980 paper using international data from twelve major countries. Feldstein (1980) reached the same conclusion from his previous 1974 study, defending that social security depresses private savings. His estimate was that a 10 percentage point increase in the benefit to income ratio reduced the saving rate by 2 percentage points.

Attanasio and Brugiavini (2003) worked with a time series of Italian cross sections, which is particularly relevant since most of the literature uses either international or U.S. data. They found that pension wealth is a substitute for private financial wealth, therefore reducing savings. The substitution level, nevertheless, is not uniform, depending on the age group and specification used, reaching its highest in the middle of the individuals' life cycle.

More recently, Hurd *et al*. (2012) used micro-data from twelve countries and took into account the differences in between countries' generosity and progressivity of the social security systems. They found that an additional dollar of social security wealth reduces accumulated financial assets by 22 cents, which implies imperfect substitution. They concluded as well that, in general, workers retire earlier the more generous the pension system is. Their findings are particularly relevant, not only due to the recent data used, but also because they are robust to the inclusion of differential mortality, bequest motives for savings and private pension schemes.

4. Data and Algorithms

This section of the study will explain the social security Wealth (*SSW*) concept we adopted.

We initially used Feldstein's (1974) *SSW* algorithm, adjusted to Portuguese data and a different time period, from 1982 to 2012. Following his argument, consider an individual worker with age *a*, at year *t*, that pays social security taxes. Assuming the official retirement age is 65 years old, that individual will receive, if he survives until there, a pension benefit from social security, $b_{a,t}$, which will be paid to him until he dies. As explained earlier, Feldstein believed that $b_{a,t}$, the old age pension divided by old age beneficiaries, had varied without any perceivable trend in terms of per capita disposable income, around a mean of 0.41. Therefore, the author assumes individuals expect such ratio to remain constant in the future, so that, when they retire (at age 65), their pension benefit will be 0.41 Y_{t+65-a}. This future disposable income per capita is estimated by multiplying the current one for a constant growth rate, which the author considered to be the annual average over the analyzed period. This way, Y_{t+65-a} = $Y_t(1+g)^{65-a}$. At age 65, $b_{a,t}$ = 0.41 $Y_t(1+g)^{65-a}$. Assuming the benefit will grow at the same rate as the per capita disposable income, g, at age *n* > 65, the annual benefit will be $b_{a,t}(1+g)^{n-65}$. If $S_{i,j}$ is the probability of an individual with age *i* surviving to, at least, age *j*, and *d* is the discount rate used by the individual, then, at 65 years old, the present value of his future benefits is:

$$(1)\sum_{n=65}^{100} S_{65,n} b_{a,t} (1+g)^{n-65} (1+d)^{-(n-65)},$$

And, at time *t*, when the individual is age *a*, the present value of the future social security annual benefits, $A_{a,t}$, is equal to:

$$(2)\ A_{a,t} = S_{a,65}(1+d)^{-(65-a)} \sum_{n=65}^{100} S_{65,n} b_{a,t} (1+g)^{n-65} (1+d)^{-(n-65)}.$$

If we substitute for $b_{a,t}$, we get:

$$(3)\ A_{a,t} = 0.41\ Y_t S_{a,65}(1+g)^{65-a}(1+d)^{-(65-a)} \sum_{n=65}^{100} S_{65,n} (1+g)^{n-65} (1+d)^{-(n-65)}.$$

The value of $GSSW_t$ is the weighted sum of $A_{a,t}$ for each age *a* and sex, multiplied by the number of covered workers of that age and sex at year *t*[7].

We did small adjustments to his original algorithm, concerning the survival probabilities. Feldstein considered only survival probabilities for different age groups and sexes, with $S_{a,j}$ representing the probability of a male/female individual with age *a* surviving, at least, until age *j*. But looking into Portuguese Mortality Tables from Statistics Portugal[8] we can clearly see that such probabilities changed considerably with time, and as a result, in our Gross *SSW* algorithm, we introduce $S_{a,j,t}$:

$$(4)\ A_{a,t} = 0.33\ Y_t S_{a,65,t}(1+g)^{65-a}(1+d)^{-(65-a)} \sum_{n=65}^{100} S_{65,n,t} (1+g)^{n-65} (1+d)^{-(n-65)}.$$

[7] This algorithm is only valid for workers, retirees have a different one.
[8] INE, Instituto Nacional de Estatística.

Our 0.33 is the 1983-2012 simple average old age pension per old age beneficiary, obtained from PORDATA, divided by disposable income per capita, calculated using data from Statistics Portugal and Bank of Portugal's BPstat. This value corresponds to the 0.41 presented in Feldstein's original work. Y_t is the disposable income per capita for each different year, extracted from BPstat. The survival probabilities, $S_{a,j,t}$, were calculated from the data available in the Mortaility Tables for every year within the analysis period, by just dividing the number of estimated survivals, from the original 100,000 newborns, at age *j,* by the number of estimated survivals at age *a*; different probabilities are assigned to males and females. The average annual real growth rate, *g*, is constant throughout this work and equal to 1.7%, approximately, and was calculated as the disposable income per capita historical average real growth rate for the period 1983-2012. The annual average real discount rate is not as straightforward to apply as the growth rate. Feldstein (1974) considered the real rate of return of several financial securities and came up with a value he considered "reasonable". We analyzed the interest rate on bank deposits in Portugal for our period of analysis, extracted from Bank of Portugal historical series and BPstat, the Portuguese Treasury Bonds rates of return for the same period, which are available at Eurostat, and the PSI20 rates of return since 1992, because the index only started by that year. Then we subtracted the annual inflation rate (available in PORDATA) for each year, and obtained a proxy for the real rates, for every return we have mentioned above. The real average annual return rates were 0.033, 0.016 and 0.041, for the Treasuries', the deposits and the PSI20, respectively. The simple mean gives approximately 0.03, which is the real discount rate we use throughout.

The number of covered workers, by age and sex for every *t*, was provided to us by the Social Security Institute[9], being available from the author at request. However, the exact number of old age retirees by age and sex was unavailable due to an internal restructuring on the internal software system of that same Institute, so the best data given to us was the number of old age retirees by age group and sex, starting in 1988. We assumed that the within age group retiree population distribution is the same as the within age group total population distribution, for each year and age group; this way we were able to estimate the number of old age retirees by age and sex. Concerning the 1983-1987 missing data period, we assumed that, during those years, the number of old age retirees grew at the same annual rate as the next following five years, 1988-1992, which allowed us to come up with estimates for that period. Finally, there is no information regarding the number of old age retirees (not even total population) over age 84 by age; to overcome this data hole, we assumed that the distribution of the old age retirees over age 84, for each year, follows the distribution of the Mortality Tables from age 85 until 100, for each corresponding year, allowing us to have an estimate for the number of old age retirees over age 84 per age and sex, based on the number of total old age retirees per sex, which was made available to us at request by the Social Security Institute.

For individuals of age 65 or higher, the algorithm is different. We use the same one for both retirees and workers over age 65 because there is no way to know how long will, for instance, a worker of age 68 continue to work; it can be one more day, one more year, 10 more years, so, to simplify, we just assume that every registered worker over age 64 paying social security taxes will retire at the age he currently is.

[9] Instituto da Segurança Social, I.P.

This way, we can model everyone using only two different algorithms, one for individuals under 65, and other for individuals with 65 or more. An exception is made for retirees that retired between 60 and 64 years old, which are treated using the algorithm for people over 65, with the required adjustments to make it suitable; old age retirees younger than 60 are almost irrelevant in macro terms and will not be considered in this paper. Just as in Feldstein's, we assume no one lives longer than 100 years old, which is an acceptable assumption since, in macro terms, the impact of people over 100 years old is negligible. So, the algorithm for individuals over 64[10] is:

$$(5)\ A_{a,t} = 0.33\, Y_t \sum_{n=a}^{100} S_{a,n,t}(1+g)^{n-a}(1+d)^{-(n-a)}, 65 \leq a \leq 100.$$

The values of $A_{a,t}$ are then multiplied by the number of covered workers and old age retirees with age *a*[11], in each year *t,* and summed, creating the 2nd part of $GSSW_t$, which sums to the under 65 year old covered workers, and allows us the get the full value for $GSSW_t$.

Feldstein (1974), as already mentioned, also came with the Net *SSW* concept. Following his methodology, we assume individuals perfectly forecast the ratio of social security taxes for covered workers to per capita disposable income, θ_t, until the last period we analyze, 2012; after that, individuals are assumed to consider the ratio will remain constant forever. On average, a covered worker with *a* years old, in year *t,* pays a tax of $\theta_t Y_t$, whichever the age. When he reaches *m* years old, he will pay a tax of $\theta_{t+m-a} Y_t (1+g)^{m-a}$.

[10] For the restrict group of retirees between 60 and 64 years old, the algorithm is the same, except for *a*; in that case, $60 \leq a \leq 64$.

[11] The covered workers over age 64 are truncated at age 75, since, above this age, the data was inconsistent and the macroeconomic impact is negligible.

Assuming all workers will retire at age 65, they will only pay social security taxes until age 64[12], so the present value of all social security taxes for this individual, with age *a,* at year *t,* is equal to:

$$(6)\ TAX_{a,t} = \sum_{m=a}^{64} S_{a,m}\,\theta_{t+m-a} Y_t[(1+g)/(1+d)]^{m-a}.$$

TAX_t is simply the sum of $TAX_{a,t}$, multiplied by the number of covered employees with age *a,* for males and females. The only change we introduced in $TAX_{a,t}$ is the survival probabilities changing over time, so our algorithm is:

$$(7)\ TAX_{a,t} = \sum_{m=a}^{64} S_{a,m,t}\,\theta_{t+m-a} Y_t[(1+g)/(1+d)]^{m-a}.$$

Going back to the Gross *SSW*, one of the criticisms Feldstein received was from Leimer and Lesnoy (1982; 1985), as previously explained, because of his too simplistic assumption that workers perceive a constant average old age benefit to per capita disposable income. While they believed that the ratio was far from having small deviations from the mean, Feldstein disagreed with that, hence his persistence on using the 0.41 value. Concerning the Portuguese case, for our time period, an increasing time trend is obvious:

[12] Feldstein (1974) made an "adjustment" for those who were still working over age 64. We assume every covered worker over age 64 will retire immediately, no one of those workers will pay any more social security taxes, so we can just use one algorithm (adjusted for males and females) to obtain the present value of all future social security taxes.

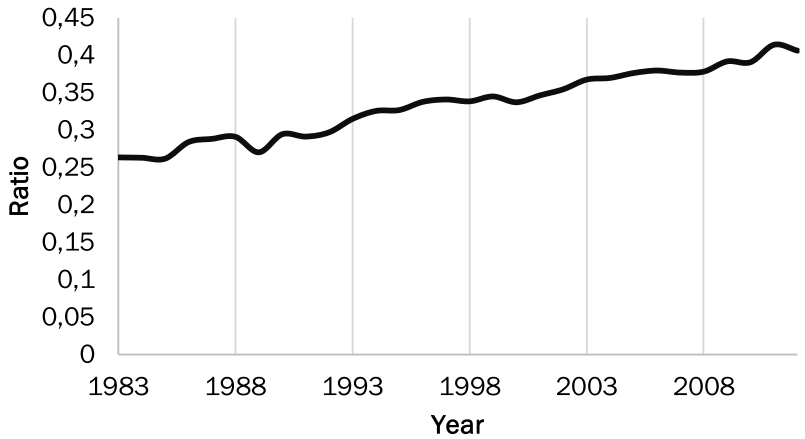

FIGURE 1 – AVERAGE OLD AGE BENEFIT DIVIDED BY PER CAPITA DISPOSABLE INCOME (SOURCE: AUTHOR'S CALCULATIONS)

Consequently, to consider only a constant ratio, representing the individuals' perception about their future benefits, seems too restrictive, since it is impossible to know for sure what people actually perceive about their future old age benefits. To deal with this issue, which is exacerbated by the Portuguese data, we follow Leimer and Lesnoy (1982; 1985) alternative perceptions, the current ratio, the adaptive expectations ratio and the perfect forecast perception. We exclude the best information ratio, but enhance the adaptive expectations' one. Unfortunately, Leimer and Lesnoy do not present the technical details about their adaptive expectations, only revealing that they use past and present information to forecast. Absent of more detailed information, we decided to use exponential smoothing models to represent this perception, since they use both past, whose weight decreases exponentially, and present information to forecast for the future. We enhance this by accepting two different ways about how individuals perceive the data; one of them is assuming individuals do not realize the existence of an increasing trend in the ratio, which is modeled by simple exponential smoothing; the other is assuming individuals are aware of a linear trend, which is modeled by Holt Winters exponential smoothing. According to Gardner (1985), simple exponential smoothing is represented by the following equation:

$$(8)\ \hat{a}_t = \alpha y_t + (1-\alpha)\hat{a}_{t-1}, with\ 0 < \alpha < 1\ .$$

We let the computer estimate the values of α, for every *t;* the higher the α, the lower the weight of the past information in the estimate. The forecasts are equal to:

$$(9)\ \hat{Y}_{T+h|T} = \hat{a}_T\ , h = 1,2, \ldots$$

This means the forecasts are constant, whatever the number of *h* periods ahead. On the other hand, Holt Winters exponential smoothing needs not one estimate, but two, in order to represent both the level of the trend and its slope, as Gardner (1985) stressed:

$$(10)\ \hat{a}_t = \alpha y_t + (1-\alpha)(\hat{a}_{t-1} + \hat{b}_{t-1}), with\ 0 < \alpha < 1,$$

$$(11)\ \hat{b}_t = \beta(\hat{a}_t - \hat{a}_{t-1}) + (1-\beta)\hat{b}_{t-1}, with\ 0 < \beta < 1.$$

The level is represented by $\hat{a}_t$ and the slope by $\hat{b}_t$. Once again the computer estimates the unknown parameters, α and β in this case. The forecast function is given by:

$$(12)\ \hat{Y}_{T+h|T} = \hat{a}_T + \hat{b}_T . h\ , h = 1,2, \ldots$$

With Holt Winters, the forecasts increase linearly every period ahead by $\hat{b}_t$. From now on, we will refer to the simple exponential smoothing forecasts simply as the adaptive expectations perspective, whilst for the Holt Winters case they should be referred as the adaptive expectations perspective with trend.

The current and adaptive expectations perspectives use the same algorithm for registered workers under 65 years old:

$$(13)\ A_{a,t} = R_t Y_t S_{a,65,t}(1+g)^{65-a}(1+d)^{-(65-a)} \sum_{n=65}^{100} S_{65,n,t}(1+g)^{n-65}(1+d)^{-(n-65)}.$$

The only difference compared to the constant ratio perspective is that instead of the 0.33 average old age pension to per capita disposable income ratio, we have R_t, representing that same ratio, but, in both the current and adaptive expectations perspectives, it changes with *t*; in the current perspective R_t equals the value of the ratio in year *t,* while in the adaptive expectations it equals the most recent forecast, using past and *t* information. For retirees and registered workers aged 65 or more, we have:

$$(14)\ A_{a,t} = R_t Y_t \sum_{n=a}^{100} S_{a,n,t}(1+g)^{n-a}(1+d)^{-(n-a)}, 65 \leq a \leq 100.$$

Concerning the perfect forecast, both active registered workers and retirees know exactly how much will their average old age pension to disposable income ratio be, for every different *t.* For instance, a worker with age 60 at year *t* knows that when he retires, at age 65, year *t*+5, his R_{t+5} will be *x,* or a retiree with age 70 at year *t* knows that 5 years later, at *t*+5, his R_{t+5} will also be *x*. This way, all $R_{T+h|T}$ will be correctly forecasted; after the last period of our analysis, 2012, the forecasted values remain constant, at 2012 levels, which is in accordance with Leimer and Lesnoy (1982):

$$(15)\ R_{T+h|T} = R_{2012}, for\ h = 1,2, \dots\ and\ T+h\ \geq 2012.$$

Regarding the adaptive expectations with trend perspective, both registered workers and retirees make their forecasts, using the Holt Winters exponential smoothing, but after 2012, just for this approach to be coherent with the perfect forecast one, we assume their forecasts will equal the 2012 forecast. This way, the algorithm we use for the perfect forecast and the adaptive expectations with trend perceptions, for registered workers aged 64 or less, is:

$$(16)\ A_{a,t} = \sum_{m=65}^{100} S_{a,m,t}\, R_{t+m-a} Y_t[(1+g)/(1+d)]^{m-a}, 15 \leq a \leq 64.$$

For registered workers with, at least, 65 years old and retirees, the algorithm is very similar, with only a change on the first term of the summation, which now starts at a variable age *a* instead of the fixed 65:

$$(17)\ A_{a,t} = \sum_{m=a}^{100} S_{a,m,t}\, R_{t+m-a} Y_t[(1+g)/(1+d)]^{m-a}, 65 \leq a \leq 100.$$

For these alternative perceptions to be consistent not only for the *GSSW*, but also for the *NSSW*, Leimer and Lesnoy (1982) extended their innovations to the present value of all future social security taxes paid by the registered workers in the future. The tax algorithm with the equivalent constant perspective becomes:

$$(18)\ TAX_{a,t} = 0.0953 \sum_{m=a}^{64} S_{a,m,t}\, Y_t[(1+g)/(1+d)]^{m-a},$$

With 0.0953 being the 1983-2012 average ratio of social security taxes for covered workers to per capita disposable income. For the current and adaptive expectations without trend we get:

$$(19)\ TAX_{a,t} = \sum_{m=a}^{64} S_{a,m,t}\, \theta_t Y_t[(1+g)/(1+d)]^{m-a},$$

Since, under this assumption, θ becomes only time variant, not age variant. For the adaptive expectations with trend, the algorithm remains unchanged compared to the original Feldstein perception for θ, the perfect forecast.

Besides these baseline scenarios, we also performed sensitivity analysis on the real discount rate, *d*, changing it positively and negatively by 1 percentage point, to

4% and 2%, respectively, whose main purpose was to check the robustness of the econometric results to such changes.

5. Methodology and Results

To estimate the impact of social security on private savings, Feldstein (1974) used the following consumption expenditure function:

$$(20)\ C_t = \beta_0 + \beta_1 YD_t + \beta_2 YD_{t-1} + \beta_3 RE_t + \beta_4 W_{t-1} + \beta_5 SSW_t,$$

Where C_t is consumer expenditure at year t, YD_t and YD_{t-1} represent disposable income at year *t* and *t-1*, and are a proxy for permanent income at year *t*, RE_t is retained earnings at year t, W_t is the stock of household wealth at year t and SSW_t is as previously defined in the Data and Algorithms section. Later in his paper, Feldstein (1974) also included a RU_t variable, representing the unemployment rate at year *t*, although he ended up excluding this variable claiming it was statistically insignificant. All values are defined in constant prices and divided by population.

Our initial equation is very similar to Feldstein's, although we use family savings, S_t, instead of consumer expenditure as the dependent variable, exclude the retained earnings due to data problems and also include the unemployment rate:

$$(21)\ S_t = \beta_0 + \beta_1 YD_t + \beta_2 YD_{t-1} + \beta_3 W_{t-1} + \beta_4 SSW_t + \beta_5 RU_t.$$

Family savings, S_t, was extracted from PORDATA, which standardized to the most recent accounting method all values for the whole period and used Bank of Portugal and Statistics Portugal as their source; disposable income, YD_t, was obtained from Bank of Portugal's BPstat; household wealth, W_t, is financial and real assets held by families minus their respective liabilities, and was available at

BPstat; social security wealth, SSW_t, was calculated as previously explained; the unemployment rate, RU_t, was extracted from Valério (2001)[13] until 1991, and later on from Statistics Portugal. All variables are expressed in millions of euros, except the unemployment rate, at constant 2011 prices, deflated using the GDP deflators available at PORDATA, excluding family savings, which we found more appropriate to multiply by the private consumption deflator, available at PORDATA as well, and divided by total population, obtained in Statistics Portugal, for each corresponding year. The results, using OLS, Feldstein's original perception for *SSW*, gross and net, respectively, and *d* = 3% can be seen in Tables III and IV.

As one can observe, there are no statistically significant regressors at 5% for neither *SSW* variable and the p-values for YD_{t-1} and RU_t are particularly high, so their inclusion may cause statistical problems (Brooks, 2008). Furthermore, by looking to the sample partial correlation function of *YD*[14] (Figure 3):

$$(22)\ \widehat{YD}_t = \widehat{\phi_{k0}} + \widehat{\phi_{k1}} YD_{t-1} + \widehat{\phi_{k2}} YD_{t-2} + \ldots + \widehat{\phi_{kk}} YD_{t-k},$$

We can see that $\widehat{\phi_{k1}}$ = 0.928, a value very close to the unity, whose inclusion can raise high multicollinearity issues, as explained in Brooks (2008), so despite the inclusion of YD_{t-1} in the literature, due to econometric reasons we will remove that regressor from our equations. After such transformation, *RU* continued to feature too high p-values to be included, so we decided not to use it. Our next equation, became, as a result, the following:

$$(23)\ S_t = \beta_0 + \beta_1 YD_t + \beta_2 W_{t-1} + \beta_3 SSW_t.$$

With the changes we did, apart from the constant *C* with the *GSSW* concept, all regressors are now significant at 5% (W_{t-1} is only at 6%). *YD* has a positive

[13] Valério (2001) is the only reliable source for narrow unemployment rate calculations prior to 1992.

[14] See Enders (2008)

coefficient, which is expected given than an increase in disposable income, unless the marginal consumption rate was 100%, automatically increases savings. *W* features a negative one, again it is according to the theory: more wealth means more assets to deccumulate during old age, so less need to save for retirement. The theoretically ambiguous coefficient sign is for *SSW,* and for both gross and net, the sign is negative and statistically significant, which seems to indicate that, in Portugal, and during our analysis period, social security has reduced family savings, a result in accordance to Feldstein's findings. We performed residual diagnostic tests in order to access the quality of the model, before any further conclusions. To test until 2nd order residual autocorrelation we followed Brooks (2008) and used the Breusch-Godfrey LM test. The p-value of the F-Statistic was 0.3093, not rejecting the null hypothesis of no serial correlation. We followed the same author to test for the presence of heteroscedasticity, using the White test, although in this case we also used the Breusch-Pagan test to complement the diagnostic checking; the p-values of the F-Statistics were, correspondingly, 0.2527 and 0.2502, not rejecting the null hypothesis of homoscedasticity. Equation (23) estimates, with all the different perceptions, for both *GSSW* and *NSSW*, but still with d = 3%, are presented in Table V and the results show that *SSW*, gross or net, has always a negative estimated coefficient and is statistically significant at 5% and even 1% except for one situation. Besides the constant term, the other coefficient estimates and respective p-values appear somewhat robust, with only relatively small changes (never in sign) and very similar p-values. We re-estimate all regressions using the *SWW* variables with d = 2% and d = 4%, but all coefficient estimates and p-values suffered very minor changes, with the only exception being the constant term, which is the one we care less about.

We also enhanced our equations by adding two more regressors: one is the real interest rate, *RI,* (we use real deposit rates) obtained from Bank of Portugal historical series and BPstat, introduced in Darby (1979), and the other is government balance, *GB,* which was included in Barro (1978)[15]. The inclusion of a lagged *YD* regressor would bring the multicollinearity problem back, so we will only include *RU* and see if its p-value decreases. The equation becomes:

$$(24)\ S_t = \beta_0 + \beta_1 YD_t + \beta_2 W_{t-1} + \beta_3 SSW_t + \beta_4 RU_t + \beta_5 RI_t + \beta_6 GB_t.$$

The results (Tables VI and VII), using Feldstein original perception and d = 3%, for *GSSW* and *NSSW*, are now sensitive to the used *SSW* concept, although all coefficient signs are coherent with the theory. When using the *GSSW*, its own coefficient estimate is now statistically insignificant at 5%, but significant at 10%, and the same applies to *RU*, which represents a major change compared to equation (21). Nevertheless, if we use the *NSSW* concept, the *SSW* coefficient estimate remains statistically significant at 5%, but *RU* becomes once more completely insignificant. The new regressors, *RI* and *GB* are, respectively, statistically insignificant and significant, regardless of the used *SSW* concept. We decided, following Brooks (2008), to re-estimate the equation without *RU* and *RI*, since removing one of them automatically made the other insignificant. The new equation is:

$$(25)\ S_t = \beta_0 + \beta_1 YD_t + \beta_2 W_{t-1} + \beta_3 SSW_t + \beta_4 GB_t,$$

And the estimation outputs are available in Tables VIII and IX. Now, all coefficients are statistically significant at 5% except the constant under the *NSSW*

[15] The theoretical reason to include the government balance is that if individuals have rational expectations, an improvement in the government balance will lead to a lower public debt later on, which translates into lower taxes in the future, leading to higher disposable income in the future, therefore there is less need to save today to keep a stable consumption during life. In Leimer and Lesnoy (1981).

concept, which is no major concern. These results did not show any statistical evidence of residual autocorrelation and heteroscedasticity under the same tests we performed for equation (23) and were stable under the alternative perceptions and *d*'s, except for the constant, which is highly volatile, and *GB*, which remained stable under all but the adaptive expectations with trend perception with *d* = 3% and 2%. So far we have following our main literature to model our regressions with some adjustments to increase their statistical quality, according to Brooks (2008). However, nowadays we are aware of econometric issues that had not been developed by the time of Feldstein's and Leimer and Lesnoy's main papers. One of such issues is stationarity or non-stationarity of time series (also called Unit Roots). If our regression contains only stationary time series, our results are statistically valid, but if it has non-stationary ones, they are not, as stressed in Brooks (2008) and Enders (2008). To test for non-stationarity we follow these authors and perform Augmented-Dickey-Fuller (ADF) tests. For our variables with clear time trends we test the null hypothesis of a stochastic trend versus the alternative of a deterministic trend, whilst for series without apparent trends we test the null hypothesis of non-stationarity against the alternative of stationarity. By analyzing the series' graphical representations, it is clear that the ones with an unambiguous trend are *YD*, *W* and all *SSW* variations. *S* does not have such a strong trend but it still appears to be decreasing over time and *RU* has been very mean reverting except in the final periods of the time series, which are obvious outliers. *RI* and *GB* show no trend at all.

Table X summarizes the results of the ADF tests, including the automatically adjusted p-values for the Dickey-Fuller distribution. We never found statistical evidence against the existence of a unit root at the 5% critical value, except for *GB*.

The reason for the cell corresponding to *SSW* adjusted p-value being empty is because it differs across the *SSW* variations; despite having significantly different p-values among the several perceptions, at 5% there was never statistical evidence against the existence of a unit root.

These findings mean that all results so far may not be statistically valid, unless the variables are cointegrated, a process at which non-stationary regressors have a long-run linear stationary relationship, which would just require us to make some adjustments in order to have valid statistical inference, as Brooks (2008) points out. If cointegration is not verified, our regressions are spurious and we must obtain first differences to have a good econometric model. The potential cost is that the economic reasoning and interpretation of the model becomes very weak. We will follow Brooks (2008) approach and use the Engle-Granger test to access this issue and check the robustness of the results by performing another cointegration test, the Phillips-Ouliaris. Since only *S*, *YD, W* and *SSW* are non-stationary with a trend, we will do the cointegration tests for only these four variables[16]; the null hypothesis for both tests is of no cointegration between the variables and the reported p-values are in accordance to the Engle-Granger and Phillips-Ouliaris distributions. The results, using *d* = 3%, are presented in Table XI.

All p-values are below the 10% significance level, using either test, and the majority are below the 5%. Furthermore, the p-values only decrease slightly, for all *SSW* concepts and perceptions, using the Phillips-Ouliaris test compared to the Engle-Granger, becoming even more statistically significant, and the results never change more than 1 percentage point with *d* = 2% or 4%. Therefore we can

[16] We also did the cointegration tests for all non-stationary variables at once, adding *RU* and *RI*, but the results showed evidence of no cointegration if such variables were included. This is expected since both *RU* and *RI*, despite non-stationary, have no trend.

conclude that there is no statistical evidence that *S, YD, W* and *SSW* are not cointegrated. With such results, our regressions need the estimator to take this information about cointegration into account; such can be done using the Fully Modified Least Squares (FMOLS) estimator (Phillips and Hansen, 1990), and will allow us to have valid statistical inference. The p-values for the *SSW* variables, for all *d*'s, are presented in Table XII.

Before we analyze the results, it is important to stress that besides *YD, W* and *SSW* being estimated in cointegration with *S*, we also included *GB*, which is stationary, and the first differences of *RU* and *RI*, but the latter were always statistically insignificant at 10%, therefore we excluded them. All explanatory variables, except *SSW,* the constant and the trend, were always statistically significant at 5%.

Almost under all alternative perceptions, the *SSW* coefficient estimates have a negative sign, which may be tempting for one to conclude that social security has depressed private savings, but the p-values do not support such statement.

Starting with the *GSSW* concept, the lowest achieved p-value is with *d* = 2% and under the adaptive expectations without trend perception, being equal to 0.2989. This value is way above the 10% significance level, which means that, even at 10%, there is no statistical evidence against the null hypothesis of the *SSW* variable being statistically irrelevant to explain *S*, whichever the perception we choose. Turning to the *NSSW*, the lowest p-value is once more estimated under *d* = 2% and the adaptive expectations without trend perception. With a value equal to 0.0965, this result is statistically significant at 10%, by a very narrow margin, but not at 5%; all other p-values are above 10%, ranging from 0.1035 (under *d* = 3% and adaptive expectations without trend) to 0.2356 (under *d = 3%* and perfect forecast), if one excludes the results from the adaptive expectations with trend perception, which are clearly outliers either under the net or the gross concept, and are also the only ones to feature a positive coefficient estimate.

We want to highlight the fact that the latest estimated results, with the FMOLS estimator, are the only ones statistically adequate, and they clearly indicate that an increase in disposable income *per capita* increases family savings *per capita,* as expected; an increase in household wealth *per capita* in *t-1* decreases family savings *per capita* in *t*, which is theoretically coherent; and that an improvement in the Government balance also decreases family savings *per capita*, giving some insight that individuals may have rational expectations. Concerning social security wealth *per capita*, our results for Portuguese time series data contradict Feldstein's (1974; 1982), showing that this variable has no statistical effect on family savings *per capita*, a conclusion that favors Leimer and Lesnoy's (1982;1985). Theoretically our results mean that the substitution effect of social security wealth, in Portugal, have canceled out the early retirement effect, hence the statistical irrelevance or, if one believes in Cagan (1965), for instance, it means that the educational effect of social security has made individuals aware of the need to save for retirement, and this effect is similar in magnitude to the substitution effect (reduction in private savings in favor of social security wealth).

6. Conclusions and Future Research

The way social security affects private savings has been widely studied since the late 1970's, yet no consensus on the topic was reached so far. Whilst some authors found empirical evidence of social security having a negative impact on private savings, others stated that such impact is not statistically relevant.

This work used Portuguese time series data, from 1983 to 2012, to seek out what effect has social security had on private savings in Portugal. When we make use of recent econometric developments, taking into consideration certain aspects such as non-stationarity and cointegration, we conclude that, according to the model and data we used, social security in Portugal has not had any significant impact, either positive or negative, on private savings, regardless of the alternative scenarios we employed. With PAYG mature systems facing a growing opposition concerning the economic and financial impact they have, our results challenge the idea that PAYG systems reduce private savings, which may be useful for policy makers in Portugal.

However, caution must be taken since this paper has some limitations, such as a small time series (30 years), some assumptions, mainly in the construction of the social security wealth variable, that are not free of subjectivity, and some data that had to be estimated given the fact that, at the time this paper was produced, the corresponding true values were not made available to us by the official institutions that could provide it. Although we believe *SSW* values would not change dramatically, one can never be totally sure.

Further research on this topic could be, for instance, the introduction of recent econometric methods to previously published papers, to see if the previous results still hold, since, in our work, the results changed completely with such introductions, or alternative private savings/consumer expenditure functions for time series data. Different methodologies, focusing on questionnaires and micro data, to gather some insights about how individuals perceive, in the present, their future social security benefits/taxes would also be both interesting and important.

References

Abel, A. B., Bernanke, B. S., & Croushore, D. (2014). *Macroeconomics* (8th ed.). Pearson Education.

Aghion, P., Comin, D., & Howitt, P. (2006). *When does domestic saving matter for economic growth?* (No. w12275). National Bureau of Economic Research.

Ando, A., & Modigliani, F. (1963). The" life cycle" hypothesis of saving: Aggregate implications and tests. *The American Economic Review*, 55-84.

Attanasio, O. P., & Brugiavini, A. (2003). Social security and households' saving. *The Quarterly Journal of economics*, 1075-1119.

Barr, N. (2012). *Economics of the Welfare State* (5th ed.). Oxford: Oxford University Press.

Barro, R. J. (1998). *Determinants of Economic Growth: A Cross-country Empirical Study*. MIT Press.

Blake, D. (2006). *Pension economics*. John Wiley & Sons.

Blanchard, O. (2006). *Macroeconomics* (4th ed.). Pearson Prentice Hall.

Bodie, Z. (1990). Pensions as Retirement Income Insurance. *Journal of Economic Literature*, 28-49.

Boeri, T. (2002, December 3). Let Social Policy Models Compete and Europe Will Win. TRANSATLANTIC PERSPECTIVES ON US-EU ECONOMIC RELATIONS: CONVERGENCE CONFLICT AND COOPERATION (p. 23). Harvard: John F. Kennedy School of Government, Harvard University.

Brooks, C. (2008). *Introductory econometrics for finance*. Cambridge University Press.

Caballé, J., & Santos, M. S. (1993). On endogenous growth with physical and human capital. *Journal of Political Economy*, 1042-1067.

Cagan, P. (1965). The effect of pension plans on aggregate saving: Evidence from a sample survey. *NBER Books*.

Darby, M. R. (1979). *The effects of social security on income and the capital stock*. Washington, DC: American Enterprise Institute for Public Policy Research.

David, M., & Menchik, P. L. (1985). The effect of social security on lifetime wealth accumulation and bequests. Economica, 421-434.

Dooley, M., Frankel, J., & Mathieson, D. J. (1987). International capital mobility: What do saving-investment correlations tell us?. *Staff Papers-International Monetary Fund*, 503-530.

Dynan, K. E., Skinner, J., & Zeldes, S. P. (2002). The importance of bequests and life-cycle saving in capital accumulation: A new answer. *American Economic Review*, 274-278.

Enders, W. (2008). *Applied econometric time series*. John Wiley & Sons.

Feldstein, M. (1974). Social security, induced retirement, and aggregate capital accumulation. *The Journal of Political Economy*, 905-926.

Feldstein, M. S. (1979). The Effect of Social Security on Saving. *NBER Working Paper*, (w0334).

Feldstein, M. (1980). International differences in social security and saving. *Journal of Public Economics*, *14*(2), 225-244.

Feldstein, M. S. (1982). Social security and private saving: reply. *The Journal of Political Economy*, 630-642.

Feldstein, M., & Horioka, C. (1980). Domestic Saving and International Capital Flows. *The Economic Journal*, *90*(358), 314-329.

Friedman, M. (1971). *A Theory of the Consumption Function* (6th ed.). Princeton: Princeton University Press.

Garcia, M.T., & Silva, C.M. (1994). A função poupança em Portugal: Ensaio da aplicação da teoria do ciclo de vida. *Estudos de Economia,* 175-193.

Gardner, E. S. (1985). Exponential smoothing: The state of the art. *Journal of Forecasting*, *4*(1), 1-28.

Harrod, R. F. (1939). An essay in dynamic theory. *The Economic Journal*, 14-33.

Hurd, M., Michaud, P. C., & Rohwedder, S. (2012). The displacement effect of public pensions on the accumulation of financial assets*. *Fiscal studies*, *33*(1), 107-128.

Instituto de Gestão Financeira da Segurança Social, I.P. (2015). *Conta da segurança social 2013.* Retrieved from Social Security website: http://www4.seg-social.pt/publicacoes?bundleId=11474397

Kuijs, L. (2005). Investment and saving in China. *World Bank Policy Research Paper Series*, (3633).

Leimer, D. R., & Lesnoy, S. D. (1981). Social security and private saving: New time series evidence with alternative specifications. (No. w22). ORES.

Leimer, D. R., & Lesnoy, S. D. (1982). Social security and private saving: New time-series evidence. *The Journal of Political Economy*, 606-629.

Lesnoy, S. D., & Leimer, D. R. (1985). Social security and private saving: theory and historical evidence. *Soc. Sec. Bull.*, *48*, 14.

Menchik, P. L., & David, M. (1983). Income distribution, lifetime savings, and bequests. *The American Economic Review*, 672-690.

Modigliani, F. (1988). The role of intergenerational transfers and life cycle saving in the accumulation of wealth. *The Journal of Economic Perspectives*, 15-40.

Phillips, P. C., & Hansen, B. E. (1990). Statistical inference in instrumental variables regression with I (1) processes. *The Review of Economic Studies*, *57*(1), 99-125.

Rebelo, S. (1991). Long-Run Policy Analysis and Long-Run Growth. *The Journal of Political Economy*, *99*(3), 500-521.

Romer, D. (2006). *Advanced macroeconomics* (3rd ed.). McGraw-Hill/Irwin.

Romer, P. M. (1986). Increasing returns and long-run growth. *The Journal of Political Economy*, 1002-1037.

Romer, P. M. (1994). The origins of endogenous growth. *The Journal of Economic Perspectives*, 3-22.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 65-94.

Stern, N. (1991). The determinants of growth. *The Economic Journal*, 122-133.

Sturm, P. H. (1983). Determinants of saving: theory and evidence. *OECD Economic Studies*, *1*(1983), 147-96.

Triantis, S. G. (1997). Life cycle theory and the impact of the rate of economic growth on saving. *Applied Economics Letters*, *4*(11), 661-663.

Valério, N (coord). (2001). *Estatísticas históricas portuguesas: Portuguese historical statistics. Instituto Nacional de Estatística.*

Legislative:

Council of Ministers Resolution no. 110/2005, D. R. I Série. 124 (2005-06-30) 4054-4056

Decree (Portaria) no. 514/90, D. R. I Série. 154 (1990-07-06) 2846-2847

Decree-Law no. 140-D/86, D. R. I Série. 134 (1986-06-14) 1406

Decree-Law no. 259/89, D. R. I Série. 186 (1989-08-14) 3277-3279

Decree-Law no. 9/99, D. R. I Série. 6 (1999-01-08) 92-95

Decree-Law no. 187/2007, D. R. I Série. 90 (2007-05-10) 3100-3116

Decree-Law no. 167-E/2013, D. R. I Série. 253 (2013-12-31) 364-369

Law no. 28/84, D. R. I Série. 188 (1984-08-14) 2501-2510

Law no. 19A/96, D. R. I Série-A. 149 (1996-06-29) 1690

Law no. 17/2000, D. R. I Série. 182 (2000-08-08) 3813-3825

Law no. 32/2002, D. R. I Série. 294 (2002-12-20) 7954-7968

Law no. 4/2007, D. R. I Série. 11 (2007-01-16) 345-356

Annexes

The following figure decomposes Boeri's (2002) four models into four social protection categories[17], providing a better perspective of their dimensions:

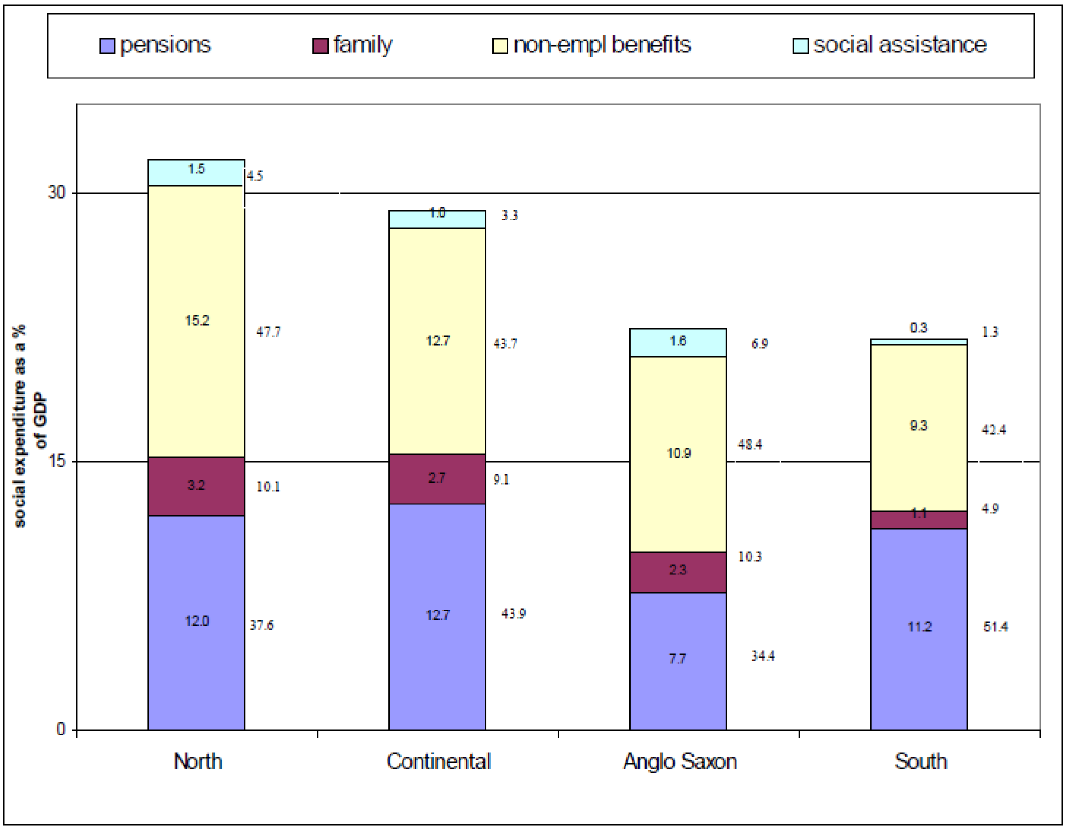

FIGURE 2 – WEIGHTS OF SOCIAL EXPENDITURE PER MODEL (SOURCE: BOERI, 2002)

TABLE III - FIRST MODEL USING FELDSTEIN'S ORIGINAL PERSPECTIVE AND *GSSW*

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*p-value*
C	15.68694	1082.691	0.014489	0.9886
YD_t	0.359447	0.177479	2.025297	0.0546
YD_{t-1}	0.002545	0.138541	0.018371	0.9855
W_{t-1}	-0.030212	0.020135	-1.500497	0.1471
GSSW	-0.072865	0.040434	-1.802064	0.0847
RU	-4.181201	17.93429	-0.233140	0.8177

Source: EViews 8 output

[17] Pensions include old age and survival pensions, family incorporates child-care and family benefits, non-employment benefits refers to unemployment, sickness, invalidity benefits, among others, and lastly social assistance is focused on mean-tested benefits.

TABLE IV - FIRST MODEL USING FELDSTEIN'S ORIGINAL PERSPECTIVE AND *NSSW*

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*p-value*
C	553.5669	921.3377	0.600829	0.5538
YD_t	0.253698	0.147062	1.725113	0.0979
YD_{t-1}	0.001259	0.141537	0.008893	0.9930
W_{t-1}	-0.034946	0.020947	-1.668300	0.1088
NSSW	-0.068001	0.044289	-1.535370	0.1383
RU	5.471178	25.52990	0.214305	0.8322

Source: EViews 8 output

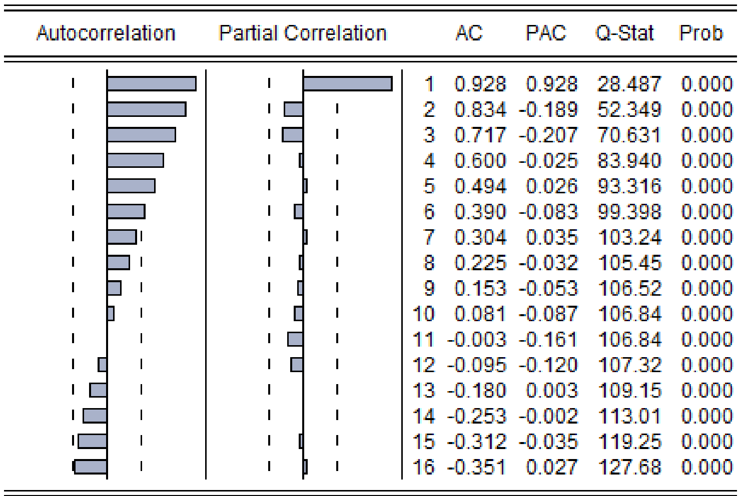

FIGURE 3 – SAMPLE AUTO AND PARTIAL CORRELATION FUNCTIONS (SOURCE: EVIEWS 8)

TABLE V - ADJUSTED FIRST MODEL USING ALL PERCEPTIONS AND *SSW* CONCEPTS

Concept	*Perception*	*C*	*p-value*	*YD*	*p-value*	*W*	*p-value*	*SSW*	*p-value*
Gross	Feldstein	-189.9	0.731	0.392	0.000	-0.031	0.059	-0.080	0.001
Gross	Constant	-189.9	0.731	0.392	0.000	-0.031	0.059	-0.080	0.001
Gross	Current	459.8	0.258	0.266	0.002	-0.031	0.062	-0.037	0.001
Gross	Simple Smoothing	437.5	0.279	0.268	0.002	-0.030	0.061	-0.038	0.001
Gross	H.W. Smoothing	527.6	0.224	0.263	0.004	-0.029	0.097	-0.039	0.004
Gross	Perfect Forecast	-92.34	0.862	0.370	0.001	-0.031	0.057	-0.059	0.001
Net	Feldstein	733.4	0.039	0.231	0.006	-0.034	0.038	-0.059	0.002
Net	Constant	565.8	0.140	0.248	0.004	-0.032	0.047	-0.059	0.001
Net	Current	919.8	0.005	0.207	0.011	-0.035	0.034	-0.034	0.002
Net	Simple Smoothing	904.7	0.006	0.208	0.011	-0.035	0.034	-0.034	0.002
Net	H.W. Smoothing	1222	0.000	0.166	0.051	-0.034	0.061	-0.023	0.020
Net	Perfect Forecast	614.5	0.102	0.247	0.004	-0.033	0.040	-0.047	0.002

Source: EViews 8 output

TABLE VI - EXTENDED MODEL USING FELDSTEIN'S ORIGINAL PERSPECTIVE AND *GSSW*

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*p-value*
C	-46.81817	834.9469	-0.056073	0.9558
YD_t	0.392735	0.132053	2.974077	0.0070
W_{t-1}	-0.043390	0.013145	-3.300803	0.0033
GSSW	-0.057497	0.032173	-1.787103	0.0877
RU	-27.64210	15.09317	-1.831431	0.0806
RI	17.54594	11.94958	1.468331	0.1562
GB	-39.30443	10.18426	-3.859329	0.0008

Source: EViews 8

TABLE VII - EXTENDED MODEL USING FELDSTEIN'S ORIGINAL PERSPECTIVE AND *NSSW*

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*p-value*
C	2.139079	696.6370	0.003071	0.9976
YD_t	0.355390	0.102575	3.464676	0.0022
W_{t-1}	-0.048477	0.012799	-3.787434	0.0010
NSSW	-0.071873	0.034281	-2.096596	0.0477
RU	-11.74684	19.92988	-0.589409	0.5616
RI	15.99336	11.76782	1.359075	0.1879
GB	-42.46623	10.01885	-4.238635	0.0003

Source: EViews 8

TABLE VIII - ADJUSTED EXTENDED MODEL USING FELDSTEIN'S ORIGINAL PERSPECTIVE AND *GSSW*

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*p-value*
C	-1188.893	554.0664	-2.145759	0.0422
YD_t	0.556855	0.095362	5.839389	0.0000
W_{t-1}	-0.040502	0.013421	-3.017800	0.0059
GSSW	-0.107983	0.020186	-5.349338	0.0000
GB	-33.12242	10.07340	-3.288109	0.0031

Source: EViews 8

TABLE IX - ADJUSTED EXTENDED MODEL USING FELDSTEIN'S ORIGINAL PERSPECTIVE AND *NSSW*

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*p-value*
C	-250.3836	348.8969	-0.717644	0.4799
YD_t	0.378728	0.068505	5.528455	0.0000
W_{t-1}	-0.046226	0.012298	-3.758923	0.0010
NSSW	-0.092598	0.015195	-6.093984	0.0000
GB	-41.93171	9.923712	-4.225406	0.0003

Source: EViews 8

TABLE X - UNIT ROOT AUGMENTED DICKEY-FULLER TESTS' RESULTS

Variable	*Deterministic component*	*Adjusted p-value*	*Stationarity*
S	Intercept and Trend	0.0719	Non-stationary
YD	Intercept and Trend	0.9978	Non-stationary

W	Intercept and Trend	0.9940	Non-stationary
SSW	Intercept and Trend		Non-stationary
RU	Intercept	1	Non-stationary
RI	Intercept	0.1924	Non-stationary
GB	Intercept	0.0043	Stationary

Source: EViews 8

TABLE XI - COINTEGRATION ENGLE-GRANGER AND PHILLIPS-OULIARIS TESTS' RESULTS

Concept	*Perception*	*E-G tau-Statistic*	*E-G p-value*	*P-O tau-Statistic*	*P-O p-value*
Gross	Feldstein	-4.836586	0.0631	-4.943515	0.0525
Gross	Constant	-4.836586	0.0631	-4.943515	0.0525
Gross	Current	-5.006523	0.0471	-5.160104	0.0358
Gross	Simple Smoothing	-4.920058	0.0547	-5.053349	0.0433
Gross	H.W. Smoothing	-5.054948	0.0432	-5.232964	0.0314
Gross	Perfect Forecast	-4.845028	0.0622	-4.955903	0.0514
Net	Feldstein	-5.030778	0.0451	-5.190815	0.0339
Net	Constant	-4.970829	0.0501	-5.116457	0.0387
Net	Current	-5.092393	0.0404	-5.250537	0.0304
Net	Simple Smoothing	-5.034376	0.0448	-5.186748	0.0341
Net	H.W. Smoothing	-4.797782	0.0674	-4.886581	0.0580
Net	Perfect Forecast	-4.991757	0.0483	-5.142267	0.0370

Source: EViews 8

TABLE XII - FINAL MODEL'S P-VALUES FOR THE *SSW* COEFFICIENT

Concept	*Perception*	*d = 3%*	*d = 2%*	*d = 4%*
Gross	Feldstein	0.4768	0.4793	0.4906
Gross	Constant	0.4768	0.4793	0.4906
Gross	Current	0.4074	0.3826	0.4243
Gross	Simple Smoothing	0.3141	0.2989	0.3266
Gross	H.W. Smoothing	0.9124	0.8468	0.8505
Gross	Perfect Forecast	0.4591	0.4493	0.4683
Net	Feldstein	0.1430	0.1811	0.1294
Net	Constant	0.1970	0.2407	0.1704
Net	Current	0.1482	0.1605	0.1400
Net	Simple Smoothing	0.1035	0.0965	0.1166
Net	H.W. Smoothing	0.9405	0.8762	0.8846
Net	Perfect Forecast	0.2138	0.2356	0.1921

Source: EViews 8