MASTER OF MONETARY AND FINANCIAL ECONOMICS

MASTERS FINAL WORK

DISSERTATION

ASSESSING PENSION EXPENSES DETERMINANTS – THE CASE OF PORTUGAL

André Fernando Rodrigues Rocha da Silva

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Supervisor: Maria Teresa Medeiros Garcia

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Glossary

FEFSS – “Fundo de Estabilização Financeira da Segurança Social” in Portuguese;

GDP – Gross Domestic Product;

LHS – Left-Hand Side;

OLG – Overlapping Generations Model;

PAYG – Pay-As-You-Go Pension Scheme;

RHS – Right-Hand Side;

TFP – Total Factor Productivity;

TSU – Contribution rate (“Taxa Social Única” in Portuguese);

VAR – Vector Autoregressive Model;

VEC – Vector Error Correction;

VECM – Vector Error Correction Model.

Abstract

The lack of studies about the impact of demographic and economic variables such as ageing, productivity and unemployment, on Portuguese Social Security expenditures, arises expected concerns on its financial sustainability. From a theoretical perspective, low fertility increases old-age dependence index and decreases economic growth, reinforced by unemployment which shrinks the contributory base and productivity (increasing the burden of pension expenditures on the overall economy). However, it is crucial to develop an applied work in this field in Portugal to assess these conclusions.

Using Portuguese time-series data from 1975 to 2014, it was found statistical evidence of cointegration between unemployed people aged between 15 and 64 years old, apparent productivity of labour and old-age dependence index (explanatory variables) and pension expenditure as a share of GDP (dependent variable), but the sign of long-run coefficient for the demographic component differs when the dummy components are excluded, raising doubts about the impact of ageing on pension expenditures. The remaining explanatory variables present a positive sign, positively influencing the pension expenditure as a share of GDP. At last, it was developed a VECM model with impulse-response functions and variance decomposition, and the results showed that, in Portugal, ageing has an almost insignificant impact in the long-run, comparing with unemployment and productivity.

JEL Classification: C32, C51, C52, H55

Keywords: Social Security, Unemployment, Productivity, Ageing, VECM, Portugal.

Acknowledgements

This dissertation tries to bring an alternative point of view in relation to a topic which has become a great concern for public finances in Portugal and a big question mark for contributors and pensioners: the future of the Social Security System in an increasing ageing society.

I would like to thank Professor Teresa Garcia, who helped me surpass the problems concerning the data and the theoretical framework of this work, being extremely helpful to me.

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This work is fully dedicated to my parents and my girlfriend. Without their support (not only financial, but also for believing in my ability to provide a useful contribution to society), I would feel completely lost and unmotivated.

All errors are mine.

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1. Introduction

Nowadays, there is an increasing interest in the analysis of the impact of ageing on public finances, particularly in terms of fiscal costs and consequently government deficits in Portugal, raising questions about the financial sustainability of the social security system. As Carone *et al.* (2005) pointed out, recent demographic forecasts about the evolution of Portuguese population induce several impacts on real economy, encompassing the quality of labour inputs (influenced by the age structure and the human capital accumulated by the workforce), the capital/labour ratio, labour-augmenting technical progress and labour input as direct effects. Moreover, the reinforcement of indirect effects, such as the rise in labour taxes to finance age-related spending (which may cause unemployment and distortions of economic decisions, affecting the labour supply) can step up an even more shrinkage on economic growth.

But the literature arguments diverge: for instance, such change on the population age structure and the progress on life expectancy are associated to profound changes (and, some of them, positive) suffered by the social structures, such as the creation of social security, the increase of education, the increase of productivity or the decrease of hours worked. A young age structure can be beneficial in a rural society, mostly dependent on the quantity of labour force, but can be disadvantageous in an advanced industrial society mostly dependent on capital and labour force knowledge, allowing the connection between ageing and economic growth (Rosa, 1996).

Regarding the mainstream literature about pensions, the last changes on population and social structures are leaving several European Social Security Systems in distress: declining fertility and increasing longevity would place public finances under pressure due to the rise of expenditures on age-related programs (pensions and health), causing unsustainable public debts, cuts in other type of important spending and large tax increases. Such events could reduce economic growth and, without a proportional reduction in interest rates, hamper reductions on debt-to-GDP ratio (Clements *et al.*, 2015).

In Portugal, there are few studies about what influences the behaviour and evolution of Portuguese pensions expenditure and which link is established between pensions expenditure as dependent variable and other relevant explanatory variables, with the inclusion of the most recent developments on relevant variables, covering today´s Portuguese environment and data[1]. Then, it is crucial to determine the causes of that kind of relationship, how to handle the present situation and its implications in the following generations, and the right policies to adopt. Only such analysis allows to confirm or deny the existing conclusions, or even discover alternative ones.

As such, this work aims to understand which variables have a relevant influence on social security pensions expenditure, providing some evidence about the impact of ageing on public finances and comparing the main arguments about this topic. Thereafter, the determination of the variables and its influence on pension expenditure will be measured and predicted using econometric techniques in order to bring an additional contribution and an alternative methodology in relation to previous studies.

Chapter 2 explains the evolution of the Portuguese Social Security System. Chapter 3 presents some of the literature covering some projections and policy

[1] Some exceptions are Andraz & Pereira (2012), Garcia & Lopes (2009), Garcia (2014), Martins (2014), Rodrigues (2015) and Castro *et al.* (2015).

approaches about pensions, ageing and macroeconomic variables. Chapter 4 focuses on the data and methodology used. Chapter 5 explains the results. Chapter 6 concludes, showing the main limitations and comments on future researches related to this theme.

2. The Portuguese Social Security System

The First Social Security Act was published in 1984 (Decree-Law no. 28/84. 14th August), establishing a contributory regime (guaranteeing the protection to workers and their families in the case of disability, unemployment, death or family expenses) and a non-contributory regime (protecting individuals with lack of subsistent resources, not covered by the contributory regime). It is "an earnings-related public pension scheme with a means-tested safety net" (OECD, 2015, p. 325), where the contributory regime is financed by Social Security budget (mainly by contributions from workers and employers), while the non-contributory regime and social action are financed mainly by State budget transfers (Segurança Social, 2015).

Important legislation was implemented in the following years:

- Decree-Law no. 140-D/86, 14th July - Contribution rates (TSU) are set to be paid by employees and employers in 11% and 24%[2], respectively, of remuneration for work performed, being the percentage of 0,50% to finance the professional sickness benefit;
- Decree-Law no. 259/89, 14th August – The Social Security Reserve Fund (FEFSS) was created in order to guarantee the financial stabilization of the social security system;

[2] Today, contribution rates are 11% for employees and 23,75% for employers.

- Decree-Law no. 514/90, 6th July – The attribution to retirees and pensioners of a 14th month, making them equivalent (in number of payments) in relation to the majority of the active workers.
- Decree-Law no. 329/93, 25th September – The reform of the juridical regime of old-age and disability pensions, which includes the standardization of the official retirement age of 65 years.[3]

The Second Social Security Act was published in 2000 (Law no. 17/2000, 8th August), but was revoked by the Third Social Security Act in 2002 (Law no. 32/2002, 20th December) dividing the system into three subsystems: Social Security Public System, Social Support System and Complementary System[4]. It is equally important to refer the approval of Council of Ministers Resolution no. 110/2005, which intends to start the convergence of the Civil Servants Fund to the General Social Security System[5].

The Fourth Social Security Act (Law no 4/2007, 16th January) approved the general basis of the General Social Security System currently implemented, creating three subsystems: Citizenship Social Protection, Social Welfare System and Complementary System[6]. Moreover, the Decree-Law no. 187/2007 introduced a sustainability factor[7], having into account the evolution of an increasing life expectancy, penalizing anticipated

[3] However, it includes a "transitional period of six years for the gradual introduction of the measure that takes into account the higher life expectancy of women and the frequent existence of shorter careers" (Segurança Social, 2015).

[4] Sistema Público de Segurança Social, Sistema de Acção Social and Sistema Complementar, respectively (Segurança Social, 2015).

[5] General Social Security System encompasses the workers from private sector.

[6] Sistema de Proteção Social de Cidadania, Sistema Previdencial and Sistema Complementar, respectively (Segurança Social, 2015).

[7] Ratio between life expectancy at 65 years in 2006 (changed to 2000 by Decree-Law no. 167-E/2013) and the life expectancy at 65 years in the year before the request for retirement.

retirements[8]. (Segurança Social, 2015). This reform, whose effects will mainly be felt in the medium and long term, intends to promote the sustainability of the public finances, reducing the value of future pensions expenditure relative to what had been expected prior to the reform and a subsequent decrease of replacement rates (Braz & Cunha, 2012). It was aggravated in 2013 by the Decree-Law no. 167-E/2013.

It is possible to verify that the changes suffered by the General Social Security System were caused mainly by social and political motivations from subsequent Governments. The 63rd Article of the Portuguese Constitution (the right to Social Security) assumes that the Social Security System is embodied by successive Social Security Acts which adjust the System to the national social and economic evolution (Segurança Social, 2015).

In sum, Portugal presents a PAYG[9] pension scheme[10], when young workers agree to pay (out of their labour income) the pension of the retired people in return for the promise that the next generation does the same for them, and a Bismarckian system, trying to provide reasonable living standards after retirement, without additional arrangements (Blake, 2006)[11]. It is also a defined-benefit system (European Commission, 2015), offering pensioners more measurable post-employment income benefits (Ramaswamy, 2012). The pension is indexed to prices and GDP and valorised in relation to prices (European Commission, 2015)[12].

[8] The Solidarity Extraordinary Contribution was also introduced in 2011 by Law no. 55-A/2010, 31st December, levied on all sorts of pension income, foreseeing their extinction in 2017.

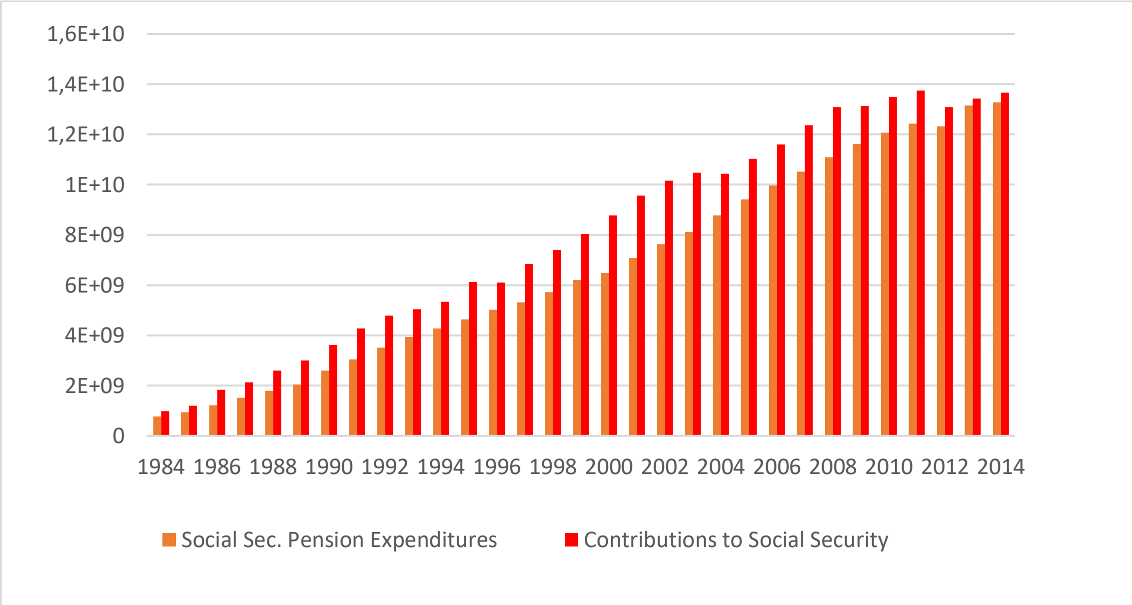
[9] The first studies about social security were developed by Samuelson in 1958 and Aaron in 1966, arguing that PAYG systems can increase welfare if the sum of population growth rate with the rate of growth of productivity (real wages) is higher than the real interest rate (World Bank, 2006; Martins, 2014).

[10] Supplemented by a funded component: the FEFSS.

[11] Individual-voluntary private pension schemes in the private sector only exist to a minor extent in Portugal (European Parliament, 2011).

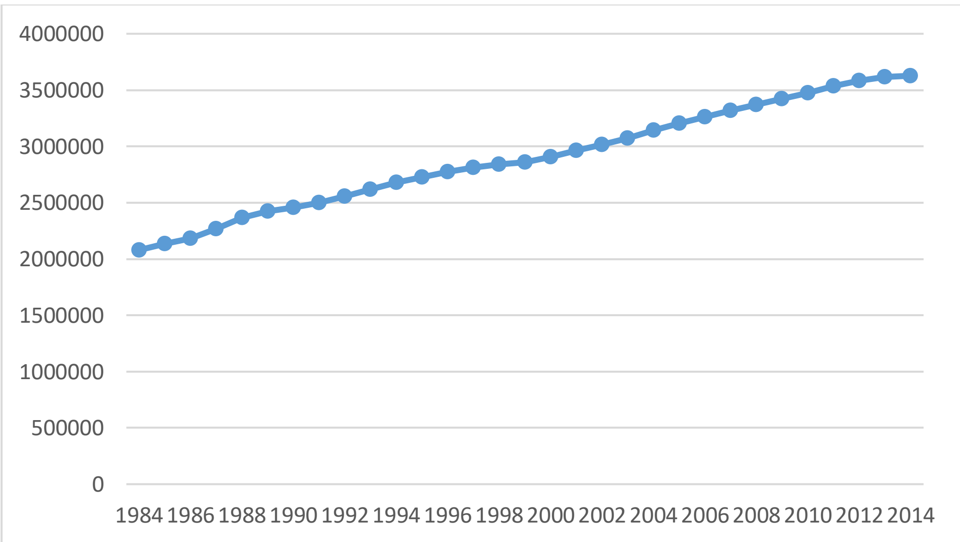
[12] “Valorisation rules define how pension contributions paid during the working life are indexed before retirement”, while “indexation of pensions in payment measures how the pension preserves its value over time” In European Commission (2015).

A synthesis of the evolution of public pension expenditure is illustrated in the following figures:



Source: PORDATA (2015). Values in Euros (at current prices).

FIGURE 1 – EVOLUTION OF THE GENERAL SOCIAL SECURITY PENSION EXPENDITURES (ALL THE SUBSYSTEMS) AND CONTRIBUTIONS TO GENERAL SOCIAL SECURITY (1984-2014)



Source: PORDATA (2015). Values in individuals.

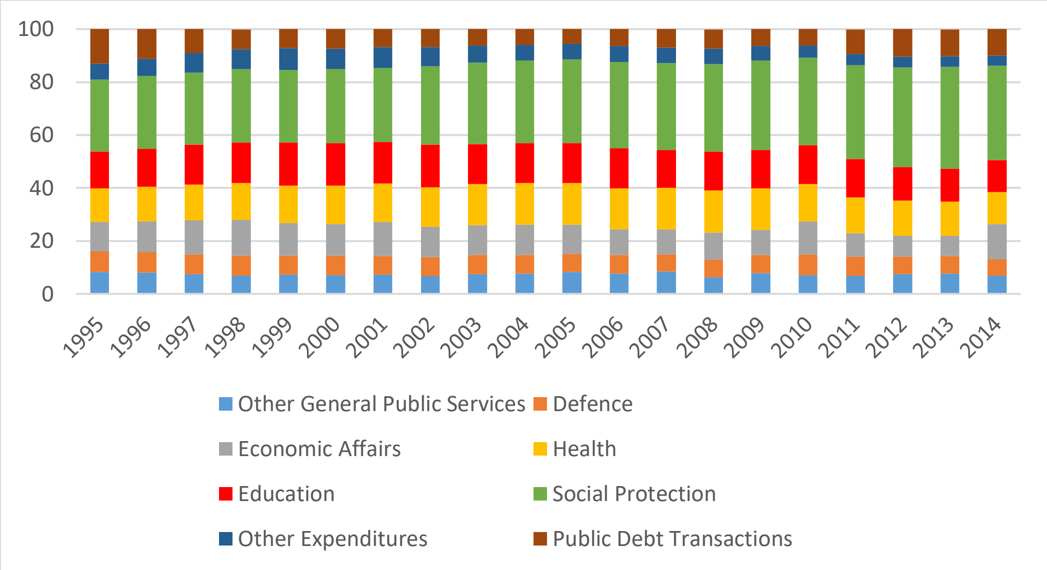
FIGURE 2 – TOTAL PENSIONERS IN SOCIAL SECURITY SYSTEM (1984-2014)

According to Figure 1, it seems that the issue about the sustainability of Social Security management is overestimated: the contributions to General Social Security System have been higher than the expenditures with old-age, disability and survivor pensions since 1984, reaching a value of 13663 million euros in 2014, against a value of 13277 million euros in expenditures in the same year, and both of them have presented an increasing trend. Moreover, the pensioners shown in Figure 2 has registered the same evolution, surpassing the value of 3.5 million in 2010[13], revealing the Social Security System maturation process and the accomplishment of its purpose.

However, it can bring an additional pressure on the Government expenditures. Between 1995 and 2013, total public pension expenditure rose 6.5 p.p. (from 9.2% of GDP to 15.7%), representing one of the main factors accounting for the strong growth in primary spending (excluding other obvious factors such as unemployment or reduced economic growth), particularly after 2000 (Braz & Cunha, 2012; PORDATA, 2015). Furthermore, expenditures with social protection represent the biggest portion of total public expenditure (36.1% in 2015), surpassing the values for EU-28 Member States (on average)[14] regularly since 2011 (PORDATA, 2015). As such, it is required an attentive analysis in order to clarify these events and their impacts on public accounts.

[13] It can also be explained by the successive incorporation of civil servants from Civil Servants Fund to the General Social Security System since 1st January 2006 (GEP/MSESS, 2015).

[14] 34.3% in 2015 (PORDATA, 2015).



Source: EUROSTAT (2016). Values in percentage of total.

FIGURE 3 – GENERAL GOVERNMENT EXPENDITURE[15] BY FUNCTION[16] (1995-2014)

Assessing Figure 3, the evidence shows that the expenditure with Social Protection has been the General Government most relevant expenditure (which is expected in Euro Area on average), and its percentage of total has verified an increasing trend, evolving from 27.1% in 1995 to 35.7% in 2014, following the evolution of the pension expenditures analysed previously, being the biggest type of expenditure during the referred time period. The increasing trend of social benefits (together with public consumption) helps to explain the growth of public expenditures, increasing from 42.6% of GDP in 1995 to 48.3% in 2015, illustrating the big weight of the Government on the overall economy (PORDATA, 2015; Santos *et al.*, 2010).

[15] It includes Central Government, Local Government and Social Security System.

[16] “Other expenditures” includes expenditure on environmental protection, housing and community amenities and recreation, culture and religion. “Defence” includes defence, public order and safety. “Public Debt Transactions” could be included in “General Public Services”, but it is separated in order to facilitate the analysis. “Economic Affairs” are mainly related to activity sectors support.

If public revenues are insufficient to cover expenditures, the deficit will be financed by the issuance of public debt (both for private agents as for the Central Bank), creating an additional burden over public finances. However, an expansionist fiscal policy and resulting deficit could generate a lower capital accumulation and subsequent crowding-out[17] of private investment. Regarding private consumption, the future Government payment commitment in the future will demand more taxes. If consumers are not myopic (smoothing its consumption over time), the expectation of more taxes in the future will reduce private consumption now (Santos *et al.*, 2010).

Public debt transactions (the debt service) have registered values (10% in 2014) close to health and education expenditures (12.1% and 12% in 2014, respectively), with the repercussions highlighted previously, resulting on a difficult trade-off: lower interest rates and low taxes are needed to increase investment and economic growth, but it ends up worsening deficits in the short term, raising interest rates. Consequently, it is likely that the Government will have to cut the biggest expenditures, namely social transfers, health and education in order to balance public finances (Moniz *et al.*, 2014)[18].

These facts arise an important analysis methodology of public expenditures: not only the size of expenditures are important but also its priorities and the following repercussions on the economy.

3. Literature Review

3.1. Projections

[17] The crowding-out effect is an increase of interest rates caused by an increase of public consumption financed by the issuance of public debt, reducing private investment (Santos *et al.*, 2010).

[18] Piketty (2014) also highlighted this impact, reinforced the fact that a high economic growth followed by a proportional evolution of tax base in relation to debt interest rates can easily reduce the weight of public debt in percentage of GDP.

According to the Bank of Portugal (2015), the financial unsustainability of Social Security System and its impact on public accounts are issues that have been motivated mostly by demographic changes, with social, economic and political implications. The dynamics of the resident population growth in Portugal since the beginning of the XXI Century is characterized by a reduction of both the natural balance and the net migration which have become negative, explained by the increasing burden of the central age groups. This can happen due to the fact that the increase of old people has been lower than the decrease of young people, resulting on higher unemployment rates (Castro *et al.,* 2015).

The progressive deterioration of ageing both the base and the top of the pyramid of ages, resulting from a decrease on the proportion of young people (under 15 years) and an increasing on the proportion of the elderly population (65 and over), respectively, illustrates the population dynamics in Portugal, reinforced by a low fertility (it has decreased from 3.20 children per women on average in 1960 to 1.23 in 2014 , illustrating a level of *lowest-low fertility*) that does not ensure the level of generational replacement (2.1 children per woman) and the recovery is not expected in the next forty years (Carrilho & Craveiro, 2014). Consequently, the potential sustainability index[19] is expected to evolve from 330 in 2014 to 149 in 2060 (INE, 2014).

The relevance of economic environment evolution over time on PAYG systems has also stressed by several authors. According to Piketty (2014), the PAYG pensions systems, applied during the half of XX Century, were developed having into account high

[19] Number of people aged between 15 and 64 years in percentage of the number of people aged 65 or more years (INE, 2014).

demographic growth and economic growth rates near 5% in Europe. Nowadays, the situation is different: the economic growth rate is 1.5% in rich countries, reducing at the same proportion the PAYG accrual rates.

These developments will motivate capital outflows to developing countries with younger population[20] (Domeij & Flodén, 2006). Ludwig *et al.* (2012) referred a beginning of a period of declining interest rates, increasing gross wages and decreasing replacement rates, possibly aggravating the financial burden of pay-as-you-go public pension systems. The impact on savings has been broadly discussed too, stressed by Feldstein (1974) who reinforced the life-cycle hypothesis: providing income during retirement, social security reduces savings during the working years, as well as capital accumulation due to the increased taxes/levies on workers to finance pensions, which reduces the total amount of physical capital that can be accumulated[21].

PAYG pension systems bring challenges to governments: in periods of economic crisis, followed by high unemployment, lower tax revenues and pension contributions received may require governments to temporarily fund pension payments by issuing public debt. While the ability of governments to honour their commitments on public pensions is usually taken for granted and the size of pension liabilities is not reported on sovereign balance sheets, the ability of guaranteeing its compliance is questioned, especially in long periods of economic shrinkage (Ramaswamy, 2012).

[20] Obviously, the international capital are also dependent on other factors such as business cycle fluctuations, long-term growth trends and volatile fiscal policy (Domeij & Flodén, 2006).

[21] This idea was contested by Leimer and Lesnoy in 1982 (they found a programming error influenced Feldstein's outcome) and Barro in 1974, who argues that savings were not reduced but were shifted to bequests (World Bank, 2006).

Given these scenarios, it is important to have into consideration the trade-off between sustainability of public finances and its adequacy. Due to the population ageing and the public expenses increase, it could be inevitable to reduce benefits to accommodate for the problem. This is, however, very difficult with regard to adequacy, arising complaints that future pensioners will not receive enough income (European Parliament, 2011). However, these objectives can be complementary, to the extent that financial sustainability of a pension system is a necessary condition to ensure adequacy in a long time horizon (Chybalski & Marcinkiewicz, 2014).

Cipriani (2013) tested an OLG model with PAYG pensions with exogenous fertility and other with endogenous fertility, and he concluded that "if the pension tax rate and the child-rearing cost are sufficiently high, a fall in fertility leads to an increase in pensions, but an increase in longevity always affects negatively the public pensions [in the first model]" (Cipriani, 2013, p. 254) and "if life expectancy increases, there is a fall in fertility, which reinforces the ageing of population, and there is a consequent fall in PAYG pensions [in the second model]" (Cipriani, 2013, p. 255). In other words, ageing and lower fertility can reduce the value of the pension paid to an old individual in addiction to an increase in the number of pensioners.

The sensitivity of Social Security expenditures in relation to these kind of phenomena is also highlighted in several studies. Andraz & Pereira (2012) referred that the component of the social security budget sensitive to the business cycle (that is, the evolution of GDP) is about 30% of the total spending, including mostly unemployment benefits and different types of social action spending, which illustrates its strong vulnerability in relation to other factors beyond economic ones. Moreover, they used a

VAR model and data for the period 1970-2007[22] and they concluded that the possible increases on Social Security total spending[23] bring negative effects on both labour markets and financial markets, caused by higher unit labour costs, higher unemployment rates and lower saving rates, resulting on a negative impact on GDP (marginal product of 2.40, 1.70, -0.28 and -2.90, respectively[24]).

The European Commission Ageing Report (2015) also stressed several demographic impacts (and economic ones) on Portuguese public pension expenditures to GDP:

TABLE I - AGEING REPORT SENSITIVITY TESTS (2013-2060)

Scenarios	Impact on Pensions/GDP	The Biggest Impact in European Union?
An increase of life expectancy at birth.	+ 1 p.p.[25]	Yes
20% less net migration.	+ 0.25 p.p.	No
A higher employment rate of older workers (for age group 55-74) of 10 p.p., introduced up until 2025.	- 0.7 p.p.	No
A higher employment rate (for age group 20-64) of 2 p.p..	- 0.3 p.p.	No
A permanent increase of 0.25 p.p. in the labour productivity growth rate.	- 1 p.p.	No
A permanent decrease of 0.25 p.p. in the labour productivity growth rate.	+ 1 p.p.	Yes
A lower Total Factor Productivity growth - convergence to 0.8% in 2060 compared to 1% in the baseline scenario.	+ 1.2 p.p.	Yes
An automatic link between early and statutory retirement ages and life expectancy, starting from the base year.	- 0.35 p.p.	No

Source: European Commission (2015).

[22] This analysis does not encompass the reforms applied in 2007.

[23] It encompasses retirement pensions for both private and public sector employees, their dependents and their survivors, as well as unfunded social benefits and social assistance programs.

[24] With an increase of 1 percentage point (p.p). on the ratio of social security spending to GDP, the unit labour costs increase 2.40 p.p., the unemployment rate increases 1.70 p.p., the saving rate decreases -0.28 p.p. and the GDP decreases 2.90 p.p..

[25] An increase of life expectancy at birth (of 2 years by 2060 compared to the baseline projection) will cause an increase of 1 p.p. on public pension expenditure change over 2013-2060. This explanation remains in relation to the other scenarios.

In spite of the existence of a sustainability factor in Portuguese public pension system which provides an automatic pension spending stabilization, the impact of an increase of life expectancy at birth is extremely high, but the impacts caused by changes in employment (less pensioners, less pensions and less inactive population, causing a positive effect on GDP growth) and productivity are more significant in these sensitivity tests, intensified by the fact that Portuguese pensions are not fully indexed to wages after retirement, and consequently higher labour productivity growth leads to a faster GDP and labour income growth than pension growth. Through the analysis of this impact, the overall effect projected is a decrease of gross public pension expenditure in Portugal of 0.7 p.p. in period 2013-2060 (European Commission, 2012; 2015; Portugal Stability Program, 2015). The OECD Pensions at a Glance (2015) reinforces these projections, highlighting the importance of demographic factors such as the old-age dependency ratio, projecting an increase of 38.1 p.p. for Portugal between 2015 and 2050. Nevertheless, cuts in benefits for future retirees, through lower indexation and valorisation or benefit formulae with increases in the minimum age allowed to claim pension benefits, will reduce growth in public pension expenditure. Hence, these measures can act as stabilizers of effects of ageing.

The Bank of Portugal (2015) has also addressed the demographic transition in Portugal and its connections with economic growth, using a growth accounting approach and a Cobb-Douglas production function logarithm with isolated demographic evolution impact. The projections highlighted an extremely negative impact of pure demographic evolution (measured by the ratio between 15-64 population and total population) on GDP per capita until 2050. However, it is expected that the contribution of human capital (with an average number of schooling years reaching 11 in 2060 caused by a catching-up effect in relation to other developed countries) largely offsets the negative contribution of pure demographics during this period. In cumulative terms, their contribution amounts to 16.9 p.p. in 2050 and 18.2 p.p. in 2060. With regard to the employment rate, its contribution is particularly strong during the first ten years, reflecting a reduction of 14.8% of unemployment rate in 2015 to 8.9% in 2025. Later, this contribution becomes relatively small, such as the activity rate over the entire period. Consequently, it is possible to conclude that the adverse impact on growth resulting from demographic trends will coexist with a favourable impact of the higher qualification of the workforce (Bank of Portugal, 2015).

According to these sensitivity tests, population dynamics and productivity of labour assumes a huge relevance on public pension expenditures. Using the Solow production function, Castro *et al.* (2015) concluded that all the countries deal with a possible slowdown of technical progress, converted into the quality of life. Consequently, and dealing with a stagnation of the Portuguese population, it is expected a positive rate of growth of technical progress (in a broad sense) of 1.5% (European Commission, 2015; Castro *et al.*, 2015) and a GDP per capita growth until 1.4-1.5% over the whole period 2013-2060 in European Union, with a possibility of countries like Portugal being affected by country specificities, such as cyclical developments, periods of (protracted) economic adjustment and catching-up effects (European Commission, 2015).

3.2. Policy Approach

The change of demographic pattern has arisen an inversion of the relationship between demography and economics: from ancient times to nowadays, the issue is to know how economic growth allows the increase of population and, more recently, the living standards; in the future, policy makers will need to know whether the demographic evolution allows the continuation of economic growth (Castro *et al*., 2015).

Halmosi (2014) highlights that all European Union Member States, facing ageing and the 2008 economic crisis, applied quick and drastic measures which did not favour systemic pension reforms; in fact, some studies referred that ageing can contribute to a possible future financial crisis. In the Portuguese case, which came to the crisis with reformed systems that were supposed to deal with increases in spending (sustainability factors and longevity indexation), should set up further reforms (Grech, 2015), needing additional measures pointed by several authors such as the reduction of current benefits[26]. Assessing the impact of pension cuts in Portugal, Spain and Italy, opinions differ: Matsaganis *et al* (2014) present evidence that pension cuts had a varied distributional impact, being some of these changes progressive. By contrast, Natali & Stamanti (2014) refer that expenditure control measures jeopardize the future adequacy, causing problems of inequality, risk individualization and increasing vulnerability to external shocks.

Assuming macroeconomic impacts on a PAYG Portuguese Social Security system, Garcia & Lopes (2009) argued that some measures such as a changing of indexing rules,

[26] These measures are susceptible to cause social conflicts due to the low average pension values, justifying its unconstitutionality in Portugal (Pedroso, 2014; PORDATA, 2015).

a better actuarial match between pensions and contributions and measures to increase the effective age of retirement could have a bigger impact on reducing the expected increase in pension expenditure, and applying a pension reform in isolation can only have a less effective impact on reducing it. Using a macroeconomic model of the Portuguese economy, the tests suggest that the elimination of early retirement schemes combined with an increase in effective contribution rate could be a good alternative, promoting the financial sustainability of the Social Security System and economic growth strengthened by a reserve fund (such as Social Security Reserve Fund, which presents an average annual nominal rate of return of 5.17% during the period 1989-2014 with relatively low administrative costs compared with other public pension reserve funds), bringing more advantages in relation to a fully pre-funded system (Garcia & Lopes, 2009; Garcia, 2014; IGFCSS, 2014), with too much high transition costs such as the payment by current tax payers of both existing pensioners and again to fund their own pensions (European Parliament, 2011).

These transition costs and the challenges associated to the maintenance of a PAYG pensions system have motivated an important question: could a pensions system be left to voluntary decisions and private insurance, with no need for government involvement? Barr & Diamond (2006) argued that such possibilities are insufficient: firstly, economic agents have to deal with imperfect information, missing markets, risk, uncertainty and progressive taxation, which should be attenuated by public intervention. Secondly, public policy cares about poverty relief and redistribution beyond improving consumption smoothing and insurance.

Nevertheless, highlighting the advantages of a possible transition of the system, the European Parliament (2011) reinforced that the PAYG pension systems can be advantageous during periods of economic growth, but, being economic growth a function of the rise in productivity, the amount of capital employed and the size of the workforce, if the latter decreases, it will be harder for the real economy to grow in the foreseeable future. Besides, PAYG financing encompasses higher transfers of wealth from future to present generations due to the increase of contribution rates in order to match current pension expenditures in relation to funded systems, where the return of fund´s assets reduces the required amount of contributions (Van den Noord & Herd, 1993).

So, financial markets seem to be a good alternative, to the extent that it is possible to find higher returns than the contribution from the growth in the real economy: the differences between the average rate of return of capital (between 4.5% and 5% in the XXI Century) and economic rate of growth (1.5%) reinforce this point. However, Piketty (2014) added an important critique: in spite of the rates of return in the financial markets (capital rates of return) surpass the wage progress, the wage evolution is 5 to 10 times less volatile, turning the total application of contributions on financial markets too risky[27].

Concerning possible pension reforms, Diamond (1996) suggested an indexation of normal retirement age to life expectancy[28] and the investment of part of the trust

[27] The 30´s Great Depression and 2008 financial crisis are sound examples of this volatility, generating big losses for those who applied great amounts of retirement contributions on financial markets (Piketty, 2014).

[28] This measure was already implemented in Portugal: the normal retirement age was 66 years in 2014, but It will increase to 66 years and two months in 2015, following the automatic process of adjusting the normal age of retirement by two-thirds of gains in life expectancy from age 65 measured as the average of the previous two years. (OECD, 2015).

funds in the private economy (taking advantage of higher rates of return with caution in relation to higher risks comparing to government bonds, which present greater liquidity[29]). On the contrary, replacing part of Social Security with individual accounts leads to high administrative costs and higher taxation, and replacing all of Social Security with individual or firm mandates seems to be expensive, caused by administrative costs, problems of cashing-out or bad investment decisions (Diamond, 1996). Regarding the evolution of life expectancy, evidence from other countries like Spain suggests that the sustainability factor should be linked to other factors such as employment or dependency rates, and not only to life expectancy, in order to clarify which can really influence the financial health of the pension system. Reinforcing such factor, increasing the retirement age, extending the pension calculation period and increasing the number of contribution years required to be entitled to 100% of the regulatory base, can stabilize pension expenditure, at least during the application of such reforms (Doménech & de la Fuente, 2011).

Measuring some policy measures to stress the fiscal challenge of shrinking populations, Clements *et al.* (2015) studied the impact of some policies in developed and undeveloped countries. The evidence suggests that encouraging bigger birth rates could reduce the evolution of ageing and fiscal costs, but the effects seem to be modest for most countries. Pro-migration policies would reduce age-related expenditures on long-term, but it is not enough to extinguish the impact of ageing in more developed countries. Raising labour force participation rates (especially for women and older

[29] However, government bonds are subject to lower rates of return and vulnerability in relation to certain macroeconomic phenomena such as rapid inflation (Diamond, 1996).

workers) can increase production increasing the workforce, which would mitigate or at least delay some of the projected impact from ageing. At last, some measures such as raising retirement ages, reducing pensions relative to wages, increasing taxation of pensions for upper income groups and increasing pension contributions could promote the sustainability of public pensions and it should start now, although gradually so.

More recently, using a dynamic general equilibrium model (with an OLG à la Blanchard-Yaari[30] and hand-to-mouth pensioners to simulate the Portuguese demographic structure), the European Central Bank (2015) tested the impact of a two-year increase in the retirement age, a permanent cut in the pension replacement ratio by 15% and an increase in the consumption tax by 1 p.p.. The first measure can reduce the share of old-age pensioners and increase overall social security contributions, enlarging their base and stabilising the impact of the ageing population on labour supply, per capita consumption and real GDP[31]. The second measure produces better results than the first one, because cuts in the replacement ratio reduce the old-age pension expenditure, the government spending and the required increases in social security contribution rates (combined with the first measure, the overall impact of ageing can be positive in the short run, and close to nil over the medium run). The third measure does not provide significant evidence.

4. Data and Methodology

4.1. Data Description

[30] See also Blake (2006).

[31] This measure cannot act solely (European Central Bank, 2015).

In order to stress which variables have a relevant influence on the Portuguese social security system pension expenditure, the chosen ones were selected having into account the studies analysed previously, particularly the European Commission Ageing Report (2015). As the analysis will be developed in the Portuguese case, only time series data will be used in this work.

The dependent variable that will be stressed is pension spending by General Social Security System on elderly, disability and survival support as a share of GDP at current prices (pensions_to_gdp). It is a smaller component of total pension expenditures analysed by the European Commission Ageing Report (2015), OECD Pensions at a Glance (2015) and Chybalski (2014), but with more available yearly observations. The time-series data from 1975-2014 was chosen as a result of the limitations concerning the absence of more available observations during the research.

Regarding the possible factors affecting the level of pension expenditures, and the availability of statistical data, the following explanatory variables were organised in groups:

TABLE II – BRIEF DESCRIPTION OF THE EXPLANATORY VARIABLES[32] [33]

Group	Variables	Description	Unit	Source
Demographics	OAD	Old age dependence Index	Percentage	PORDATA (2015)
Labor Market	Lun15_64	Logarithm of unemployed persons aged 15 to 64	Individuals	PORDATA (2015)
Domestic Product	LAPL	Logarithm of apparent productivity of labor	Ratio	PORDATA (2015); OECD (2016)
Dummie	rev1974	Revolution of April 1974	1 between 1975 and 1979; 0 otherwise	Andraz & Pereira (2012)
Dummie	r1984	First Social Security Act	1 since 1985; 0 otherwise	Andraz & Pereira (2012)
Dummie	r1993	1993 Social Security Reform	1 since 1994; 0 otherwise	Andraz & Pereira (2012)
Dummie	r2002	Third Social Security Act	1 since 2003, 0 otherwise	Andraz & Pereira (2012)
Dummie	r2007	Fourth Social Security Act	1 since 2008; 0 otherwise	Andraz & Pereira (2012)

[32] The Lun15_64 and LAPL variables are presented in a logarithmic form in order to normalize and smooth the deviations and to help the coefficients interpretation, identified with L.

[33] The dummy variables assume the value 1 after the structural changes not only to measure their impacts in the following years, but also in order to avoid problems concerning the econometric specifications.

TABLE III – DESCRIPTIVE STATISTICS OF THE VARIABLES

	LAPL	LUN15_64	OAD	PENSIONS_TO_GDP
Mean	2.691084	12.74500	22.34500	5.045000
Median	2.768843	12.72366	22.00000	5.150000
Maximum	3.005914	13.65909	30.70000	7.700000
Minimum	2.175561	12.08673	16.30000	2.200000
Std. Dev.	0.247991	0.383335	4.087125	1.278812
Skewness	-0.528981	0.646218	0.331632	0.160801
Kurtosis	2.030302	3.140318	1.938730	2.817378
Jarque-Bera	3.432663	2.816797	2.610354	0.227965
Probability	0.179724	0.244535	0.271125	0.892274
Sum	107.6433	509.8001	893.8000	201.8000
Sum Sq. Dev.	2.398482	5.730890	651.4790	63.77900
Observations	40	40	40	40

Source: Eviews 9 Output

The *OAD* (number of elderly persons aged 65 and over per 100 persons of working age - from 15 to 64 years old) quantifies the impact of demography through the connection between old age and working age on pensions_to_gdp (European Commission, 2015).

The *un15-64*[34] (all individuals aged between 15 and 64 years old without job and available for work, having actively sought paid or unpaid work in the last 30 days, on strict sense) can be useful to stress the impact of unemployment on pensions. In PAYG systems, the unemployment contributes for the unsustainability of pension systems, shrinking the contribution base, at least in the short term (European Commission, 2015).

The APL (real GDP in terms of expenditure at constant prices of 2011 per annual hours worked by employed people), as stressed by Castro *et al.* (2015), can present enough potential to overcome the negative effects of ageing.

[34] This variable is a proxy of unemployment in the absence of more available data concerning the unemployment rate.

Regarding dummy variables, Andraz & Pereira (2012) analysed the possible existence of four structural breaks during this sample period: Revolution of April 1974 (important social and economic changes during the second half of the 70´s), First Social Security Act of 1984 (the great expansion of beneficiaries and more generosity concerning the benefits), the Social Security Reform of 1993 (equality between women and men in relation to the retirement age and several changes in pension calculation) and the Third Social Security Act of 2002 (revocation of the Second Social Security Act in 2000, concerning new changes of pension calculation and a new General Social Security institutional organization). In this work, the significance of these structural breaks will be also analysed, adding the Fourth Social Security Act in 2007 (introduction of the sustainability factor, which introduced an important change on pension calculation concerning the increasing of life expectancy).

The descriptive statistics of the variables are specified in Table III.

If the purpose is to analyse the relationship between several variables using a regression model, it is important to assume some stability through time: if this relationship was arbitrary in each period, it would not be possible to know how a variable affects another only with a unique process realization (Wooldridge, 2009). To test for stationarity, the conduction of unit root tests is needed.

TABLE IV – UNIT ROOT AUGMENTED DICKEY-FULLER AND PHILLIPS-PERRON TEST´S RESULTS

	Dickey-Fuller Test			Phillips-Perron Test		
Variables	**Deterministic Component**	**P-Value**	**T-Stat**	**Deterministic Component**	**P-Value**	**Adj. T-Stat**
pensions_to_gdp	constant and trend	0.4379	-2.273162	constant and trend	0.2874	-2.588373
lapl	constant and trend	0.8648	-1.332065	constant and trend	0.8274	-1.456712
lun1564	constant and trend	0.3919	-2.362997	constant and trend	0.6949	-1.780441
oad	constant and trend	0.9818	-0.448775	constant and trend	0.9986	0.414222

Source: Eviews 9 Output

TABLE V - UNIT ROOT AUGMENTED DICKEY-FULLER AND PHILLIPS-PERRON TEST´S RESULTS WITH FIRST DIFFERENCES

	Dickey-Fuller Test			Phillips-Perron Test		
Variables	**Deterministic Component**	**P-Value**	**T-Stat**	**Deterministic Component**	**P-Value**	**Adj. T-Stat**
pensions_to_gdp	constant	0	-6.227754	constant	0	-6.239673
lapl	constant and trend	0.0166	-4.013996	constant and trend	0.0166	-4.013996
lun1564	none	0.0002	-3.971594	none	0.0002	-3.971594
oad	constant and trend	0.0045	-4.533609	constant and trend	0.004	-4.580826

Source: Eviews 9 Output

Following the methodology adopted by Brooks (2014), the chosen tests were the Augmented Dickey-Fuller test and Phillips-Perron test (Table IV and V). The p-values analysis of both tests suggests that the null hypothesis of the presence of a unit root cannot be rejected in all variables at 10% significance level, but the stationarity is achieved with first differences through the rejection of the same null hypothesis at 5% significance level, highlighting their strong persistence (I(1) process).

4.2. Adopted Methodology

To estimate the impact of Lun15_64, LAPL and OAD on pensions_to_gdp, it is intended to stress the following function:

$$(1)\ pensions\_to\_gdp_t = \beta_0 + \beta_1 Lun15\_64_t + \beta_2 LAPL_t + \beta_3 OAD_t + \delta_0 rev1974_t + \delta_1 r1984_t + \delta_2 r1993_t + \delta_3 r2002_t + \delta_4 2007_t$$

The finding of non-stationarity may turn the potential econometric results statistically invalid. Typically, the linear combination of I(1) variables will be I(1), but it is desirable to obtain I(0) residuals which are only achieved if the linear combination of I(1) variables will be I(0), that is, if the variables are cointegrated (Brooks, 2014).

Regarding the hypothesis of the existence of more than one linearly independent cointegration relationship between more than two variables, it is appropriate to stress the issue of cointegration using the Johansen VAR test, as recommended by Brooks (2014).

To develop the Johansen VAR framework, the selection of the optimum number of lags is needed to avoid problems of residual autocorrelation, using the VAR Lag Order Selection Criteria (Table VII). The Likelihood Ratio Criteria (LR), Final Predictor Error (FPE) and Hannan-Quinn Information Criteria (HQ) selected two lags as an optimum limit, against the evidence of Akaike Information Criteria and Schwarz Information Criteria (SC), which presented the optimum selection of three and one lag, respectively.

The Johansen Cointegration Test allows to select the appropriate lag length and model to choose (Table VIII and IX), and the evidence suggests that the number of appropriated lags is two (as referred before) with one cointegrating vector, and the model to adopt consists on the allowance of a quadratic deterministic trend, with intercept and trend in the cointegration equation and intercept in VAR, following Akaike Information Criteria (Brooks, 2014).

It was decided to use an error correction model "incorporated" into a VAR framework in order to model the short and long run relationships between variables: a Vector Error Correction Model (VECM). The VECM can be set up in the following form (Brooks, 2014):

$$(2)\ \Delta\gamma_t = \Pi\gamma_{t-k} + \mathit{\Gamma}_1\Delta\gamma_{t-1} + \cdots + \mathit{\Gamma}_{k-1}\Delta\gamma_{t-(k-1)} + u_t{}^{35}$$

[35] $\Pi = \left(\Sigma_{i=1}^{k}\beta_i\right) - I_g$ and $\mathit{\Gamma}_i = \left(\mathit{\Sigma}_{j=1}^{i}\beta_j\right) - I_g$

This VECM is composed by first differenced g variables on the LHS, and k-1 lags of the dependent variables (differences) on the RHS, each with a Γ short-run coefficient matrix. Π consist on a long-run coefficient matrix, since in equilibrium, all $\Delta\gamma_{t-i} = 0$, and establishing u_t with the expected value of zero it implies that Πy_{t-k}= 0. Π illustrates the speed of adjustment back to equilibrium, that is, it measures the proportion of last period´s equilibrium error that is corrected for (Brooks, 2014).

The VECM model is illustrated in Table XI[36]. Figure 8 shows that the model is stable, because all inverse roots of characteristic polynomial are inside the unit circle.

The residuals assumptions were tested, and it is possible to verify that the mean of the residuals is almost zero (Table XII), the White Heteroskedasticity Test p-value does not allow the rejection of homoskedastic residuals (Table XIII), the covariance between residuals and explanatory variables are almost zero, satisfying the assumption of no relationship between them (Table XIV), the residuals are normally distributed (Table XV) and the null hypothesis of no residual serial correlation is not rejected at 5% significance level with the use of two lags (Table XVI).

As such, the estimators are efficient, and the confidence intervals and hypothesis tests using t and F-statistics are reliable.

5. Results

5.1. Cointegration Equation

The presence of a cointegrating vector illustrates an equilibrium phenomenon, since it is possible that cointegrating variables may deviate from their relationship in the

[36] The analysed VECM model encompasses the cointegration equation with dummy variables.

short run, but their association would return in the long run (Brooks, 2014). Then, it exists a long-run relationship between the analysed variables, illustrated by the following normalized cointegrating model, without dummy variables[37]:

$$(3)\ pensions\_to\_gdp = 1.320370\ Lun15\_64 + 1.818858\ LAPL - 0.221652\ OAD$$

$$(0.16300) \qquad (0.93573) \qquad (0.08153)$$

At first sight, it is admissible to think that in Equation 3 the long-run relationship between OAD and pensions_to_gdp does not make sense. The negative coefficient induces that, with the remain variables constant, an increase of 1 p.p. in OAD will cause a decrease of 0.221652 p.p. on pension expenditure to GDP on average, seeming to be contradictory: how the increase of old people (or the decrease of young people) can cause a decrease of pension expenditure as a share of GDP?

It is possible to extract some possible interpretations from the negative OAD long-run coefficient. Assuming that in the future old people will work more years due to several factors such as the indexation of the official retirement age to life expectancy or an individual option to work beyond the retirement age, an increase of old people does not compulsorily imply an increase of pension expenditure as a share of GDP in the long run, contradicting the mainstream literature about pension spending and other research sources such as OECD (2015) and European Commission (2015).

In fact, the indexation of the official retirement age to life expectancy has been supported by several authors analysed before such as Clements *et al.* (2015) or Diamond (1996) as a crucial measure to guarantee the financial sustainability of Social Security, smoothing the impact of an ever increasing number of pensioners. Moreover, if the

[37] Standard errors in parenthesis.

knowledge and accumulated experience provided by old people were exploited in an industrialized society as referred by Rosa (1996), it would be possible to increase the effective retirement age, extending the contributory career. Other possible reason can be the fact that ageing can have a stronger impact on the pension value than on GDP in the long run, which can be explained by successive reforms reducing pension entitlements such as the sustainability factor, that is, in spite of Portuguese pensions are not fully indexed to wages after retirement (European Commission, 2015), the applied reforms by Portuguese Government cause a bigger reduction on pension payments than a probable reduction on GDP caused by ageing (Andraz & Pereira, 2012).

The remaining long-run coefficients seem to be reliable. The positive long-run coefficient of Lun15_64 shows that, letting the remain variables constant, an increase of 1% on unemployed people aged between 15 and 64 years old causes an increase of 1.320370/100 = 0.01320370 p.p. on pension expenditure to GDP on average, corroborating the common interpretation about the negative effect of unemployment on any pension system supported by the analysed authors. High unemployment leads to negative migratory balances (affecting mostly the young people), aggravating the ageing process and consequently the demographic declining. With less people, the investment decreases, shrinking the economic growth[38] (Castro *et al.,* 2015)

Regarding the LAPL long-run coefficient, the evidence suggests that, letting the remain variables constant, an increase of 1% on APL results on an increase of 1.818858/100 = 0.01818858 p.p. on pension expenditure to GDP on average. It implies

[38] The causality from ageing and unemployment to productivity are confirmed by a VEC Granger Causality Test, at 5% and 10% significance level, respectively. However, it was not included for a matter of space.

that APL has a stronger impact on pension growth than GDP growth, contradicting the European Commission (2015) approach. Nevertheless, these results reinforce the importance of APL on pension growth and support the hypothesis that, in the future, the transfer rate from wages to pensions will increase, being that structural change a requirement when the ratio between old people and people of working age increases significantly (Castro *et al.*, 2015).

The fact that OAD presents a negative relationship with pensions_to_gdp arises the hypothesis of a spurious result. As such, it was developed a Johansen Cointegration Test with dummy variables (Table X), with the problem that critical values may not be valid with exogenous series such as dummy variables. With this new test, the OAD long-run coefficient is positive and the sign of the remain coefficients does not change, that is, an increase on OAD causes an increase on pensions_to_gdp as has been supported by the analysed authors, turning the results more credible: less contributions combined with an indirect negative impact on potential economic growth through the decrease of labour supply increase the burden of pension expenditures to GDP (Portugal Stability Program, 2015). However, it is important to have into account the econometric limitations of this change.

5.2. VECM Model Coefficients

To derive the VECM p-values, it was developed the VECM model with the coefficients as C(1) until C(16) (Table XVII). C(1) is the coefficient of the cointegration equation (as well as the speed of adjustment back to equilibrium), C(10) is the constant, C(2) until C(9) are the short-run coefficients of the lagged variables (until the second lag) and C(12) until C(16) are the coefficients of the dummy variables. C(11) is the trend coefficient (Brooks, 2014).

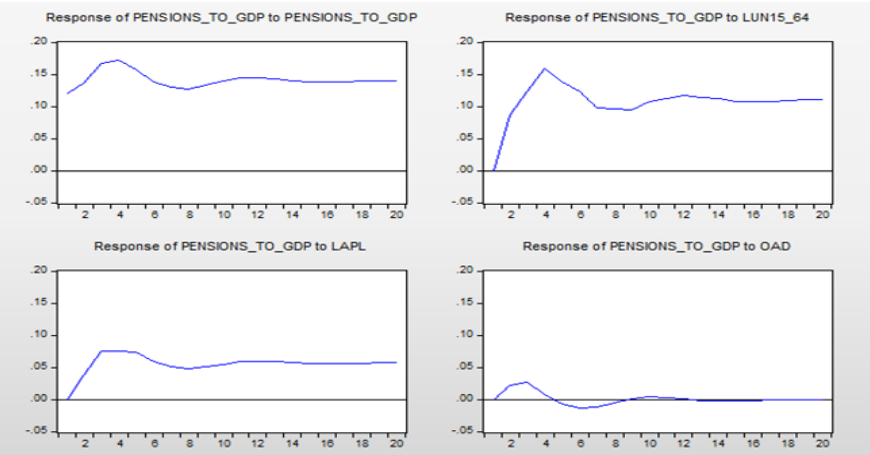
Looking at C(1), it is negative and statistically significant at 5%, confirming the long-run relationship between pensions_to_gdp, Lun15_64, LAPL and OAD and the existence of a correction mechanism of deviations (Wooldridge, 2009). Developing the Wald Tests (Table XVIII), it is not possible to reject the null hypothesis of C(4)=C(5)=0, C(6)=C(7)=0 and C(8)=C(9)=0, and the conclusion to be stressed is the absence of short-run causality running from Lun15_64, OAD and LAPL to pensions_to_gdp.

Regarding the short-run coefficients of the dummy variables, only the revolution of April 1974 (at 10% significance level) and the 1993 Social Security Reform (at 5%) present statistical significance, and the negative coefficients illustrate each contribution to the decrease of pension expenditure as a share of GDP: the possible causes can be the high average real GDP growth rate after 1976 until 1979 of 5.4% in the first case (PORDATA, 2015) and the implementation of the same official retirement age between men and women, as well as the increase of the minimum contributory period from 10 to 15 years in the latter case (Segurança Social, 2015) .

5.3. Impulse – Response Functions

At last, it was stressed the impulse-response functions and the variance decomposition for pensions_to_gdp, strongly dependent of the Cholesky ordering which does not follow a specific requirement (Brooks, 2014). In order to guarantee some consistency and reasonability of the results, it was considered that the order will be from the most exogenous variable to the most endogenous one, determined by a VEC Granger Causality Test[39].

The adopted order is as follows: OAD, Lun15_64, pensions_to_gdp and LAPL.



Source: Eviews 9 Output

FIGURE 4 – RESPONSE TO CHOLESKY ONE STANDARD DEVIATION INNOVATION

Following Brooks (2014) methodology, Figure 4 gives the impulse responses for pensions_to_gdp, regarding several unit shocks to OAD and Lun15_64 and their impact during 20 periods (years) ahead. Considering the signs of the responses, innovations to OAD have a positive impact until the 5^{th} year, achieving its peak in the 3^{rd} year. After that, the impact is negative, but the effect of the shock ends up dying down. A standard deviation shock to Lun15_64 and LAPL has always a positive impact on pensions_to_gdp, reaching its peak in the 4^{th} and 3^{rd} year, respectively, stagnating in the long-run. At last, the own innovations to pensions_to_gdp register a similar impact in relation to Lun15_64, that is, reaches the peak in the 4^{th} year and a stagnation thereafter.

[39] The higher the p-value, the greater the exogeneity of the variable. The other ordering possibilities were not included in this work for a matter of space.

Analysing this approach, the main highlight is the fact that OAD registers an almost irrelevant contribution for the evolution of pensions_to_gdp in the long-run comparing with the remain variables, surpassed by the contributions of Lun15_64 and LAPL, reinforcing the doubts about the contribution of ageing on pension expenditures. It is also possible to verify the relevance of unemployment in the presence of a positive shock immediately in the first years (as stressed by the European Commission (2015)) and in a 20-year forecasting horizon (positive but constant impact), shrinking the contributory base and the economic growth, and a similar pattern in relation to the apparent productivity of labour, guaranteeing higher pension entitlements.

5.4. Variance Decomposition

TABLE VI – VARIANCE FOR THE PENSIONS_TO_GDP RESIDUALS

Years Ahead	pensions_to_gdp	Lun15_64	LAPL	OAD	St. Errors
1	39.75548	57.38656	0.000000	2.857965	0.120497
2	14.08738	81.98100	1.800683	2.130935	0.206266
3	6.506829	86.96445	4.916684	1.612034	0.303806
4	4.121266	87.13196	5.941479	2.805292	0.390854
5	3.155232	86.14967	6.969393	3.725705	0.449405
6	2.681086	85.39148	7.331064	4.596374	0.490008
7	2.405232	85.04415	7.550595	5.000024	0.518948
8	2.194605	85.06123	7.564982	5.179188	0.544869
9	2.021894	85.24482	7.580635	5.152655	0.571267
10	1.835527	85.49395	7.565629	5.104890	0.600105
11	1.667450	85.65787	7.609152	5.065524	0.629854
12	1.523000	85.72672	7.655780	5.094500	0.659096
13	1.404929	85.72433	7.721031	5.149708	0.686239
14	1.307722	85.70800	7.765147	5.219132	0.711306
15	1.227116	85.70338	7.801512	5.267990	0.734649
16	1.156579	85.72203	7.820927	5.300469	0.757110
17	1.093640	85.75321	7.838002	5.315151	0.779112
18	1.035675	85.78749	7.851151	5.325681	0.800913
19	0.982888	85.81437	7.867364	5.335376	0.822386
20	0.934854	85.83266	7.883034	5.349449	0.843404

Source: Eviews 9 Output

Accessing Table VI, it is possible to verify that, in the 20-year forecasting horizon, the OAD shocks account for only around between 2.86% and 5.35% of the variance of the pensions_to_gdp and Lun15_64 contributes between 57.87% and 85.83%, reinforcing the huge importance of unemployment on pension expenditure and the reduced impact of ageing comparing with the remain variables. It is also important to stress the own shocks of pensions_to_gdp, which accounts between 0.93% and 39.76% of its movements[40].

6. Conclusions and Future Research

Regarding the VECM model and the results obtained (taking into consideration certain aspects such as non-stationarity, cointegration and residuals testing), the evidence suggests that unemployment, apparent productivity of labour and old-age dependence index jointly present a long-run relationship with pension expenditure as a share of GDP, but not in the short-run.

The unemployment is crucial to explain the increase of pension expenditure as a share of GDP, as reinforced by the analysed authors and the mainstream literature about pensions. This interpretation is illustrated by the variance decomposition of pensions_to_gdp and the impulse-response functions.

The apparent productivity of labour has also a positive impact on pension expenditure to GDP according to the results stressed in this work, conflicting with studies stressed by the European Commission (2015), which supports the assumption that GDP growth is bigger than pension growth in Portugal due to the fact that the Portuguese pensions are not fully indexed to wages after retirement.

[40] These results, however, need to be analysed carefully: if the order of variables changes, the results of impulse-response functions and variance decomposition can change drastically, mainly the variance decomposition between pensions_to_gdp and Lun15_64. Nevertheless, it is noticeable that the unemployment strongly influences the pension expenditure behaviour.

The most intriguing result concerns the old-age dependence index: after the development of one Johansen Cointegration Test without dummy variables and other with dummy variables, the OAD long-run coefficient presents different signs, arising the hypothesis that ageing may not be a "catastrophic" factor which jeopardizes the financial sustainability of the Portuguese Social Security System (as Castro *et al.* (2015) pointed out). This fact is corroborated by the almost irrelevant influence of OAD (in the long-run) on the impulse-response-functions, but the empirical evidence found by the majority of the analysed authors contests such conclusion.

This overall analysis needs to be assessed with caution since this work presents some limitations, such as a small time series (40 years) and different results regarding the different econometric techniques adopted, and challenges concerning the choice of the appropriate variables to determine the impacts stressed by the analysed literature and the choice of a suitable econometric model to take the statistical characterization of the variables into account.

Further research on this topic could be, for instance, the choice of different explanatory variables or a different econometric model to see if the previous results still hold, a profound study assessing the impact of ageing on Portuguese pension expenditures (in order to clarify the doubts arisen in this work) in the long-run and a deep analysis about the role of the apparent productivity of labour as a possible "smoothing component" of it.

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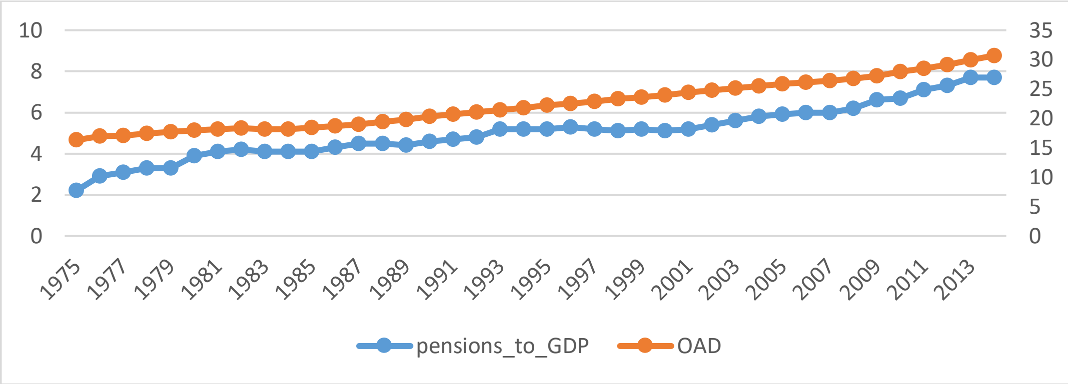
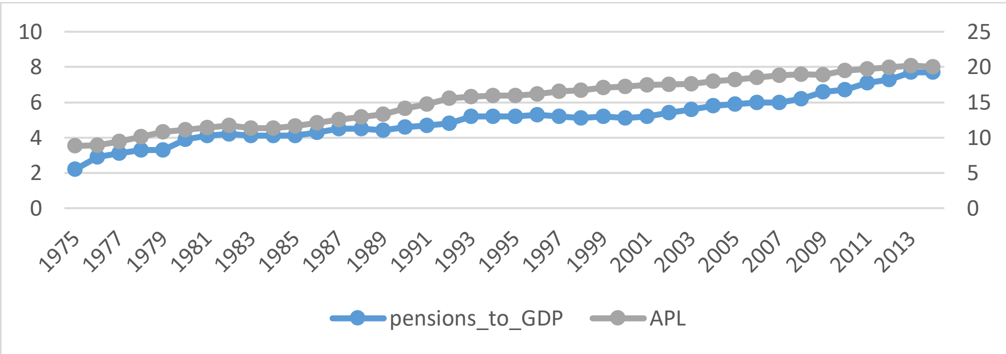
Annexes



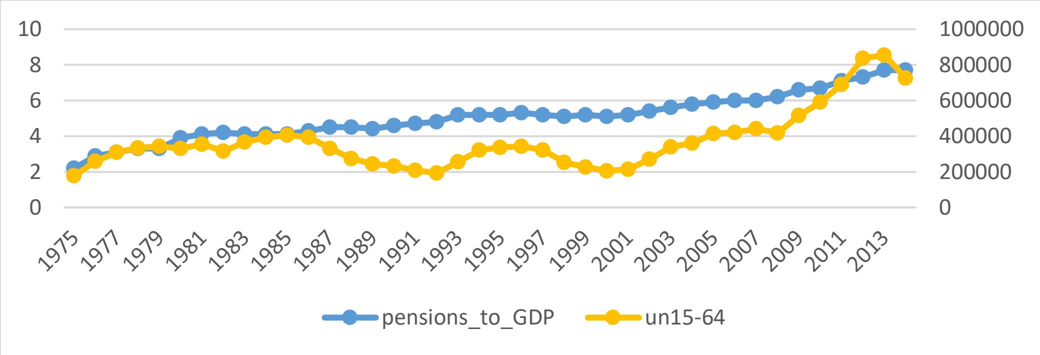
Source: PORDATA (2015). Values in Percentage.

FIGURE 5 – PENSION SPENDING BY GENERAL SOCIAL SECURITY SYSTEM ON ELDERLY, DISABILITY AND SURVIVAL SUPPORT AS A SHARE OF GDP AND OLD-AGE DEPENDENCE INDEX (1975-2014)



Source: PORDATA (2015), OECD.stat (2016) and own calculations. Values in Percentage (pensions_to_gdp) and Ratio (APL).

FIGURE 6 – PENSION SPENDING BY GENERAL SOCIAL SECURITY SYSTEM ON ELDERLY, DISABILITY AND SURVIVAL SUPPORT AS A SHARE OF GDP AND APPARENT PRODUCTIVITY OF LABOUR (1975-2014)



Source: PORDATA (2015). Values in Percentage (pensions_to_gdp) and Individuals (un15_64).

FIGURE 7 – PENSION SPENDING BY GENERAL SOCIAL SECURITY SYSTEM ON ELDERLY, DISABILITY AND SURVIVAL SUPPORT AS A SHARE OF GDP AND UNEMPLOYED PERSONS AGED BETWEEN 15 AND 64 YEARS OLD (1975-2014)

TABLE VII – VAR LAG ORDER SELECTION CRITERIA PROCEDURE

Endogenous variables: PENSIONS_TO_GDP LUN15_64 LAPL OAD						
Exogenous variables: C REV1974 R1984 R1993 R2002 R2007						
Sample: 1975 2014						
Included observations: 36						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	73.71374	NA	7.52e-07	-2.761875	-1.706195	-2.393414
1	223.7269	216.6857	4.61e-10	-10.20705	-8.447584*	-9.592949
2	251.7059	34.19661*	2.65e-10*	-10.87255	-8.409300	-10.01281*
3	269.2584	17.55245	3.03e-10	-10.95880*	-7.791761	-9.853418
4	284.9447	12.20047	4.62e-10	-10.94137	-7.070548	-9.590351
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Source: Eviews 9 Output

TABLE VIII – JOHANSEN COINTEGRATION TEST SUMMARY

Sample: 1975 2014					
Included observations: 37					
Series: PENSIONS_TO_GDP LUN15_64 LAPL OAD					
Lags interval: 1 to 2					
Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	0	1	1	1	1
Max-Eig	0	1	1	1	1
*Critical values based on MacKinnon-Haug-Michelis (1999)					
Information Criteria by Rank and Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Rank or	No Intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No Trend	No Trend	No Trend	Trend	Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	192.5650	192.5650	195.6342	195.6342	199.7912
1	199.4257	208.0199	210.6990	212.6689	216.0536
2	204.8373	214.6224	217.2509	223.7600	226.8486
3	207.8471	218.6760	220.1204	228.7651	229.9657
4	210.2947	221.3637	221.3637	231.0177	231.0177
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	-8.679192	-8.679192	-8.628876	-8.628876	-8.637363
1	-8.617606	-9.028103	-9.010758	-9.063185	-9.083981
2	-8.477689	-8.898507	-8.932482	-9.176216	-9.235057*
3	-8.207949	-8.631136	-8.655158	-8.960277	-8.971121
4	-7.907822	-8.289927	-8.289927	-8.595552	-8.595552
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	-7.285965*	-7.285965*	-7.061496	-7.061496	-6.895830
1	-6.876073	-7.243032	-7.095072	-7.103961	-6.994141
2	-6.387850	-6.721591	-6.668490	-6.825147	-6.796911
3	-5.769803	-6.062375	-6.042859	-6.217363	-6.184668
4	-5.121369	-5.329322	-5.329322	-5.460793	-5.460793

Source: Eviews 9 Output

TABLE IX – JOHANSEN COINTEGRATION TEST WITHOUT DUMMY VARIABLES

Sample (adjusted): 1978 2014				
Included observations: 37 after adjustments				
Trend assumption: Quadratic deterministic trend				
Series: PENSIONS_TO_GDP LUN15_64 LAPL OAD				
Lags interval (in first differences): 1 to 2				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace	0.05	
		Statistic	Critical Value	Prob.**
None *	0.584823	62.45298	55.24578	0.0102
At most 1	0.442063	29.92813	35.01090	0.1580
At most 2	0.155065	8.338298	18.39771	0.6481
At most 3	0.055277	2.103951	3.841466	0.1469
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen	0.05	
		Statistic	Critical Value	Prob.**
None *	0.584823	32.52485	30.81507	0.0306
At most 1	0.442063	21.58983	24.25202	0.1082
At most 2	0.155065	6.234347	17.14769	0.7936
At most 3	0.055277	2.103951	3.841466	0.1469
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
PENSIONS_TO_GDP	LUN15_64	LAPL	OAD	
6.459502	-8.528931	-11.74891	1.431758	
1.636999	-6.766814	-37.79332	-1.097487	
6.475763	-3.688677	-25.99676	-0.853253	
-1.854818	3.512219	20.29810	-2.584471	
Unrestricted Adjustment Coefficients (alpha):				
D(PENSIONS_TO_GDP)	-0.049258	0.008812	-0.016745	-0.027399
D(LUN15_64)	0.049632	0.030766	-0.012136	-0.015591
D(LAPL)	-0.007377	0.006679	0.000878	0.001188
D(OAD)	-0.029153	0.014410	0.032894	-0.001872
1 Cointegrating Equation(s):		Log likelihood	216.0536	
Normalized cointegrating coefficients (standard error in parentheses)				
PENSIONS_TO_GDP	LUN15_64	LAPL	OAD	
1.000000	-1.320370	-1.818858	0.221652	
	(0.16300)	(0.93573)	(0.08153)	
Adjustment coefficients (standard error in parentheses)				
D(PENSIONS_TO_GDP)	-0.318180			
	(0.16656)			
D(LUN15_64)	0.320601			
	(0.12175)			
D(LAPL)	-0.047652			
	(0.01652)			
D(OAD)	-0.188316			
	(0.11411)			

Source: Eviews 9 Output

TABLE X – JOHANSEN COINTEGRATION TEST WITH DUMMY VARIABLES

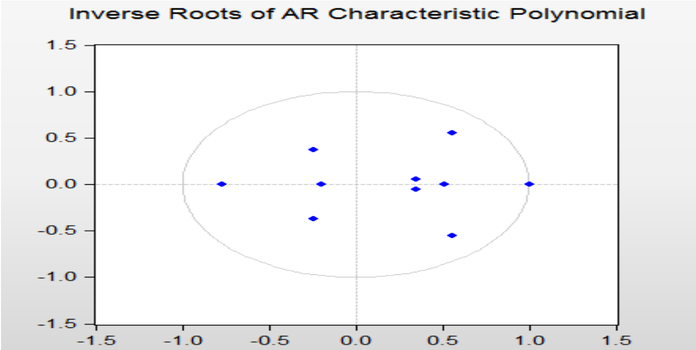
Sample (adjusted): 1978 2014				
Included observations: 37 after adjustments				
Trend assumption: Quadratic deterministic trend				
Series: PENSIONS_TO_GDP LUN15_64 LAPL OAD				
Exogenous series: REV1974 R1984 R1993 R2002 R2007				
Warning: Critical values assume no exogenous series				
Lags interval (in first differences): 1 to 2				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. Of CE(s)		Trace	0.05	
	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.739543	84.74033	55.24578	0.0000
At most 1	0.465835	34.96358	35.01090	0.0506
At most 2	0.248994	11.76271	18.39771	0.3270
At most 3	0.031076	1.168073	3.841466	0.2798
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)		Max-Eigen	0.05	
	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.739543	49.77675	30.81507	0.0001
At most 1	0.465835	23.20086	24.25202	0.0684
At most 2	0.248994	10.59464	17.14769	0.3447
At most 3	0.031076	1.168073	3.841466	0.2798
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
PENSIONS_TO_GDP	LUN15_64	LAPL	OAD	
12.69343	-11.85874	-43.80396	-1.447985	
-1.652246	-4.792849	1.232785	-0.865513	
6.893543	-12.18419	-77.04275	3.624849	
-2.640094	3.024320	51.60657	6.022865	
Unrestricted Adjustment Coefficients (alpha):				
D(PENSIONS_TO_GDP)	-0.064894	0.049043	0.017126	0.003598
D(LUN15_64)	0.027971	0.066820	0.009376	0.000114
D(LAPL)	-0.006699	-0.000976	-0.001274	-0.001297
D(OAD)	-0.018053	-0.022361	0.024004	-0.006894
1 Cointegrating Equation(s):		Log likelihood	259.8113	
Normalized cointegrating coefficients (standard error in parentheses)				
PENSIONS_TO_GDP	LUN15_64	LAPL	OAD	
1.000000	-0.934243	-3.450917	-0.114074	
	(0.08485)	(0.61569)	(0.07355)	
Adjustment coefficients (standard error in parentheses)				
D(PENSIONS_TO_GDP)	-0.823727			
	(0.25145)			
D(LUN15_64)	0.355044			
	(0.27994)			
D(LAPL)	-0.085035			
	(0.02454)			
D(OAD)	-0.229154			
	(0.19648)			

Source: Eviews 9 Output

TABLE XI – VECM MODEL

Cointegrating Eq:	CointEq1	Sample (adjusted): 1978 2014		
PENSIONS_TO_GDP(-1)	1.000000	Included observations: 37 after adjustments		
LUN15_64(-1)	-0.934243	Standard errors in ( ) & t-statistics in [ ]		
	(0.08485)			
	[-11.0107]	Determinant resid covariance		9.01E-11
LAPL(-1)	-3.450917	Determinant resid covariance		9.35E-12
	(0.61569)	Log likelihood		259.8113
	[-5.60500]	Akaike information criterion		-10.36818
OAD(-1)	-0.114074	Schwarz criterion		-7.407571
	(0.07355)			
	[-1.55089]			
@TREND(75)	0.024757			
C	18.19483			
Error Correction:	D(PENSIONS_	D(LUN15_64)	D(LAPL)	D(OAD)
CointEq1	-0.823727	0.355044	-0.085035	-0.229154
	(0.25145)	(0.27994)	(0.02454)	(0.19648)
	[-3.27589]	[1.26830]	[-3.46495]	[-1.16627]
D(PENSIONS_TO_GDP(-1))	0.048722	-0.134046	0.037997	0.216371
	(0.23937)	(0.26649)	(0.02336)	(0.18705)
	[0.20354]	[-0.50301]	[1.62640]	[1.15678]
D(PENSIONS_TO_GDP(-2))	-0.023504	-0.327028	0.023747	0.140985
	(0.19428)	(0.21629)	(0.01896)	(0.15181)
	[-0.12098]	[-1.51196]	[1.25233]	[0.92867]
D(LUN15_64(-1))	0.402031	0.652833	-0.002592	0.147807
	(0.24351)	(0.27110)	(0.02377)	(0.19028)
	[1.65098]	[2.40812]	[-0.10904]	[0.77679]
D(LUN15_64(-2))	-0.006098	0.136222	-0.054351	-0.148583
	(0.24210)	(0.26952)	(0.02363)	(0.18918)
	[-0.02519]	[0.50542]	[-2.30024]	[-0.78542]
D(LAPL(-1))	-0.221389	3.246082	-0.463845	-1.234411
	(2.35803)	(2.62517)	(0.23014)	(1.84257)
	[-0.09389]	[1.23652]	[-2.01547]	[-0.66994]
D(LAPL(-2))	0.580083	0.776474	-0.055980	-0.496768
	(1.60695)	(1.78900)	(0.15684)	(1.25567)
	[0.36098]	[0.43403]	[-0.35693]	[-0.39562]
D(OAD(-1))	0.170345	-0.345219	0.035069	0.468223
	(0.26139)	(0.29100)	(0.02551)	(0.20425)
	[0.65169]	[-1.18632]	[1.37463]	[2.29241]
D(OAD(-2))	0.371367	-0.035296	0.046423	0.150022
	(0.20938)	(0.23310)	(0.02044)	(0.16361)
	[1.77363]	[-0.15142]	[2.27169]	[0.91694]
C	-0.066069	-0.010129	0.001324	-0.066055
	(0.13892)	(0.15466)	(0.01356)	(0.10855)
	[-0.47559]	[-0.06550]	[0.09766]	[-0.60851]
@TREND(75)	0.007064	0.012654	-0.001357	0.003988
	(0.01497)	(0.01667)	(0.00146)	(0.01170)
	[0.47172]	[0.75905]	[-0.92828]	[0.34082]
REV1974	-0.268243	-0.002228	0.053747	0.162941
	(0.13658)	(0.15206)	(0.01333)	(0.10673)
	[-1.96393]	[-0.01465]	[4.03186]	[1.52670]
R1984	0.077589	-0.199898	0.054140	0.244170
	(0.11939)	(0.13292)	(0.01165)	(0.09329)
	[0.64988]	[-1.50395]	[4.64628]	[2.61728]
R1993	-0.383299	0.032310	-0.040317	-0.117924
	(0.17433)	(0.19408)	(0.01701)	(0.13622)
	[-2.19869]	[0.16648]	[-2.36955]	[-0.86567]
R2002	-0.099864	-0.004149	0.002105	-0.144916
	(0.16839)	(0.18746)	(0.01643)	(0.13158)
	[-0.59306]	[-0.02213]	[0.12808]	[-1.10136]
R2007	0.169199	-0.040558	0.000708	0.179928
	(0.10280)	(0.11445)	(0.01003)	(0.08033)
	[1.64589]	[-0.35438]	[0.07054]	[2.23988]
R-squared	0.685045	0.413290	0.802777	0.842369
Adj. R-squared	0.460078	-0.005789	0.661903	0.729776
Sum sq. resids	0.304910	0.377908	0.002904	0.186175
S.E. equation	0.120497	0.134148	0.011760	0.094157
F-statistic	3.045086	0.986188	5.698563	7.481515
Log likelihood	36.27442	32.30368	122.3691	45.40105
Akaike AIC	-1.095914	-0.881280	-5.749681	-1.589246
Schwarz SC	-0.399301	-0.184667	-5.053068	-0.892633
Mean dependent	0.124324	0.023130	0.020237	0.367568
S.D. dependent	0.163987	0.133761	0.020226	0.181129

Source: Eviews 9 Output



Source: Eviews 9 Output

FIGURE 8 – VECM STABILITY

TABLE XII – DESCRIPTIVE STATISTICS - RESIDUALS

	RESID01	RESID02	RESID03	RESID04
Mean	2.25E-17	-3.00E-18	5.06E-18	7.50E-18
Median	-0.006967	0.014785	-0.001034	0.007436
Maximum	0.235601	0.245342	0.017635	0.131231
Minimum	-0.190502	-0.219649	-0.020875	-0.168580
Std. Dev.	0.092031	0.102457	0.008982	0.071913
Skewness	0.399830	0.198200	-0.065383	-0.106813
Kurtosis	3.113281	2.896632	2.899390	2.324144
Jarque-Bera	1.005611	0.258718	0.041967	0.774560
Probability	0.604831	0.878658	0.979235	0.678901
Sum	9.30E-16	-5.55E-17	1.89E-16	3.05E-16
Sum Sq. Dev.	0.304910	0.377908	0.002904	0.186175
Observations	37	37	37	37

Source: Eviews 9 Output

TABLE XIII – WHITE HETEROSKEDASTICITY TEST (NO CROSS TERMS)

Sample: 1975 2014		
Included observations: 37		
Joint test:		
Chi-sq	df	Prob.
257.1420	250	0.3646

Source: Eviews 9 Output

TABLE XIV – COVARIANCE BETWEEN VARIABLES AND RESIDUALS

	RESID01	RESID02	RESID03	RESID04
LAPL	0.000203	0.000378	6.809052e-05	-0.000336
LUN15_64	-0.00071	-0.000166	-6.941109e-05	0.000966
OAD	-0.002602	-0.006206	8.657489e-05	0.007871
PENSIONS_TO_GDP	0.002162	-0.000867	-6.561464e-05	0.000443

Source: Eviews 9 Output

TABLE XV – RESIDUAL NORMALITY TEST

Orthogonalization: Cholesky (Lutkepohl)				
Null Hypothesis: residuals are multivariate normal				
Sample: 1975 2014				
Included observations: 37				
Component	Skewness	Chi-sq	df	Prob.
1	0.399830	0.985828	1	0.3208
2	-0.039593	0.009667	1	0.9217
3	0.267474	0.441177	1	0.5066
4	-0.430280	1.141701	1	0.2853
Joint		2.578373	4	0.6307
Component	Kurtosis	Chi-sq	df	Prob.
1	3.113281	0.019784	1	0.8881
2	2.672602	0.165250	1	0.6844
3	2.471544	0.430535	1	0.5117
4	2.776496	0.077013	1	0.7814
Joint		0.692582	4	0.9522
Component	Jarque-Bera	df	Prob.	
1	1.005611	2	0.6048	
2	0.174917	2	0.9163	
3	0.871713	2	0.6467	
4	1.218713	2	0.5437	
Joint	3.270955	8	0.9162	

Source: Eviews 9 Output

TABLE XVI – RESIDUAL SERIAL CORRELATION LM TEST

Null Hypothesis: no serial correlation at lag order h		
Sample: 1975 2014		
Included observations: 37		
Lags	LM-Stat	Prob
1	26.53845	0.0469
2	23.67038	0.0970
3	14.33662	0.5737
4	12.13793	0.7344
5	17.84991	0.3328
6	15.06970	0.5195
Probs from chi-square with 16 df.		

Source: Eviews 9 Output

TABLE XVII – VECM MODEL WITH P-VALUES

Dependent Variable: D(PENSIONS_TO_GDP)				
Method: Least Squares (Gauss-Newton / Marquardt steps)				
Sample (adjusted): 1978 2014				
Included observations: 37 after adjustments				
D(PENSIONS_TO_GDP) = C(1)*(PENSIONS_TO_GDP(-1) - 0.934243024013*LUN15_64(-1) - 3.45091727663*LAPL(-1) - 0.114073635473*OAD(-1) + 0.02475749296*@TREND(75) + 18.1948315066) + C(2)*D(PENSIONS_TO_GDP(-1)) + C(3) *D(PENSIONS_TO_GDP(-2)) + C(4)*D(LUN15_64(-1)) + C(5) *D(LUN15_64(-2)) + C(6)*D(LAPL(-1)) + C(7)*D(LAPL(-2)) + C(8) *D(OAD(-1)) + C(9)*D(OAD(-2)) + C(10) + C(11)*@TREND(75) + C(12) *REV1974 + C(13)*R1984 + C(14)*R1993 + C(15)*R2002 + C(16) *R2007				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.823727	0.251451	-3.275886	0.0036
C(2)	0.048722	0.239372	0.203541	0.8407
C(3)	-0.023504	0.194285	-0.120977	0.9049
C(4)	0.402031	0.243510	1.650984	0.1136
C(5)	-0.006098	0.242097	-0.025189	0.9801
C(6)	-0.221389	2.358032	-0.093887	0.9261
C(7)	0.580083	1.606951	0.360983	0.7217
C(8)	0.170345	0.261388	0.651695	0.5217
C(9)	0.371367	0.209383	1.773629	0.0906
C(10)	-0.066069	0.138920	-0.475587	0.6393
C(11)	0.007064	0.014974	0.471721	0.6420
C(12)	-0.268243	0.136585	-1.963930	0.0629
C(13)	0.077589	0.119390	0.649881	0.5228
C(14)	-0.383299	0.174330	-2.198694	0.0392
C(15)	-0.099864	0.168388	-0.593060	0.5595
C(16)	0.169199	0.102801	1.645886	0.1147
R-squared	0.685045	Mean dependent var		0.124324
Adjusted R-squared	0.460078	S.D. dependent var		0.163987
S.E. of regression	0.120497	Akaike info criterion		-1.095914
Sum squared resid	0.304910	Schwarz criterion		-0.399301
Log likelihood	36.27442	Hannan-Quinn criter.		-0.850326
F-statistic	3.045086	Durbin-Watson stat		2.327696
Prob(F-statistic)	0.009733			

Source: Eviews 9 Output

TABLE XVIII – WALD TEST FOR THE VECM SHORT-RUN COEFFICIENTS

Test Statistic	Value	df	Probability
F-statistic	1.364688	(2, 21)	0.2772
Chi-square	2.729377	2	0.2555
Null Hypothesis: C(4)=C(5)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(4)		0.402031	0.243510
C(5)		-0.006098	0.242097
All restrictions are linear in coefficients.			
Test Statistic	Value	df	Probability
F-statistic	0.066009	(2, 21)	0.9363
Chi-square	0.132018	2	0.9361
Null Hypothesis: C(6)=C(7)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(6)		-0.221389	2.358032
C(7)		0.580083	1.606951
Test Statistic	Value	df	Probability
F-statistic	1.851988	(2, 21)	0.1817
Chi-square	3.703976	2	0.1569
Null Hypothesis: C(8)=C(9)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(8)		0.170345	0.261388
C(9)		0.371367	0.209383

Source: Eviews 9 Output