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PENSION SYSTEM DESIGN AND ITS EFFECT ON SAVING

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Thesis submitted to the University of Nottingham

for the degree of Doctor of Philosophy

OCTOBER, 2012

ABSTRACT

The objective of this thesis is to examine the effect of pension system design on saving.

Chapter II analyses the relationship analytically, in a two-period two-generation partial equilibrium Samuelson-type of OLG model in the logarithmic format, augmented by design of the public pension system and by the mandatory funded pension programme with the displacement coefficient. The model predicts higher household saving for countries with a lower contribution rate, higher redistribution within the public system and greater importance of private pension savings, i.e. systems that could be classified as 'Beveridge'. Partial derivatives of the model are numerically simulated.

Chapter III first deals with the measurement issue, defining the set of 'pension design indicators' that will be used later for the empirical analysis. Then it tests the 'convergence hypothesis' of pension models using several methods. The results unambiguously suggest that, despite a convergence in pension policy goals, convergence of pension models has not occurred i.e. the pension systems around the world are still influenced by their historical paths.

Chapter IV empirically investigates the effect of pension system design on saving rates. The first part of the analysis closely follows work in Disney (2005), with somewhat differently calculated public pension design variables and with data for the 2000s. I also tested the impact of private pension component on household saving. The overall pension system

design was estimated using principal components composite indices. The results obtained using a number of estimation methods have not confirmed the predictions of the theoretical model, and are actually counter-intuitive. In addition to methodological issues related to household saving data, a possible explanation for this could be the complexity of household saving behaviour that needs to be adequately controlled for.

The final chapter summarizes the findings, discusses limitations of empirical investigation and sets forth directions for future research.

ACKNOWLEDGMENTS

I would like to thank my supervisor, Professor Richard Disney of the University of Nottingham, for invaluable comments, guidance, and a lot of patience through this long period. My examiners, Professor Sarah Brown of the University of Sheffield and Dr John Gathergood of the University of Nottingham, provided excellent comments that are much appreciated.

I would like to express my thanks to the *Foundation of Crown Prince Alexander II for Culture and Education, Belgrade, Serbia,* for providing tuition waiver at the University of Nottingham, and to Professor Oliver Morrissey for helping with this arrangement. I am also thankful to *Open Society Foundations* for supplementary grants. I am grateful to *Center for Liberal Democratic Studies (CLDS), Belgrade, Serbia,* and Dr Gordana Matković in particular, for invaluable support.

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Glossary

ADF (Augmented Dickey-Fuller) test: a test for a unit root in higher order AR process, which includes lagged changes of the variable as regressors.

AMECO: The Annual Macro-Economic Database of the European Commission's Directorate General for Economic and Financial Affairs. Contains data for EU-27, candidate countries and other OECD countries (United States, Japan, Canada, Switzerland, Norway, Iceland, Mexico, Korea, Australia and New Zealand)

Balancing mechanism: the automatic indexation system used in the Sweden public pension scheme – if pension assets fall below liabilities, the standard indexation is corrected by the assets/liabilities ratio.

CV (coefficient of variation): is a normalized measure of dispersion of a probability distribution. It is defined as the ratio of the standard deviation to the mean.

DB (defined-benefit): a pension plan where benefit is predetermined, calculated on the basis of a formula that accounts for a worker's years of service and earnings; sponsor of the plan bears the risk.

DC (defined-contribution): a type of retirement plan in which the amount of the employer's annual contribution is specified, and the benefit depends on the contributions paid into the individual account and the earned rate of return; the risk is borne by the beneficiary.

CWED (Comparative Welfare Entitlements Dataset): compiled by Lyle Scruggs (University of Connecticut) and consists of six datasets on institutional features of social insurance programmes in 18 countries spanning much of the post-war period.

EC (European Commission): executive body of the European Union, which is responsible for proposing legislation, implementing decisions, and manages the day-to-day business of implementing EU policies and spending EU funds.

ESA95 (European system of national and regional accounts): collects comparable, up-to-date and reliable information on the structure and developments of the economy of the Member States of the European Union. The system is broadly consistent with the System of National Accounts of the United Nations (1993 SNA) with regards to definitions, accounting rules and classifications, but it also has some specificities, particularly in its presentation, which is more in line with EU practices.

EUROSTAT: the statistical office of the European Union, based in Luxembourg.

EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

EU-10: Ten countries that accessed the EU in 2004 (Malta, Cyprus, Slovenia, Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, and Hungary).

EU-8: Eight ex-communist countries that accessed the EU in 2004 (Slovenia, Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, and Hungary).

EU-25: EU-15 and EU-10.

EU-27: EU-25 and Bulgaria and Romania (accessed in 2007).

FE (fixed effect): estimators used in the panel data analysis obtained by applying pooled OLS to time-demeaned data.

GDP (gross domestic product): market value of all officially recognised final goods and services produced within a country in a given period.

GLS (generalised least squares): an estimator that accounts for a heteroskedasticity, serial correlation, or both, via transformation of the original model.

GMM (general method of moments): an estimator based on the population moments conditions.

HDI (household disposable income): the sum of wages and salaries, mixed income, net property income, net current transfers and social benefits other than social transfers in kind, less taxes on income and wealth and social security contributions paid by employees, the self-employed and the unemployed.

LHC (life cycle hypothesis): model of individual consumption patterns developed by Modigliani and Brumberg (1954).

IRA (individual retirement accounts): a form of retirement plan that provides tax advantages for retirement savings in the United States.

IRR (internal rate of return): the interest rate at which the average present value of the stream of contributions paid is equal to the average present value of the stream of pension benefits.

Kaiser criterion: the number of factors equal to the number of eigenvalues of the correlation matrix that are greater than one.

KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test: a one-sided right-tailed stationarity test, where the null hypothesis is trend-stationarity against the unit root alternative hypothesis.

NPISH (non-profit institutions serving households): non-profit institutions which are not predominantly financed and controlled by government and which provide goods or services to households free or at prices that are not economically significant. This sector includes such bodies as charities, trade unions and churches.

MISSOC (Mutual Information System for Social Protection): a prime source of information on the status of social protection in Europe; produces regularly updated comparative tables covering all areas of social protection.

NDC (notional defined contributions): a variant of an earnings-related scheme that combines a defined contribution system financed on the pay-as-you-go basis. Contributions are recorded in an individual account and they earn a notional interest rate (wage bill or GDP growth). At retirement, the accumulated notional capital in each account is converted to a stream of pension payments using a formula based on life expectancy at the time of retirement.

OECD (Organization for Economic Cooperation and Development): is an international economic organisation of 34 countries founded in 1961 to stimulate economic progress and world trade.

OLG (overlapping generations model): popularised by Samuelson (1958) is a dynamic economic model, which contains agents born at different dates and with finite lifetimes.

OMC (open method of coordination): a form of EU soft law, which aims to spread best practices and achieve greater convergence towards the main EU goals.

PAYG (pay as you go): the method of financing pension where the benefits are paid directly from current workers' contributions and taxes.

PCA (principal component analysis): a mathematical procedure that transforms a number of correlated variables into a smaller number of uncorrelated variables called *principal components*, which account for most of the variance of the observed variables.

Pension variation: a variable that measures 'intragenerational redistribution' of the pension system. It is calculated as the coefficient of variation of replacement rates across several household types.

Pension tax: an indicator devised by Disney (2004) to capture the absolute 'tax component' of the contribution rate. It is calculated by multiplying a 'pension variation' by the average effective contribution rate.

Point system: a variation of defined-benefit pension system, where benefit is defined as a product of a number of personal points and the pension (general) point value. Workers earn pension points based on their individual earnings for each year of contributions. At retirement, accumulated pension points are multiplied by a pension-point value to convert them into a monetary payment.

RE (random effects): a feasible GLS estimator used in the panel data analysis, where the unobserved effect is assumed to be uncorrelated with the explanatory variables.

RR (replacement rate): the ratio of the first post-retirement income to pre-retirement income.

SOCX (Social Expenditure Database): the OECD database with social expenditure data stemming from the 1980s.

SNA 93 (System of National Accounts 1993): a coherent, consistent and integrated set of macroeconomic accounts, balance sheets and tables based on a set of internationally agreed concepts, classifications and accounting rules.

TSFA (tax-favoured savings accounts): a variety of options for receiving tax benefits for retirement saving. Tax-favoured accounts fall into two broad categories: those offered through an employer and those established by an individual.

WDI (World Development Indicators): the primary World Bank collection of development indicators, compiled from officially recognised international sources.

I INTRODUCTION

The reforms of pension systems around both OECD and developing countries have been at the top of the agenda since the second half of the 1980s and there is no sign that the issue is gaining less importance. Hence, reforming pension systems around the world has become an ongoing process.

One of the important arguments for the choice of a particular pension model is its contribution to the increase in national saving. Using this, among other arguments, during the 1990s, the World Bank (1994) promoted the concept of pension reform based on the Chilean experience – the so-called multi-pillar model, which in turn was inspired by the Anglo-Saxon Beveridge pension model. Its side effect — the increase in national saving — has been seen as one of the important arguments for the introduction of this type of pension model. Thus, the effect of the pension system on saving is of the utmost interest.

The theory linking a pension system and saving is not straightforward though. A standard life-cycle hypothesis predicts a one-for-one displacement effect of a pension programme on household saving. When additional assumptions are introduced into the LCH framework, such as myopic behaviour – one of the arguments for a public pension intervention, liquidity constraints, income uncertainty, bequest motive, etc., the offset is no longer expected to be one-for-one, and its size becomes an empirical question.

In the 'extended life cycle model', Feldstein (1974; 1976) shows that the displacement is less than one due to the 'induced retirement' – additional wealth brought about by social security would induce individuals to retire earlier than otherwise, which in turn leads to higher lifetime savings needed for a longer period of retirement.

When it comes to the empirical literature on effects of the size of the unfunded (PAYG) pension system on saving, there is a large body of literature. This literature can be classified into the time series analysis, cross-country and cross-section analysis, and usually looks at the effect of magnitude of a PAYG pension programme on aggregate saving.

The most influential work in this area is Feldstein's (1974) time series analysis of the social security effect on savings. He estimates from annual time series US data for social security wealth (both gross and net) the impact on consumption for the period 1929–1971 and finds that social security depresses personal saving by 30-50 percent per dollar of benefit, depending on specification.

This article is perhaps the most famous in the PAYG and saving literature, but it also produced a good deal of controversy. Many authors critically responded to his analysis, such as Barro (1978) and Leimer and Lesnoy (1982), while Feldstein also continued to build on his seminal work. In his 1996 paper, he addressed the issues that were subject to criticism, and confirmed his results.

There are also a significant number of cross-section studies of the pension system effect on saving rates, including Feldstein and Pellechio (1979), Novos (1989), Kotlikoff (1979), Gale

(1995), as well as cross-country studies: Barro and MacDonald (1979), Feldstein (1980), Edwards (1996) etc.

In general, findings of this vast literature suggest that reducing the generosity of pay-as-you-go (PAYG) systems is likely to stimulate a small increase in private saving, but this effect depends on many factors – such as the demographic composition and economic institutions of each country.

However, the debate on pensions and saving has focused on the effect of the size of an unfunded programme on saving, but as argued by Disney (2005; 2006a), the *design of an unfunded programme* may also matter. Disney introduced the analysis of the effect of design of social security programmes on saving into the empirical literature, arguing that the household behaviour depends on the pension programme design features, such as how closely a particular social security programme mimics private retirement saving programmes and the degree of 'intragenerational redistribution'.

When it comes to the analysis of private pension programmes on saving rates, the literature is mainly focused on the effects of voluntary (tax-favoured) private pensions on savings and rarely deals with the effect of a mandatory fully-funded system. Furthermore, it mostly utilises cross-section analyses within a country, and single country studies (time series), rather than cross-country analyses. The reason may be data availability, since the collection of cross-country data is a demanding task.

Motivated by the relevance of the pension-saving relationship, and inspired by Disney's (2005; 2006a) work on the effect of the *design* of public pension (social security) programmes on saving, I chose to investigate the effect of *pension system design on saving.* I look at both the public and private component of pension design.

Firstly, in Chapter II PENSION SYSTEM DESIGN AND SAVING: TWO-PERIOD PARTIAL EQUILIBRIUM MODEL, I embark on the theoretical analysis of the effects of both the design of the social security system and the private pension component on household saving.

I derive a two-period two-generation partial (household sector) equilibrium Samuelson-type of OLG model in the risk-aversion logarithmic format, including a design of the public pension system as in Disney (2005; 2006a) and further augmenting it by the mandatory funded pension programme with the displacement coefficient. The novelty of this model is derivation of saving rate and looking at two types of offsets from household saving – induced by public pensions, and induced by mandatory saving programmes. At the end of the Chapter II, I numerically test the partial coefficients of the model.

Prior to getting on to the empirical analysis of the effect of the pension system design on saving, it was important to define a set of measures of the design of a pension system, and to test empirically whether it still makes sense to regard pension models as Beveridge vs. Bismarck, as it has been done in the analytical Chapter II, following Disney (2005; 2006a), Lindbeck and Persson (2003), Pestieau (1998; 1999), Casamatta et al. (2000). The question of convergence vs. path dependence is of great importance, both for further empirical testing of theoretical model obtained in Chapter II, as well as for policy implications when it comes to pension design reforms.

Chapter III PENSION SYSTEM DESIGN: MEASUREMENT AND CONVERGENCE first deals with the measurement issue. There are various indicators of 'pension system design' measured in the literature, though there are no readily available datasets. Section 2 of Chapter III describes and measures various pension indicators and explains in detail what the pension indicators are, how they are calculated and what are the data sources. This set of indicators is later used in the empirical analysis of pension system design and saving.

As the proposed indicators overlap and correlate, I have also performed principal component analysis to identify commonalities on indicators in line with the typology of pension programmes – Beveridge vs. Bismarck, and to create composite indices that can be later used in the empirical analysis.

The empirical analysis of this Chapter answers the question whether there have been convergences in the design of pension systems around the world or are pension models still influenced by their historical paths.

Pension systems around the world originated with the choice between two models – Bismarck, with the aim to provide income maintenance, or Beveridge, aiming to alleviate poverty across the whole old-age population. The decision toward a pension model was not made at once, but was rather a result of 'longer and sometimes inconsistent history from the 1880s up to the 1950s' (Ebbinghaus and Gronwald, 2009:6). Nonetheless, at the end of the 1950s, countries could be quite easily classified according to original pension policy that prevailed at the time into ‘Bismarck’ or ‘Beveridge’. This division is used as a base for the analysis throughout the Chapter, translated into the ‘Bismarck dummy’.

However, the evolution of pension systems since the beginning of the 1960s and the latest developments – the retrenchment policies caused by growing pension deficits and the issue of an aging population, as well as the European Union’s ‘Open Method of Coordination’ – all this together brought the question whether the convergence in pension models occurred, or historical origins are still important.

I have tested empirically the ‘convergence hypothesis’ in section 3 of Chapter III, using a number of estimation methods. Firstly, I pursue a Disney (2000a) type of estimation to test whether ‘Bismarckian’ countries tend to hinder the development of private pension arrangements – a form of ‘crowding out’ hypothesis, using longer data series and a slightly different set of variables. Then I use Bonoli`s (1997) ‘two-dimensional approach’, which classifies welfare regimes according to two dimensions of social policy, and apply it to the pension models. I look to see if countries still tend to group as ‘Bismarck’ and ‘Beveridge’ according to the pairs of pension policy dimensions.

Finally, I formally test the ‘convergence hypothesis’ by testing the stationarity of the difference of selected pension indicators for the ‘Bismarck’ and ‘Beveridge’ group. This is a method that has been used in the literature testing convergence of various topics, for example by Harvey (2002) for economic growth, Affinito and De Bonis (2008) for convergence of the banking sector, etc. I also follow Johnson (1999) and investigate whether there has been a decrease in the coefficient of variation of pension indicators across countries over time.

The contribution of this Chapter is developing a defined and calculated set of pension design indicators, including composite indices, which can be used for the empirical analysis of pension design and its effect on various variables, including saving. Furthermore, it includes the empirical testing of 'convergence hypotheses', using a comprehensive set of measures and a number of estimation methods. These results are of importance both for testing the relationship between pension system design and saving, as well as for general pension reform recommendations. In case of non-convergence, policy makers should be more carefully in choosing reform options, and consider more the adequacy of each option in relation to the existing pension system set up.

Finally, I look for the empirical evidence on the effect of pension system design on household saving in Chapter IV PENSION SYSTEM DESIGN AND SAVING: EMPIRICAL EVIDENCE.

Since the empirical analysis of saving is quite challenging due to the problems of saving data availability and quality, after the literature review and theoretical framework, section 4 deals with the data and estimation problems, in particular with the methodological issues concerning household saving data.

The empirical analysis, given in section 5, splits into three parts. The first part closely follows Disney (2005, 2006a) in an attempt to investigate the effect of public pension design on household saving. I try to replicate his work with somewhat more comprehensive data and for a longer time period. In the second part, I estimate the effect of the private pension component on the saving rate, proxied with the stock of private pension assets as a share of GDP. In the third part I attempt to model the overall pension design, taking into account both the public and private component, using the principal component composite index dubbed the 'Bismarck index'.

The contribution of this Chapter is the use of a comprehensive pension indicator dataset including composite indices, stemming four decades, and the use of several estimation methods to assess the impact of the overall pension system design on saving – both public pension design and private component.

II PENSION SYSTEM DESIGN AND SAVING: TWO-PERIOD PARTIAL EQUILIBRIUM MODEL

1. INTRODUCTION

The relationship between a pension system and household saving has been a subject of debate for a long time – both theoretically and empirically. A standard life-cycle hypothesis (LCH) predicts a one-for-one displacement effect of a pension programme on household saving. When additional assumptions are introduced into the LCH framework, such as myopic behaviour – one of the arguments for a public pension intervention, liquidity constraints, income uncertainty, bequest motive, etc., the offset is no longer expected to be one-for-one, and its size becomes an empirical question.

In the 'extended life cycle model', Feldstein (1974; 1976) formalises the 'induced retirement' argument – additional wealth brought about by social security would induce individuals to retire earlier than otherwise, which in turn leads to higher lifetime savings needed for a longer period of retirement. Feldstein (1987) compares a universal and a means-tested pension programme in terms of a more optimal solution, and though not settling for either, he believes a means-tested programme with a very low level of benefit is preferable, but not politically attainable (Feldstein, 2005).

Disney (2006a) argues that the design of a pension system also matters. Using the Lindbeck and Persson (2003) format, he includes pension design in budget constraints and argues that the closer the pension programme is to a saving programme (the internal rate of return closer to the market interest rate), the greater the potential offset for private saving. Further, he argues that the higher the degree of redistribution within the programme, the average offset should be lower.

In this Chapter, I analytically examine the effect of pension system design on household saving. After providing a background discussion in Section 2, in Section 3 I set out the Aaron-Samuelson-type model of social security and derive saving rate, integrating various aspects of pension system design into the format of Lindbeck and Persson (2003) and Disney (2005; 2006a).

The model is a two-period two-generation partial equilibrium OLG model set in logarithmic format, capturing behaviour of the risk-averse individuals. This is a Samuelson-type of OLG model, without production. There is a possibility to save, but there is no firm sector (production) in the model, hence the market interest rate is an exogenous variable. This means that only the households sector is taken into account.

The model includes design of the public pension system as in Lindbeck and Persson (2003) and Disney (2005; 2006a) and is further augmented by the mandatory funded pension programme with displacement coefficient. Thereby, I derive saving rate and analyse analytically two types of offsets from household saving – induced by public pensions, and induced by mandatory saving programmes. Obviously, these offsets are expected to differ and neither needs to be one-for-one.

At the end of Section 3, I set out and explain some partial derivatives, which are numerically illustrated in Section 4, and empirically tested later in the thesis.

The contribution of this Chapter is a derivation of the household saving rate using risk-aversion logarithmic utility function, based on the two-period budget constraints problem set in Disney (2005), and further augmenting it by the mandatory funded pension programme and displacement coefficient. Additional contribution is numerical simulations of the model.

2. BACKGROUND: THE RATIONAL AND DESIGN OF PENSION SYSTEM

2.1. LIFE-CYCLE HYPOTHESIS (LCH) AND THE RATIONALE FOR PUBLIC PENSIONS

Life-Cycle Hypothesis

The standard framework for the analysis of savings decisions at the *microeconomic (individual) level* is the ***Life-Cycle Hypothesis*** developed by Modigliani and Brumberg (1954), and Ando and Modigliani (1963), which is based on the Irving Fisher's model of inter-temporal choice and Harrod`s notion of hump-saving.

According to the life cycle hypothesis (henceforth LCH), individuals maximise their utility by *smoothing lifetime consumption*, while consumption is a function of lifetime resources. The assumption of this model is that consumers are forward looking and rational and there is no bequest motive. The utility function is homogeneous – a function where multiplying all the arguments by any constant multiplies the value of the function by some power of this constant[1].

Let us consider a two-period model (working in period 1 and retired in period 2) with forward-looking behaviour and no bequests.

An individual maximises his/her lifetime utility function:

$$V = u(c_1) + \beta u(c_2) \qquad u'(c) > 0 \qquad u''(c) < 0 \qquad \text{(II-1)}$$

where V is the life-time utility function;

$u(\bullet)$ is the instantaneous utility function

c_t is consumption of the individual during the year t (in this case 1 or 2);

the parameter β is the subjective discount factor ($\beta = \frac{1}{1+\rho}$ and $\rho \geq 0$ captures time preference, $\rho = 0$ if the individual values future the same as current consumption),

Subject to budget constraints:

$$c_1 = A_0 + W_1 - s_1 \quad \text{and} \quad c_2 = (1 + r)[A_0 + W_1 - c_1] \qquad \text{(II-2)}$$

where A_0 is household net worth (wealth) carried over from the previous period (given in first period); W is labour income (wage).

[1] If the power is 1 then it is said that function is homogenous of degree 1, if the power is 2 then function is homogeneous of degree 2 etc.

Combining the constraints yields the *intertemporal budget constraint,* meaning that the present value of lifetime consumption must equal present value of lifetime income and initial assets.

$$c_1 + \frac{c_2}{1+r} = A_0 + W_1 \qquad \text{(II-3)}$$

This gives the maximisation problem:

$$L = u(c_1) + \beta u(c_2) - \lambda[c_1 + \frac{c_2}{1+r} - A_0 - W_1] \qquad \text{(II-4)}$$

$$\frac{\partial L}{\partial c_1} = u'(c_1) - \lambda = 0, \qquad \frac{\partial L}{\partial c_2} = \beta u'(c_2) - \frac{\lambda}{1+r} = 0$$

and *Euler equation:*

$$u'(c_1) = \beta(1+r)u''(c_2)$$

A change in consumption over time depends on the form of the utility function $u(\bullet)$, the subjective discount rate β (time preference ρ), and the interest rate r.

For $r = \rho$ it follows that the consumer wishes to smooth consumption completely. That is $c_1 = c_2$, as long as there are no preference shifters between periods.

For the *logarithmic* inter-temporal utility function $= lnc_1 + \beta lnc_2$, which captures the behaviour of risk-averse individuals, the Euler equation is

$$c_2 = \beta(1+r)c_1 \qquad \text{(II-5)}$$

Plugging budget constraint (II-1) into Euler equation (II-5)

$$(1+r)[A_0 + W_1 - c_1] = \beta(1+r)[A_0 + W_1 - s_1]$$

$(1+r)$ cancels and substituting for $c_1 = A_0 + W_1 - s_1$ we get:

$$(1+\beta)s_1 = \beta(A_0 + W_1)$$

Therefore the optimal saving rate is:

$$s_1 = \frac{\beta}{1+\beta}(A_0 + W_1)$$

and since the parameter β is the subjective discount factor $\beta = \frac{1}{1+\rho}$

$$s_1 = \frac{A_0 + W_1}{2+\rho}$$

This result demonstrates that individuals seek to maximise their utility by smoothing life-cycle consumption, which means that there should be no discontinuity (i.e. sharp reduction) in consumption at retirement. Almost half of the household wealth carried over from the past and labour income earned in the period one will be saved for the retirement.

Consequently, the LCH shows that 'consumption smoothing leads to a humped-shaped age path of wealth holding, a shape that had been suggested earlier by Roy Harrod (1948) under the label of hump saving' (Modigliani, 1986:300).

<u>The Rationale for a Public Pension System</u>

From a <u>microeconomic or individual point of view</u>, consumption smoothing requires *a mechanism*. When saving, people face a range of uncertainties, including *longevity risk* – how long they are going to live. If saving as an individual, a person faces the risk of outliving those savings, or of consuming very little. Therefore, we need the insurer to 'pool the risk' – life expectancy of a larger group of people is better known (Barr and Diamond, 2006). Furthermore, there is always a risk that an individual does not earn enough to save – *earnings risk.*

Samuelson (1958) provides a rationale for the introduction of social security from the <u>macroeconomic/state view.</u> Assuming no capital accumulation and constant productivity in a three-period two generation overlapping model, he proves that the introduction of a pay-as-you-go social security system is welfare improving for each individual, as long as population growth is higher than the market interest rate. Aaron (1966) extends his model assuming stationary productivity growth, and argues that the social security program is welfare improving so long as the sum of the rates of growth of per capita wages and population, being a return to the social security program, exceeds the interest rate. Samuelson (1975), as well as Blanchard and Fischer (1989), allow capital accumulation and argue that in a dynamically inefficient economy, introduction of social security is welfare improving – see the discussion in Disney (1996). However, most economies are traditionally regarded as dynamically efficient so long as capital is scarce.

There are two other major reasons for state/public intervention suggested by Diamond (1977) – *paternalism* and *market failure*. Hozlmann and Hinz (2005) classify both arguments under market failure, dividing them into market failure from the demand side (myopia/paternalism) and from the supply side (absence of financial products).

One of the assumptions of the LCH and Samuelson (1958) is that consumers are rational and forward-looking. On the other hand, there is a view that individuals may save insufficiently due to *myopia* and *time-inconsistency*, which actually strengthens the argument for public pensions. For example, Diamond (1977) suggests that individuals if left alone will not save enough for their old age because of irrationality in decision-making or because of a lack of good information about their future incomes or expected lifetimes. Consequently, he points to the paternalist motive as one of the justifications for Social Security.[2]

On the other side of the argument, Feldstein (1985) performs a theoretical and numerical analysis of the two-period OLG model with productive capital and myopia, and argues that even if every individual is substantially myopic, it may be optimal to have either no social security retirement program or very low benefits based on means-testing. In the case of completely myopic individuals, social security is justified, nevertheless 'the optimal level of benefits may be quite low, unless a large fraction of the population is completely myopic' (page 318).

[2] Once a public pension program exists, however, it is hard to prove the counterfactual that individuals would not save enough without a public pension program.

A stream of research dubbed the ‘retirement-consumption puzzle’ may seem to give empirical support for the existence of myopic individuals. A number of empirical studies using survey data, starting with Hamermesh (1984) for the United States, found an unexpected drop in consumption at retirement, apparently incompatible with the assumption of underlying consumption smoothing. For example, Banks et.al. (1998) observe a sudden fall of consumption in retirement in United Kingdom household survey data, which cannot be explained by the LCH even when the researchers controlled for a decrease of work-related expenditures and substitution of purchased with home-produced goods, as well as allowing for age-related change in consumption preferences. Furthermore, they rule out a negative shock to wealth owing to unanticipated earlier retirement due to for example health event, unemployment, marital status as possible causes (Disney and Tanner, 1998; Hurd and Rohwedder, 2003). However, Banks *et.al.* argue that this fall does not need to be the result of the lack of rationality in consumption choices over the life cycle, but can rather be explained by the change of information in retirement or what they call ‘systematic arrival of unexpected adverse information’, such as unanticipated shocks to perceived lifetime needs through health or life expectancy (page 769).

On the contrary, Bernheim *et al.* (2001: 855) argue that the puzzle cannot be explained within the LHC framework, and that it can be more easily explained if ‘one steps outside the framework of rational, farsighted optimization’. Consequently, they see the cause of the retirement-consumption puzzle in myopic individuals, to whom post-retirement consumption feasibility is a surprise.

Holzmann and Hinz (2005:40) state, 'myopia may be the result of an insufficient planning horizon or a high personal discount rate. Empirically, it is difficult to distinguish between both causes, but there are strong indications for the latter. A perceived high discount rate can be the result of restricted credit markets, the existence of other, more urgent, lifetime risks (such as sickness, disability, and family dissolution) or natural and political risks'.

There is also a stream of research that points to the problem of *time-inconsistency (*Laibson, 1996; Laibson and Harris, 2001 etc.). Laibson with his 'pull of instant gratification' explains that individuals conceive a long-term viable savings plan, but tend to deviate from it. In such cases inadequate old-age savings may be attributed to psychological reasons – current needs and satisfactions are what makes people save less than they rationally know they should.

On the *supply side*, there are failures that prevent private markets to provide adequate financial products. Diamond (1977: 279) points to the three types of failures: the absence of safe investment opportunities, the absence of real annuities and the problems in insuring the risk associated with a varying length of working life. In addition, any attempt to insure the risk faces severe moral hazard and adverse selection problems (Ibid, p. 280).

Hence, the rationale for public intervention is the lack or suboptimal supply of market-based retirement products. 'Even when such products exist, they often require public intervention in the form of public education and guarantee funds' (Holzmann and Hinz, 2005:40). Annuity companies face adverse selection – only the healthy sign up, which prevents private markets from offering an appropriate level of coverage.

Besides providing a consumption smoothing mechanism, public policy might have two additional objectives for a pension scheme. The first is *poverty relief*: a society might wish its pensioners to have a minimum standard of living in retirement. The second is a *redistributive objective*: a society might wish to distribute additional resources above the poverty level to certain members of society (Barr, 2006).

Overall, the pension system has multiple objectives – the most important being poverty prevention/reduction and consumption smoothing. A pension system is therefore said to be adequate when it manages to accomplish these two major goals: to provide the *absolute level of retirement income* (preventing/reducing old-age poverty), and to provide the *relative level of retirement income* (income replacement or maintaining the relative standard of living) (Holzmann and Hinz, 2005). These are the main reasons for the introduction of a pension system.

2.2. The Overlapping Generations Model (OLG) and Aaron`s Condition

The main framework to analyse the social security effect on aggregate household saving i.e. at the *macroeconomic level* is the ***Overlapping Generations Model (OLG)***, popularised by Samuelson (1958).

Samuelson considers a three-period three-generation one-sector model. He assumes no saving and investment, ‘all loans being consumption loans’. His model is partial with only one sector – household - and no production. Another feature of the model is that at every point in time, finitely lived individuals of different generations are alive. Agents are forward looking and rational and there is no bequest motive. He assumes stationary population growth.

The essential feature of this model is that at every point in time, finitely-lived individuals of different generations are alive. Time preference is constant across time (individuals do not change the time preference over time) and it is the same for each generation. Future consumption is discounted at the subjective interest rate i that can be $>=< 0$, not necessarily positive as in Bohm-Bawerk. There is no possibility to store goods.

Samuelson (1958) looks at three generations and each generation has *three periods in life* – workers produce one unit of product in period 1 and one in period 2 (when ‘young’), and in period 3 they retire and do not produce (when ‘old’). Each person maximises his/her lifetime utility function:

$$V = U(C_1^Y, C_2^Y, C_3^O)$$

where C_1^Y and C_2^Y is the consumption of young age groups (generations) in period 1 and 2, and C_3^O in period 3

subject to the inter-temporal budget constraint:

$C_1^Y + RC_2^Y + R^2C_3^O = 1 + 1R + 0R^2$ where $R = \frac{1}{1+i}$

This merely says that the total discounted value of the individuals' consumption must equal the discounted value of their production over the lifetime. Hence, net lifetime saving is equal to zero:

$$S_1^Y(R) + RS_2^Y(R) + R^2S_3^O(R) = 0 \quad \text{(II-6)}$$

As in the previous section, the solution to this maximisation problem depends on the form of the utility function and the value of the subjective preference rate. If we assume $i = 0$, then 'individual inter-temporal equilibrium is obtained where marginal utility of consumption is equated across time-periods' (Disney, 1996: 38). Similarly, if we assume $i \neq 0$ and the logarithmic utility function, then discounted marginal utilities are equated across periods. This is the same result obtained in the previous section. Consequently, we can see that the life-cycle model is embedded in the OLG framework.

Let us consider the implications at the macroeconomic level. The assumption is that no goods can be stored – it means that 'total net saving of community must cancel out to zero in every period' (Samuelson, 1958: 470). Hence, equilibrium requires:

$$B_1S_1^Y(R) + B_2S_2^Y(R) + B_3S_3^O(R) = 0$$

where the population size in each period of time is B_t with population growth m. If the first generation is normalised at 1, then we have:

$$S_1^Y(R) + (1+m)^{-1}S_2^Y(R) + (1+m)^{-2}S_3^O(R) = 0 \quad \text{(II-7)}$$

Recalling the budget identity, we can see that $R = (1 + m)^{-1}$ i.e. $i = m$

'Every geometrically growing *consumption-loan economy* has an equilibrium market rate of interest exactly equal to its biological percentage growth rate' (Samuelson, 1958: 472). Samuelson also proves that the solution is a socially optimal one.

However, this solution is not unique. In addition, there is an equilibrium where $i = -1$ (or $R = +\infty$). The interpretation is that the oldest generation 'is prepared to pay up to all its previous resources to persuade successive generations to support it in its retirement' (Disney, 1996: 39).

To resolve this suboptimal solution, Samuelson suggested the use of money as a store of values, as well as a *social security programme* as a form of 'social contract' between generations. He argued that the introduction of a social security program as a form of 'Hobbesian contract' would be welfare improving for each individual, as long as population growth or the 'biological interest rate', being the rate of return on social security, was higher than the market interest rate (page 479).

Aaron (1996) with his 'social insurance paradox' further formalized Samuelson`s conclusion. Besides steady (constant) population growth, he also assumes steady productivity growth. He proved that a social security program is welfare improving as long as the sum of the rates of growth of per capita wages and the population, being the return to the social security program, exceeds the interest rate. He adds though that 'if saving and, hence, investment and, hence, the rate of growth of income are reduced as the level of social insurance increases, this conclusion does not necessarily follow' (Aaron, 1966: 374).

Let us introduce a *social security program*, which is in balance. The government faces the following budget constraint at each period t:

$$b_t^O O_t = tW_t^Y Y_t \tag{II-8}$$

The left hand side of the equation represents the pension liability of the government to the current old generation. Pension benefit equals the replacement rate on the previous salary $b_t = RR \times W_{t-1}^O$; the number of pensioners equals the total number of the old generation in the period, O_t. The right hand side of the identity is the amount of contributions paid to the social security program in each period – with t being the contribution rate, W_t^Y the wage of working generation and Y_t the number of the working (young) generation.

In the case of a stationary population, meaning no population growth, generations are the same size ($Y = O$). If we assume a steady-state, which was Samuelson`s and Aaron`s assumption, population growth is constant n so that $Y = (1 + n)O$

From the social security balancing identity (II-8), we can derive the rate of return on PAYG system, being the ratio of benefits received during retirement and contributions paid during working life.

$$\frac{b_t^O}{t \times W_{t-1}^O} = \frac{RR \times W_{t-1}^O}{t \times W_{t-1}^O} = \frac{RR}{t}$$

Substituting in II-8 for the pension benefit and the size of the population and rearranging, we get:

$$RR \times W_{t-1}^{O} \times \frac{Y_t}{(1+n)} = t(1+w)W_{t-1}^{O}Y_t$$

As the wages and young population cancels, it follows that:

$$\frac{RR}{t} = (1+w)(1+n) \qquad \text{(II-9)}$$

which is the *Aaron (1966) condition*. Hence, society is better off with an unfunded social security program, with the implicit return of $(1+w)(1+n)$, as long as this is higher than $(1+r)$, the return on funded pensions (or 'free'retirement saving).

Lindbeck and Persson (2003), following Disney (2004), use G as the notation for Aaron`s internal rate of return of the social security program:

$$G = (1+w)(1+n)$$

Hence, in a dynamically efficient economy - where the population growth rate exceeds the steady state marginal product of capital (r), as assumed by Samuleson and Aaron, the 'return' on contributions to an unfunded defined benefit program G ≥ r. Nowadays, however, due to population aging, slow growth and a higher capital stock, economies may be approaching dynamically inefficiency, so that the internal rate of return G ≤ r.

2.3. Types of Social Security Programs, 'Bismarkian Factor' and 'Actuarial-Basis'

According to historical foundations, we usually make a distinction between the 'Beveridge' and 'Bismarck' models of pension provision. A characteristic of the original 'Beveridge' model of pension provision is a flat benefit so that, if contributions are related to earnings, vertical intra-generational redistribution is achieved. The primary aim of such programs is poverty prevention. In contrast, benefits in the 'Bismarck' model of pension provision are typically earnings-related, with the aim of income replacement in old age.

Typically, however, nowadays pension programs offer some hybrid mixture of the two program types, with variation in the relative importance of the two components. Moreover, during later development since 1960, most of the Beveridge countries introduced earning-related components, often being mandatory or quasi-mandatory funded 'investment-based' programs, usually privately managed. Nowadays, most such countries, such as the United Kingdom, Canada and Asutralia, have some combination of private-public i.e. PAYG-funded mix, though this varies significantly across countries.

Hence, we can formally characterise three broad types of social security intervention:

A Bismarck-type program

The Bismarkian system is characterised by an earnings-related system i.e. a close link between contributions and benefits. Hence the pension benefit in a Bismarck type of program is:

$$b = (1 + \bar{G})tW$$

where $\bar{G}$ is the internal rate of return on the social security program as in Aaron (explained in the previous sub-section) *equal for everybody in the system*, regardless of the wage level during working history; t is the pension contribution and W is the wage.

A Beveridge-type program

The original Beveridge type of program aimed at poverty prevention, hence the benefit is flat and the program has within-generation redistributive features:

$$\bar{b} = (1 + G)tW$$

In this program the *benefit $\bar{b}$ is equal for everyone in the system*, regardless of the wage level during the working history, hence the *internal rate G is not the same and varies across the income distribution* – higher for those with lower wages, and lower for those with higher wages. Concisely, this program is redistributive within a generation towards lower earners.

A Funded ('investment-based') type program

A funded or 'investment-based' social security (as dubbed by Campbell and Feldstein, 2001) is an actuarially based system. One version of a mandatory funded program is considered here – defined contribution individual accounts program. With this type of program, employees pay contributions into individual accounts, contributions are accumulated and invested and earn market interest rate r.

$$b_f = (1 + r)tW$$

Portfolio allocations for pension funds are generally restricted due to the need for safe investments where benefit levels are pre-committed, and these restrictions are more pronounced in developing countries where quantitative limits are in place[3]. In the case of quantitative limits, the returns on pension fund assets r^f may be lower than the market interest rate. It follows that the pension benefit is:

$$b_f = (1 + r^f)tW \quad \text{where} \quad r^f < r$$

The 'Bismarckian' factor and actuarial-basis

The distinction of Beveridge and Bismarck models is not clear-cut in modern pension systems. The 'Bismarckian factor', first introduced by Cremer and Pestieau (1998) and developed in successive papers (Cremer and Pestieau, 2000 and 2003; Pestieau, 1999), as

[3] The reasons for quantitative limits are explained in World Bank (2000), 'Portfolio limits: pension investment restrictions compromise fund performance', *Pension Reform Primer briefing*

well as by Casamatta et al. (2000) and used by Disney (2004), is therefore useful for analytical analysis.

Cremer and Pestieau (1998) introduced a benefit formula for a social security system with a combination of Bismarck and Beveridge features:

$$b = \bar{b} + \alpha w$$

where b is pension benefit coming from the public (social security) system; $\bar{b}$ is basic social benefit (flat component) and the parameter α is the 'Bismarckian factor'.

Here the terms Beveridge and Bismarck are used by reference to the benefit rule. A Bismarckian scheme is one where the link between individual contributions and benefits is tight, while the Beveridgian scheme builds in a degree of deliberate redistribution across individuals by income level. The higher the α, benefit is more closely linked to contributions and the system is less redistributive (i.e. more Bismarckian)[4]. When $\alpha = 1$, the pension system is purely Bismarckian. As noted in Pestieau (1999:7), the Bismarckian factor is the 'fraction of pension benefit that is related to contributions'. When $\alpha = 0$, it means that pension benefit is flat and the system is purely Beveridgean.

In subsequent papers, starting from Casamatta, Cremer and Pestieau (2000a), the pension benefit formula was rewritten as:

$$b = (1 - \alpha)(1 + n)t\bar{w} + \alpha(1 + n)tw$$

[4] In their paper, Cremer and Pestieau use different notation for the Bismarckian factor (k)

or $\quad b = (1+n)t[(1-\alpha)\overline{w} + \alpha w]$

where n is population growth, $\overline{w}$ is average wage, w is individual wage; so with a pure Bismarckian type of system ($\alpha = 1$) the implicit rate of return of social security is $(1+n)$ while where $\alpha \neq 1$, the implicit rate of return equals $(1+n)[(1-\alpha)\frac{\overline{w}}{w} + \alpha]$

Similarly, Disney (2004) following Lindbeck and Persson's (2003) notation for the internal rate of return (G), defines benefit as:

$b = (1-\alpha)\bar{b} + \alpha(1+G)tw$

Disney (2004, 2006b) refers to the Bismarckian component i.e. to the tight link between contributions and benefits, as 'actuarial fairness'. An actuarially fair programme would match individual entitlements exactly to lifetime earnings (Disney, 2004). Hence, the closer is α to 1, the system is more 'actuarially fair'.

The term 'actuarial fairness' is not consistently used in the literature. As noted in Lindbeck and Persson's (2003: 75) who use the term in the same manner as Disney, 'the notion of actuarial fairness appears under different guises in the literature' – Kotlikoff (1996, 1998) uses the term 'degree of linkage,' while Fenge (1995) uses the term 'intragenerationally fair.'

Queisser and Whitehouse (2006) and Abatemarco (2006) define actuarial fairness as the requirement that the present value of lifetime contributions equals the present value of lifetime benefits. This is equivalent to the term *'actuarial-based'* defined in Disney (2006b: 271), which includes the two aspects of a pension programme. First, the requirement that an individual's contributions are exactly matched to his or her pension benefits – the '*actuarial fairness'* as in Disney (2004, 2006b) and Lindbeck and Persson (2003), or more precisely, '*within-generation actuarial fairness'* (Disney, 2004: 271). The second requirement is that a generation retiring at a particular period earns a return on contributions at least as high as some international risk-free rate of interest *r*.

Consequently, there are few possible departures from actuarial-basis. Firstly, if the rate of return of the PAYG system is lower than the market interest rate *r*, there is a departure from actuarial basis, which Fenge and Werding (2003) call an *implicit tax* from the PAYG financing. Disney (2004, 2006b) calls the *departure from intergenerational equity* ('*intergenerational redistribution'* in Abatemarco, 2006) if there are different rates of return across generations[5]. Secondly, there is an *intragenerational* or *within-generation departure from the actuarial fairness* or *intragenerational (within generation) redistribution* (Disney, 2004; 2006b).

[5] According to Disney (2006), intergenerational equity is achieved when each generation receives the long-rung sustainable return to contributions.

3. THE EFFECT OF MANDATORY PENSION PROGRAMMES ON HOUSEHOLD SAVINGS

Let us consider a simple *two-period OLG model* with these different forms of pension provision. Individuals in this economy live for two periods (period 1 and period 2), working in the first period when they are Young (Y) and being retired in the second when they are Old (O). In period 1 agents/households work and save (the Young); in period 2, they consume what they saved in period 1 (the Old). Every household is assumed to live for only two periods at every period there is an overlapping generation of one young and one old cohort of agents. Agents are forward looking and rational, there is no myopia in the model.

The aim is to analyse saving of generation born in the period 1, in the presence of a mandatory public-private (PAYG-funded) mixed pension system, and to see how each component affects individual saving decisions.

First period consumption is:

$$c_1^Y = A_0 + (1 - t - f)W_1^Y - vs_1^Y$$

where t is the payroll tax (used to finance the PAYG system) and f is the contribution into the funded system (mandatory individual saving account); vs_1^Y is other forms of voluntary saving.

Consumption in the second period is:

$$c_2^O = (1 + r)[A_0 + (1 - t - f)W_1^Y - c_1^Y] + b_2 + b_2^f \qquad \text{(II-10)}$$

where $$b_2 = \alpha(1+\bar{G})tW_1^Y + (1-\alpha)\bar{b} \qquad \text{(II-11)}$$

is the 'pension benefit' stemming from the public pension system (PAYG). The pension benefit captures the design of the public pension system – the first component is the earnings related component of the pension; the second component is the flat benefit, redistributive component. The first component is weighted with Bismarckian factor α and the second by $(1-\alpha)$. In the case of a pension program which is completely earnings related (Bismark), $\alpha = 1$; hence total pension benefit is related to earnings history $(1+\bar{G})tW_1^Y$; if the system is only redistributive and is not related to earnings (Beveridge), $\alpha = 0$ and everyone gets the same flat benefit $\bar{b}$.

The pension benefit from the funded component is:

$$b_2^f = (1+r)fW_1^Y \qquad \text{(II-12)}$$

or in case of investment restrictions:

$$b_2^f = (1+r^f)fW_1^Y \qquad \text{(II-13)}$$

where $r^f < r$

Substituting (II-11) and (II-12) into second period consumption (II-10), and rearranging we get:

$$c_2^O = \{A_0 + W_1^Y[1 - \frac{(1+r)-\alpha(1+\bar{G})}{(1+r)}t] - c_1^Y\}(1+r) + (1-\alpha)\bar{b} \qquad \text{(II-14)}$$

The term $\frac{(1+r)-\alpha(1+\bar{G})}{(1+r)}t$ is what Disney (2004: 282; 2005: 7) calls the effective 'tax component' or the 'effective tax rate' in Lindbeck and Persson (2003: 79). The 'tax component' of contributions is the difference between the return on saving and the 'return' on social security contributions (Disney, 2005: 7). It arises from departures from both actuarial fairness $(1-\alpha)$ and intergenerational equity ($\bar{G} < r$). The higher the degree of the earnings related component in the PAYG system (α closer to 1) and the closer $\bar{G}$ to r, the lower is the *effective tax* component.

I now develop the model in the case of the risk-aversion logarithmic utility function. Using the Euler equation for the logarithmic utility function $c_2^O = \beta(1+r)c_1^Y$ we get:

$$\{A_0 + W_1^Y[1 - \frac{(1+r) - \alpha(1+\bar{G})}{(1+r)}t] - c_1^Y\}(1+r) + (1-\alpha)\bar{b}$$

$$= \beta(1+r)[A_0 + (1-t-f)W_1^Y - vs_1^Y]$$

and substituting for c_1^Y:

$$vs_1^Y = \frac{A_0 + (1-t-f)W_1^Y - (1+\rho)\alpha\frac{1+\bar{G}}{1+r}tW_1^Y - \frac{1+\rho}{1+r}(1-\alpha)\bar{b} - (1+\rho)fW_1^Y}{2+\rho}$$

(II-15)

Rearranging, other forms of voluntary household savings are equal to:

$$vs_1^Y = \frac{A_0 + (1-t)W_1^Y - (1+\rho)\alpha\frac{1+\bar{G}}{1+r}tW_1^Y - \frac{1+\rho}{1+r}(1-\alpha)\bar{b} - (2+\rho)fW_1^Y}{2+\rho}$$

(II-16)

Equation (II-16) predicts no change in the amount of household saving with the introduction of a funded pension system, as there is a displacement of other forms of voluntary savings.

However, in case of restricted investments (quantitative restriction), which earn a lower return than the market rate of return, displacement is lower:

$$vs_1^Y = \frac{A_0 + (1-t)W_1^Y - (1+\rho)\alpha\frac{1+\bar{G}}{1+r}tW_1^Y - \frac{1+\rho}{1+r}(1-\alpha)\bar{b} - \left[1+(1+\rho)\frac{1+r^f}{1+r}\right]fW_1^Y}{2+\rho} \tag{II-17}$$

Since $r^f < r$, the term in brackets $[1 + (1+\rho)\frac{1+r^f}{1+r}]$ in equation (II-16) – logarithmic case where the pension fund has quantitative restrictions, is lower than the equivalent term $(2+\rho)$ in the logarithmic case where the pension fund has a free choice of investment portfolio (equation II-16).

Furthermore, there are reasons to believe that displacement is not going to be exactly one-for-one – this is due to borrowing constraints, induced retirement and/or recognition effects.

In the case of *imperfect capital markets (borrowing constraints)*, the private saving/consumption decision could be suboptimal, thus saving displacement does not necessarily need to be 'one for one'. It means that some households are forced to save more than they would without the interference of the state that mandated funded saving program, while at the same time households cannot borrow to restore consumption fully to its optimal level in the first period.

Another reason why displacement of saving does not have to be 'one-for-one' is *induced retirement.* Feldstein (1974) argued that, beside the negative impact that public pensions have on personal saving, there is also a positive effect – social security might contain incentives that would induce individuals to retire earlier than otherwise, leading to a larger pool of wealth to draw upon in earlier retirement and therefore to higher lifetime savings. This 'induced retirement effect' could increase personal savings according to Feldstein. In addition, Sheshinski (1978) argues that social security benefits may have a very pronounced effect in inducing earlier retirement - a replacement ratio of twenty percent reduces the retirement age by more than fifty percent relative to retirement in the absence of social security.

Likewise, Munell (1982: 70) argues that private pensions may also stimulate aggregate saving. This additional saving could stimulate people to retire early, i.e. they would not mind higher saving than is optimal since this provides the opportunity for early retirement. This would naturally hold only if the private pension retirement age were flexible.

Another reason against one-for-one saving displacement is the *'recognition effect'.* The development of funded pension schemes might raise awareness among the general population of the need to save for retirement (Baillu and Reisen, 1997). Cagan (1965) analyzed the saving behaviour in 1958-59 of over 15,000 members of the Consumers Union and found that private pensions are not substituted for other forms of saving i.e. that actually pension saving represents a net addition to personal saving. He explains this effect by a term he dubbed the 'recognition effect'. That is, the individual 'recognizes that a reasonable degree of financial independence in retirement is attainable for him when a pension program is made applicable to him in addition to his social security income prospects. At this point, his motivation to save on his own to increase the adequacy of his retirement income is stimulated by the realization that such a goal is within his grasp' (Murray, 1968: 58 as in Cagan, 1965).

Due to all of these reasons, I introduce a **displacement coefficient** into the analysis**,** where I assume $d \leq 1$, and if $d = 1$ displacement is one-for-one. In that case, other forms of voluntary savings are:

$$vs_1^Y = \frac{A_0+(1-t)W_1^Y-(1+\rho)\alpha\frac{1+\bar{G}}{1+r}tW_1^Y-\frac{1+\rho}{1+r}(1-\alpha)\bar{b}-d(2+\rho)fW_1^Y}{2+\rho}$$

(II-18)

Equation (II-18) therefore demonstrates the effect of overall pension system design on the other forms of voluntary household savings in the logarithmic case.

Now let us see the effect on total household saving:

$$s_1^Y = \frac{A_0+(1-t)W_1^Y-(1+\rho)\alpha\frac{1+\bar{G}}{1+r}tW_1^Y-\frac{1+\rho}{1+r}(1-\alpha)\bar{b}-d(2+\rho)fW_1^Y}{2+\rho} + fW_1^Y$$

Substituting for $\bar{b}$, which can also be expressed as a return to the contributions (internal rate of return G that varies across different type of earners), and rearranging, we get *saving as a share of income* to equal to:

$$\frac{s_1^Y}{W_1^Y} = \frac{1}{2+\rho}\{1 + \frac{A_0}{W_1^Y} - [1 + \alpha\,\frac{(1+\rho)(1+\bar{G})}{1+r} + (1-\alpha)\,\frac{(1+\rho)(1+G)}{1+r}]t + (2+\rho)(1-d)f\}$$

(II-19)

and in the case of the restrictive investment policy on pension funds:

$$\frac{s_1^Y}{W_1^Y} = \frac{1}{2+\rho}\{1 + \frac{A_0}{W_1^Y} - [1 + \alpha\,\frac{(1+\rho)(1+\bar{G})}{1+r} + (1-\alpha)\frac{(1+\rho)(1+G)}{1+r}]t + \left(1 + (1+\rho)\frac{1+r^f}{1+r}\right)(1-d)f\}$$

(II-20)

where

$\frac{\partial(s_1^Y/W_1^Y)}{\partial t}<0, \frac{\partial(s_1^Y/W_1^Y)}{\partial \bar{G}}<0, \frac{\partial(s_1^Y/W_1^Y)}{\partial G}<0, \frac{\partial(s_1^Y/W_1^Y)}{\partial(1-\alpha)} = \frac{1+\rho}{1+r}(\bar{G}-G)>0,$

$\frac{\partial(s_1^Y/W_1^Y)}{\partial f}>0, \frac{\partial(s_1^Y/W_1^Y)}{\partial d}<0$

These partial derivatives suggest that household saving as a share of income is negatively affected by the size of the PAYG public pension system – the higher the payroll tax for financing it, the lower the savings.

Moreover, household saving also depends on the design of public pension system. In particular, the closer is $\bar{G}$ (the internal rate of return from the earnings related component) to the market interest rate, implying the public pension system more closely mimics the private pension programmes, the lower is the savings ratio. Conversely, lower the $\bar{G}$ i.e. higher the 'implicit tax', the higher is savings ratio.

Similarly, the more generous the redistributive component of pension system (the higher the G), the lower the saving ratio.

The effect of 'intragenerational redistribution' $(1-\alpha)$ is not straightforward. The partial coefficient $\frac{\partial(s_1^Y/W_1^Y)}{\partial(1-\alpha)} = \frac{1+\rho}{1+r}(\bar{G} - G)$ is positive if the internal rate of return in a redistributive 'Beveridge' system (G) is higher than it would be in a Bismarckian system ($\bar{G}$), which is the case for average and high-income earners. For low-income earners, the internal rate of return in a Beveridge system is higher than it would be in a Bismarckian system for the given overall generosity – the replacement rates for earners below average are typically higher than for average earners. Concisely, in systems closer to 'Beveridge' i.e. $(1-\alpha)$ closer to one, lower-income earners have less incentive to save and average and high-income workers more than they would have in a non-redistributive 'Bismarck-style' programme. Since higher-income earners are generally higher savers, and usually most of private saving is done by them (see Blinder, 1975; Diamond and Hausman, 1984; Bosworth et al., 1991; Bernheim and Scholz, 1993; Hubbard et al., 1995; Dynan et al., 2004, etc.), one may expect the overall positive effect of 'intragenerational redistribution' on private saving.

When it comes to a mandatory funded programme, the effect of this component on private saving is positive, but the magnitude depends on the displacement coefficient – the higher the displacement coefficient, the lower the effect of a funded programme and vice versa. In the case of restricted pension fund investment policies, displacement is reduced.

The overall impact of pension programmes on household saving amended for the effect on government and national saving is summarised in Table II-1. First row illustrates the effect of 'Beveridge-type' system on different income groups and in total – positive effect for higher-income earners and negative for lower-income earners. Overall, the effect is ambiguous but more likely positive, since higher-income earners are usually higher savers.

Second row shows negative effect of ‘Bismarck-type’ of pension programmer for each earning group and hence overall, while the effect of mandatory funded programme (row three) is different regarding liquidity constraints. With tight liquidity constraints overall effect is positive, while with no constraints effect is ambiguous.

Table II-1 The Impact of Pension System Programmes on Household Savings

	Household saving		
	Low income-earner	High income-earner	Total
PAYG-Beveridge	–	+	+/–
PAYG-Bismarck	–	–	–
Funded-Mandatory			
Tight liquidity constraints	+	0	+
No liquidity constraints	+/–	+/–	+/–

Source: Table is amended version of Bailliu and Reisen (1997) table by further including impact of PAYG-Beverigde system
Note: (+) positive effect; (-) negative effect; (+/–) ambiguous effect; (0=) no effect on savings.

4. NUMERICAL ANALYSIS

To illustrate the effect of various mandatory pension components on the household saving rate, this subsection presents some numerical examples for ‘reasonable’ parameter values.

Table II-2 first presents a general example of a two period economy with no social security system. In that case, with the assumption of 5% market interest rate and 4% discount rate, the saving ratio is 49%, indicating how a representative individual will divide his/her first period earning for two periods.

Table II-2 Saving ratio with and without social security (baseline case)

General parameters	
Market interest rate	$r = 0.05$
Discount rate	$\rho = 0.04$
Saving ratio (without social security)	0.4901
Baseline parameters (for average worker)	
Bismarckian factor	$\alpha = 0.7$
Internal rate of return in earnings-related scheme	$\bar{G} = 0.04$
Internal rate of return in redistributive scheme	$G = 0.015$
Payroll tax	$t = 0.16$
Contributions to funded DC account	$f = 0.025$
Interest rate in funded DC scheme	$r^f = 0.045$
Displacement coefficient	$d = 0.3$
Saving ratio (with social security)	0.3480

When a social security system is introduced, the saving ratio decreases significantly. For a baseline pension system with various assumed parameters, the first period saving ratio falls to 35% or first period earnings.

I justify these pension parameters as follows. This *baseline pension system* is a hypothetical system similar to Sweden - with a 16% contribution rate for the PAYG component of the program, and a 2.5% contribution for the mandatory individual account component. The rate of return on the mandatory funded component is assumed to be slightly lower then market interest rate, due to a conservative investment policies of pension funds. Taking a crude average from the coefficients found in the literature, the displacement coefficient is assumed to be 0.3[6]. In other words, an increase of one dollar in the mandatory funded component reduces other assets by 30%. The general parameters – interest and discount rate – are fixed to 5% and 4% throughout all numerical examples. For simplicity, there is no initial wealth.

Let us first consider the negative effect of the contribution rate on the saving ratio, as predicted by the model in equations II-20, i.e. other parameters are fixed for the baseline case, while the contribution rate varies.

[6]The literature looking both at PAYG and funded pension programmes found various displacement coefficients. For example, Feldstein (1974), using annual time series US data for social security wealth for the period 1929–1971, finds that social security depresses personal saving by 30-50 percent per dollar of benefit, depending on specification. The estimates in Hubbard (1986) and Dicks-Mireaux and King (1984) are between 0.15 and 0.40. Kohl and O`Brien (1998) provide a survey of the effects of tax-favoured saving accounts (henceforth TFSA) on private savings, concluding that TFSA increased net private saving by 20 to 25 percent of total amount placed in a TFSA. Samwick (2003) concludes that the coefficient of displacement found in the literature ranges between 0.2 and 0.5. Hurd *et al*. (2009) combine cross-country and within-country variation exploiting survey data for a few countries. They estimate the effect of pension system on financial wealth and suggest a displacement effect of roughly 25 to 45 percent.

Figure II-1 Saving ratio for various contribution rates

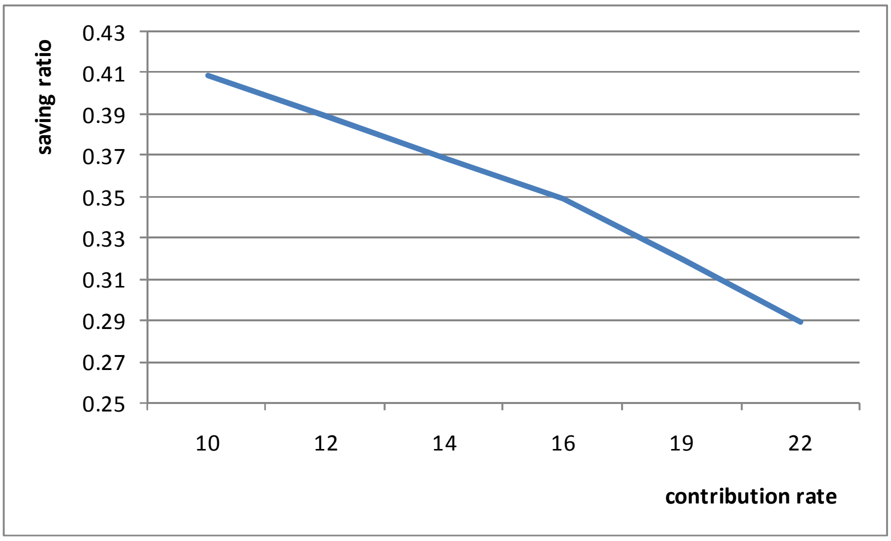
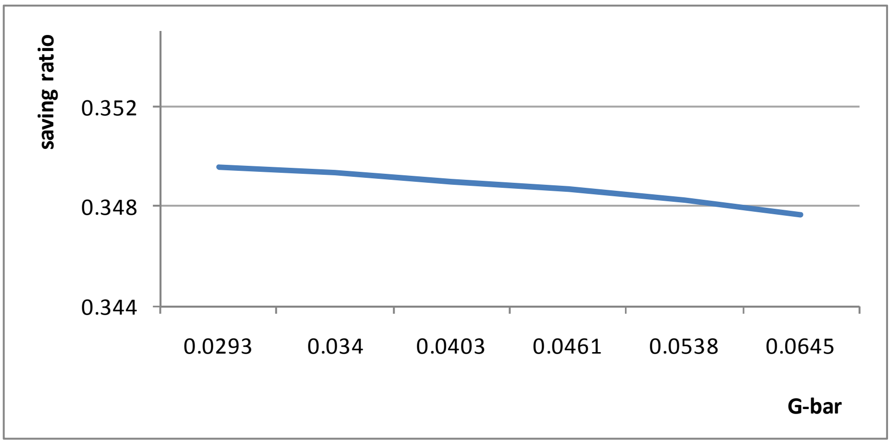


Figure II-1 presents how the level of the contribution rate significantly affects the saving ratio – with a contribution rate of 22%, the saving ratio is as low as 28.9% of the first period income, with the 'baseline' 16% saving ratio around 35%, while in the case of a 10% contribution rate, the saving ratio increases significantly to almost 41% of the first period income.

Let us now consider the impact of the IRR of the earnings-related component ($\bar{G}$) on the saving ratio. Figure II-2 shows a negative relationship – the higher the IRR, the lower the saving ratio and vice versa. In other words, the more closely the public earnings-related system mimics a private retirement saving account, the lower the household saving ratio. However, the magnitude of the impact is rather small compared to contribution rate - with a 3.5 percentage points decrease in the IRR, the increase in the saving ratio is only 0.2 percentage points.

Figure II-2 Saving ratio for different internal rates of return



Furthermore, if we take into account that the IRR is in part a function of the contribution rate, then the impact of the lower IRR is completely annulled by the increase in the contribution rate. For example, if we imagine the time path of a newly introduced generous pension system over several decades, we can expect this system to have high IRRs in the first decades. However, as the system matures, higher contributions are needed to finance benefits, and therefore with the course of time, as contribution rates increase, the IRR declines.

Table II-3 Saving ratio for different values of IRR and contribution rates when IRR is a function of contribution rate

Saving ratio	**0.4076**	**0.3881**	**0.3685**	**0.3490**	**0.3196**	**0.2903**
$\bar{G}$	0.0645	0.0538	0.0461	0.0403	0.0340	0.0293
t	0.10	0.12	0.14	0.16	0.19	0.22

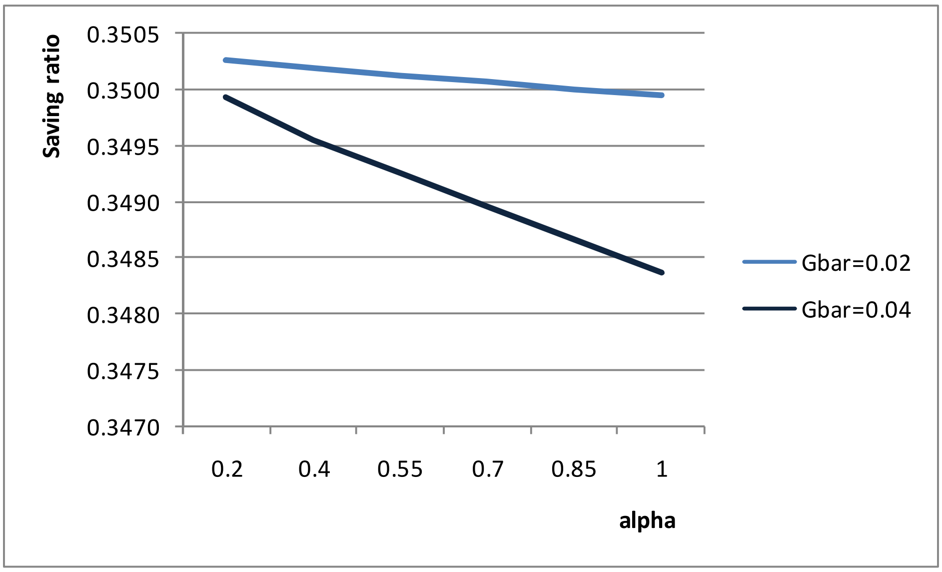
Table II-3 shows the case where the IRR is a negative function of the contribution rate, so that the IRR is decreasing as the contribution rate is increasing. The overall effect is a significant decline in saving ratio.

Now let us consider variations in the Bismarckian factor. Table II-4 presents the values of the saving ratio for different combinations of the Bismarckian factor coupled with different internal rates of return in an earnings-related scheme.

Table II-4 Saving ratio for different values of IRR and contribution rates when IRR is a function of contribution rate

α	**1**	**0.85**	**0.7**	**0.55**	**0.4**	**0.2**
$\bar{G} = 0.02$	0.3499	0.3500	0.3501	0.3501	0.3502	0.3503
$\bar{G} = 0.04$	0.3484	0.3487	0.3490	0.3492	0.3495	0.3499

Figure II-3 Saving ratio for different values of the Bismarckian factor and IRR in an earnings related scheme



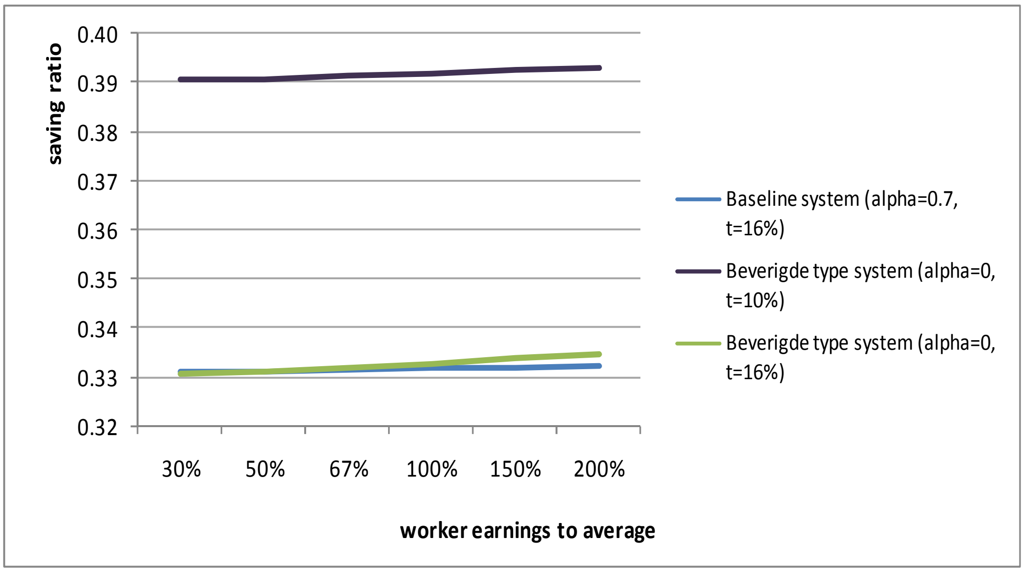
The higher the Bismarckian factor, the lower the saving ratio. This effect is more pronounced for schemes that mimic more closely the private retirement saving programme (higher Gbar), though in general is very small.

Examining the effect of internal rates of return from the redistributive component, we can see from Table II-5 that saving is lower for low-income earners, since the system is more generous for them, while the saving ratio is higher for richer workers. This effect is more pronounced as the system is closer to a ’pure’Beveridge type (alpha closer to zero).

Table II-5 The saving ratio in a redistributive programme, different types of workers (earnings level)

Earnings to	**30%**	**50%**	**67%**	**100%**	**150%**	**200%**
$\boldsymbol{G}$	**0.047**	**0.043**	**0.030**	**0.020**	**0.005**	**-0.005**
Baseline system	0.3311	0.3312	0.3315	0.3317	0.3321	0.3323
$\alpha = 0, t = 0.16$	0.3307	0.3310	0.3321	0.3328	0.3340	0.3348
$\alpha = 0, t = 0.10$	0.3906	0.3908	0.3915	0.3920	0.3927	0.3932

Figure II-4 Saving ratios for different types of workers (various pension systems)



Nonetheless, the crucial effect comes from the fact that a Beveridge type of pension programme is typically characterised by lower contribution rates, meaning that the contribution rate is a function of alpha. Considering that, we can see that the overall effect of 'intragenerational redistribution' is quite signficant (Table II-6).

Table II-6 Saving ratio for different values of alpha when contribution rate is a function of alpha

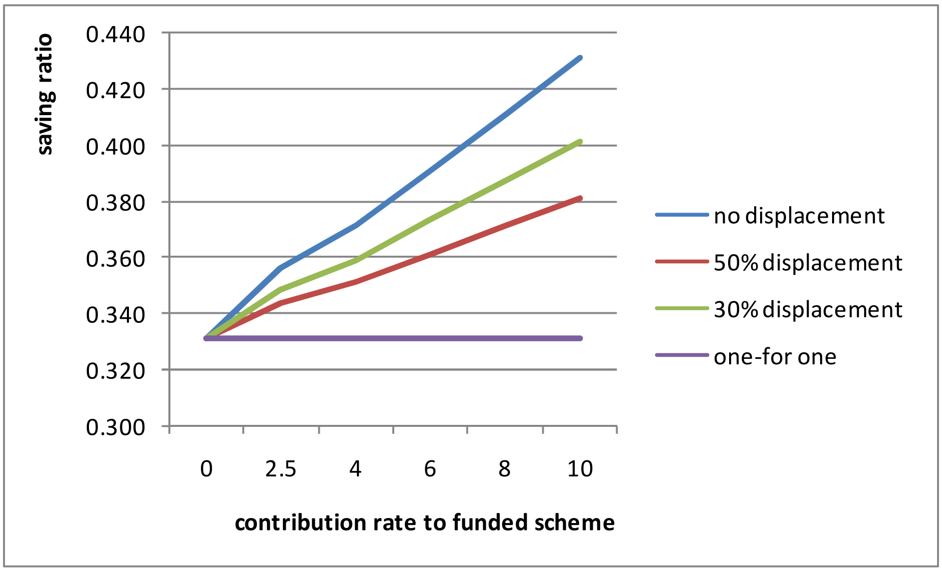
Saving ratio	0.3086	0.3387	0.3688	0.3987	0.4286	0.4682
α	1	0.85	0.7	0.55	0.4	0.2
$t = f(\alpha)$	0.20	0.17	0.14	0.11	0.08	0.04

Assuming the contribution rate is a positive direct proportional function of the 'Bismarckian factor', with a constant 0.2 representing a 20% contribution rate needed to finance a pure earnings-related system[7], i.e. t=0.2xalpha, the saving ratio increases from around 31% in a 'Bismarck-style' programme, to almost 47% in a highly redistributive 'Beveridge-style' programme.

Finally, consider the effect of the mandatory funded saving component on the saving ratio. Figure II-5 presents saving ratios for different levels of contribution rates into a funded system coupled with various displacement coefficients. For the 'baseline' case, a 30% displacement translates into an increase in the saving ratio of almost 7 percentage points.

[7] Generious system paying approximately 70% net replacement rate

Figure II-5 Effect of funded scheme on saving ratio, baseline 2.5% contributions



5. Conclusion

The relationship between a pension system and household saving has been a subject of debate for a long time. In this Chapter, I analysed the relationship analytically, using the two-period two-generation partial equilibrium household sector Samuelson-type of OLG model, set in logarithmic form. The model is augmented by design of the public pension system as in Lindbeck and Persson (2003) and Disney (2005; 2006a) and by the mandatory funded pension programme. Thereby, I analysed two types of offsets from household saving – induced by public pensions, and induced by mandatory saving programmes.

The model predicts that household saving as a share of income is unambiguously negatively affected by the size of the PAYG public pension system – the higher the payroll tax for financing it, the lower the savings. Household saving also depends on design of a public pension system. In particular, the closer is the internal rate of return from the earnings related component to the market interest rate, implying that the public pension system more closely mimics private pension programmes, the lower is the savings ratio. Furthermore, the higher the 'intragenerational redistribution' in the system, the system is on average expected to have a positive effect on household saving. When it comes to a mandatory funded programme, the effect of this component on private saving is expected to be positive, but the magnitude depends on the displacement coefficient – the higher the displacement coefficient, the lower the effect of a funded programme and vice versa. In the case of restricted pension fund investment policies, displacement is reduced.

I illustrated the model predictions with numerical simulations, using 'reasonable' general parameters – a 5% market interest rate and 4% discount rate. For the baseline scenario the contribution rate for the PAYG programme is set at 16% of gross wage; the contribution rate for the mandatory individual account component to 2.5%, with the rate of return slightly lower than the market interest rate (due to conservative investment policies of pension funds), and displacement coefficient of 0.3.

Varying the level of the contribution rate for the PAYG programme, simulations show the significant effect of the scale of the PAYG system on the saving ratio – with a contribution rate of 22%, the saving ratio is as low as 27% compared to 33% with the 'baseline' contribution rate and a 49% saving ratio in the case where the PAYG system does not existl.

Variations of the internal rate of return in the earnings related component show that the magnitude of the impact is actually rather small compared to contribution rate – with a 3.5 percentage point decrease in the IRR, the increase in the saving ratio is only 0.2 percentage points. When it comes to 'intragenerational redistribution', simulations again show a very small effect – for example, in a highly redistributive system (with the 'Bismarckian factor' 0.2), the saving ratio is only 0.0015 percentage points higher than it would be in the purely earning-related system that provides the IRR of 4% to its beneficiaries. Nonetheless, assuming the contribution rate is a positive direct proportional function of the 'Bismarckian factor', the effect of 'intragenerational redistribution' becomes significant – the saving ratio increases from around 31% in a 'Bismarck-style' programme, to almost 47% in a highly redistributive 'Beveridge-style' programme.

III PENSION SYSTEM DESIGN: MEASUREMENT AND CONVERGENCE

1. INTRODUCTION

The foundations of pension systems across the world were laid from the end of the 19th century until the beginning of World War II. The onset of pension system development is usually considered to be 1889, when Germany`s *Chancellor Bismarck* established a pension scheme for industrial workers, with the aim to provide *income maintenance.* At the same time, in 1891 Denmark and, a few years later, New Zealand introduced pension schemes with the aim to *alleviate poverty* across the whole old-age population. Other countries followed one of these two approaches. The German system was very influential in continental Europe, while the 'New Zealand approach' was dominant in the Anglo-American world, apart from the US at the very beginning.

Countries that chose the 'assistance' approach initially set the systems as means-tested benefits financed from taxation, but later changed them into universal basic pensions. Countries that chose the 'insurance' approach had different trajectories – some originally set their systems as they are nowadays, such as Germany and then the Austro-Hungarian Empire, while a few – Belgium, France, Italy and Spain, originally introduced subsidised voluntary systems that later took the form of public mandatory systems (Gordon, 1988; Overbye, 1996). A few countries, such as the Netherlands, Sweden and Finland, deliberated between two approaches, while those that introduced pension systems later – such as Japan, the US and Switzerland – used a 'hybrid' approach.

Table III-1 Development of original model of pension policy

		Beveridge origin			Bismarckian origin		
		Means-tested	**Basic scheme**		**Subsidised voluntary contribution schemes**	**Compulsory old-age contribution schemes**	
			Contribution based	Universal		Workers	Whole population
1st wave	Origins	Denmark 1891 New Z. 1898 Australia 1908 UK 1908 Ireland 1908			Belgium France Italy Spain Switzerland	Germany 1898 Austro-Hungarian Empire 1906	
	until WWII	Sweden 1913 Canada 1927 Norway 1936 USA 1936		New Zealand 1938		France 1910 Netherlan. 1913 Greece Italy 1919 Spain 1919 Belgium 1924	Sweden 1913 USA 1936 Finland 1937
2nd wave			UK 1942 Ireland 1961 Japan 1954	Sweden 1946 Nether.1946(56) Canada 1951 Denmark 1956 Norway 1956 Finland 1957		Japan 1942	Switzerland 1946

Source: Amended version of table in Overbye (1996:4).

As a result, countries were grouped into two distinct clusters: countries with a 'Bismarck pension model', characterised with a low degree of 'intragenerational redistribution', a larger size of the public pension system, and a smaller fraction of private pensions, vs. countries with a 'Beveridge pension model', characterised by universal (or means-tested), tax-financed, flat rate pension provision and 'typically accompanied by substantial private funded provision of retirement benefits' (Disney, 2004: 286).[8] Table III-2 presents classification of pension systems as Bismarck and Beveridge according to the original model of pension policy – the one that prevailed in the last part of the long period of pension system foundation, the end of the 1950s.

Table III-2 Original model of pension policy

Bismarck	Beveridge
Germany (1889)	Denmark (1891)
Austria (1906)	New Zealand (1898)
Italy (1919)	UK (1908)
France (1931)	Sweden (1913)
Belgium (1926)	Norway (1936)
US *(1936)	Ireland (1908)
Japan* (1942	Australia (1908)
Greece	Canada (1927)
Luxembourg	Switzerland* (1948)
Portugal	Finland (1956)
Spain (1919)	Netherlands (1946)

SOURCE: Supplemented version of Table ? in Bonoli (2000: 11).
* Hybrid/mixed system.
NOTE: In the brackets is the year when the first nation-wide compulsory system was introduced.

Since the end of the 1950s the process of institutional convergence in pension programmes began. Bismarckian countries that started out with contribution-based income-maintenance

[8]Although Sir William Beveridge produced a report which proposed a programme for social insurance for the UK no sooner than in 1942, still this type of pension system is dubbed after him. In addition, Beveridge argued for contributory financing, though nowadays the 'Beveridge model' usually refers to general taxation financing.

schemes limited to some groups of employees, extended coverage to other groups or introduced parallel schemes for various occupational groups, thereby providing most of the working population with earnings-related pensions (Overbye, 2006). Moreover, they all introduced some kind of minimum income provision (Gordon, 1988).

Table III-3 Evolution of pension system toward two-tiers

	First tier – Poverty prevention			Second tier – Income Replacement	
	Minimum/ Means-tested	Basic: Tax-financed	Basic: Contributory	PAYG	Funded
Bismarck					
Germany	1968			1957 ←	1889
Belgium				1953 ←	1924 (1900*)
Austria					1906
France	1956			1945 ←	1910 (1850*)
Italy	1968			1952 ←	1919 (1898*)
Spain					1919 (1909*)
Portugal					
Bismarck hybrid					
USA				1936	
Japan					
Beveridge – early birds					
Sweden	1913**	1946 ←	1936	1959	
Finland		1956		1961	1937 - 1945
Canada	1927 →	1951		1965	
Norway	1935 →	1956		1966	
Beveridge – latecomers					
Australia	1908				1986
Demark	1891 →	1965 (1970)			1991 (1964)
UK	1908 →	→	1946	1975 (1959)	1975
Netherlands			1946 (1956)		1947 CA-OP
Switzerland				1946	1985
Beveridge – 'no top-up'					
New Zealand	1898 →	1938			
Ireland	1908 →	1946			

* Voluntary subsidised systems.
** Abolished scheme.
NOTE: OP-occupational pension; CA- collective agreements.
Source: Hinrichs (2000), Ebbinghaus and Gronwald (2009).

On the other side, most of the ‘Beveridge countries’ introduced earning-related systems since 1960. ‘Early birds’ introduced the public unfunded (PAYG) tier by the late 1960s. ‘Latecomers’ did not introduce the earnings-related system until the early 1970s, and they used various solutions – occupational schemes mandated by the law in Switzerland and Australia, occupational schemes via collective agreements in Denmark and the Netherlands, and the unique opt-out scheme in the UK. There are only two countries – Ireland and New Zealand, where no comparable topping up occurred (Hinrichs, 2000), and even New Zealand is recently taking again some steps toward earning-related system introducing the ‘KiwiSaver’ – voluntary retirement saving scheme with automatic enrolment.

The result of these processes has been *convergence toward a two-tiered pension system (Table III-3),* in which the basic pension aims at guaranteeing a subsistence level to the whole population, while the second tier allows retirees to maintain a living standard close to the one they had while working (Bonoli, 2000; Overbye, 1996; Gordon, 1988).

By the 1980s, increased generosity of pension systems coupled with economic crises brought about huge pension deficits (OECD, 1985). There has also been increasing recognition of the aging population impact for fiscal, economic and social policies (OECD, 2003). Consequently, the focus of pension policy makers moved towards a *policy of retrenchment,* which includes targeting universal benefits, tightening the link between contributions and benefits, raising the retirement age, and increased need for private pensions to fill the income gap (Myles and Quandano, 1997; Hinrichs, 2000).

As a result, the design of pension systems across OECD countries has been changing toward *three-tiered pension systems* (Gordon, 1988). Indeed, 'most countries nowadays either have or are evolving toward retirement income systems that contain three basic elements': i) minimum income provision, (ii) mandatory earnings-related component, (iii) supplementary pension programmes on a voluntary basis (Thompson, 2006:235).

These developments, together with the process of Open Method of Coordination within EU social protection policy, can be viewed as an instrument toward convergence to a unique EU pension model, dubbed 'contingent convergence' by Hemerijck (2006: 18). Furthermore, the process of globalisation, which allowed governments to increasingly seek to learn from international experience, and public policy ideas have been more easily disseminated across national boundaries - a process that has been termed 'policy transfer' by Banks, *et. al.* (2005), has been additional reason to expect convergence in pension policies.

Consequently, Overbye (1996:149) argues that there has been convergence in 'pension policy outcomes' – i.e. towards pension systems that 'provide roughly similar groups of citizens with roughly similar benefits'. Johnson (1999) searched for the evidence of convergence in outcomes and found it for high-income earners, but not for average and lower-income earners. He suggests that pension systems may have converged along other dimensions – for example, through encouragement of private pension provision, or an increase in the normal retirement age – but not by average earner entitlement.

Bonoli (2000:13) points out that convergence occurred mainly with regard to the 'functions of pension policy' – poverty prevention and income maintenance. When the analysis shifts to details of various components of pension systems, he believes the variation across countries is impressive and that 'the initial choice in terms of the Bismarck or the Beveridge model still affects the current shape of a pension system'.

Myles and Pierson (2003) argue that pension policy is a '*locus classicus* for the study of path-dependent change', because policy options are heavily influenced by the existing commitments and institutional designs inherited from the past. Similarly, Banks et al. (2005) believe that, despite common problems facing OECD countries, true convergence in retirement programmes is not realistic due to huge differences between countries in terms of initial conditions, demographics and labour markets.

Hinrichs (2000: 366) sums up the literature stating that the answer to the question is that convergence is not straightforward and depends on the 'criteria defined for convergence, which can either be structural design, the outcome, the instruments, or the goals'.

Despite the presence of the 'convergence hypothesis', models of pensions – both theoretical (e.g. Pestieau, 1998; 1999) and Casamatta et al. (2000), and empirical (e.g. Disney, 2004) – still tend to classify pension systems into 'Beveridge' and 'Bismarck', according to their historical origins. The theoretical model in Chapter II suggested that these models would have different impacts on household saving. Therefore, prior to testing whether this empirically holds, it is of importance to examine whether pension systems still classify in such a way or convergence in pension systems has occurred.

The motivation to empirically test the design of pension systems in OECD countries, and to see whether they still classify in traditional Bismarck-Beveridge way or they converged due to the junction in pension policy goals and the process of 'policy transfer' is two-fold. Firstly, it is needed to further empirically test theoretical model from Chapter II. In addition, this question is of great importance for policy recommendations. In case of juncture in pension systems 'one size fits all' policy recommendations, which have been around since World Bank's 1994 study, make much more sense compared to the situation where pension systems are still influenced by historical origins.

To analyse pension system design and examine its impact on household behaviour we need some measurable indicators. There are various indicators of 'pension system design' measured in the literature, though there are no ready available datasets. Thus, the first question to pose is how can we measure these indicators on a consistent and time-varying basis?

This chapter describes and measures various pension indicators and explains in detail what the pension indicators are, how they are calculated and what are the data sources. This set of indicators is later used in the empirical analysis of pension system design and saving.

As the proposed indicators overlap and correlate, the second question is whether we can 'package' these measures together? I have performed the factor and principal component analysis and tried to identify commonalities on indicators in line with the typology of pension programmes – Beveridge vs. Bismarck.

The empirical analysis is devoted to the central question of this chapter – to what extent historical differences are still evident between pension systems, or have pension models converged. To answer this question, I pose three sub-questions.

Firstly, is there evidence that the development of 'Bismarck' programmes has 'crowded out' private pension plans? This is the same point as Disney (2000), but with somewhat more sophisticated indicators – using 'Bismarck dummy' variable as a proxy for Bismarck system instead of public pension expenditures, and including more control variables, such as financial liquidity. The second sub-question is 'do countries still group as Bismarck and Beveridge'? I follow Bonoli (1997) using the two-dimensional approach to see if countries still group as Bismarck and Beveridge. Lastly, I test formally whether there is any empirical evidence that 'convergence' of pension models has happened in practice.

Contribution of this chapter is comprehensive and careful data gathering, which highlights the problem of the quality of 'pension data', and makes the gaps in the provision of data in this field particularly apparent. Furthermore, I have tested empirically 'convergence hypotheses', using a comprehensive set of measures and a number of estimation methods.

Findings of all three sub-sections unambiguously suggest that true convergence has not happened, and that pension models are still heavily influenced by their historical paths – Bismarck vs. Beveridge.

2. MEASURING PENSION SYSTEM DESIGN

2.1. PENSION SYSTEM INDICATORS

As the pension system has multiple objectives, there are a number of pension system indicators which might be used to measure different characteristics of pension programs. Pension indicators are complementary and should be looked at together for a better understanding of any pension system (EC, 2006).

Pension indicators can be crudely divided into i) those that measure the *relative living standard* of pensioners, i.e. income replacement; ii) those designed to measure the *absolute living standard* of pensioners and poverty in old-age. Further, we can divide both groups of indicators into those measuring the *design* and those measuring the *actual outcome*. In addition, there is a set of indicators that measure the *financial stance and stability* of the pension system.

Table III-4 summarise the most important goals of the pension system, parameters used to design the pension system, and the indicators used to measure the achievement of goals.

Table III-4 Goals, Parameters and Indicators of Pension System

Goal *(covered risk)*	Pension system parameters	Measurement/Indicators	
		Design	**Actual**
Poverty reduction/ Redistribution *(earnings risk)*	Minimal benefit provision (flat/targeted/ minimum pension) Different accrual rates for different earnings levels Contribution/Benefit ceiling	Minimal benefit/average earnings ratio Hypothetical replacement rate for low income earners (below 50% average) Coefficient of variation of hypothetical RR (higher than 0)	Poverty and inequality indexes Coefficient of variation of actual RR
Income maintenance (consumption smoothing mechanism) *(longevity risk, myopia, time inconsistency, adverse selection)*	*TRADITIONAL DB* Valorisation Accrual rate *POINT SYSTEM* General point value General point indexation	Hypothetical replacement rate Relative pension level Pension wealth	*Micro measures:* Actual (individual) replacement rate *Macro measures:* Ratios of elderly to non-elderly income ▪ Ratio of economy-wide pension to wage ▪ Aggregate replacement ratio

Source: Table is an amended version of table in Fornero (2008).

Various pension indicators can be found in the literature. For example, Disney and Whitehouse (2001) focus on alternative measurements of pensioners' income and the extent to which pensioners are lifted out of poverty. A recent series of OECD publications called 'Pensions at a Glance' describe a number of pension indicators, including expected replacement rate (RR), pension wealth, a progressivity index, share of pension expenditures in GDP etc. The European Union's Open Method of Coordination process has also formulated a set of so-called 'indicators of the pension strand', which include adequate objective pension indicators, sustainable pension indicators and modernised pension indicators (EC, 2009c: 2). However, readily available cross-country datasets including historical data, which capture all these potential indicators, do not exist in any single source.

In what follows, I list the set of indicators which will be used in my subsequent empirical analysis and explain how I have collected and constructed the data where appropriate.

2.1.1. Replacement Rate

The average replacement rate (RR) is the most commonly used indicator in pension analysis[9]. Nevertheless, despite the broad usage of the replacement rate, there is no single definition, and one can come across various ratios dubbed 'the' replacement rate. Mitchell and Phillips (2006: 1) point that 'despite the myriad ways in which the replacement rate concept is used, there is no single commonly agreed-on definition of the term or exactly what it is intended to capture'.

What is usually referred to as the *replacement rate* (henceforth RR) is the ratio of the first *post-retirement income to pre-retirement income*[10]. Defined in such a way, this is a *micro or individual* measure of income maintenance.

[9] 'The number is a spiritual descendent of 'life-cycle theory', as it implicitly assumes that retirement consumption should be equated to some fraction of pre-retirement consumption (Mitchell and Moore, 1998: 375).

[10] Pre-retirement income may be defined as last salary prior to retirement, or individual lifetime-average earnings (re-valued in line with economy-wide earnings growth). With flat lifetime earners lifetime average re-valued earnings and individual final earnings are identical.

In terms of the parameters of the pension system, the RR is a reflection of *valorisation* and *accrual rate* in the traditional defined benefit system, or *value of general point* and/or *indexation of general point* in a points-based system. In defined contribution systems, the RR reflects the product of the amount of contributions and yield on investments in case of funded DC, or the 'balancing mechanism' in NDC[11].

The RR can be calculated based on hypothetical or actual earnings. ***Hypothetical (theoretical) RRs*** reflect pension system design i.e. 'measure the extent to which pension systems enable workers to preserve their previous living standard when moving from employment to retirement' (EC, 2006:3). It be calculated as a *current* measure – showing the consequences of the design of the pension system for those retiring nowadays, or a *prospective (expected)* measure, explaining what the pension system is designed to provide to future pensioners. It is generally calculated for a hypothetical worker. The usual *base case* is a worker on *average earnings with a full contribution record.* Naturally, given the diversity of real-life situations, the base case is not representative for all workers and, in fact, very few may exhibit a profile that closely resembles the hypothetical worker. However, theoretical RRs allow us to analyse the design of the pension system and to compare pension systems across countries.

A more realistic measure of old-age income replacement is the ***actual RR***. Sources of data used for the calculation of the actual RR could be survey, as well as administrative data.

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[11] NDC is abbreviation for notional defined contribution system. For definitions of NDC, balancing mechanism and point system see the Glossary at the beginning of thesis.

As the interest of this chapter is in the design of a pension system rather than outcomes for specific workers, hypothetical replacement rates will be used henceforth.

Available cross-country data and sources

Over the past two decades, RRs were frequently used in the pension's literature. However, it is still quite challenging to find a cross-country and time panel dataset of RRs.

During the 1980s and 1990s, a few datasets were available. For example, a publication by the Commission of European Communities (1993) provided a 'snapshot' of RRs for member countries. A dataset on 18-OECD countries for the period 1930-1985 was developed by the Swedish Institute for Social Research and used by Palme (1990) and Esping-Andersen (1990).

Blöndal and Scarpetta (1999) developed a more comprehensive dataset on OECD countries for the period 1961-1995. This dataset provides *expected gross RRs at the age of 55* – how much those who started working aged 20 and were at the moment 55-years-old could expect to receive retiring at the standard retirement age in each country. The Blöndal and Scarpetta dataset provides *four types of replacement rate* – for single people and couples, and for average and low income (66% of average) earners.

Recent data on hypothetical RRs are available from two main sources. One source is the *European Commission (Social Protection Committee-Indicators Sub-Group),* providing current as well as prospective RRs. The second source is the *OECD Pensions at a Glance* publication, which provides only prospective RRs. There is one more source of data – the *Comparative Welfare Entitlements Dataset (CWED),* which presents both historical and current RRs, though for a limited number of countries. This dataset provides RRs for both singles and couples, but only for the average earning worker.

The advantage of European Commission data is that it provides both current and prospective RRs, while OECD (Pensions at Glance) presents only future replacement rates. However, the EC dataset is limited only to EU countries and provides replacement rates only for two types of workers – singles at average and 67% of average earnings[12], while the OECD data supply rich information with replacement rates for 5 different earnings levels. In addition, since 2009 the OECD's Pension at a Glance provides RRs separately for public and private workers, and for mandatory and voluntary schemes.

The methodologies for RR calculations are somewhat different for these two sources. In the EC calculation, working career is standardized to 40 years of service. OECD data, like Blondal and Scarpetta and CWED , calculate RRs for those who started working at the age of 20 until the standard retirement age, meaning that years of service varies according to the retirement age in each country.

Both the EC and OECD data provide short time series data – EC for the 2000s and the OECD projected RRs for the 2050s. In that respect, the best-suited data is CWED, which is the longest time-series; nonetheless, this database covers only OECD-18 countries.

[12] The 2009 EC report provides only RRs for the average earning worker

Further details on data sources and methodologies can be found in the Appendix to this thesis.

<u>Replacement rate trends across countries</u>

Since there is no single panel data series on RR, there was a need to compile one for my research. Bearing in mind all the methodological differences between available sources, this was not a straightforward exercise. For example, in the cases of Blöndal and Scarpetta and the EC data, the career length of a hypothetical worker is different in the two calculations; hence the two series cannot be simply merged. Blöndal and Scarpeta and the OECD data methodologically correspond in that respect, but data for those retiring in the 2000s are missing as the OECD provides only the prospective RRs. Furthermore, errors and inconsistencies can be found both within the same source, as well as when comparing data from different sources.

Taking into account the above explained sources and their methodological differences, as well as information about pension parameters across countries, I have constructed the RR panel time series presented in Table III-5. The table shows the gross current RR at the year of statutory retirement – usually 65 years, for those who started *working at the age of 21*. Since the statutory retirement age differs among countries, *the length of career varies as well*.

Table III-5 Current gross RR for OECD and EU-8: 1961-2050
(Public PAYG pension, from 21 to retirement age)

	1961	1975	1985	1995	2005	2050
High-income OECD countries						
Australia	12	20	23	24	23	..
Canada	17	30	39	40	39	40
Japan	26	37	47	44	41	..
New Zealand	18	26	32	39	38	39
Norway	16	52	51	51	52	52
Switzerland	19	37	36	36	36	36
United States	28	35	37	43	47	40
Average	***19***	***34***	***38***	***40***	***39***	***41***
EU-15						
Austria	80	80	80	80	70	70
Belgium	60	50	56	54	39	40
Denmark	23	26	30	37	41	40
Finland	24	27	44	59	58	65
France[a)]	40	50	58	65	65	50
Germany	60	55	55	50	44	40
Greece	..	78	98	117	108	95
Ireland	21	23	30	30	34	34
Italy	37	58	63	75	80	70
Luxembourg	..	79	85	91	90	90
Netherlands	20	31	33	31	33	30
Portugal	80	70	72	73	73	60
Spain	..	50	92	93	89	83
Sweden	40	60	65	63	53	38
United Kingdom[b)]	20	24	22	20	17	17
EU-15 average	***42***	***51***	***59***	***63***	***60***	***55***
EU-10						
Czech Republic	..	..	..	38	61	50
Estonia	..	..	..	..	36	23
Hungary	..	..	..	51	66	45
Latvia	..	..	..	..	55	..
Lithuania	..	..	..	..	25	..
Poland	..	..	..	..	63	30
Slovak Republic	..	..	..	..	50	24
Slovenia	..	..	..	..	64	40
Average	*..*	*..*	*..*	***44.5***	***52.5***	***35.3***

Source: Own compilation based on various sources (EC/SPC-ISG; B&S, Scruggs, APEX)
a) Occupational schemes included (ARRCO & AGIRC) since they function as a public scheme – PAYG financed and managed by non-private entities.

Only public mandatory pensions – 'social security programmes' in US terminology – are included in this calculation of RRs. Private saving plans (mandated and/or occupational) are excluded, except for the French occupational scheme that is financed on a PAYG basis.

The data in the table show the increasing trend in public RRs over the decades. RRs in EU-15 countries have been always higher than in the rest of the high-income OECD countries. However, some reduction has been witnessed in the 2000s, and a further modest decline in The EU-15 is anticipated in the future, arising from current and prospective pension reforms. On the other hand, EU-8 countries have envisaged a radical drop in public pension benefits, which may be explained by the more radical World Bank reforms conducted in these countries during the 1990s.

2.1.2. Pension Expenditures

Pension expenditure expressed as a percent of GDP indicates the burden of current pensioners on the overall economy. This measure captures both the number of pensioners and the generosity of the system. Generosity reflects both the level of RR at retirement, as well as indexation of pensions in payment. The number of pensioners reflects demography, participation and employment rates in the previous decades, as well as policy measures such as the standard retirement age, early retirement possibilities etc.

Long time series on pension expenditures are not readily available. Pension expenditures for EU-25 countries are available from EUROSTAT, but only from the start of the 1990s. ILO used to produce the publication the 'Cost of Social Security' with data stemming from the 1960s, but ceased a number of years ago.

Data for OECD countries are available from the *Social Expenditure Database (SOCX)* stemming from the 1980s, while historical data can be found in the publication *Social Expenditures 1960–1990: Problems of Growth and Control*, OECD (1985). However, these two datasets cannot simply be merged because of somewhat different methodologies[13].

I have constructed a *Public Old-Age Pension Expenditure*[14] panel dataset for the period 1960–2010, using OECD SOCX data combined with OECD historical data. I have matched these two datasets cross-validating the matching with ILO data at the point where both series are available (1981). Since historical data are available for total pension aggregates, I estimated old-age pensions based on the trend of total pension aggregates. Where OECD historical data were not available, I have based the estimates on ILO data.

The constructed data series are presented in Table III-6 and show an increasing trend in expenditure as a fraction of GDP in all countries until the 1990s, since when the share has remained stable. During the 1970s and 1980s, pension liabilities were growing only partly due to demographic reasons (Disney, 1999). Alongside with the increase of the elderly population, pension coverage was expanding while the benefits were increasing (OECD,

[13] It seems that the major change relates to the public/private division of pension expenditure. Furthermore, historical data are available only for the total pension aggregate - they are not disaggregated according to old age, survivors and disability function.

[14] This aggregate includes cash benefits for old-age pension, anticipated old-age pension, partial pension and early retirement (excluded are early retirement benefits for labour market reasons, which are classified under unemployment).

1985). In addition, unemployment in the 1970s, which initiated early-retirement policies, coupled with a decrease in the standard retirement age, brought about a huge increase in expenditures, which resulted in 'retrenchment' policies since the beginning of 1990s.

Table III-6 Old-age public pension expenditures, % of GDP

	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010
High-income OECD countries											
Australia	1.9	2.2	2.5	2.7	3.1	2.9	2.8	3.4	3.6	3.2	3.2
Canada	1.8	2.0	2.2	2.4	2.8	3.5	3.9	4.3	3.9	3.8	3.8
Japan	0.9	1.2	1.5	1.8	2.9	3.8	4.0	5.1	6.1	7.2	7.2
Korea	..	..	..	..	..	..	0.6	1.1	1.2	1.2	1.2
New Zealand	3.5	3.9	4.4	4.8	6.8	7.4	7.2	5.6	4.9	4.2	4.2
Norway	1.3	2.2	3.1	4.0	4.0	4.3	5.3	5.1	4.5	4.6	4.6
Switzerland	1.6	2.9	4.1	5.3	5.5	5.7	5.3	6.3	6.3	6.4	6.4
US	3.0	3.7	4.3	5.0	5.1	5.3	5.1	5.3	5.1	5.4	5.4
Average	***2.0***	***2.6***	***3.2***	***3.7***	***4.3***	***4.7***	***4.3***	***4.5***	***4.5***	***4.5***	***4.5***
EU-15											
Austria	7.0	7.7	8.4	9.1	9.8	10.8	11.1	12.1	11.9	11.9	11.5
Belgium	3.4	4.1	4.9	5.6	5.9	6.3	6.5	6.9	6.8	7.0	6.9
Denmark	2.7	3.3	3.9	4.5	4.6	4.7	5.1	6.2	5.3	5.1	5.5
Finland	1.8	2.6	3.3	4.0	4.7	6.4	6.3	7.0	6.6	7.5	5.1
France	3.8	4.4	4.9	5.5	7.5	8.4	9.1	10.4	10.3	10.5	10.5
Germany	7.2	8.0	8.7	9.5	9.1	9.2	8.9	9.6	10.2	11.0	10.2
Greece	3.8	4.1	4.4	4.7	5.1	8.0	10.5	10.2	11.2	11.7	10.7
Ireland	2.0	2.4	2.9	3.4	4.0	4.2	2.9	2.6	2.3	2.5	2.8
Italy	3.3	4.3	5.2	6.2	7.2	9.0	8.2	9.3	11.1	11.3	11.1
Luxembourg	3.7	4.4	5.1	5.8	6.6	6.2	8.5	9.2	7.2	4.4	4.3
Netherlands	1.2	2.3	3.4	4.4	5.4	5.3	5.6	4.9	4.6	4.7	4.7
Portugal	1.9	2.2	2.6	3.0	3.4	3.6	4.4	6.5	7.3	9.0	9.9
Spain	2.5	3.0	3.5	4.0	4.6	5.7	7.1	8.1	8.0	7.4	7.5
Sweden	2.6	3.4	4.2	4.9	6.6	7.0	7.1	7.5	6.8	7.1	6.9
United Kingdom	2.3	2.7	3.1	3.5	3.8	4.1	4.6	5.1	5.2	5.2	5.2
EU-15 average	***3.3***	***3.9***	***4.6***	***5.2***	***5.9***	***6.6***	***7.1***	***7.7***	***7.7***	***7.8***	***7.5***
EU-10											
Estonia	1.8	2.2	2.5	2.9	3.2	3.6	3.9	5.4	5.8	5.1	5.4
Latvia	2.0	2.3	2.7	3.0	3.3	3.7	4.0	8.0	7.9	5.3	8.2
Lithuania	1.5	1.8	2.0	2.3	2.5	2.8	3.0	5.7	6.9	5.5	5.5
Hungary	2.0	2.2	2.5	3.5	4.9	5.6	6.2	6.3	6.4	7.7	7.7
Czech Republic	2.5	3.0	3.4	3.9	4.3	4.8	5.2	6.0	7.4	7.2	6.8
Poland	2.0	2.1	2.8	3.1	3.4	3.8	4.2	7.7	9.9	10.9	9.1
Slovenia	4.0	4.7	5.3	6.0	6.7	7.3	8.0	9.2	9.5	9.1	9.2
Slovakia	2.8	3.3	3.8	4.3	4.7	5.1	5.6	6.2	6.2	6.4	5.8
Cyprus	0.3	0.3	0.7	1.0	1.4	1.7	2.1	4.5	5.2	6.2	7.0
Malta	1.8	2.2	2.5	2.9	3.3	3.6	4.0	6.5	7.1	8.1	9.3
EU-10 average	***2.1***	***2.4***	***2.8***	***3.3***	***3.8***	***4.2***	***4.6***	***6.6***	***7.2***	***7.1***	***7.4***

Source: Author`s compilation based on *Social Expenditures 1960–1990: Problems of Growth and Control*, OECD (1985), OECD SOCX database, ILO data.

2.1.3. The Effective Contribution Rate

In a Pay-as-you-go (PAYG) program in which current tax receipts finance current spending on pensions, the earnings related (insurance) component is usually financed with separate social insurance contributions. In such cases, the administrative contribution rate should be an adequate measure of the workforce burden of current pensioners. However, as pointed out by Disney (2004), in several countries this assumption is unsatisfactory. This is because countries have different social security financing designs.

Some countries, like Australia, New Zealand, Denmark and Ireland, have a significant component of the total pension system in the form of social pensions, which are financed by general taxes. Some countries subsidise public pensions by budgetary transfers. Other countries earmark part of the social security tax for purposes other than pension financing, and a few (such as the USA) partially pre-fund the programme.

Bearing this in mind, Disney (2004) constructed the variable the *effective average contribution rate*, which is the contribution rate that would be required to finance total spending on public pensions out of labour force income. Exploiting the PAYG formula, he calculated the effective contribution rate as the average replacement rate divided by the support ratio. He used Blöndal and Scarpetta (1998) data for RRs, and adjusted ILO data on activity rates for support ratios (workers 15-59 to people over 60) [15]. The source for the latter is the ILO LABORSTA database.

Following Disney (2004), I calculate the effective average contribution rate, but in a slightly different manner. Again exploiting the PAYG balancing identity, the contribution rate can be also expressed by the ratio of pension expenditure to the wage bill in the economy. I chose this approach because derivation of this variable is made on two original data series, instead of estimating one - the system support ratio - prior to deriving effective contribution rate.

To construct such a time series I have used pension expenditure series presented in Table III-6 and the variable *Compensation of employees: total economy* from National Accounts, drawn from an AMECO database[16]. This database contains time series going back to 1960, as well as data for some non-EU countries such as New Zealand, Canada, the US. Data for the EU-10 are generally not available for the period before the 1990s. For missing intervening data points, I have applied extrapolation. The 'Compensation of Employees' *data* includes employers' social security contributions; hence, the result is the *total effective contribution rate* paid by both the employer and employee, expressed as a percentage of

[15] Workers aged under 20 are removed; since not all people over 60 receive a pension the denominator is adjusted according to participation rates.

[16] This database is maintained by the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN)

gross labour[17]. This is actually equivalent to the OECD's Taxing Wages methodology, and more appropriate for both within time and across country comparisons[18].

Table III-7 Effective contribution rates (as % of labour cost) for public old-age pension programmes

	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010
High-income OECD countries											
Australia	3.9	4.4	4.7	4.8	5.8	5.7	5.6	7.0	7.4	6.7	6.7
Canada	3.6	3.9	4.1	4.4	5.2	6.6	7.2	8.3	7.7	7.5	6.8
Japan	2.3	2.8	3.5	3.3	5.5	7.1	7.7	9.3	11.4	13.9	13.6
Korea	..	..	..	..	..	..	1.3	2.2	2.9	2.7	2.4
New Zealand	8.3	8.9	8.8	8.5	12.3	15.2	16.1	13.2	11.7	9.6	9.0
Norway	2.9	4.7	6.5	7.7	8.4	9.5	11.0	11.0	10.4	10.9	9.5
Switzerland	3.3	5.6	7.9	9.3	9.5	9.7	8.7	10.1	10.5	10.3	10.5
US	5.3	6.5	7.2	8.6	8.6	9.1	8.8	9.3	8.7	9.5	9.5
Average	***4.2***	***5.3***	***6.1***	***6.7***	***7.9***	***9.0***	***8.3***	***8.8***	***8.8***	***8.9***	***8.5***
EU-15											
Austria	15.1	15.9	17.5	16.5	17.8	20.4	21.1	22.5	23.2	24.3	23.3
Belgium	8.1	9.3	10.7	10.4	10.6	12.0	12.9	13.6	13.4	14.0	13.3
Denmark	5.8	6.7	7.6	8.3	8.5	8.9	9.4	11.9	10.2	9.7	9.7
Finland	4.0	5.1	6.7	7.1	8.8	11.8	11.6	14.1	14.0	15.3	9.9
France	8.5	9.1	9.9	10.0	13.5	15.4	17.6	20.0	19.9	20.1	20.2
Germany	15.9	16.3	17.1	17.2	16.2	17.0	16.9	17.8	19.2	21.9	20.4
Greece	13.3	14.9	15.3	16.1	15.8	23.0	29.4	31.4	33.8	33.8	29.8
Ireland	4.7	5.5	6.2	6.6	7.3	8.5	6.4	5.7	5.8	6.1	6.9
Italy	8.1	9.5	11.3	12.1	14.9	19.3	18.3	22.5	28.3	27.8	26.3
Luxembourg	10.6	11.2	13.7	11.5	12.7	12.9	18.1	19.6	15.5	9.6	9.0
Netherlands	2.6	4.5	6.1	7.6	9.4	10.2	10.7	9.6	9.1	9.6	9.1
Portugal	4.1	4.9	5.3	4.6	6.3	7.2	9.1	13.5	14.5	17.9	19.7
Spain	6.3	7.1	7.9	7.9	8.9	12.3	14.4	16.6	16.1	15.7	16.1
Sweden	5.0	6.0	7.1	8.2	10.4	12.2	12.1	14.4	12.3	13.0	12.6
United Kingdom	3.9	4.5	5.2	5.4	6.4	7.5	8.3	9.7	9.5	9.6	9.7
EU-15 average	***7.7***	***8.7***	***9.8***	***10.0***	***11.2***	***13.3***	***14.4***	***16.2***	***16.3***	***16.5***	***15.7***
EU-10											
Estonia	4.3	5.0	5.7	6.3	7.0	7.6	8.1	10.3	12.7	11.5	10.1
Latvia	4.5	5.3	6.1	6.9	7.7	8.5	9.4	18.2	19.1	12.7	16.6
Lithuania	4.0	4.6	5.1	5.6	6.1	6.6	6.8	14.8	17.5	13.5	13.9
Hungary	4.3	4.6	5.1	7.1	9.6	10.8	11.8	13.6	14.7	16.4	16.1
Czech Republic	7.2	8.3	9.3	10.3	11.3	12.2	13.1	14.1	17.5	16.7	15.3
Poland	5.8	6.2	7.9	8.6	9.3	10.0	10.8	19.5	24.7	30.3	25.2
Slovenia	7.9	9.0	10.1	11.1	12.1	13.0	13.9	16.5	18.5	17.9	17.9
Slovakia	7.7	8.8	9.9	10.9	11.8	12.4	13.4	15.4	15.3	17.1	15.1
Cyprus	0.7	0.7	1.5	2.3	3.1	3.9	4.8	10.3	12.2	13.8	15.4
Malta	4.8	5.6	6.4	7.2	7.9	8.6	9.3	14.5	16.2	18.2	21.1
EU-10 average	***5.1***	***5.8***	***6.7***	***7.6***	***8.6***	***9.4***	***10.1***	***14.7***	***16.8***	***16.8***	***16.7***

Source: Own calculations based on pension expenditure data (Table III-6) and AMECO database.

[17] Gross labour costs are equal to gross wages plus the employer part of social security contributions

[18] For example, an increase in effective contribution rates expressed on gross wages as a base may not be that evident, since the gross wage is already affected by the increase in nominal contributions.

'Effective contribution rates' since the 1960s are presented in Table III-7. The trend is similar to that of pension expenditure as a share of GDP – an increase until the 1990s, then stabilisation, and even a slight decrease in high-income countries in 2010.

2.1.4. Measures of Progressivity

Redistribution within a pension system can be *intra-generational* - among members of the same cohort, and *inter-generational* – between different cohorts[19]. *Vertical (progressive) redistribution* characterises the 'Beveridge' pension model. Such progressivity can be achieved via a *minimum benefit* (flat or targeted), *differential accrual rates for different earning levels* (lower accrual for higher income), or by a *link between maximum benefit and a ceiling to contributions*[20].

I follow Disney (2004) to construct indicators of vertical progressivity using '*pension variation'* and '*pension tax'* as measures[21].

Pension Variation

'Pension variation' is a coefficient of variation (henceforth CV)[22] of replacement rates across several household types. This is a *measure of vertical intragenerational redistribution* within

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[19] Intra-generational redistribution can be vertical or horizontal. *Vertical redistribution* is most often progressive (from rich to poor), while *horizontal* goes from one group to another – men to women, singles to couples, etc.

[20] See Appendix for discussion on information on ceilings across countries

[21] Whitehouse devises another measure of vertical progressivity , the 'progressivity index', which is calculated as 100 minus the ratio of the Gini coefficient of pension entitlements divided by the Gini coefficient of earnings (Pension at Glance, 2007)

the pension programme, which is a proxy for the term $(1-\alpha)$ explained in Chapter II. 'Intragenerational redistribution' means higher RRs for lower-income workers and lower RRs for higher-income workers. Thus, RRs vary with the income level and CV is higher. In the 'Bismarckian-style' of programme, with low or no 'intragenerational redistribution', everyone earns the same RR, hence CV is zero or close to zero.

Disney (2004) calculated the CV using Blöndal and Scarpetta (1999) replacement rates for four different household types (for single and couples, average and 66% of average earners). As there is no later update of the Blöndal and Scarpetta dataset, it is not possible to calculate CVs for the 2000s in the exact same manner and thereby to extend the data series. Still, it is feasible to construct a CV data series merging several sources. RRs for two types of earners – 67% and 100% for EU countries – can be merged using Blöndal and Scarpetta (1998) for the period 1960–1990s and EC data for the 2000s, correcting where there are differences in years of service. For the rest of the high-income OECD countries, I used the data presented in Table III-5 single workers on average earnings and made estimates for those on 67% of average earnings based on information from 'Pensions at a Glance' and the US Social Security Administration's 'Social Security Around the World'. For couples, I used Blöndal and Scarpetta for the first three decades, CWED for the 2000s (for average earners), and made estimates for couples with 67% of average earnings as before[23].

[22] Coefficient of variation (CV) is a normalized measure of dispersion of a probability distribution. It is defined as the ratio of the standard deviation to the mean.

[23] In order to have consistent data series, in some cases the same 'mistakes' in calculations as in Blöndal and Scarpetta were repeated. For example, Blöndal and Scarpetta calculated RRs for Australia without GIS (guaranteed income supplement); RR for Sweden was calculated with the occupational scheme part.

Coefficients of variation calculated in this way (Table III-8) show that, in general, there have been no significant changes in the level of redistribution in the recent decades. Countries that traditionally have a higher level of redistribution are Australia, Canada, Denmark, the Netherlands, New Zealand, the UK and the US. There was a decrease in redistribution in the 1970s in Nordic countries (Sweden, Norway, Finland); countries which started out with 'Beveridge' models, but introduced an earnings-related component to pensions at the end of the 1960s, thereby reducing redistribution within their systems.

Table III-8 Coefficient of variation, 4 household types (67% and average, single/couple)

	1961	1975	1985	1995	2005
Australia	0.33	0.36	0.37	0.38	0.38
Austria	0.00	0.00	0.00	0.00	0.00
Belgium	0.16	0.13	0.12	0.13	0.14
Canada	0.45	0.23	0.28	0.29	0.28
Denmark	0.33	0.34	0.32	0.33	0.32
Finland	0.28	0.03	0.02	0.00	0.08
France	0.23	0.23	0.11	0.00	0.00
Germany	0.00	0.09	0.05	0.02	0.00
Greece	0.02	0.02	0.02	0.03	0.02
Ireland	0.37	0.38	0.36	0.37	0.38
Italy	0.04	0.00	0.00	0.00	0.00
Japan	0.11	0.12	0.14	0.15	0.13
Luxemborg	0.01	0.01	0.01	0.03	0.04
Netherlands	0.27	0.32	0.32	0.31	0.30
New Zealand	0.40	0.37	0.35	0.33	0.36
Norway	0.34	0.14	0.14	0.13	0.11
Portugal	0.07	0.10	0.07	0.04	0.00
Spain	0.00	0.00	0.00	0.00	0.00
Sweden	0.18	0.13	0.13	0.12	0.12
Switzerland	0.30	0.26	0.26	0.27	0.28
UK	0.37	0.36	0.24	0.21	0.30
US	0.26	0.27	0.26	0.24	0.25

Source: Own calculations based on B&S, CDEW, Pension at Glance and national data

Another source of RR data, - the OECD 'Pensions at a Glance' data, which provides replacement rates for five different types of earners – 50%, 75%, 100%, 150% and 200% of average[24], certainly composes the richest available data to capture vertical redistribution. However, data are available only for 2050s (prospective RRs for those entering the labour market in 2000s). In addition, since most OECD countries have ceilings on pensions subject to pension contributions below two times average earnings, there is actually no value in calculating CV with all five income levels. Details on CVs calculated with 'Pension at a Glance' data are presented in the Appendix to this thesis.

Pension Tax

Pension tax is a calculated variable of the previously described 'pension variation' multiplied by the average effective contribution rate. This is an indicator devised by Disney (2004) to capture the absolute 'tax component' of the contribution rate. He argues that treating social security contributions as a pure tax on wages, as in the OECD studies of the 'tax wedge', can be misleading. Contributions to public pension programmes differ from other taxes because individuals may observe them as a claim to future pension benefits and hence, do not perceive social security contribution as a tax, but rather as a saving. This is most likely in earnings-related pension programs (Bismarck) and least plausible with programs with a high degree of vertical progressivity and little relation between contributions and benefits ('Beveridge').

[24] Details are in the section III2.1.1,

Since there is a negative correlation between the redistributive component of pension systems – 'pension variation' - and the effective contribution rate, the product of these two variables – 'pension tax' – has less absolute dispersion than the effective contribution rate (Disney, 2004: 293). This is illustrated in Figure III-1.

Figure III-1 Effective contribution rate and effective tax component (pension tax), OECD countries, 2000s

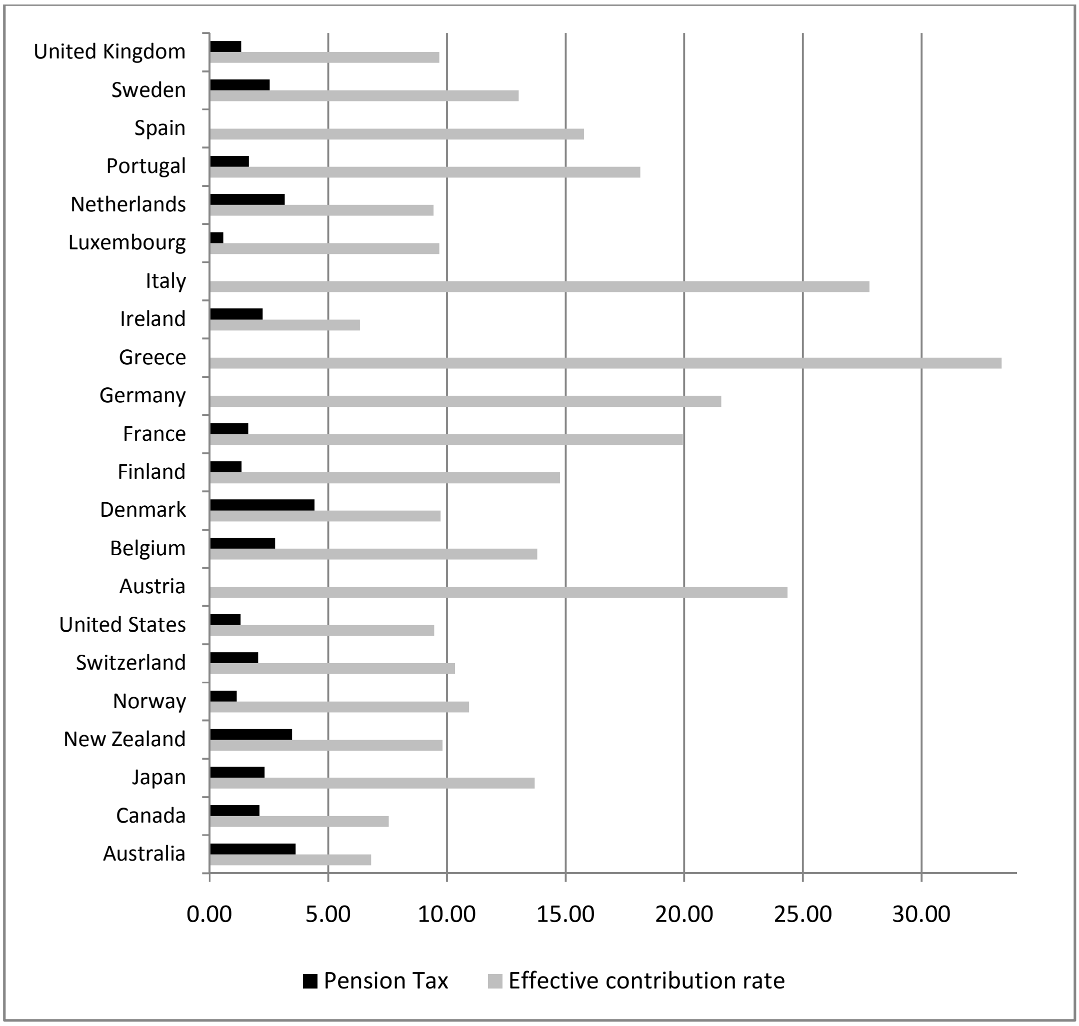


Figure III-2 confirms that there is a relationship between effective contributions and pension tax, which is negative albeit not particularly strong – the correlation coefficient is -0.339.

Figure III-2 Effective contribution rate and tax component of contributions, 1960s-2000s (mid decades)

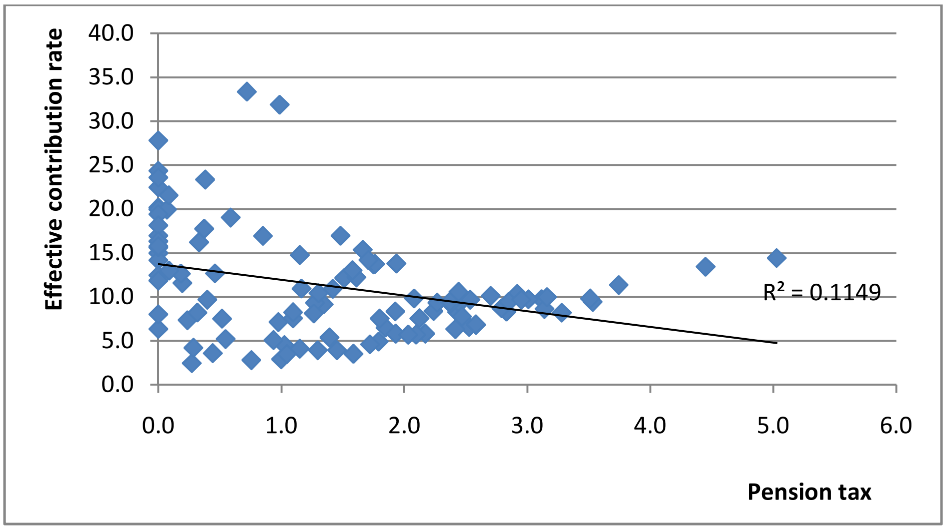
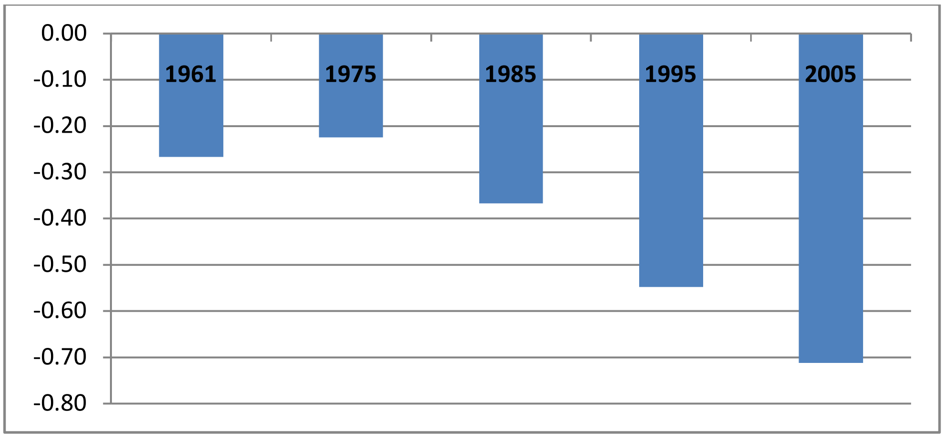


Figure III-3 Coefficient of correlation between contribution rate and tax component of contributions (pension tax) 1960s-2000s (mid decades)



The negative relationship is however getting stronger during recent decades (Figure III-3). This is probably because generous pension systems with no redistribution – Bismarck systems - faced a larger increase in the effective contribution rate than Beveridge countries in the face of population ageing.

2.1.5. The Internal Rate of Return

The internal rate of return (IRR) on a pension program is the interest rate at which the average present value of the stream of contributions paid is equal to the average present value of stream of pension benefits. It is a measure of the 'profitability' of the PAYG system for a representative member of a generation. Comparing IRRs across generations i.e. at different points in time, one can measure the *intergenerational redistribution* i.e. *intergenerational equity* of a pension program (Disney, 2004).

According to Queisser and Whitehouse (2006), a social security programme is *'actuarially fair'* when the IRR to a given generation equals the market rate of return of an asset invested in the capital market over the same period. However, in a dynamically efficient economy, the market rate of return is typically higher than the IRR in the pension system. Fenge and Werding (2003) call this difference an *implicit tax* from PAYG financing, while Disney (2004) refers to it as *departure from actuarial basis.*

In general, the measured IRR depends on the benefit formula and method of indexation of pensions in payment, on the length of the retirement period and the value of pension contributions paid into the system. In addition to the pension design parameters, the IRR also depends on the pace of wage growth during the contribution period – the higher the wage growth, the higher the IRR.

In order to make it possible to isolate the effect of pension design on IRR, I have calculated four versions of the internal rate of return (Table III-9). Variable IRR1 measures the actual internal rate of return. Variables IRR2 and IRR4 are constructed to isolate the effect of wage growth, with the assumption of no wage growth and with wage growth of 2.5% during the employment history in all countries. Variables IRR3 and IRR4 are calculated assuming that the first cohort only started contributing in the 1950s, while for variables IRR1 and IRR2 an attempt was made to estimate the effective contribution rate since the introduction of the pension system in the country. The preferred measure is IRR2, since it isolates the pension design excluding the effect of wage growth, and at the same time takes into account the reality i.e. the period when the system was founded. However, as the correlation between variables is high – more than 0.9 (except for IRR2 and IRR3 – 0.79), it is actually reasonably safe to use any of them.

Table III-9 Four versions of IRR

	Wage growth during contribution (employment) period	Wage growth during benefit payment	Start date of contributions
IRR 1	Actual growth	Actual growth	Introduction
IRR 2	No	2.5%	Introduction
IRR 3	Actual growth	Actual growth	1950
IRR 4	No	2.5%	1950

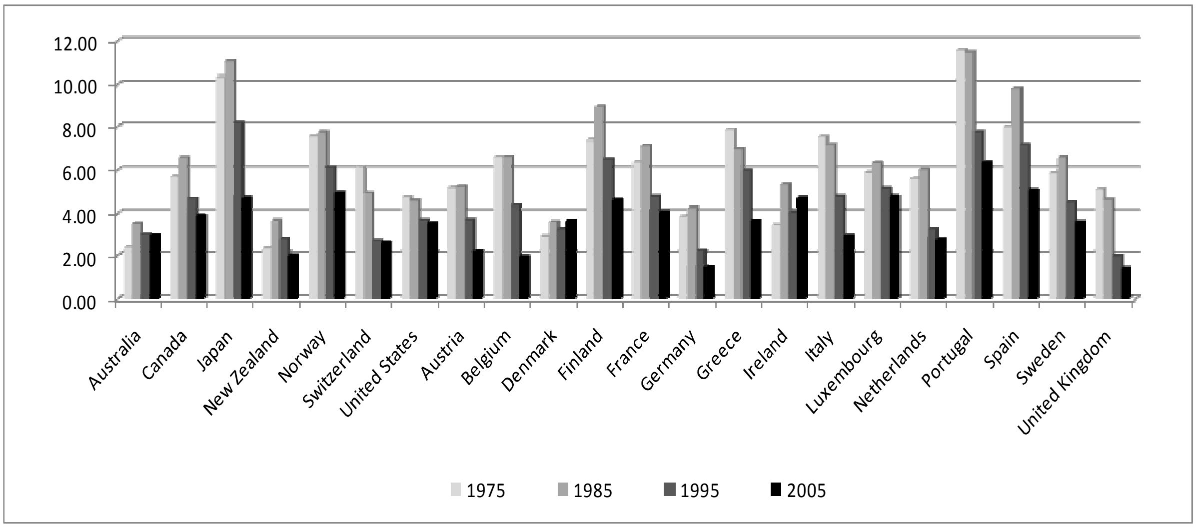
To calculate the stream of contributions, I use effective contribution rates *(Table III-7)* and a wage growth index *(Real Compensation per Employee, local currency 2000=100)* obtained from the AMECO database.

To calculate the stream of pension benefits, I use the gross replacement rate from the public system for the first year of retirement; then index benefits in payment in line with the indexation formula. Information on the indexation formula in each country is obtained from EC-ISG reports, from Pensions at a Glance various issues and Pensions Panorama (which is World Bank`s publication). The retirement duration is estimated based on the statutory retirement age for each country and average life expectancy at the age of retirement, obtained from EUROSTAT.

Calculated in this way, IRR is slightly overstated since contributions are expressed as the rate on total compensation and the RR on gross wage. This should not cause a problem for time and cross-country comparisons, however.

Figure III-4 shows IRR1 over time for OECD countries. One can see a general trend of an increase in IRR in the 1980s and then a decrease in the following years. As Disney (2004) points out, although one might think that 'Bismarck' programs will have higher IRRs as they are more generous, this does not need to be the case. Generous systems mean at the same time higher contribution rates, therefore the IRR does not necessarily need to be high in such countries. Indeed, the correlation of IRR with RR is only 0.35.

Figure III-4 Internal Rate of Return (IRR1), over time and across countries



Source: Own calculations.

2.1.6. Private Pensions Statistics

The difficulty in collecting private pension data stems from the fact that pension assets are not always managed separately from other financial products, such as life insurance, bank assets etc[25]. In addition, databases with historical data on pension assets do not exist.

Historical data could be found in a few academic and analytical papers. Davis (1993) provides pension assets and life insurance data for around 10 developed countries. There are some data tables in the WB (1994) and OECD (1998). In addition, there are country papers where data on private pensions can be found, for example Bateman and Piggott (1997) for Australia, Whelan (2005) for Ireland, Schieber and Shoven (1997) for the US, etc.

[25] Details are explained in the Appendix to this Chapter

There are three sources for recent private pension data: OECD Institutional Investors' Statistics, OECD Global Pension Statistics and EUROSTAT, though the later is available only for EU countries.

Data from ***OECD Institutional Investors Statistical Yearbook*** are financial assets managed by *autonomous pension funds*. Pension arrangements that do not constitute a separately organised and independent legal entity, such as pension assets managed by life insurance companies, are not included (Baillu and Reisen, 1997). This source also provides information on *financial assets managed by life insurance companies*. Baillu and Reisen (1997) argue that one should consider the life insurance sector since assets of certain pension schemes are managed by life insurance companies, while life insurance companies insure certain pension plans. However, by including the total assets of life insurance companies — and not just those attributed to pension schemes — is in fact overestimating the extent of pension wealth (Baillu and Reisen, 1997).

Consequently, the major drawback of the publication OECD Institutional Investors Statistics is that it does not contain separate figures on pension assets managed by funds or insured by insurance companies. Furthermore, data on financial assets managed by life-insurance companies and non-autonomous funds (book reserves) are not complete.

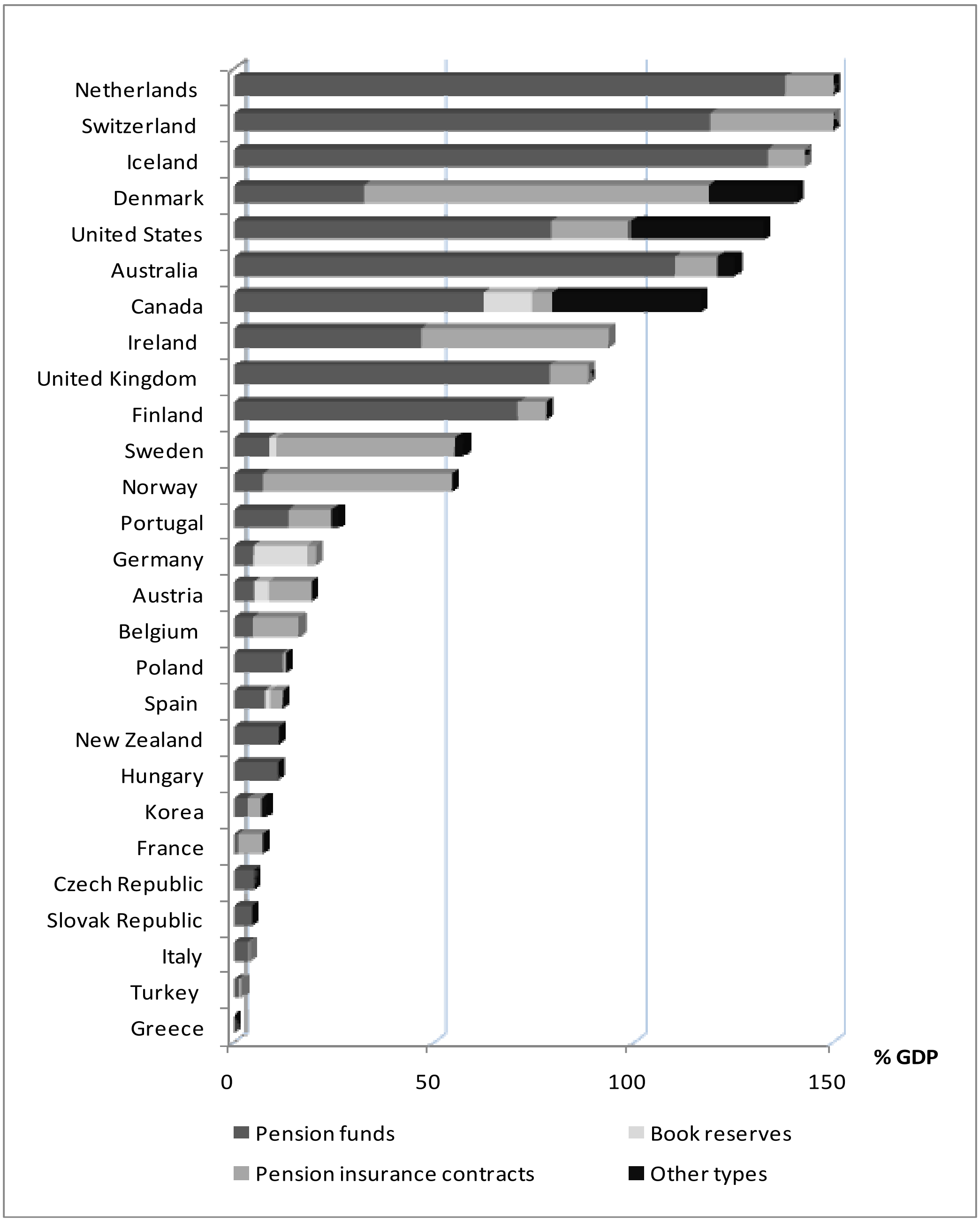
In order to fill this significant data gap in pension statistics, in 2002 the OECD Financial Markets Division initiated a statistical project with the aim to set up a dataset of *Global Pension Statistics*. Pension assets in this database are available according to the financing vehicle – those managed by autonomous pension funds, book reserves, pension insurance contracts and other types of private pensions (such as Individual Saving Accounts in the US etc.). These data are presented in *Pension Markets in Focus* – a brief OECD publication published annually since 2005, and in an on-line database. In general, data stem from 2001, though in some cases such as the US, the Netherlands, Norway, Germany, the time series is much longer. Consequently, the major drawback of this database is the short time span.

According to OECD Statistics, in 2007, the Netherlands with 155% followed by Switzerland with 150%, were the countries with *the highest share* of pension assets relative to GDP. The majority of these funds are managed by a separate legal entity (autonomous fund)[26].

Other countries with a *very high share* of pension assets to GDP are Iceland, Denmark, the US, Australia and Canada. In all these countries, assets are managed by separate legal entities, except in Denmark where the majority of funds are under the management of life insurance companies. Countries with a *medium share* of pension assets relative to GDP are the UK, Ireland and the rest of Nordic countries (Finland, Sweden and Norway). All other countries have a quite *low share* of pension assets in GDP.

[26] In most countries a typical financing vehicle are autonomous pension funds except for three Scandinavian countries where the major financing vehicle are insurance companies. For the available methods of implementing private pension plans across countries see the Appendix.

Figure III-5 **Pension funds by type of financing vehicle in % of GDP, 2007**



Source: OECD.stats

Since there is no unique dataset on pension funds available for a longer period, I constructed panel data in the following way – I started with the most recent and best quality data from Global Pension Statistics and extended them with Institutional Investors data, cross validating the data for the years where both sources are available. I estimated data prior to the 2000s for pension assets managed by life-insurance companies calculating the percentage of pension funds within total funds managed by life insurance companies, for the years where both data sets were available. I have then applied this percentage to historical (Institutional Investors) data to obtain historical data on pension funds managed by insurance companies. For years between the 1960–1980s, I have used some additional sources – Davis (1993), country-specific papers, and information on countries' pension systems, such as when each scheme was introduced. Table VII-8 in the Appendix to thesis presents decade averages of private pension fund shares since the 1960s. There is an obvious upward trend among all countries, while EU-8 countries started introducing private pension funds only in the 2000s.

2.2. Bismarck Factor and Composite Indicators

The previously described indicators overlap and correlate, so it is desirable to 'package' these measures together. I am going to use the principal component analysis to construct the composite index that will be used later in the empirical analysis, and to try to identify commonalities on indicators in typology of pension programmes (Beveridge v Bismarck).

I conduct ***principal component analysis*** (PCA)[27], which aims to reduce pension indicators to a composite index. The analysis is performed on two combinations of variables with the difference between them being the inclusion/omission of the 'pension tax' variable and the IRR. In the first case, the PCA is performed on 7 variables excluding 'pension tax', and in the second case on 7 variables excluding IRR but including 'pension tax'.

Table III-10 Principal component loadings (1960s–2000s)

	PCA 1 - Bismarck	PCA 2 - Beveridge
Variables:		
Pension variation	-0.45047	0.44206
Pension tax	…	0.35967
RR (public system)	0.42668	-0.41015
Private pension assets	-0.32398	0.24139
Pension expenditure	0.37840	-0.35817
Contributions	0.39233	-0.37205
Single/couple ratio	-0.43683	0.42663
IRR1	0.14877	…
eigenvalue	4.36508	4.686
% total var	62.36	66.94
Number of observations	*88*	*107*

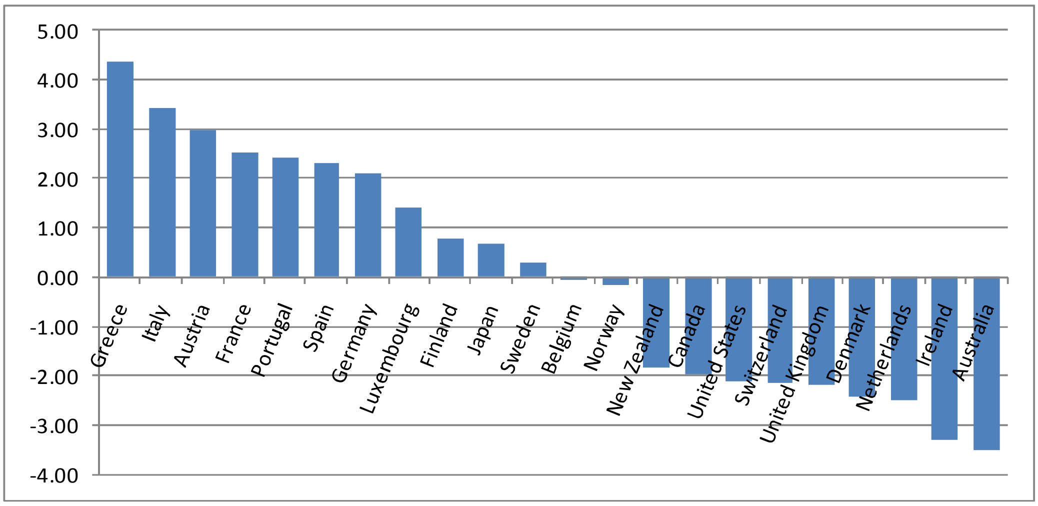
In the first case, the PCA extracts component that can be dubbed the '*Bismarck'*, and in the second case, the '*Beveridge'* component is extracted (Table III-10). Indeed, the 'Bismarck' PCA composite index is highly correlated with the Bismarck dummy[28], with coefficients of correlation being greater than +-0.8. The Bismarck component is, as expected, positively correlated with the level of RR, contribution rates and expenditure rates, and the IRR, and

[27] Principal component analysis involves a mathematical procedure (orthogonal transformation) that transforms a number of correlated variables into a smaller number of uncorrelated variables called *principal components*.

[28] Dummy variable applied to countries according to the original pension model (see Appendix for the table of countries with values 1 for Bismarck dummy)

negatively with variables of the 'Beveridge kind' – 'pension variation', private pension assets and the single/couple ratio[29]. The second PCA run extracts the 'Beveridge' component, since more of the 'Beveridge-type' of variables ares included in the analysis (e.g. 'pension tax' instead of IRR).

Figure III-6 PCA1 scores by countries (for 2000s) – Bismarck composite index



If one looks at the PCA1 i.e. 'Bismarck' scores (Figure III-6), for the 2000s for example, it seems that countries still group similarly to their original pension model presented in the amended Bonoli (2000: 11) Table III-2 Original model of pension policy'.

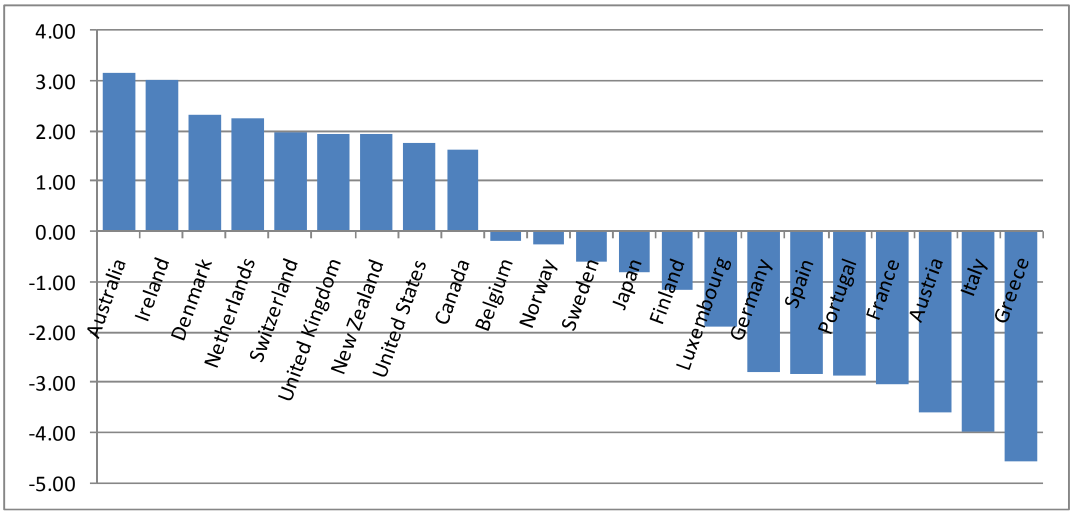
The exceptions are countries that are close to zero, such as Sweden and Norway, as well as Belgium, and to some extent Finland and Japan. According to the 'original model of pension policy', which prevailed in the late 1950s, Nordic countries are classified as 'Beveridge' countries. However, these countries are 'early birds' that introduced the earnings-related

[29] Single/couple ratio is taken as 'Beveridge' variable, since this system were founded on the basis of redistribution and targeted towards general population, not just working class. Therefore very often pension for those with non-working spouses were accelerated.

public unfunded (PAYG) tier by the end of the 1960s. Thus, if the classification was made according to the model that prevailed at the end of the 1960s, the 'Nordic' model - the one which combines elements of both 'Beveridge' and 'Bismarck', would stand out as well. Therefore, zero scores for Sweden, Norway and Finland are not surprising. Japan is also not a surprise, since it introduced its pension system quite late and therefore used the 'hybrid' approach. The only exemption is actually Belgium, the original 'Bismarck' country, but with a lower replacement rate and therefore lower pension expenditures than in comparable 'Bismarck' countries.

Scores of the 'Beveridge' composite index, presented in Figure III-7, are a mirror image of the 'Bismarck' PCA index scores. Greece has the lowest values of the 'Beveridge' score, while Australia has the highest, and it is vice versa for the 'Bismarck' score.

Figure III-7 PCA2 scores by countries (for 2000s) – Beveridge composite index



3. EMPIRICAL ANALYSIS: CONVERGENCE VS. PATH DEPENDENCE

The two original pension models – Bismarck and Beveridge, differ in a number of features: the degree of 'intragenerational redistribution', the size of the public pension system and the way of financing.

Ebbinghaus and Gronwald (2009) highlight the connection between the original pension model and private pensions using the 'crowding-out' hypothesis, which postulates that Bismarckian pension systems are limiting the scope for the development of private pensions because state pensions provide sufficient earnings-related benefits[30].

The evolution of pension systems and the latest developments (explained in the introduction of this Chapter), brought the question whether the historical paths are still important, or whether there has been convergence in pension models.

The dilemma 'convergence' vs. 'path dependence' is the central to this section, which I attempt to answer examining three sub-themes. Firstly, following Disney (2000a), I will test the 'crowding-out' hypothesis, which indirectly implies whether it still makes sense to talk about Bismarck vs. Beveridge differences.

[30] Conversely, the 'insufficient state pension' hypothesis suggests that Beveridge basic pension systems have the largest potential for occupational pension development. This is actually in line with one of the principles Beveridge stated in his Report (1942: 6-7) that 'social security must be achieved by co-operation between the state and the individual; in establishing a national minimum, it (state) should leave room and encouragement for voluntary action by each individual to provide more than that minimum for himself and his family'.

Secondly, I will analyse whether countries still group as they used to – Bismarck and Beveridge. The methodology that will be employed is Bonoli`s (1997) 'two-dimension approach', combining various dimensions of pension policy.

Lastly, motivated by the notion of 'convergence' (Overbye, 1996; Bonoli, 2000; Hinrichs (2000; Hemerijck, 2006; etc.) and 'policy transfers' (Banks et al. 2005), I proceed to formally test if there is empirical evidence for the 'convergence hypothesis'.

The empirical analysis is conducted on the sample of 22 OECD countries over five decades. The pension design indicators used are explained in detail in the section 2.1. and listed in the appendix to this Chapter. For variables that do not vary at high frequency, such as RR, pension variation, single/couple ratio, *mid-decade points* are used; for variables that do fluctuate, such as pension assets, contributions, expenditures, *mid-decade five year averages* are used.

The *Bismarck dummy* variable is derived from the Table III-2 Original model of pension policy', presented in the introduction of this Chapter. There are three alternative Bismarck dummies, which differ depending on the classification of countries with a 'hybrid' original model. For example, one version of dummy variable – 'Bismarck2' - considers the US as a Beveridge country (see Appendix to the thesis). Although founded its social security system as earnings-related, hence according to original model of pension policy it should be classified as Bismarck country, with high level of private pension assets and redistribution within public system US fits better into the Beveridge group. Therefore, 'Bismarck2' is preffered version of Bismarck dummy variable[31].

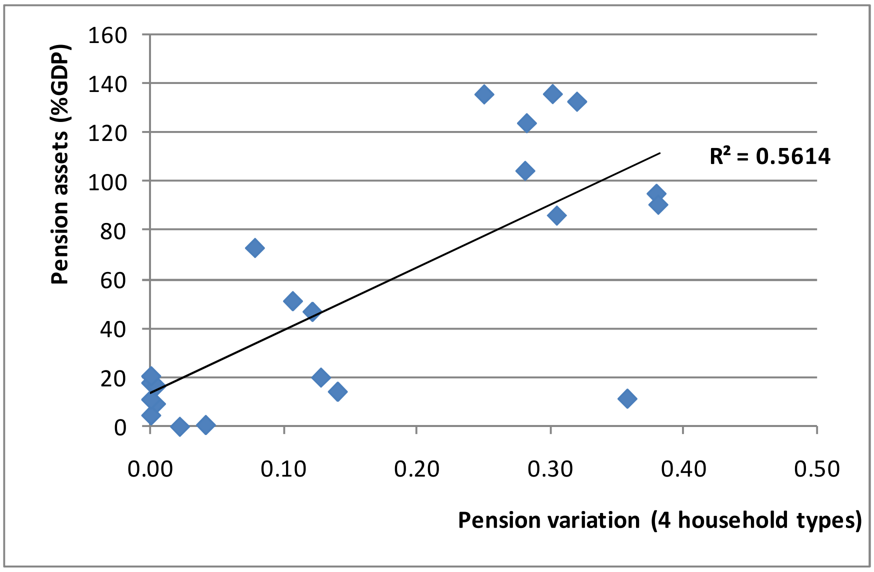
3.1. Do Bismarck Systems Crowd Out Private Pension Savings?

Disney (2000a) notes that public pension programs with a strong earnings-related component ('Bismarckian') tend to hinder the development of private pension arrangements – a form of 'crowding out'. In this sub-section, I follow his analysis using longer data series and a slightly different set of variables - 'Bismarck dummy' as a proxy for Bismarck system instead of public pension expenditures, and more control variables including a proxy for financial liquidity.

By a natural converse, preliminary data analysis suggests that countries that originated with Beveridge-type programmes are more likely to encourage private pension savings. There is quite a strong relationship between 'pension variation' - a good indicator of a 'Beverige' programme, and private pension assets– a positive correlation of 75% (see Figure III-8)

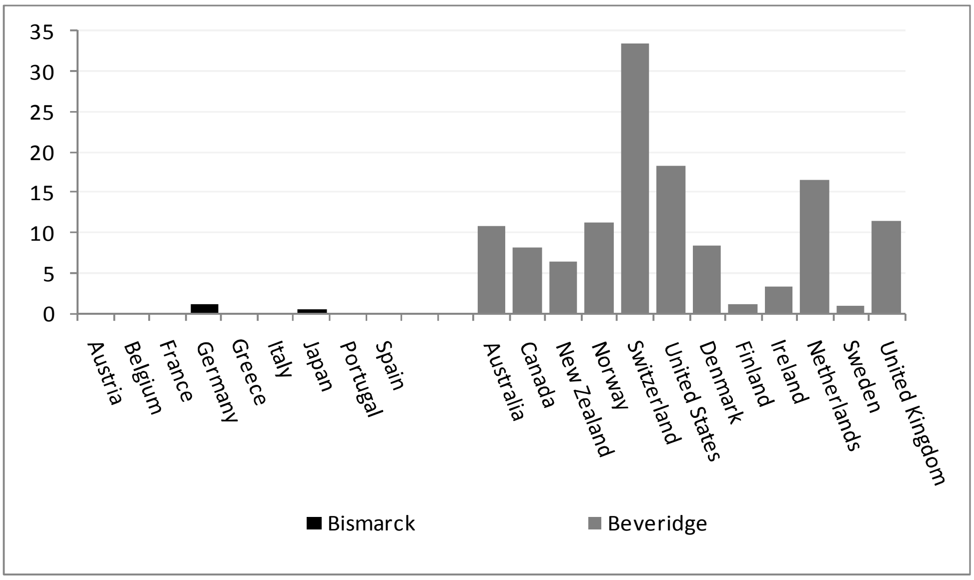
[31] Unless otherwise stated, the 'Bismarck dummy' refers to the second alteration, i.e. 'Bismarck2' dummy.

Figure III-8 Pension variation and private pension assets, OECD-20 (mid-2000s)



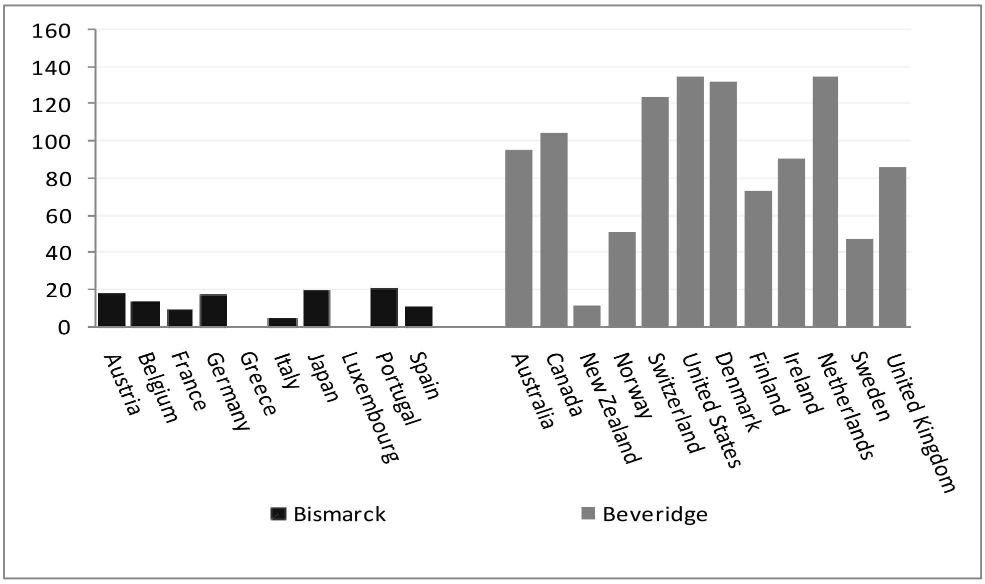
In addition, if one looks at private pension assets according to the Bismarck-Beveridge origin (using the 'Bismarck2 dummy', based on the Table III-2[32]), the difference between countries is obvious and persists over time (Figure III-9 and Figure III-10).

Figure III-9 Private pension assets in Beveridge and Bismarck countries in 1961



[32] See the appendix to thesis for the list of countries

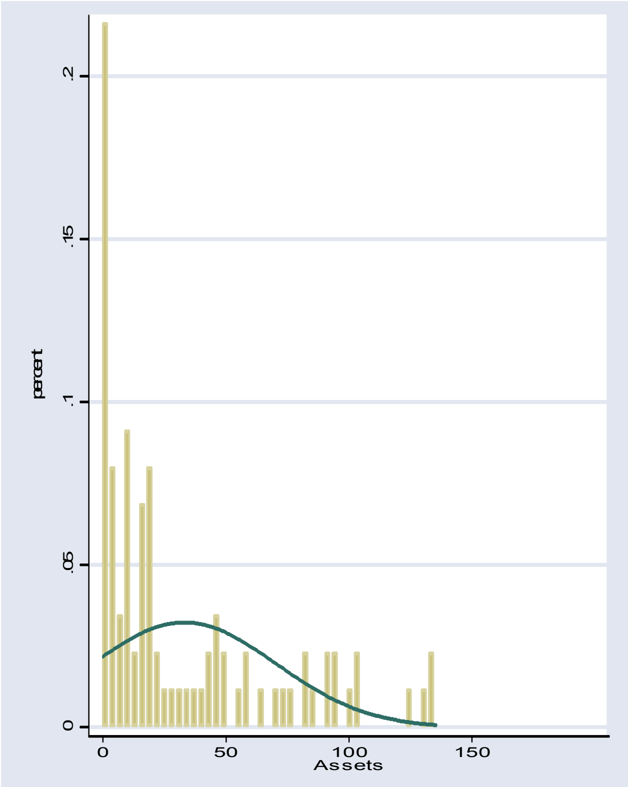
Figure III-10 Private pension assets in Beveridge and Bismarck countries in 2005



I follow Disney (2000a) and formalise this finding with a simple reduced form panel-data regression of private pension assets on the 'Bismarck 2' dummy, including some control variables. I do not use the PCA indicators since they already contain private assets data; therefore, such a regression could suffer from endogeneity bias. Predating the 'Bismarck dummy' on program origins i.e. constructing the dummy so that it captures the system type at its origin, gives a degree of identification to the econometric analysis.

Distribution of dependent variable 'private pension assets' is skewed to the left (Figure III-11). Given the fact that a number of countries did not have private pension assets until 1990s, and a few still do not have or have negligible values, it is not surprising that 12.5% of observations is of value zero and almost 20% below 2% of GDP.

Figure III-11 Histogram of private pension asset variable



Therefore, I have decided to use a Tobit specification with two lower bands: zero % and 2% of GDP, though OLS estimators also give strong results.

The results in Table III-11 suggest a strong impact of historical origins on the volume of private assets in a country. The coefficient on the Bismarck dummy implies that countries with the original Bismarck pension model have, on average, around 50 percentage points lower pension assets of potential (latent) pension assets as percent of GDP.

Table III-11 Private pension assets and Bismarck dummy – tobit specification (OECD-22, 1975-2005)

Dependent variable: Private Pension Assets (%GDI)	Pooled data (LL=0 % of GDP)		Random effects (LL=0 % of GDP)		Random effects (LL=2% of GDP)	
	Coefficient (Std.Err)	*z*-ratio (p-value)	Coefficient (Std.Err)	*z*-ratio (p-value)	Coefficient (Std.Err)	*z*-ratio (p-value)
Bismarck dummy	-52.13 (5.67)	-9.19 (0.000)	-52.53 (8.26)	-6.36 (0.000)	-55.42 8.76	-6.32 (0.000)
Financial development*	0.44 (0.07)	5.94 (0.000)	0.39 (0.07)	5.36 (0.000)	0.43 (0.07)	5.53 (0.000)
Old-age dependency	-0.10 (0.81)	-0.13 (0.895)	0.17 (0.80)	0.21 (0.830)	0.12 (0.86)	0.14 (0.887)
Government consumption	1.01 (0.76)	1.33 (0.188)	0.90 (0.92)	0.98 (0.329)	1.50 (1.00)	1.50 (0.134)
GDP pc	$2e^{-4}$ ($4e^{-4}$)	0.72 (0.475)	$8e^{-4}$ ($5e^{-4}$)	1.71 (0.087)	$8e^{-4}$ ($5e^{-4}$)	1.58 (0.114)
Constant	-7.155 16.58	-0.43 0.667	-18.522 18.391	-1.01 0.314	-32.28 20.28	-1.59 0.111
Number of observations	88		88		88	
Uncensored observations	77		77		71	
LR chi2 (Prob>chi2)	109.85 (0.000)		155.41 (0.000)		155.27 (0.000)	

NOTE: LL for lower limit

* Proxy for financial development is variable *credit to private sector*

When only data from the 2000s are analysed, the sample is slightly different since most of the countries nowadays have non-zero value of pension assets in GDP. Therefore, OLS estimators are more approapriate estimators, and I use employ Tobit estimators with 2% assets of GDP as the lower band.

Table III-12 Private pension assets and Bismarck dummy – OECD and EU-8 in 2000s

Dependent variable: Private Pension Assets (%GDI)	OLS		Tobit (LL=2% of GDP)	
	Coefficient (Std.Err)	*t*-ratio (p-value)	Coefficient (Std.Err)	*t*-ratio (p-value)
Bismarck dummy	-60.11 (12.83)	-4.68 (0.000)	-64.58 (13.42)	-4.81 (0.000)
Financial development*	0.38 (0.12)	3.05 (0.006)	0.46 (0.13)	3.55 (0.002)
Old-age dependency	-1.16 (1.46)	-0.80 (0.433)	-0.74 (1.57)	-0.47 (0.641)
Government consumption	0.74 (1.44)	0.51 (0.612)	1.27 (1.46)	0.87 (0.393)
GDP pc	$-2e^{-4}$ ($4e^{-4}$)	-0.49 (0.630)	$-2e^{-4}$ ($5e^{-4}$)	-0.50 (0.621)
Constant	52.17 (36.19)	1.44 (0.162)	23.33 (37.82)	0.62 (0.543)
Number of observations	30		30	
Uncensored observations	...		24	
F-stat/LR chi2 (Prob>chi2)	20.97 (0.000)		48. 21 (0.000)	

NOTE: LL for lower limit
* Proxy for financial liquidity is variable *credit to private sector*

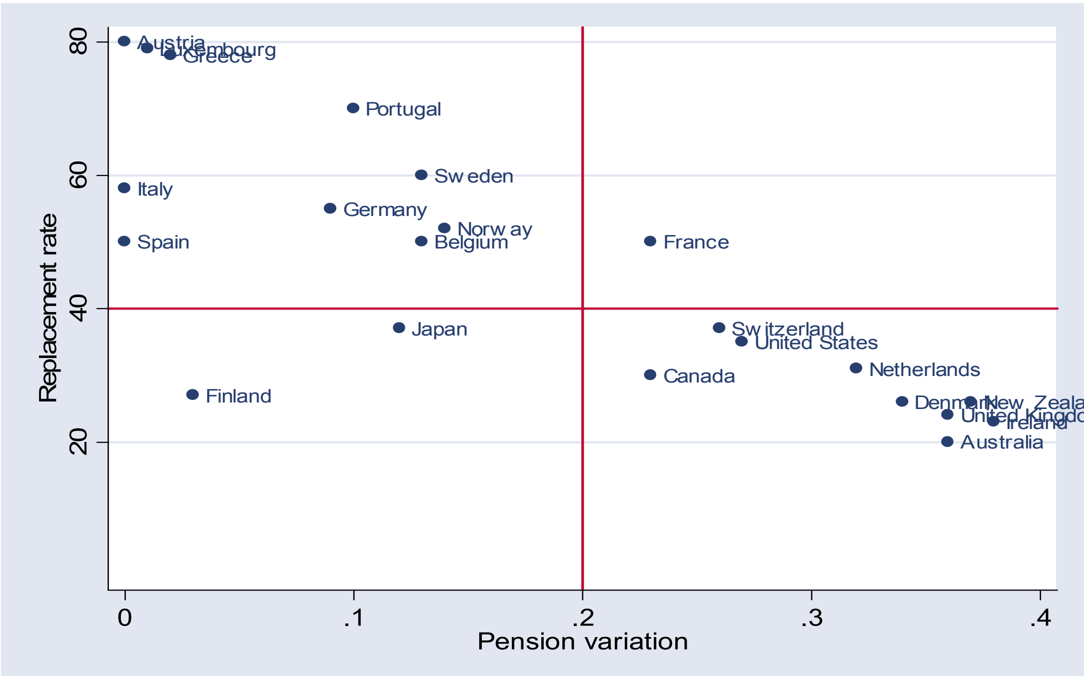
The results are very close to those for the full sample of years, implying path dependence i.e. in this context that pension systems that originated as 'Bismarck' continued to crowd out private pension savings.

3.2. Do Countries Still Group as 'Bismarck' and 'Beveridge'?

In this sub-section, I examine whether countries still group as 'Bismarck' and 'Beveridge'. I use Bonoli`s (1997) 'two-dimensional approach'[33] to investigate if countries tend to classify in a certain way according to two dimensions of pension policy.

Firstly, I choose the (i) *the generosity of a pension system (average level of RR)* and the (ii) the extent of *vertical redistribution ('pension variation'* as defined previously*).*

Figure III-12 OECD pension systems according to pension variation and replacement rate in 1975



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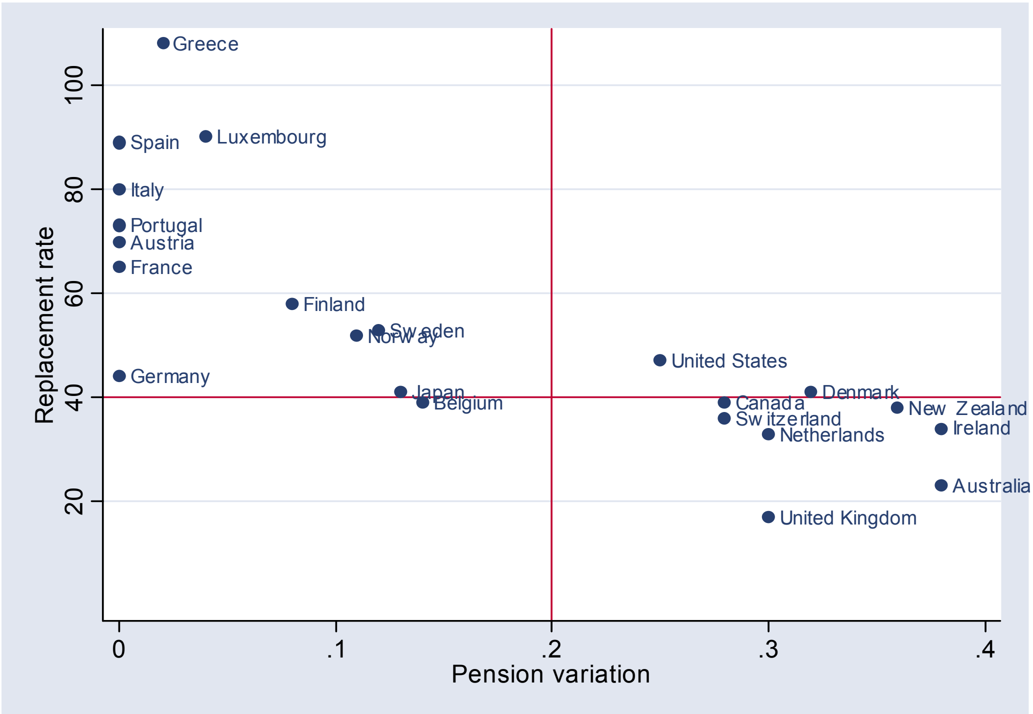
[33] Bonoli (1997) pointed out that welfare regime classifications are typically based on the single dimension, either capturing quantity (how much) or 'how' dimension. He suggests 'two-dimensional' classification, according to i) *the quantity of welfare* they provide, and ii) *where they stand on the Beveridge versus Bismarck dimension*. He uses social expenditure as a proportion of GDP as an indicator of quantitative dimension, and a percentage of social expenditure financed through contributions as a proxy for the relative size of Bismarckian and Beveridgean provision within a welfare state.

According to these two dimensions, public pension programs in 1975 are clustered in the traditional dichotomy: 'Bismarck countries' – generous systems with a low level of redistribution; and 'Beveridge countries', where the program aims at a minimum protection (i.e. a lower average RR) with a high level of redistribution (Figure III-12).

There are a few outliers. The United States clusters in the group of Beveridge countries. Japan, as a country that originated as a hybrid (mixed) model, is located somewhere in between Bismarck and Beveridge. France surprisingly was an outlier. Although it is a typical Bismarck country, in 70s it had a high degree of pension variation due to the high single/couple ratio (Figure III-13). Finland, which together with other Nordic countries introduced an earnings related scheme as early as in 1960s and decreased vertical redistribution, is another exception. The initial earnings related scheme introduced in Finland was small, and therefore, RR in 1975 was still very low, while Sweden and Norway group as Bismarck countries.

In the 2000s, countries still cluster in these two large groups, though somewhat differently (Figure III-13). A major difference during three decades occurred in the distribution of the average levels of RRs. In general, one can say that there is a greater dispersion of the RR level in the 2000s, especially within Bismarck countries. While in 1975, the average RR in most Bismarck countries ranged between 50 and 80%, in the 2000s it ranges from 40 to more than 100%. In addition, some Beveridge countries increased their social security RRs, so a few Bismarck countries, such as Germany, are now actually at the same level of RR as Beveridge countries[34].

Figure III-13 **OECD pension systems according to pension variation and replacement rate in the 2000s**



I use the *replacement rate of 70% as the cut-off* line to distinguish between *more* and *less generous Bismarck countries* – generous are 70% (Austria) and above. This classification is presented in Table III-13.

[34] Replacement rates are given in gross term. For example, this means that for Germany net RR amounts 63%. Source for the data in the Figures are data explained in the section 2 of this Chapter.

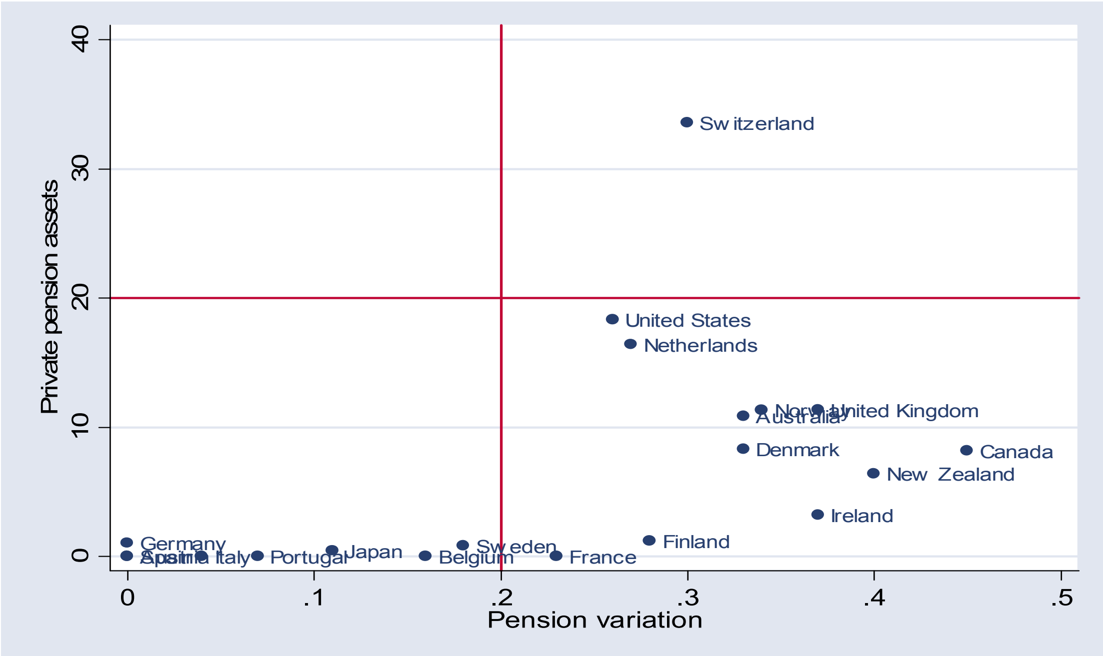
Table III-13 OECD pension systems according to pension variation and the level of replacement rate, 2000s

Beveridge	Bismarck	
	Generous	***Modest***
Australia	Austria	France
Canada	Greece	Germany
Denmark	Spain	Finland
Ireland	Luxembourg	Norway
Netherlands	Italy	Sweden
New Zealand	Portugal	Japan
Switzerland		Belgium
United Kingdom		
United States		

In what follows I analyse how countries cluster according to: (i) *pension variation* and (ii) *private pension fund assets.* In the early 1960s, all 'Bismarck countries' clustered along the x-axis, having a negligible amount of private pension assets (Figure III-14).

The Beveridge countries differ from Bismarck in having higher pension assets, though still below the demarcation line of 20% of GDP. Furthermore, there were significant differences between them – from modest pension assets in Finland and Ireland, to moderate in the UK, Norway, Australia, Canada and Denmark, to higher in the US and the Netherlands (around 20% of GDP) and exceptionally high in Switzerland. Sweden, as a Nordic country that initially followed the Beveridge policy model, actually clustered in the Bismarck group.

Figure III-14 OECD pension systems according to pension variation and private pension fund assets in 1961



In the 1970s private pension assets increased in all countries, though this increase seems more pronounced in Beveridge countries (Figure III-15). Differences between the Beveridge countries are still high, but a few countries – the US, the Netherlands and Ireland joined Switzerland in the upper 'Beveridge quadrant'. Nordic countries (except for Denmark) 'moved' to the 'Bismarck quadrant', with an inherited larger amount of private assets.

Figure III-15 OECD pension systems according to pension variation and private pension fund assets in 1975

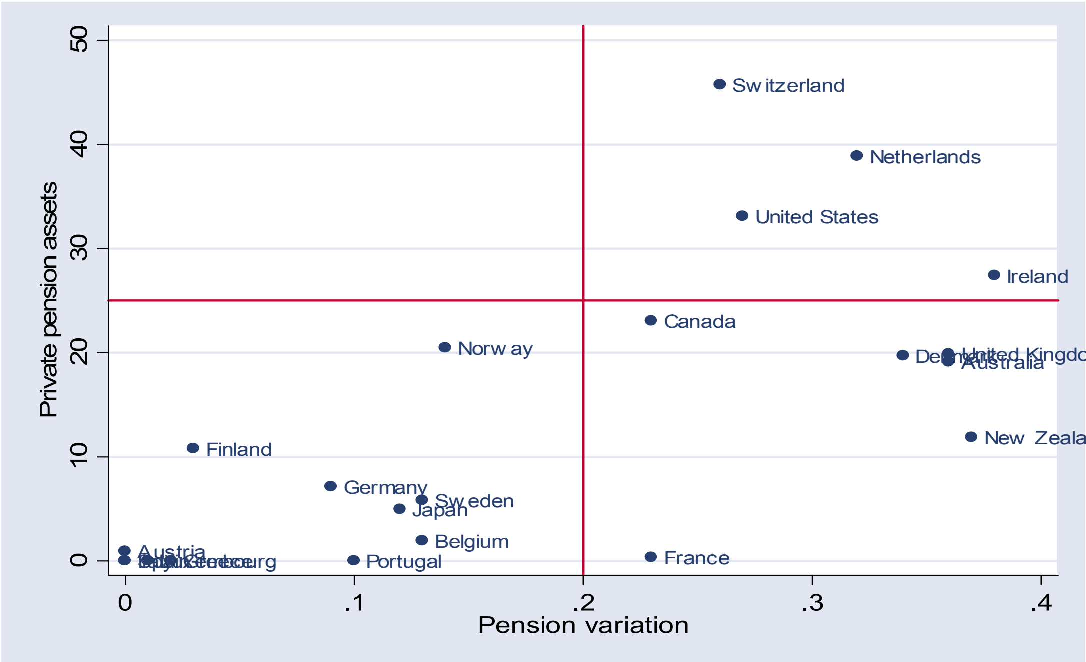
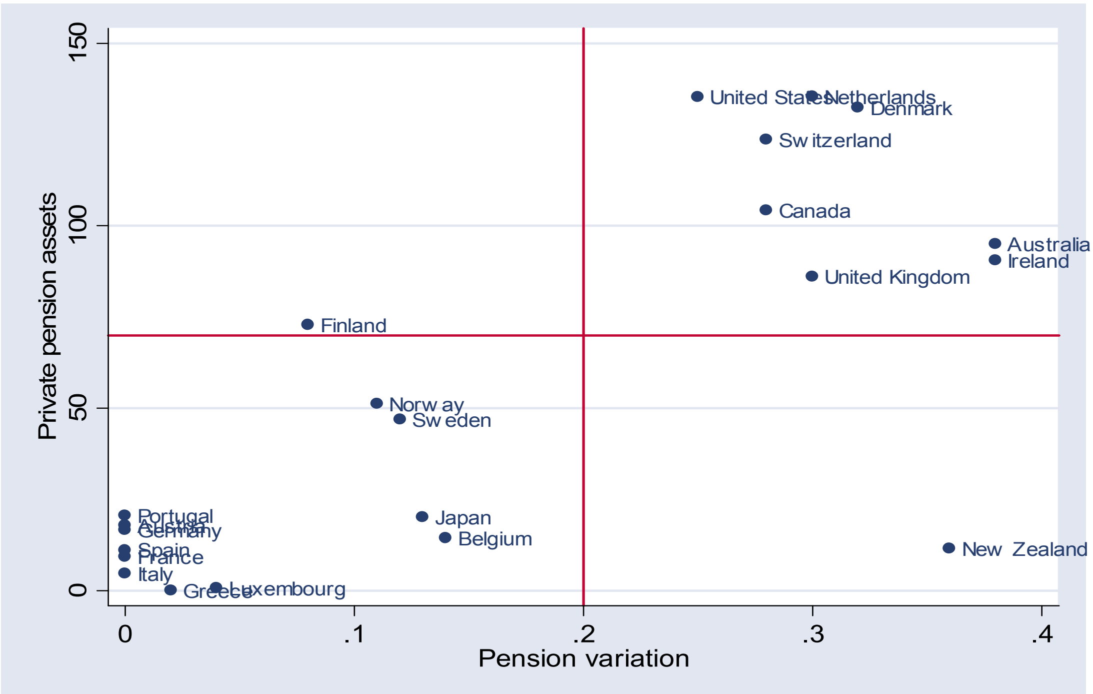


Figure III-16 OECD pension systems according to pension variation and private pension fund assets in 2005



By the 2000s, countries nicely clustered into two groups – Beveridge and Bismarck (Figure III-16). The interesting exception is New Zealand, which, although a typical Beveridge country in public pension design, had a low level of private pension assets. This is because New Zealand is a country where an earnings-related 'top-up' has never occurred (Hinrichs, 2000; Overbye, 1994; etc). Moreover, voluntary pensions were not favoured and stimulated by tax incentives pensions between 1987, when New Zealand became the only country in the OECD to eliminate all tax subsidies for pension saving, and 2007 when tax reliefs were introduced for 'KiwiSaver'[35] (Hughes, 2008:6).

Table III-14 presents the classification according these two dimensions in 2000s. Countries group nicely according to their original pension model, including the so called 'Nordic model'. Nordic countries differ from Bismarck countries as they have a higher level of private pension assets, with Finland leading in funded pensions.

Table III-14 OECD pension systems according to pension variation and private pension funds in the 2000s

Bismarck	Beveridge	Bismarck /Higher Assets (Nordic)	Beveridge/Low Assets
Germany	Australia	Norway	New Zealand
Italy	Denmark	Finland	
France	Canada	Sweden	
Austria	United Kingdom		
Greece	Netherlands		
Portugal	Switzerland		
Japan			

[35] KiwiSaver is a voluntary retirement savings scheme in New Zealand, which came into operation in July 2007.

Succinctly, according to the simple two-dimensional analysis, we can still see strong influence of original pension policy in the 2000s – countries still group according to their original pension policy models despite changes in the indicators over time. The only exception are Nordic countries, which very early converged to the 'two-tier system', thus representing a distinct model.

An analysis of the difference in the means of the values of the pension indicators between the two groups of countries – original Bismarck and Beveridge (using our original classification of 'Bismarck' v. 'Beveridge' from the end 1950s) confirm this conclusion. Differences in means of the most important pension variables are statistically significant for the sample of OECD countries throughout five decades (Table III-15).

Table III-15 Difference in means for Bismarck and Beveridge countries: OECD sample, 1960s–2000s

	Beveridge	Bismarck	t-test	p-value
RR	33.54	63.98	-8.94	0.000
IRR1	4.46	5.84	-3.01	0.003
IRR2	2.71	3.48	-2.27	0.026
Pension Variation	0.27	0.07	10.59	0.000
Pension Tax	2.09	0.71	7.75	0.000
Private Pension Assets	44.60	11.16	5.57	0.000
Pension Expenditure	4.27	6.77	-5.50	0.000
Contribution Rate	8.27	14.23	-5.80	0.000
Couple/Single ratio	1.43	1.10	9.25	0.000

NOTE: Results for 'Bismarck 1' dummy; results are even stronger when'Bismarck2' variable is used.

Differences persist over time and programs are therefore 'path dependent'. For variables such as pension variation, pension tax, pension expenditure and the effective contribution rate, the significance in the difference of the means actually increased since the 1970s. For other variables, differences remain constant, while the only variable for which we can say the means in the Beveridge and Bismarck countries converged is the average IRR– the measure of intergenerational redistribution).

3.3. IS THERE CONVERGENCE?

Motivated by the notion of 'convergence' (Overbye, 1996; Bonoli, 2000; Hinrichs (2000; Hemerijck, 2006; etc.) and 'policy transfers' (Banks et al. 2005), I proceed to formally test if there is empirical evidence of the 'convergence hypothesis'.

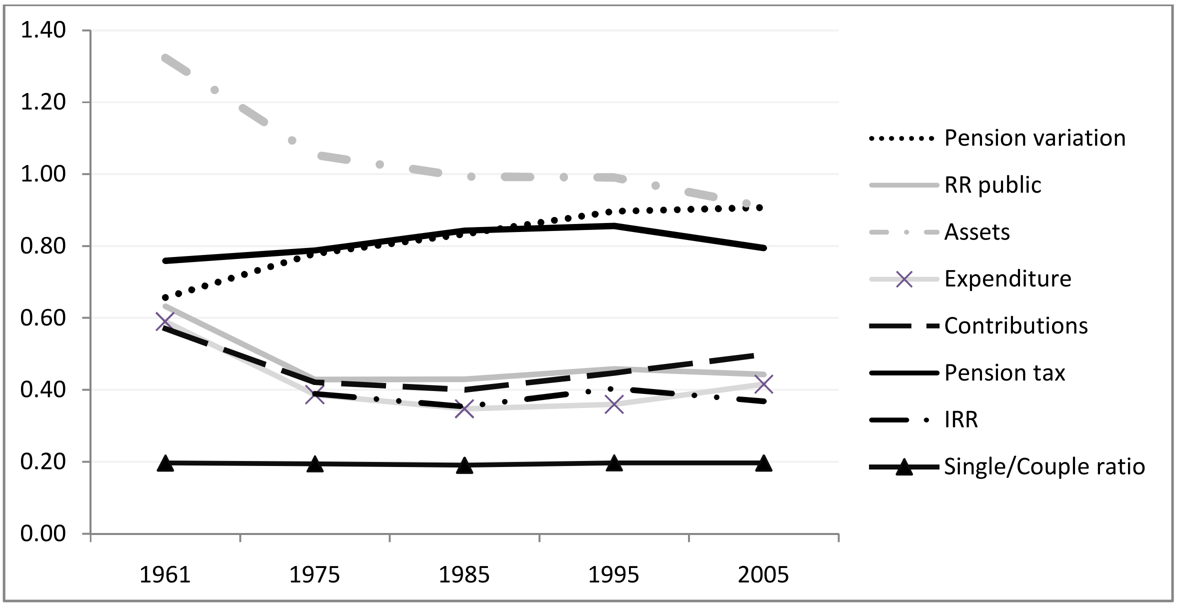
Firstly, I follow Johnson (1999) and investigate whether there has been a decrease in the coefficient of variation (CV) of pension indicators across countries over time. Johnson (1999) searched for evidence of convergence in outcomes, simulating replacement for five different earnings levels for individuals since the 1950s in five countries – France, Germany, Spain, Sweden and the UK. He calculated the coefficient of variation of hypothetical replacement rates for each earning level across countries in each decade and plotted the results. By visual inspection of the plotted data, he concludes that there is convergence for high-income earners. However, for an average income earner and 50% average earners he finds that 'not the financial retrenchment since the 1980s has made public pension outcomes more similar, but rather that retrenchment has reversed a trend towards harmonisation and has increased the variance across countries in the level of income provided for similar individuals through the public pension system'. He adds that pension systems may have converged along other dimensions – for example through encouragement of private pension provision, or an increase in the normal retirement age – but not by average earner entitlement.

This procedure is analogous to that used to capture 'sigma convergence' stemming from the Barro and Sala-i-Martin (1995) growth literature. With this approach, I will measure whether there is a decline in dispersion between *all* countries, leaving aside the Beveridge-Bismarck classification.

The only variable where we can see significant decrease in the CV of an indicator across countries over time in Figure III-17 is in private pension assets. Nonetheless, this is still the variable with the greatest variation between countries, since in the 1960s, the differences between countries regarding private pension were enormous with some countries having near-zero assets.

Many indicators, after the initial decrease in variation that happened in the 1970s, have seen a steady increase in variation, for example, in effective contributions and pension expenditure. Thus, using Johnson`s approach, we can conclude that no overall convergence occurred for pension design parameters, as measured by the most important pension indicators.

Figure III-17 Coefficient of variation of pension variables throughout decades



To give a statistical underpinning to these findings, I follow Harvey (2002) and Affinito and De Bonis (2008), and formally test convergence by testing the stationarity of the difference of the two series (D_t). The procedure is to test in the first step whether the differential of the two series is either a nonstationary or stationary process with the augmented Dickey-Fuller (ADF) test[36]:

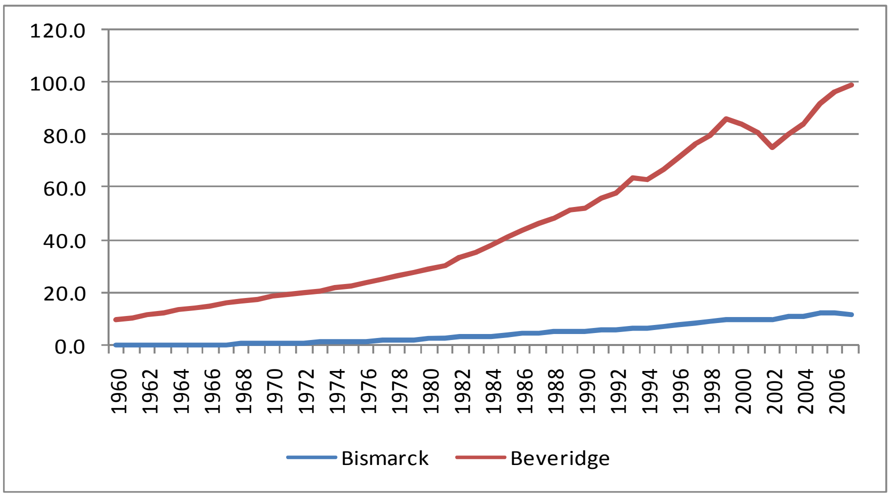
$$\Delta D_t = \propto + \theta D_{t-1} + \gamma_1 \Delta D_{t-1} + \cdots + \gamma_p \Delta D_{t-p}$$

[36] The augmented Dickey-Fuller test for a unit root is used for higher order AR process. The test includes lagged changes of the variable as regressors. It tests the $H_0: \theta = 0$. If t* > ADF crtitical value, the null hypothesis cannot be rejected, i.e. a unit root exists. The Dickey-Fuller t-statistic does not follow a standard t-distribution as the sampling distribution of this test statistic is skewed to the left with a long, left-hand-tail. Each version of the test has its own critical value which depends on the size of the sample.

In the second step, if stationarity is verified, the zero-mean stationarity is tested with Kwiatkowski-PhillipsSchmidt-Shin (KPSS) test[37]. In the case of zero-mean stationarity, the series converge.

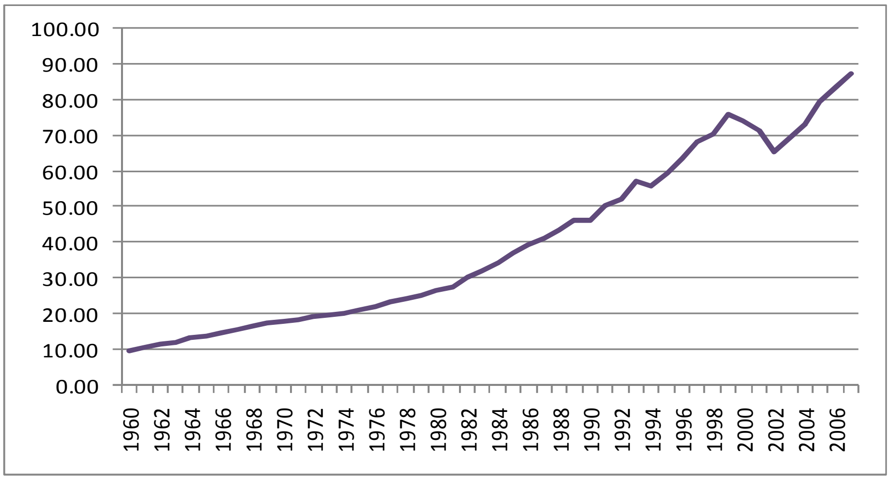
I chose to test two long time series – *private pension assets* and *pension expenditure*, for two reasons: the first is data availability and second is that these two series depict the private-public mix in models of pension provision well. There is a break in the former series in 2001, especially in Beveridge countries with high values of pension assets, most likely due to the events of September 11th and the dot-com bubble collapse (Table III-18).

Figure III-18 Private pension assets (%GDP), Beveridge and Bismarck countries



[37] KPSS is a one-sided right-tailed stationarity tests, where the null is that a time series is trend stationary against the unit root alternative hypothesis. The test is based on the auxiliary regression of Y_t upon an intercept and a time trend. The test is $KPSS = \sum_{t=1}^{T} S_t^2 / \hat{\sigma}^2$ where S_t is partial sum of residuals and $\hat{\sigma}^2$ estimator for the error variance.

Figure III-19 Difference in private pension assets between Beveridge and Bismarck countries



Just by visual inspection of the data (Figure III-18 and Figure III-19), it is obvious that the series do not converge.

The formal ADF test confirms no convergence – since the computed ADF test-statistics (65.74481) are greater than the critical value 'tau' (1.60), the null cannot be rejected. That means the series has a unit root and is non-stationary. The coefficient of somewhat more than 1 suggests divergence between the data series. Thus, there is no point in proceeding to step two – testing the zero-mean stationarity.

Table III-16 ADF test for difference in private pension assets in Beveridge and Bismarck countries

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X(-1)	1.024958	0.015590	65.74481	0.0000
DX(-1)	0.481825	0.183702	2.622858	0.0130
DX(-2)	-0.043294	0.185472	-0.233429	0.8168
DX(-3)	-0.353745	0.182827	-1.934861	0.0614
DX(-4)	0.174159	0.175791	0.990716	0.3288
DX(-5)	-0.462649	0.204483	-2.262524	0.0302
DX(-6)	0.443623	0.269418	1.646596	0.1089

R-squared	0.994156	Mean dependent var	44.66659
Adjusted R-squared	0.993125	S.D. dependent var	22.56622
S.E. of regression	1.871099	Akaike info criterion	4.245180
Sum squared residuals	119.0343	Schwarz criterion	4.537741
Log likelihood	-80.02620	Hannan-Quinn criterion	4.351715
Durbin-Watson stat	2.159645	1% critical value	ADF(6)=1,600

A similar result is found for the series of public expenditure on old-age pensions. Visual inspection of the data suggests no convergence – until the beginning of the 1980s expenditures increased by the same pace, but from the beginning of the 1980s until the 2000s there was a divergence in trends: expenditures in Bismarck countries increasing while in Beveridge countries they were quite stable. The difference stopped increasing after the beginning of the 2000s (Figure III-20 and

Figure III-21).

Figure III-20 Public old-age pension expenditures (%GDP), Beveridge and Bismarck countries

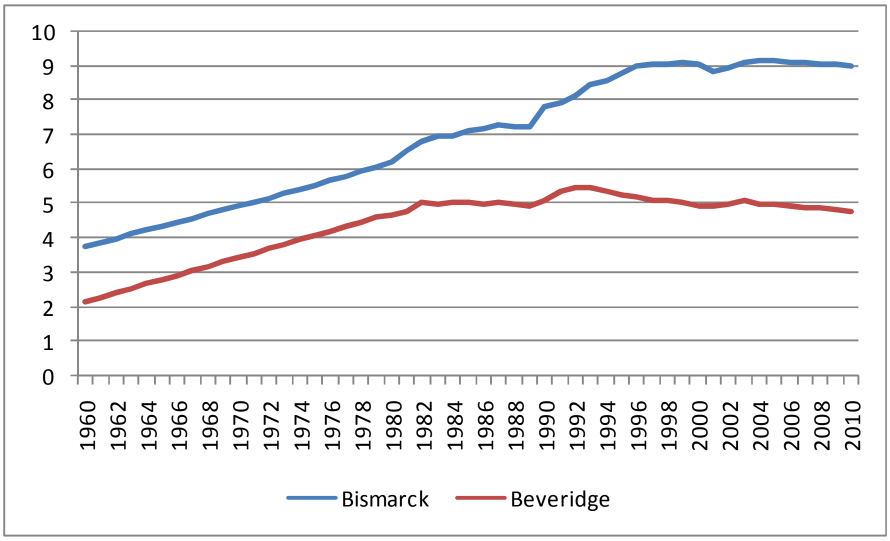
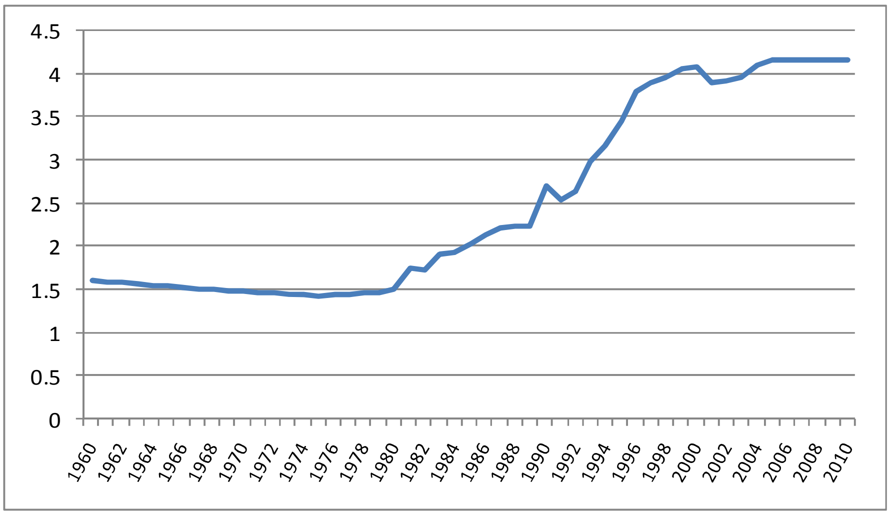


Figure III-21 Difference in public old-age pension expenditures between Beveridge and Bismarck countries



The ADF test confirms no convergence, i.e. slight divergence given the coefficient of 1.0085.

The ADF test-statistic (108.5666) is greater than the critical value ‘tau’ (0.92), hence the null cannot be rejected. The difference between the public old-age expenditure in Bismarck and Beveridge countries is a non-stationary series, and there is no sign of convergence.

Table III-17 ADF test for difference in public expenditure on old-age pensions in Beveridge and Bismarck countries

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y(-1)	1.008530	0.009290	108.5666	0.0000
DY(-1)	0.041521	0.152900	0.271556	0.7874
DY(-2)	0.170397	0.152710	1.115824	0.2712
DY(-3)	0.337040	0.155011	2.174292	0.0357

R-squared	0.988739	Mean dependent var	2.480010
Adjusted R-squared	0.987894	S.D. dependent var	1.073776
S.E. of regression	0.118145	Akaike info criterion	-1.347304
Sum squared residual	0.558328	Schwarz criterion	-1.185105
Log likelihood	33.64068	Hannan-Quinn criterion	-1.287153
Durbin-Watson stat	1.988442	1% critical value	ADF(3)=0,92

4. CONCLUSION

The foundations of pension systems across the world were laid, roughly speaking, from the end of the 19th century until the beginning of the 1960s. With the onset of modern public pension programs, policy analysts generally dichotomised countries into two distinct models – the Bismarck pension model with the aim to maintain income in old-age, and the Beveridge model introduced with the aim to prevent poverty in old-age. This original pension policy set-up was influenced by many factors – political, historical, cultural, etc.

From the beginning of the 1960s, pension programmes have evolved and converged in objectives so as to incorporate both goals of pension policy – poverty prevention and income maintenance. Nowadays, a pension is said to be *adequate* when it manages to accomplish both (Holzmann and Hinz, 2005).

By the 1980s, welfare states had reached their limits of generosity. Economic crises, and anticipated demographic pressures, together led to an increasing need for financial stability in public pension programs. Consequently, pension reform has emerged as a major issue since the early 1990s (Disney, 2000b). The focus of pension policy makers moved increasingly towards a policy of retrenchment – cutting benefits generosity by increases in the ages of first receipt of pension, changes in benefits indexation, erosion of privileged pensions etc. Furthermore, the process of globalisation and EU Open Method of Coordination allowed and contributed to the ‘policy transfer’ within pension policy.

As a result, it might appear that distinct pension models – Bismarck and Beveridge, have converged towards each other partly due to the convergence in policy objectives and partly due to retrenchment policy reforms. There has been convergence in what Bonoli (2000) names *pension functions*, or what can be called convergence in *pension policy objectives*. This convergence translates in what Overbye (1996) defines as convergence in *policy outcomes*.

Therefore, this chapter examined whether the design of modern pension systems is still influenced by their historical origins – whether the ‘Bismarck system’ or the ‘Beveridge system’, or whether programs have converged in the mean time.

For this purpose, and for later analysis of retirement saving, I constructed several measures or ‘indicators’ of pension program design. Some were utilized by Disney (2004; 2006) in his analysis of labour force participation and retirement saving, but I was able to construct them using more reliable data sources and for longer time period.

Subsequently, I conducted three types of empirical analysis using these constructed data. Firstly, using a both Tobit and OLS specification, I examined whether the ‘Bismarck design’ crowded out private pension savings. Secondly, I used Bonolli`s (1997) two-dimensional approach to see if countries still grouped as ‘Bismarck’ and ‘Beveridge’ systems i.e. ‘path dependence’. Finally, I perform formal convergence tests.

The results of the regression of private pension assets on a ‘Bismarck dummy’ and control variables suggested a strong impact of historical origins on the volume of private assets in a country. The results were robust to choice of sample and to specification – whether on cross-section or panel data.

The two-dimensional approach of Bonoli (2000), matching combinations of series of pension indicators such as pension variation and private assets, or pension variation and RR, suggest that countries still broadly cluster as ‘Bismarck’ and ‘Beveridge’, notwithstanding policy pressures towards uniformity. An analysis of difference in means between the two groups of countries – Bismarck and Beveridge - confirm this conclusion

Finally, the formal test of convergence – testing the stationarity of the difference of two series with the augmented Dicky-Fuller test, suggests, if anything, a slight divergence between Bismarck and Beveridge countries.

Consequently, despite a convergence in pension policy goals and in an outcome as reflected by the total or average replacement rate, no convergence in pension models could be found. Pension systems around the world are still very diverse and influenced by the original policy choice i.e. historical paths.

These findings are important for policy makers, as they suggest that more attention should be given to the adequacy of each pension policy measure in the particular country setting. Moreover, any analysis of household behaviour, such as retirement saving behaviour, which gives a primary role of program design, still makes a lot of sense. This analysis of retirement saving is pursued in the forthcoming chapter.

Appendix: List of variables

VARIABLE	STATA LABEL	DESCRIPTION	SOURCE	NOTE
Replacement rate	RR	The gross current RR at the year of statutory retirement (most often 65) for those who started working at the age of 21. Only public mandatory pensions included.	Compilation/calculations by author based on Blöndal and Scarpetta (1999); European Commission (Social Protection Committee-SPC and Indicators Sub-group-ISG) reports; OECD Pension at Glance publications, Comparative Welfare Entitlements Dataset (CWED); and information on pension parameters from ISSA	
Pension variation	CV2	Coefficient of variation between RRs for 4 household levels: 67% and average, single and couple.	Blöndal and Scarpetta (1999) and European Commission	
IRR- internal rate of return	IRR1	Actual internal rate of return	Own calculation based on, effective contributions, RR, AMECO database for earnings growth, UN for life expectancy	For all indicators assumption is 2.5% wage growth in retirement. Variable used in analysis, unless otherwise stated is IRR 2.
	IRR2	Assumption of no wage growth during employment		
	IRR3	Actual wage growth during employment , assumption that first cohort started contributing in the 1950s		
	IRR4	Assumption of no wage growth during employment, assumption that first cohort started contributing in the 1950s		
Private pension assets	Assets	Total private pension assets	Own compilation/calculation based on Global Pension Statistics, extended with Institutional Investors data, cross validating the data for the years where both sources are available. For historical data additional sources – Davis (1993), country papers, and information on countries' pension systems	Details for data series construction explained in the section 2.1.6

Pension expenditure	Expend	Public Old-Age Pension Expenditure as share of GDP.	Own compilation based on OECD *Social Expenditure Database (SOCX)* stemming from 1980s, historical data from publication *Social Expenditures 1960–1990: Problems of Growth and Control*, OECD (1985) and cross validated by ILO 'Cost of Social Security'	Aggregate includes cash benefits for old-age pension, anticipated old-age pension, partial pension and early retirement for non-labour market reasons
Effective pension contribution	Contr	Effective contribution rate for old-age pension, calculated as the ratio of the ratio of old age pension expenditure and wage bill in the economy.	Own calculations based pension expenditures and *Compensation of employees: total economy* from National Accounts, drawn from an AMECO database	This is total effective contribution rate paid by both the employer and employee and expressed as a percentage of gross labour
Pension tax	PensionTax	Pension variation multiplied by the average effective contribution rate	Effective contribution rate and pension variation variables	
Couple/single ratio	CoupleSingle	Ratio of replacement rate for dependent couple and single average worker	Blöndal and Scarpetta (1999) and CWED	

IV PENSION SYSTEM DESIGN AND SAVING: EMPIRICAL EVIDENCE

1. INTRODUCTION

The theoretical model derived in Chapter II predicts higher household saving rates for retirement in countries with a lower contribution rate, higher intragenerational redistribution within the public system and a greater importance of private pension savings i.e. systems that could be classified as 'Beveridge'; and lower household saving for countries with a public system that 'mimics' a private system – meaning a higher contribution rate, earnings-related pensions and lower private pension assets, i.e. those that can be classified as 'Bismarck'.

The aim of this chapter is to test empirically the relationship between pension system design and household saving. The existing empirical literature primarily deals with the effect of the scale (generosity) of a public pension system on saving. Regarding the private pension component, there is a significant literature on the effects of voluntary (tax-favoured) private pensions on aggregate savings, usually single country evidence, while there are just a few cross-country studies on the effect of a funded pension component on saving. The stream of research that I seek to address in this paper, which is the effect of pension system *design* (both public and private) on saving, is actually quite limited. A key paper on public pension system design was that of Disney (2005) on which the analysis builds on.

I use longer dataset with pension design variables calculated in slightly different manner with more reliable data sources. In particular, the effective contribution rate is calculated using original pension expenditures series instead of estimated support ratios; cross-validation of few data sources was performed to construct replacement rate series, which in turn were used for IRR construction; information on the indexation formula in each country again needed for IRR construction was carefully collected from a number of sources, such as EC-ISG reports, OECD Pensions at a Glance publications and World Bank's Pensions Panorama. Finally, I have used improved household saving dataset.

The analysis is split into three parts. The first part is an examination of the effect of public pension design on household saving rates, where I attempt to replicate the analysis of Disney (2005). In the second part, I estimate the effect of the private pension component on saving, proxied by the stock of private pension assets as a share of GDP. In the third part I attempt to model the overall pension design, taking into account both public and private components, using the principal component composite index, which I dubbed the 'Bismarck index'.

The findings obtained using a number of estimation methods do not confirm the predictions of the theoretical analysis. Moreover, the findings are counter-intuitive and do not confirm the results obtained by Disney – the study I have attempted to replicate in one part of the analysis.

Empirical analysis of the effect of pension design on household saving is confronted by a number of limitations – methodological issues concerning the household saving measure, the complexity of household saving behaviour, a number of determinants exerting the opposite effect and the difficulty of finding proxies and data for them, the need to model saving inertia and endogeneity, etc. One may argue, as do Horioka and Yin (2010), that a number of determinants that have not been controlled for, or have not adequately been controlled – such as the wealth effect and borrowing constraints, are the governing determinants of household saving, thus blurring the other relationships.

2. EXISTING EMPIRICAL LITERATURE

2.1. SOCIAL SECURITY PROGRAMMES AND SAVING

2.1.1. Effect of the magnitude of PAYG system and saving

Surveys of the empirical literature on PAYG social security programmes on private saving can be found in Magnussen (1994), Mackenzie and Gerson (1997) and Kohl and O`Brien (1998). This literature can be classified into time series analysis, cross-country and cross section analysis. In general, findings suggest that reducing the generosity of the PAYG systems is likely to stimulate a small increase in private saving, but this effect depends on many factors – such as the demographic composition and the economic institutions of each country.

Time series literature

Time series empirical analyses of the social security effect on savings stem from the work of Feldstein (1974). This seminal paper followed the method of Cagan and Katona`s analysis of the effect of private pensions on private non-retirement saving. Cagan (1965) performed a cross-sectional analysis of saving on 15,000 members of the Consumers Union in 1958–59, and found that private pensions did not substitute for other forms of saving. He explains his finding by a term he dubbed the '*recognition effect*'. It means that forced retirement saving practically has an educational effect, and that an individual is stimulated to save even more once he realises that the goal of saving a sufficient amount for the adequate pension provision in old-age is 'within his grasp' (Murray, 1965: 58). Katona (1965) explained these findings with a 'goal gradient' hypothesis – 'effort is intensified the closer one is to one's goal' (Feldstein, 1974:907 as in Katona 1964, p. 4).

Feldstein (1974) instead explains the possible and unexpected positive effect of social security on private saving by '*induced retirement'*. Social security 'increases personal saving because it lengthens the period of retirement over which accumulated assets will be spread' (Feldstein, 1974:908). Nonetheless, he reminds us that social security could also act as a substitute for household saving; hence the overall effect is not clear and is an empirical matter. Therefore, he estimates the impact on consumption for the period 1929–1971, using annual time series US data for social security wealth. He found a positive statistically significant coefficient of social security wealth on consumption, and thereby calculates the effect on saving based on the estimated coefficients. He finds that social security depresses personal saving by 30-50 percent per dollar of benefit, depending on specification.

The Feldstein 1974 article is perhaps the most famous in the PAYG/saving literature, but also produced a good deal of controversy. Barro (1978) claimed that Feldstein's estimation was biased due to the omission of government saving as one of the determinants of the consumption function. He demonstrated that social security wealth was not statistically significant when government saving was included in the regression. Leimer and Lesnoy (1982) also challenged Feldstein`s findings. They argued that the social security wealth variable used by Feldstein was seriously flawed as a result of a computer-programming error, and that findings were highly sensitive to the assumptions he made to construct the social security wealth variable. Indeed, Leimer and Lesnoy replicated Feldstein`s original analysis and found no effect of social security on saving. However, in later work, Feldstein (1996) corrected the programming error and added about 20 observations to his original 1974 paper, and found a displacement of overall private savings by nearly 60 percent.

Schmidt-Hebbel (1998) investigates the effect of the 1981 pension reform, which reduced the generosity of the public programme in Chile, by decomposing data on national savings as a percent of GDP. He finds that pension reform contributed to the overall increase in national savings.

Cross section literature

There are a number of cross-section studies, most of them using USA micro data. Using 1962–63 data from the Survey of Consumer Finances, Feldstein and Pellechio (1979) found a negative relationship between Social Security wealth and household savings – the offset in private pensions ranging from 50% to more than 100%, depending on specification.

Exploiting a larger sample of more than 2,000 observations for male household heads aged 45–59 conducted by the Bureau of Census, Kotlikoff (1979) used a similar econometric specification to the one employed by Feldstein and Pellechio (1979). He included more controls in the regression, such as dummies for marriage, race, widowed, or divorced, etc. His results are in line with those obtained by Feldstein and Pellechio.

King and Dicks-Mireaux (1982) considered the relationship in a microeconomic dataset drawn from 1977 Canadian data, which covered 8279 households excluding those headed by single women and below a certain income level. They reported an offset of private saving with public pension of around 17%.

Gale (1995) estimated a sample of USA data from 1983 that covered households with full-time workers aged 40–64 and excluded farm and self-employed households. He found displacement of around 11%.

Cross country literature

Barro and MacDonald (1979) studied 16 industrialised countries for the 1951–60 period. They found a significant negative correlation between consumption and PAYG pension benefits, implying that public pension wealth actually stimulated savings. However, when they included individual country fixed effects in their model, the sign on pension wealth reversed. They concluded that the effect of pension wealth on savings differed between cross section and time series – countries with higher levels of pension wealth had higher savings, while increases in pension wealth over time lowered private savings.

Feldstein (1980) analysed a short panel of 12 OECD countries and found that social security significantly reduces private saving – an increase of the benefit-to-earnings ratio by 10 percentage points reduces the saving rate by approximately 3 percentage points.

There are a few papers stemming from the saving determinants literature that include some measure of social security, for example, the influential work by Edwards (1996) where he estimates from a panel of 32 countries to study the determinants of private savings. Among a number of variables, he includes a social security variable that is defined as the ratio of public expenditure on social security and welfare to total public expenditures. In all the regressions presented in his paper, the social security variable has a negative statistically significant coefficient on private savings.

Callen and Thimman (1997) use a panel of 21 OECD countries spanning from 1975 to 1995. Among the usual saving determinant variables, a special focus of the paper was given to public policy in the form of tax and social security variables. They found that higher government transfers were associated with lower saving.

Bloom *et al.* (2007) model saving behaviour with respect to demographic and pension policy. They utilise a panel of 60 countries for three data points: 1961, 1981 and 2002. Pension policy is proxied with four variables – the replacement rate for PAYG and for a mandatory funded system, retirement incentives and universal coverage. Regressions are estimated with OLS, fixed effect and a dynamic panel specification. The dependency ratio is negative and significant in all specifications. The coefficient on the RR from the PAYG programme is surprisingly positive and significant, whereas the RR from the funded system is negative and significant in some specifications (OLS and fixed effects).

Hurd *et al*. (2009) combine cross-country and within-country variation exploiting survey data for a few countries. They estimate the effect of pension system on financial wealth and suggest a displacement effect of roughly -25 to -45 cents of financial assets for every additional dollar of pension wealth. They conclude that the results confirm previous findings on saving displacement, but argue that displacement is lower than what the standard life cycle hypothesis would predict. Therefore, they suggest areas for further research on institutions such as labour market regulations and borrowing constraints, to 'enrich our understanding of the reasons behind the imperfect displacement effect' (p. 16).

2.1.2. Effect of public pension system design on saving

The debate on the social security programmes and its impact on household saving has focused on size of the PAYG system, but the design of the social security programme may also matter. Pension design was a subject of analytical interest to some extent, as in Feldstein (1987) and Lindbeck and Persson (2003).

Disney (2005; 2006a) introduced the analysis of the effect of design of social security programmes on saving into the empirical literature. He argues that the effects of social security programmes on household behaviour depend on programme design features, such as how closely a particular social security programme mimics a private retirement saving programme. He examines this for the panel of 21 OECD countries, for mid-points of three decades – the 1970s, 1980s and 1990s.

Two particularly important variables were used to capture design features of the public pension programme in his analysis. The first, termed the *pension tax*, is designed to measure deviation from 'intragenerational actuarial fairness', i.e. the Beveridge component of the public pension programme. This is a coefficient of variation of replacement rates across several household types in the same country and year, multiplied by the average effective contribution rate. The first step to construct this 'pension tax' variable was to derive average *effective contribution rate* constructed as the average replacement rate of pensions to earnings divided by the system support ratio. The second step was to calculate the *coefficient of variation* of replacement rates across different household types. For this calculation, he used data in Blöndal and Scarpetta (1998) – replacement rates for workers in their mid-50s, at different levels of lifetime earnings in a single/couple household, which was expected when they reach the statutory retirement age, usually 65. The third step was to multiply this coefficient of variation by the average effective contribution rate and get the variable 'pension tax'. In his analysis, the 'pension tax' variable is expected to lower the offset effect for a given average level of social security benefits, *ceteris paribus.*

The second variable, termed the *intergenerational rate of return (IRR at 65),* is designed to capture deviations from 'intergenerational actuarial fairness' defined as the rate of return on a funded scheme, which is in turn assumed to be equal in all countries. This variable (IRR at 65) is a proxy for the Lindbeck and Persson (2003) variable G, which is a rate of return at which the present value of the stream of contributions paid is equal to the present value of the stream of pension benefits. When IRR is lower than the rate of return on private funded schemes, there is a departure from intergenerational actuarial fairness. Fenge and Werding (2003 and 2004) call this difference the 'implicit tax' arising from PAYG financing. Again, the effective contribution rate was exploited and Blöndal and Scarpetta (1998) expected replacement rates were used to calculate expected pension benefits. A higher 'IRR' is expected to *raise* the offset effect, *ceteris paribus.*

The empirical model is estimated by generalised least squares, weighted by civilian employment. Estimation shows a positive impact of 'pension tax' on household saving and a negative effect from the IRR, suggesting that public pension programmes which more closely imitate private programmes are associated with a lower household saving rate. This finding implies that the question of the effect of pension system design on saving is closely related to tax incentives. Since the whole idea behind the analysis is the individual perception of contributions – tax or contributions – when contributions are perceived as merely a 'tax', they do not act as a disincentive for saving, while when perceived as a pension 'contribution' with a rate of return as in private investments, this will offset any additional private saving.

2.2. PRIVATE PENSIONS AND SAVING

When it comes to the analysis of private pension programmes on savings, the literature is mainly focused on the effects of voluntary (tax-favoured) private pensions on savings. The literature mostly utilises cross-section and time series analyses within a single country, rather than cross-country analyses.

Kohl and O`Brien (1998) provide a survey of the effects of tax-favoured saving accounts (henceforth TFSA) on private savings, concluding that TFSA increased net private saving by 20 to 25 percent of total amount placed in a TFSA, but as they generate tax expenditures, national saving is almost unchanged. Engen et al. (1994, 1996) and Poterba et al. (1995, 1996) debate whether US retirement saving schemes (IRA and 401k) increased the private saving rate, and argue that the bulk of IRA and 401(k) contributions are net additions to saving. However, Davis and Hu (2005) in their review of the literature concluded that empirical work finds positive but limited influence of pension funds on saving.

A paper by Samwick (2000) tried to estimate whether a transition to a funded public pension programme results in higher savings. The sample comprises 150 countries and spans the years 1960 to 1995. He first estimates panel fixed effects regressions on typical saving determinants, and then uses residuals for each country in which a pension reform was implemented and performs a time series analysis. The residuals were regressed on dummy variables for the year of the reform. None of the countries other than Chile experienced a significant increase in the trend in the savings residual after the reform.

Buffa and Monticone (2006) used a similar approach in the analysis of pension reforms in EU countries. In the first stage of investigation, they estimated a typical saving regression using fixed effects estimators. In the second stage, they studied the behaviour of saving residuals over time for countries that implemented reform in the 1990s. They found no evidence regarding a change in neither private nor national saving with respect to pension reform.

When it comes to the line of research analysing *cross-country evidence* of the effects of private pensions on saving, there are three main papers: Baillu and Reisen (1997), Murphy and Musalem (2004) and Bebczuk and Musalem (2006). All three studies rely on the OECD as a source for pension funds assets – the Institutional Investors Statistical Yearbook.

The most cited paper in this line of research, probably since it is the oldest one, is the study by *Baillu and Reisen* (1997). They estimated the effect of funded pension wealth (using 8 different proxies – such as variations of assets managed by pension funds and life insurance companies) on private saving rates, controlling for other determinants as in Edwards (1996). They used an unbalanced panel of 11 countries, of which 7 are OECD, in the period 1982–1993. The impact of pension wealth on saving is allowed to differ for OECD and non-OECD countries by interacting the pension wealth variable with two different dummies. The methodology used is a fixed effects estimator and 2SLS to address two-way causality between the growth rate and savings. They find that the demographically adjusted stock of pension assets increases private saving rates, but the results were not significant when other variables are used (the net flow of assets and the GDP-adjusted stock). They interpret their results as showing that the increase in pension assets relative to the working-age population — but not relative to GDP — exerts a positive and statistically significant impact on aggregate savings rates. Furthermore, they find that the impact of private pension wealth on saving is more pronounced in developing countries than in OECD, which is intuitive due to tighter borrowing constraints and the mandatory rather than voluntary status of funded pension schemes. They perform the same regression on national saving data and do not find any significant results.

The study by *Murphy and Musalem (2004)* appears to be the first large cross-country empirical study on the effects of private pensions on national saving. They chose national instead of private saving, and defend this choice with the aim to avoid data measurement problems. The main determinant of interest is what they termed the *pension saving rate* – the ratio between pension saving and gross national disposable income. Pension saving is defined as a flow – the change in the value of *financial assets of autonomous pension funds*. They used an unbalanced sample of countries and a long time span – a data set which comprises 43 countries and spans from 1960 to 2002, although the span depends on the country since this panel is heavily unbalanced[38]. Countries are divided into two groups – the first comprises the countries in which the data on pension assets are predominantly (more than 50 percent) the result of mandatory funded pension programmes; and second the group of countries in which data on pension assets are predominantly the result of voluntary funded pension programmes. They control for other national saving determinants used in the saving literature (such as GDP level and growth, demographics, inflation etc.), and look at the difference between mandatory and voluntary systems utilising interaction terms[39]. They apply OLS estimators on pooled data and find one-for-one increases in national saving for the increase in mandatory pension savings i.e. 'not much substitution between mandatory pension saving and ordinary saving' (page 32). Conversely, they find a decrease in national saving for the increase in voluntary funded pension saving, and interpret this result by a fall in government saving due to the fiscal incentives typically related to voluntary pension savings. To control for country specific effects they use the two-way fixed effects model and, to control for endogeneity, GMM (Arellano-Bond) estimators. The results for mandatory pension saving regression are robust and suggest more than 50 percent of increase in saving due to the mandatory pension savings in the long run, while voluntary funded pension saving turns out not to be significant.

The more recent cross-country study is conducted by *Bebczuk and Musalem* (2006). This paper builds on the work and the database assembled by Murphy and Lopez (2004), and is

[38] The paper quotes 1960 as the first year for the data span, however, in the annex available upon request the earliest data point is 1980 for some of the OECD countries.

[39] They also ran simple regressions separately for mandatory and voluntary systems.

extended for two more years and five more countries – creating an unbalanced sample of 48 developed and developing countries, over the 1980–2004 time span. As in Murphy and Musalem (2004), the main variable of interest is a *pension saving variable* – defined as the annual change in the value of the stock of pension funds. Their main finding is that a one-dollar increase in pension saving increases national saving by between 0 and 20 cents. In the baseline regression, controlling for standard saving determinants, results suggest that a one dollar increase in pension saving translates into *10 cents of additional national* saving. Contrary to Murphy and Musalem, the findings suggest that there is no stronger effect in systems with mandatory participation. When entered separately in the regression, the age of the funded pension system variable (proxied by the number of years for which information on the stock of pension funds is available) is not only significant, but has a coefficient of 0.5. Hence, authors argue that 'each additional year adds 0.5 percentage points to the national saving rate, everything else equal'.

They also partitioned the sample into OECD and non-OECD countries. At first glance, it appears that the significance of pension saving is driven by non-OECD countries, which can be explained by the existence of borrowing constraints. However, on closer examination – excluding observations prior to 1990 – the pension saving coefficient is no longer significant. This suggests 'that there might be influential observations in the pre-1990 period' (p. 17).

The econometric methodology applied in the Babczuk and Musalem (2006) paper is to use fixed and random effects. They rightly point to the problem of endogeneity of some regressors in the savings equation, and to the bias to which this leads. Therefore, they also model the relationship dynamically, introducing lags for possible endogenous variables (such as per capita GDP growth, inflation rate, credit to private sector etc.) and for the dependent variable to capture 'inertial behaviour'. However, though they clearly state that the inclusion of the lagged dependent variable and country fixed effects renders biased and inconsistent coefficients, they nonetheless apply fixed and random effects econometric techniques to their dynamic model specification. This is done under the explanation that GMM, although a 'rather popular and sophisticated technique quite often generates weak instruments, which in the end means that the endogeneity issue is far from being solved.' (page 19.)

Succinctly, although in general there is a large body of literature when it comes to the empirical analysis of pension systems and saving, the stream of research that addresses cross-country evidence is actually quite limited, especially when it comes to the analysis of both public and private component of pension system design. In what follows is the attempt to fill in this gap in the existing literature.

3. THEORETICAL FRAMEWORK

The aim of this chapter is to examine empirically the effect of pension programme design on saving – both public pension design, as well as the extent to which contributions to private funded schemes (both mandatory and voluntary) have been offset by households reducing the other forms of saving.

I utilise the model derived in *Chapter II:*

$$\frac{s_1^Y}{W_1^Y} = \frac{1}{2+\rho}\{1 + \frac{A_0}{W_1^Y} - [1 + \alpha\,\frac{(1+\rho)(1+\bar{G})}{1+r} + (1-\alpha)\frac{(1+\rho)(1+G)}{1+r}]t + (2+\rho)(1-d)f\}$$

(IV-1)

where s_1^Y is saving by the 'young' generation in period 1

W_1^Y is the income of the 'young' generation in period 1

$\frac{s_1^Y}{W_1^Y}$ is the the saving rate of the 'young' generation in period 1

$\rho \geq 0$ captures time preference;

r is the market interest rate;

α is the 'Bismarckian factor' – the weight on the earnings related component of the system, while $(1-\propto)$ is the weight on the Beveridge (flat-rate pension) component;

$\bar{G}$ is the internal rate of return on public pension contributions in the Bismarkian component, where the rate of return is the same for every income earner level;

G is the internal rate of return on public contributions in the Beveridgean systems, where rates of return tend to vary for different earning levels,

f is the contribution into the funded system,

$0 \leq d \leq 1$ is the private funded pensions displacement coefficient,

and t is the contribution rate to the PAYG system.

This model suggests that the private saving rate is unambiguously negatively affected by the size of the PAYG public pension system – the higher the payroll tax for financing it, the lower the savings.

In addition, the private saving rate is affected by pension system design. The higher the internal rate of return in the social security system ($\bar{G}$), there is an offset in household saving ($\frac{\partial(s_1^Y/W_1^Y)}{\partial\bar{G}}$ <0). Conversely, the more redistributive the system is, i.e. closer to the Beveridge model of pension provision, the higher are the overall incentives to save. In particular, for low income earners the internal rate of return in the Beveridge system is higher than the market interest rate, meaning a disincentive to save. However, as for the average and high-income earners the internal rate of return in redistributive systems is low, for them there is an incentive to save. Since higher income earners are generally higher savers, and usually most of the private saving is done by them (Blinder, 1975; Diamond and Hausman 1984; Bernheim and Scholz 1993; Hubbard et al. 1995; Dynan et al. 2004, Disney, 2006a), one should expect an overall positive effect.

A mandatory funded pension programme should have a positive effect on overall household saving. How much exactly the maginitude of this effect is, depends on the displacement coefficient. With the hypothetical assumption of perfect capital markets (no borrowing constraint), the overall household saving would not increase with the introduction of a funded pension system, only a change in the *form* of saving would happen. Moreover, the displacement coefficient is theoretically possible to take a value greater than 1, meaning that households run into higher debt than they would otherwise. Displacement, however, is not expected to be one-for-one due to borrowing constraints, induced retirement and/or the recognition effect.

Linearising the theoretical model in equation IV-1, gives the following panel data empirical specification (dubbed *Variant 1* in the results section):

$$s_{it} = \sum \beta_{0i}\delta_{it} - \beta_1 IRR_{it} + \beta_2 PV_{it} - \beta_3 t_{it} + \beta_4 f_{it} + \beta_5 i_{it} + \beta_6 x_{it} + \varepsilon_{it}$$

(IV-2)

Where s_{it} represents $\frac{s_1^Y}{W_1^Y}$ – the household saving rate;

δ_{it} is a vector of country specific characteristics captured with country dummy variables

IRR_{it} stands for the i*nternal rate of return* of the PAYG system $(1+\bar{G})$;

PV_{it} is the *pension variation variable* and stands for $(1-\alpha)$, which is proxied by the *coefficient of variation* of replacement rates for different types of earners;

t_{it} stands for pension contributions;

f_{it} for contributions into the funded system and is proxied by the stock of private pension assets;

i_{it} stands for the interest rate;

x_{it} is a set of control variables usually used in the literature on saving determinants, such as GDP growth, old-age dependency, proxy for financial liquidity, government consumption

Coefficient on G is β_1 and captures also $\frac{1+\rho}{1+r}$ as well as alpha

Coefficient on proxy for $1-\alpha$ is $\beta_2 = \frac{(1+\rho)(1+G)}{(1+r)}$

Coefficient of funded component f is β_3 and captures $(1+\rho)(1-d)$

I also estimate a similar equation based on Disney (2005), *Variant 2:*

$$s_{it} = \sum \beta_{0i}\delta_{it} + -\beta_1 IRR_{it} + \beta_2 PT_{it} + \beta_3 f_{it} + \beta_4 i_{it} + \beta_5 x_{it} + \varepsilon_{it}$$

(IV-3)

In the ‘variant 2’, intragenerational redistribution is captured with the ‘pension tax’ variable, calculated as the product of pension variation and the effective contribution rate. In this variant, contributions do not enter the equation separately.

Hence, the difference between two variants is in the form that pension design variables enter the equation. In the ‘variant 1’, which is directly derived from the theoretical model presented in Chapter III, ‘pension variation’ variable is used as a measure of intragenerational redistribution, and effective contribution rate as a measure of burden by PAYG system enter the equation separately. In the ‘variant 2’, both intragenerational redistribution and contribution rate level is captured by one variable, the ‘pension tax’.

I use both versions to explore the robustness of the findings. The advantage of the ‘variant 1’ is being directly derived from theoretical model, while the ‘variant 2’ is preferred due to fewer number of pension design variables i.e. the less chances for multicollinearity, and since it allows to replicate Disney (2005) more accurately.

4. EMPIRICAL CONSIDERATIONS: DATA AND ESTIMATION ISSUES

The empirical analysis of saving is challenging due to the problems of saving data availability and quality. Additionally, saving modelling is hampered by endogeneity problems, saving inertia, and the complexity of saving behaviour.

4.1. MULTIPLE SAVING DETERMINANTS, SAVING INERTIA, ENDOGENEITY

The theory suggests a number of motives for household saving: the *life-cycle motive*, hence the need to save for retirement; the *precautionary motive* in response to uncertainty regarding future income and the *bequest motive.* Browning and Lusardi (1995) also describe other motives, such as the intertemporal substitution motive – to enjoy interest and appreciation; the improvement motive – to enjoy a gradual increase in spending; the independence motive, the enterprise motive; the avarice motive, being an irrational motive; and they add one more – the down-payment motive, to accumulate deposits to buy houses and durable goods.

The importance of all these motives varies across individuals/households depending on their consumption habits, time preferences, risk aversion, etc. Therefore, there are a great number of variables that can impact an saving behaviour at the national level, such as the age structure of household members, type of households (married/single/children/lone parents), life expectancy, household`s wealth, time preferences, consumption habits, risk aversion etc. In addition, there may be cross-country variation in time preference and risk-aversion, as well as in bequest motive. Furthermore, a number of public policies and institutions affect saving behavior – the development of financial markets, pension and tax policy, the health and education system etc.

Besides, the effect of some variables on saving is ambiguous from the theoretical viewpoint. For instance, income growth should raise savings; however, if this encourages individuals to anticipate higher future income, they will consume more today thus lowering the saving rate (Hufner and Koske, 2010). The effect of financial development and liberalisation on private saving is theoretically ambiguous, 'not only because the link between interest rate levels and saving is itself ambiguous, but also because some dimensions of it, such as increased household access to consumer credit or housing finance, might also work to reduce private savings rather than increasing it' (Bandiera *et al.* 2000: 1). Developed capital markets should provide greater saving opportunities, hence, stimulate household savings, but at the same time complexities of financial products may lead to financial illiteracy, which hampers savings (Lusardi, 2008; Lusardi and Mitchell, 2011). Furthermore, some parameters within the same policy field may have divergent effects. For example, in generous pension systems replacement rates should have an adverse effect on saving, while early retirement may have a positive effect due to the induced retirement effect.

Despite considerable empirical analysis, which is vast and diverse in terms of micro and macro investigation, different dependent variables used, various explanatory variables, different samples used and the estimation techniques employed[40], saving, and in particular household saving is still little understood (Börsch-Supan and Lusardi, 2002). Economists have been puzzled with high household savings in Germany and Italy, despite substantial public sector retirement and health benefits, and traditionally low and declining old saving rates in the US.

Detailed country case studies shed more light on the complexity of saving. Poterba (1994) based on the study of six countries, points to the multifaceted relationship between individual saving and social security. He suggests, 'the bequest motive or similar factors may be a key explanation for some components of saving behaviour' (Ibid: 9). Similarly, a cross-country study on 6 countries[41] conducted by Börsch-Supan and Lusardi (2002), shows how the relationship between a social security system and saving can be misinterpreted if it does not control for down-payment ratios.

Consequently, modelling saving behaviour is quite complex as there are many potentially important determinants of savings, for some of which it is often difficult to find proxies and available data, especially for the '70s and '80s and for the larger set of countries. Börsch-Supan and Lusardi (2002) argue that understanding saving behaviour cannot be achieved within single country studies – neither by time series variation in aggregate data, nor with cross sectional data from a single country. They advocate using panel data sets that

[40] Loyaza et al. (2000) and more recently Hufner and Koske (2010) provide literature survey on cross country macroeconomic determinants of saving. For example, Callen and Thiman (1997) study the household saving behaviour among 21 OECD countries over the period 1975-95; Masson *et al*. (1998) examine the determinants of the private saving rate in a sample of 21 OECD countries over 1971-93.

[41] Five of which are the same as in Poterba.

combine the cross-sectional variation within a country with the time-series variation of that country. However, as they point out, these data sets are usually short and therefore rarely include sufficient policy changes and 'historical experiments.' 'This particularly applies to one potentially very important determinant of saving, namely public pension policy' (p. 2.).

Concisely, *finding an appropriate set of data* to analyse saving behaviour, which would allow for capturing both institutional and policy variations, as well as individual/country heterogeneity, is quite a challenge. In addition, *multicollinearity issues* will usually plague saving models with a great number of explanatory variables, which are needed to understand saving behaviour.

Furthermore, most empirical studies on the determinants of saving recognise the need to model *saving inertia* with lagged saving variable. Extensions of the life cycle hypothesis, especially habit formation models, suggest *persistence in consumer behaviour,* which in turn leads to saving inertia. However, modelling saving rates with lagged saving as an explanatory variable, which is a solution to the saving inertia issue, induces *serial correlation* in the model that needs to be addressed.

Additionally, there is an *endogeneity (two-way causality)* problem whereby GDP growth is introduced as an explanatory variable to saving. First, growth will tend to affect the saving rate through income increase. On the other hand, saving will tend to impact on growth via the capital accumulation effect. Also, there might be a reverse causality between the value of *private pension assets* and the saving rate, via the income growth channel. An increase in private pension assets may exert an impact on household saving, which in turn will lead to income growth, and this will provide more room for private pension saving. Whether this will indeed further increase saving is an empirical question.

4.2. SAVING DATA DEFINITIONS AND METHODOLOGICAL ISSUES

Saving is defined as the difference between disposable income and final consumption expenditure. It therefore reflects *the residual income* used to acquire financial and non-financial assets (OECD, 2011).

Since the system of national accounts (SNA) recommends breaking the economy down into at least five sectors, aggregate saving can be calculated for each *institutional sector* and for the *whole economy*[42]. Accordingly, there are aggregates like household saving, corporate saving, personal saving, private saving, government saving, domestic and national saving.

Household saving is unconsumed household income, defined as household disposable income less current consumption. *Personal saving* is saving by households and non-profit institutions serving households (NPISH)[43]. As not all countries distinguish NPISH as a separate sector, personal saving is used interchangeably with household saving.

[42] SNA divides the economy into the corporate sector (nonfinancial and financial corporate sector), general government, and non-profit institutions serving households (NPISHs), and the household sector.

[43] This sector includes bodies such as charities, trade unions and churches (Verrinder, 2002).

Corporations by definition do not have final consumption, hence *corporate saving* equals their disposable income (OECD, 2011). *Private saving* equals personal saving plus corporate saving.

For the economy as a whole, there are two common aggregates – domestic saving and national saving. They differ concerning the measure used for disposable income – gross domestic product (GDP) or gross disposable income (GDI)[44].

Domestic saving equals GDP as a measure of disposable income minus total final consumption. *National saving is gr*oss national disposable income minus total final consumption[45]. Final consumption in either case includes goods and services that are used by households or the community to satisfy their individual wants and social needs, and thus includes final consumption expenditure of households, general government and NPISH [46].

Each aggregate is typically calculated as a ***ratio*** – a share of income that is not consumed. Each saving rate can be calculated either *gross* or *net* of consumption of fixed capital. The net measure reduces saving by the amount required to replace consumption of fixed capital.

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[44] SNA93/ESA95 use GDI. Gross Domestic Product + net primary income from the rest of the world (compensation of employees and property income) = **Gross national income (GNI).** This aggregate is similar to the gross national product (GNP), except that in measuring GNP one does not deduct the indirect business taxes. **Gross national disposable income (GNDI)** = GNI + net current transfers from the rest of the world (such as remittances).

[45] National savings equals personal saving (household and HPISH) plus corporate (enterprise) saving, plus general government saving.

[46] As already mentioned, corporations by definition do not have final consumption.

Saving data generally suffer from low quality. Since it is defined as a residual between income and consumption, saving will be affected by errors in the measurement of either receipts or disbursements. Relatively minor errors in either income or consumption can result in large errors in residually measured saving (Blades, 1982 as in Elmeskov et al, 1991). Household saving rates suffer from some additional measurement problems, which will be discussed below.

Household saving is disposable income less current consumption. Household disposable income consists essentially of income from employment and from the operation of unincorporated enterprises, plus receipts of interest, dividends and social benefits minus payments of current taxes, interest and social contributions (OECD, 2011b).

On the consumption side, both *durable and non-durable goods* are part of final consumption, while the purchases for own-construction or improvements of residential housing are treated as part of gross capital formation. Many authors argued that treating durable goods as consumption is inconsistent, as durables create a stream of services over time in a similar way to housing, thereby underestimating the household saving rate. Perozek and Reinsdorf (2002) compared the US published household saving rate data with the adjusted measure for consumer durables, and found that the adjustment raises personal saving between 1 percent and 3.1 percent of disposable income, but does not significantly alter the trend of decline in the saving rate in the late 1990s. However, in the follow-up study, Reinsdorf (2007) suggests that in the most recent decade the inclusion of consumer durable goods slightly slows the decline in the US saving rate. Blades and Sturm (1982 :18) show that the exclusion of consumer durable goods from household consumption expenditure had a significant impact on saving ratios during the 70s – around 3 percentage points of disposable income in Japan and up to 10 in Canada. Jalava and Kavonius (2007) show that, due to the exclusion of durable goods from consumption, saving ratios in the euro area were on average one to two percentage points underestimated in 1999–2003, while this effect varies significantly between member states. Consequently, it seems that such adjustments tend to reduce between-country differences significantly.

A further difficulty with household saving is that not all countries distinguish *non-profit institutions serving households (NPISH)* as a separate institutional sector. To overcome this problem it is necessary to combine NPISH with the household sector for all countries included in any comparative study. In 2003, there were five countries that did not include NPISH – the Czech Republic, Finland, France, Japan and New Zealand. So far, only New Zealand followed the instructions of the OECD National Account Expert group and included NPISH in the household saving aggregate. However, the magnitude of the NPISH sector is usually negligible, thus this methodological issue should not cause much of the problem[47].

More importantly, the household sector includes *unincorporated enterprises* that are small businesses and some partnerships. The scale and activity of these institutions vary significantly across countries, being relatively high in Mediterranean and rather low in

[47] Catte and Boissinot (2005) show that the effect of excluding NPISH for France and Japan is minuscule (the adjustment changes their saving rate by only 0.1 pp over the period 1996-2003) (cited in Hufner and Koske, 2010).

Scandinavian countries. Given that companies, by definition have no final consumption expenditure, their total income counts as saving. This may be the reason why countries with a high proportion of unincorporated enterprises, like Italy, Spain and Greece, will show correspondingly higher household saving rates (Verrinder, 2002).

A very important issue regarding the measurement of household savings is ***the treatment of pensions***. Originally, only unfunded pension schemes were registered in household accounts, while flows toward funded pension schemes were treated just as financing transactions and recorded in the financial accounts. To achieve greater correspondence with household income measures derived from household surveys, SNA 93/ESA95 recommended including funded pension schemes in the secondary distribution of income account (Harvey, 2004). This means parallel accounting of funded pension contributions and benefits as if they were unfunded plans – contributions paid into the schemes are recorded as an expense for households (therefore reducing saving), and pensions paid by the schemes as a receipt for households (thereby increasing disposable income rather than dis-saving). However, as this creates a mis-measurement that would have resulted in saving via pension funds being excluded from the measure for household saving, the SNA93/ESA95 also introduced a *correction factor* into household saving for funded schemes – *adjustment for the change in net equity of households in pension funds*[48]. Household saving ratios are derived by adding this adjustment both to the household saving and to the household disposable income.

[48] Code D8 in national accounts.

This adjustment factor may affect international comparability of household saving data if not applied consistently. For example, if one analyses adjustment factor data available from national account statistics, it is surprising to see zero values for Denmark and very low values for the UK. It is also interesting to note that 'the US, Canada and Australia – three major countries with pension funds – do not record this item because they do not use the parallel accounting that generates it' (Lequiller and Blades, 2006:174).

Furthermore, some authors argue that treatment of DB and DC funded pension should not be the same. In case of DB pensions, the firm's contribution to its pension plan does not have to equal the increase in the actuarial value of the firm's expected pension liability. Similar to the situation of household's saving being affected with capital gains, a firm that has large gains on its investments may not need to make pension contributions to meet its pension obligations. As a result, in periods of large capital gains, such as the 1990s, the pension component of personal saving may fall even if the actuarial value of promised pension benefits rises[49]. The new SNA/2008[50] provides some recommendations addressing these issues (Lequiller and Blades, 2006).

Besides, Elmeskov *et al.* (1991) argues that 'sectoral measures of saving are distorted in periods with ***<u>inflation</u>***'. Since the household sector is a net holder of corporate debt, with inflation the household sector incurs capital losses on these holdings. Correspondingly, the corporate sector incurs capital gains. Therefore, the income and saving of the household

[49] Private saving is unaffected by such changes in pension plan contributions because it combines personal and business saving (Reinsdorf, 2002; Perosek and Reinsdorf, 2007).

[50] Edited in 2008 but scheduled to be implemented in 2012.

sector is overstated during periods of inflation, while that of the corporate sector is understated by the equal amount. In particular, 'because the personal sector tends to be a net lender to other sectors, a decline in personal saving will be observed as inflationary pressures wane' (Perozek and Reinsdorf, 2002: 19). On the aggregate level these effects offset, hence the national saving rate is a more reliable measure.

Finally, one of the most important sources of non-comparability relates to the *gross vs. net method of calculation* of the household saving ratio (Lequiller and Blades, 2006). It is conceptually preferable to use net household saving ratios because the cost of using up capital assets in the process of production should be deducted from both income and saving (Harvey, 2004). However, there are reasons for preferring a gross ratio. First, it corresponds more closely to the observed financial flows, whereas the net ratio is artificial in that it incorporates an imputed flow, i.e. the consumption of fixed capital (Lequiller and Blades, 2006). Second, it may be preferable to use gross measure in international comparisons since there is probably a certain lack of harmonisation between countries` measurement of consumption of fixed capital (Eurostat, 2002).

Nonetheless, the OECD publishes net ratios, while few countries chose to report only gross ratios. In particular, until 2003, seven countries (Belgium, Denmark, Italy, Portugal, Spain, Switzerland and the United Kingdom) recorded household saving ratios in their national account on the gross basis. There are still four countries that report household saving ratios on the gross basis – France, Portugal, Spain and the UK. Lequiller and Blades (2006: 79) illustrate, using the UK example, the magnitude of improperness of the comparison that can be made. For the period 2000–2003, the gross household saving ratio for the UK reported in OECD publications/database ranged from 5–6.5 percent of household disposable income, while the net household ratio, calculated by Lequiller and Blades, ranged from 0.5–2 percent. They conclude that 'saving behaviour in the United Kingdom turns out to be comparable to that of the United States, and not, as Table 3 incorrectly indicated[51], somewhere between that of the United States and Germany' (p. 79). Therefore, one should be careful when using household saving rate data not to combine net and gross values.

As regards the interpretation of household saving data, there is also an issue of ***household consumption of public services***. The extent to which an individual pays for services such as education and health, varies considerably between countries. Household saving will not be directly affected by these differences, although household saving ratios will. Namely, if the government provides these services for 'free' – meaning they are financed by income taxes from households – income of household as well as consumption will be lower in comparison to the country where households pay for these services explicitly. However, in the first case – the one where the government provides services – the household saving ratio will be higher because the denominator (disposable income) of the ratio will be lower by the amount of additional income tax that is required to finance the free education and health services. One of the innovations of the SNA 93 was the disaggregation of government final consumption expenditure into individual (*e.g.* education and health) and collective (*e.g.* defence) expenditure. This enables an alternative household saving ratio to be calculated

[51] Table 3 shows household saving ratios as published in the OECD Economic Outlook as well as in the on-line database.

using adjusted disposable income (the sum of household disposable income and government individual consumption) rather than disposable income in the denominator (Harvey, 2004).

Another significant difficulty in interpreting household saving ratios is the fact that *capital gains and losses are excluded from the definition of income in SNA93.* The value of household assets – housing, monetary and financial investments – varies over time. As long as these assets have not been sold, these 'holding gains' are only potential – hence the term 'unrealised capital gains (or losses)' is applied to them. The day a household actually makes a capital gain by selling an asset, it is said to be 'realised'. As regards investment income, only interest and dividends are included in household income[52]. However, capital gains taxes are deducted from disposable income (Audenis *et al*, 2002:13).

The treatment of capital gains/losses in such a way raised two issues. First, *capital gains/losses affect saving, and there is a need to capture this effect.* Rather than adjusting the household saving ratio for capital gains/losses directly, it is recommended that capital gains/losses be used as an additional explanatory variable when analysing household consumption behaviour (Harvey, 2003). Indeed, several studies have related the declines in private saving rates in the late 1990s to the substantial rise in financial and housing wealth, in particular in the United States, and in general in countries where financial wealth data are available. Evidence from both household surveys and empirical analysis has shown that the sensitivity of saving to wealth can vary quite substantially depending on the source of

[52] Unlike interest and dividends, these unrealised or realised capital gains are not derived from production. They are not therefore included in household income.

capital gains – housing *vs*. stock market – and whether such gains are realised or not (De Serres and Pelgrin, 2003). This means that controlling for the wealth effect is even more difficult.

Secondly, a country in which households make large capital gains could see its *saving rate fall simply due to methodological reasons* i.e. by virtue of the taxes levied on those gains, while realised capital gains are not included in personal income. 'Given the divergence between the economic definitions of the two main variables entering the calculation of saving – income and consumption – and their respective treatment in the National Accounts, it may well be that the negative correlation between household saving and financial wealth is partly spurious' (De Serres and Pelgrin, 2003:121).

There has been a constant improvement in household saving data over the last couple of years. The *OECD National Account Expert Group* pursues the improvement of household saving data, and the 'data series are permanently revised in light of the latest available information'. That is the reason why data series from older OECD Economic Outlooks differ from data from latest issues – 'due to the regular revision of historical data'[53].

Nonetheless, household saving rates are still plagued with problems, hence many authors suggest using whole economy aggregates. For example, Perozek and Reinsdorft, (2002: 16) argue 'the boundary lines between sectors, particularly those between the business and personal sectors, are somewhat difficult to draw because of the complicated set of

[53] This is confirmed by the OECD/ECO/MASD ADB Team. Quotes are from an email correspondence dated 19th-21st of January , 2010, available on request.

interactions among participants both within and across sector lines. Though sector definitions do not alter national saving, they can affect the allocation of saving across sectors'.

5. EVIDENCE FROM 21-OECD COUNTRIES, MID-1970S TO MID-2000S

5.1. DATA AND DESCRIPTIVE ANALYSIS

To investigate the empirical relationship between the saving rate and pension system design, an empirical analysis was conducted for 21 OECD countries in four periods – from the mid-1970s until 2000s, for which consistent data are available.

The panel is unbalanced due to the availability of household saving data. Sources and details on saving data are presented in the next section and in the Appendix to this Chapter. The construction of pension design variables – IRR, pension variation, pension tax, the effective contribution rate and private pension assets, is described in Chapter III. In addition, variable descriptions and sources are also presented in an Appendix to this Chapter.

Data for variables that do not fluctuate over short periods of time are mid-decade points (1975, 1985, 1995 and 2005). For other variables, such as the household saving rate and private pension assets, which do fluctuate, 5-year averages around mid-decade point are employed[54]. Averages are used to reduce the effects of fluctuations, while the need to model saving inertia could thereby be overcome to some extent as well.

5.1.1. Saving Data and Trends

Aggregate saving ratios are generally drawn from national accounts[55]. Cross-country saving ratios are obtainable from several sources, such as EUROSTAT, AMECO database (The Annual Macro-Economic Database of the European Commission's Directorate General for Economic and Financial Affairs), OECD statistics, World Bank`s WDI (World Development Indicators).

Gross national and household saving ratios are available from EUROSTAT, though only from 1995 and for EU countries. The AMECO database contains net and gross household data series since the 1970s. The OECD compiles data on net household saving and net national saving from the 1960s onwards. The World Bank (WDI – World Development Indicators) contains data series on gross domestic savings and gross national saving.

For the net household saving ratio, I use data from the OECD statistics (Economic Outlook database). For the countries that do not report the net saving rate in OECD statistics –

[54] For example, instead of 1975 data point, the average 1973–1977 is used.

[55] Countries use many sources to compile their national accounts, among them administrative data from the government, censuses, business surveys and household surveys. Sources vary from country to country and may cover a large set of economic, social, financial and environmental items, which need not always be strictly related to national accounts. In any case, there is no single survey source for national accounts (EUROSTAT Metadata).

France, Portugal, Spain and the UK, I use the AMECO database[56]. The gross household saving rate is also drawn from AMECO; gross domestic and gross national series are taken from WDI, while net national saving from OECD statistics. Household saving data for the 1970s were missing for a few countries – Denmark, Greece, New Zealand, Norway, Portugal, Spain, Switzerland and the UK. Household saving data for Ireland are available only from 2002. Saving data for Luxembourg – both household and national, are not available in OECD statistics, and this country is therefore excluded from the analysis.

Table IV-1 shows the correlation between several saving measures – the household saving rate (gross and net), domestic and national saving ratios. It turns out that the measure of household saving is only weakly correlated with total economy saving ratios, such as national and domestic saving.

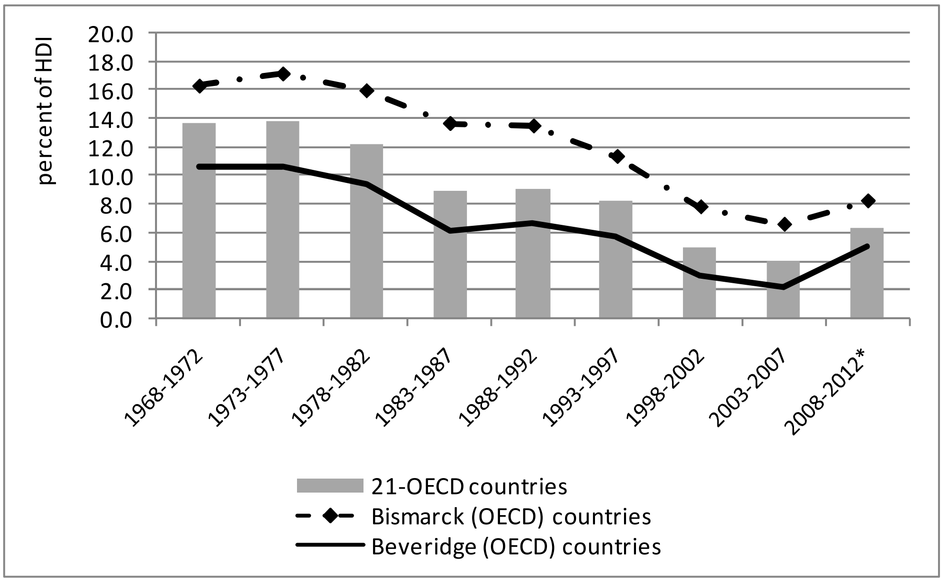
Table IV-1 Correlations between various saving ratios

	Gross Domestic Saving	Gross National Saving	Net National Saving	Gross Household	Net Household Saving
Gross Domestic Saving	1.000				
Gross National Saving	0.916	1.000			
Net National Saving	0.803	0.889	1.000		
Gross Household Saving	0.121	0.294	0.306	1.000	
Net Houshold Saving	0.052	0.229	0.332	0.957	1.000

[56] Data in OECD and AMECO databases are almost the same, except that AMECO covers a shorter time span and does not have data for some countries outside the EU (Australia, Canada). On the other side, for some countries that did not report the net saving rate to the OECD (France, Portugal, Spain and the UK), the net household saving rate is available at AMECO. Data for Luxembourg are not available from neither the AMECO nor OECD, hence this country is excluded from the empirical analysis.

Data on household savings rates in the OECD member countries show an overall downward trend of household saving in the last decades. Rather counter-intuitively, 'Bismarck countries' have had higher household savings than 'Beveridge countries'[57]. Only in the last few years has this difference been declining (Figure IV-1).

Figure IV-1 Average net household saving rate for 21-OECD countries and y Bismarck vs. Beveridge classification



SOURCE: OECD stats; AMECO for the UK, France, Portugal and Spain.

Differences between countries, as well as the downward trend in the household saving rate, have been puzzling economists for a few decades. Dean et al. (1989: 48–49) noticed that 'the decline in household saving rates during the 1980s has been particularly pronounced in North America, the United Kingdom, the Nordic countries, Australia and New Zealand – mostly countries where there has been some domestic financial liberalisation'. The authors

[57] Division into 'Beveridge' and 'Bismarck' countries according to the original model of pension policy. Countries listed in the Appendix to the thesis – Bismarck dummy. Bismarck 2 dummy - the one that treats US system as Beveridge, is used Although the US pension system originated as a 'hybrid' (explained in the introduction of Chapter III), by its overall features it belongs to Beveridge rather than to Bismarck countries.

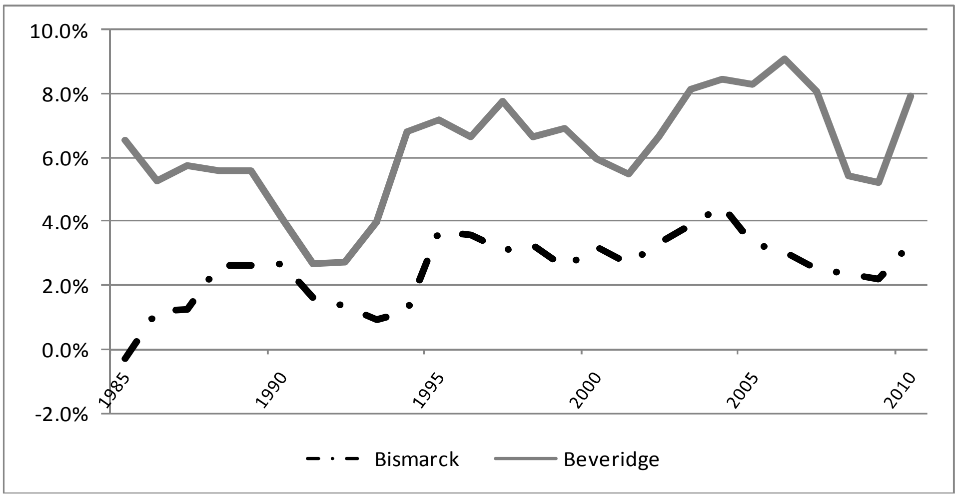
also suggest that the fall in household saving was associated with disinflation and a strong rise in personal sector wealth, which in turn resulted from the housing and equity market boom. Similarly, Lequiller and Blades (2006) argued that the dramatic fall in the saving ratio in the US was masked by the huge increase in housing prices, which is not captured by the household saving ratio as it excludes holding gains.

On the other side, for countries with the 'Bismarck pension model' such as Germany and Italy, some economists believe that household saving rates are actually higher due to the lack of confidence in the ability of their economy to guarantee them a job and a good pension (Lequiller and Blades, 2006). For some Mediterranean countries, with typically Bismarck systems, a high proportion of unincorporated enterprises may explain higher household savings (Verrinder, 2002).

Börsch-Supan and Lusardi (2002: 26) point to the complexity of household saving behaviour and to the influence of 'many opposing effects'. For example, they show how the down-payment ratio exerts a conflicting effect on household saving compared to the public pension system replacement rate, which may lead to misunderstanding of the relationships. They argue that countries with less developed financial markets may display higher saving rates. Similarly, Horioka and Yin (2010) argue that borrowing constraints are more important than social safety nets as a determinant of household saving.

In addition, Berry and Williams (2009) suggest that lower household saving may also have been offset to some extent by higher corporate saving, which indeed shows opposite trends and levels compared to household data (Figure IV-2).

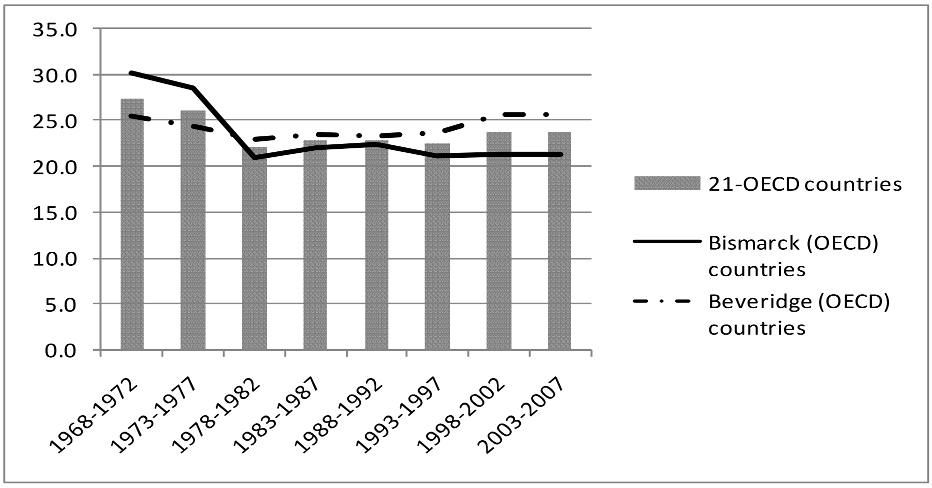
Figure IV-2 Average corporate saving rate for 21-OECD countries and by Bismarck vs. Beveridge classification



SOURCE: AMECO database

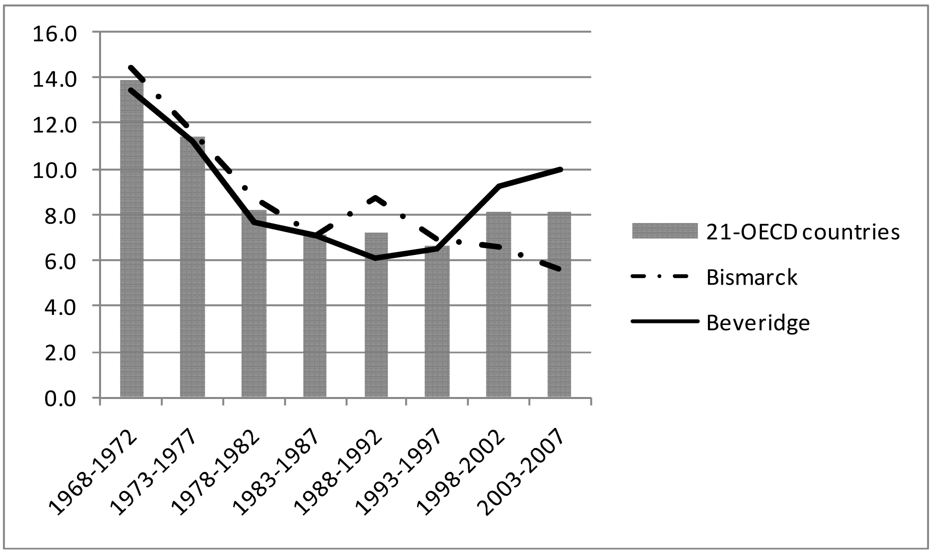
Consequently, overall economy saving aggregates such as domestic and national saving, turn out to be more stable and the differences between countries are taking somewhat different patterns (Figure IV-3and Figure IV-4).

Figure IV-3 Gross Domestic Saving for 21-OECD countries and by Bismarck vs. Beveridge classification



SOURCE: World Development Indicators, World Bank.

Figure IV-4 Net National Saving for 21-OECD countries and by Bismarck vs. Beveridge classification

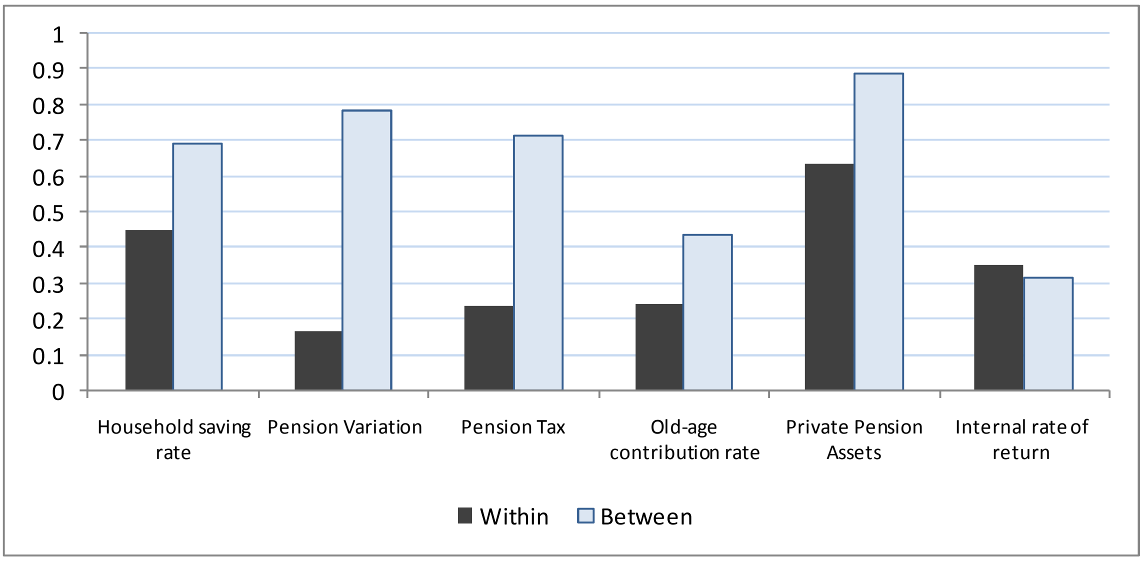


SOURCE: OECD stats

5.1.2. Descriptive Statistics

Although there has been convergence in pension policy objectives, the conclusion of the analysis presented in Chapter III is that there is no conjunction of pension models. Pension systems around the world are still very diverse and still influenced by the original policy choice. Consequently, it is not surprising that there is more variation between than within countries in the sample.

Figure IV-5 Between and within coefficient of variation for dependent and explanatory variables



The variable 'pension variation' shows a high degree of stationarity, despite such a long span of time. 'Private pension assets' show the highest degree of variation, both within and between (Figure IV-5)[58]. The only variable with the same between and within variation is

[58] Details are presented in the summary statistics table in the appendix to this chapter.

the ‘internal rate of return’ (IRR), although this depends on the exact definition of the variable that is used in the analysis[59].

There is a statistically significant difference between Bismarck and Beveridge countries in the level of the household saving rate, in the internal rate of return, in ‘pension variation’, and in private pension assets (Table IV-2). The average household saving rate is higher in Bismarck countries as well as the ‘IRR’ and the contribution rate, while ‘pension variation’ and private pension assets are higher in Beveridge countries. There is no statistically significant difference in means for any other saving variable (gross domestic saving, gross national saving or net national saving).

Table IV-2 Difference in means of main variables, Bismarck and Beveridge countries

	Beveridge	Bismarck	t-test	p-value
Household Saving	5.50	11.58	-4.28	0.000
IRR	5.26	6.75	-2.46	0.016
Pension Variation	0.26	0.06	9.98	0.000
Pension Tax	2.31	0.73	7.79	0.000
Private Pension Assets	55.67	6.68	7.80	0.000
Contribution Rate	9.24	16.40	-6.62	0.000

The correlation between pension variation and private pension assets with the household saving rate is negative, again suggesting that ‘Beveridge countries’, characterised by higher redistribution of the public system and much greater importance of private component,

[59] There are 4 versions of variable IRR, which are explained in Chapter III. In Figure IV-5 variant 3 (IRR3) is presented, which measures the actual internal rate of return assuming that the first cohort only started contributing in the 1950s, simply because it has similar between and within variation. Variant IRR2, for example, shows higher between than within variation.

have lower household saving. Similarly, the coefficient for IRR and household saving shows a positive relationship. Since the correlation coefficient between private pension assets and the 'pension variation' variable is quite high (0.64), while both variables have much lower correlation coefficients with the dependent variable – the household saving rate, this may produce problems during estimation. Same stands for contributions and pension variation.

Table IV-3 Correlation coefficients for pension design variables and household saving

	Household Saving	Contribut.	IRR	Pension variation	Private Pension Assets
Household Saving	1.00				
Contributions	0.04	1.00			
IRR	0.37	-0.24	1.00		
Pension variation	-0.28	-0.67	-0.29	1.00	
Private Pension Assets	-0.36	-0.45	-0.43	0.64	1.00

Some control variables are also highly correlated with explanatory or other control variables, there may be issues of multicollinearity. For example, the dependency ratio is strongly (negatively) correlated with pension variation; private pension assets with private credit and GDP pc, etc (see Appendix to this Chapter).

5.2. EMPIRICAL STRATEGY AND METHODOLOGY

The aim of the empirical estimation is to test the theoretical model derived in Chapter II, which examines the effect of pension system design – both public and private component – on household saving.

Since the theory explains how pension programmes affect *households'* decisions, the *household saving rate* for the dependent variable is by far the most preferable measure. However, due to the measurement issues discussed in the previous sections, there are reasons to choose national rates instead. Therefore, alternative estimations will be performed on the domestic and national saving.

The descriptive analysis suggested that counter-intuitively, household saving is higher in countries with the Bismarck model of pension provision. It would seem that the reason is a complexity of saving behaviour and the multiple factors affecting saving decisions that need to be controlled for. In particular, it is essential to isolate the effects of *financial market development* and *borrowing constraints,* as well as *the wealth effect* on household saving, which are presumably the factors that blur the relationship between social security and saving.

However, it is quite challenging to find adequate proxies, in particular longer time series across countries. Moreover, a major shortcoming of the following empirical analysis is the inability to control for wealth effects on saving. A desirable proxy for household wealth could be, for example, 'household financial assets from balance sheets' that can be found at the EUROSTAT, yet the data are available only from the mid '90s and for EU countries[60]. Another possible proxy could be share prices as a measure of unrealised stock market wealth, but this variable is available only for the most recent decades. In a nutshell, a proxy

[60] Even for the most recent decade, data for the UK are missing.

for households` unrealised gains i.e. wealth effect, for such a long time frame and a considerable number of countries, is to my knowledge not possible to obtain.

Domestic credit to private sector (as % of GDP) will be used as a proxy for financial market liquidity (borrowing constraints). Jappelli and Pagano (1994) investigate the relationship between household saving and liquidity constraints using a measure specifically designed to capture the liquidity of the household sector, such as the *maximum loan to value ratio* and *consumer credit (as % of net national product).* These controls seem to be more appropriate when it comes to household saving, nonetheless, such data are not available for the sample of 21-OECD countries spanning four decades.

In order to avoid the multicollinearity issues detected in the previous section, the empirical estimation will be split into the analysis of the impact of the public pension system component on household saving and the effect of the private pension component on household saving. In addition, the principal component index and factor analysis scores will be used as the way to solve the multicollinearity problem among the explanatory variables and to investigate the impact of overall pension system design on household saving.

The methodology that will be applied here is the usual estimators used for longitudinal data. Due to small country level sample size, I start with the *fixed effect estimators* which assumes that there are country-specific fixed effects α_i that ought to be controlled for in estimation.

$$y_{it} = \alpha_i + x'_{it}\beta + u_{it} \qquad \text{(IV-4)}$$

where i stands for individual/country, t for time and x'_{it} set of explanatory variables assumed to be independent of u_{it}. This is equivalent to the equation with dummy variables of each unit i, so that $\alpha_i = \alpha_1 d_{1it} + \alpha_2 d_{2it} + \cdots \alpha_N d_{Nit}\ d_{Nit}$, where d_{git} $(g = i)$ are group-specific dummies.

The fixed effect or *within estimator* is the OLS estimator applied to 'within transformation', which are deviations from individual means (Verbeek, 2004:346).

$$\hat{\beta}_{FE} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} (x_{it} - \bar{x}_i)\,(x_{it} - \bar{x}_i)' \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} (x_{it} - \bar{x}_i)\,(y_{it} - \bar{y}_i)$$

An advantage of the fixed effects panel data estimator is that it allows the researcher to control for unobserved heterogeneity, thus it is typically used in cross-country panel estimation.

However, fixed effect estimators exploit only the time dimension of data, while pension design variables show a significant degree of between-country variation. Therefore, although relying on the strong assumption that the unobserved country-specific effect is uncorrelated with explanatory variables and the error term, random effects estimators will be applied as well, followed by the Hausman test, which investigate whether random-effects are safe to use.

Random effects estimators take following form:

$$y_{it} = \alpha + x'_{it}\beta + u_{it} + \tau_i \qquad \text{(IV-5)}$$

where the individual-specific effect is assumed to be randomly distributed, so that $\alpha_i = \alpha + \tau_i$ and τ_i has a zero mean.

The random effect estimator $\hat{\beta}_{RE}$ can be written as:

$$\hat{\beta}_{RE} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} (x_{it} - \bar{x}_i)\,(x_{it} - \bar{x}_i)' + \theta T \sum_{i=1}^{N} (x_i - \bar{x})\,(x_i - \bar{x})' \right)^{-1} \times \left(\sum_{i=1}^{N} \sum_{t=1}^{T} (x_{it} - \bar{x}_i)\,(y_{it} - \bar{y}_i)' + \theta T \sum_{i=1}^{N} (x_i - \bar{x})\,(y_i - \bar{y})' \right)$$

where θ is function of σ_τ^2 and σ_u^2.

The Hausman test tests the null hypothesis that the difference in coefficients obtained with fixed-effect estimators vs. random-effect estimators is not systematic.

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' \left[\hat{V}\{\hat{\beta}_{FE}\} - \hat{V}\{\hat{\beta}_{RE}\} \right]^{-1} \left(\hat{\beta}_{FE-}\hat{\beta}_{RE} \right) \qquad \text{(IV-6)}$$

where $\hat{V}$ denotes the estimate of the covariance matrix. Under the null, H (Hausman test) has asympthotic Chi-squared distribution. It is possible to use random effects estimators if the null can be accepted, meaning insignificant P-value (Prob>chi2 larger than 0.05). If the null has to be rejected, then only fixed effects should be used.

In order to model the saving inertia and potential endogeneity of the certain control variables, such as GDP growth and private pension assets, the dynamic model specification will also be allowed.

$$y_{it} = \alpha_i + y_{i,t-1} + x'_{it}\beta + u_{it} \qquad \text{(IV-7)}$$

where $y_{i,t-1}$ are lags of saving as a dependent variable, capturing saving inertia.

A major drawback with this specification is that the introduction of the lagged dependent variable as an explanatory variable, in the presence of country-specific effects, renders OLS (and GLS) estimators to be biased and inconsistent[61]. By taking first-differences it is possible to eliminate the unobserved country-specific effect:

$$\Delta y_{it} = \Delta y_{i,t-1} + \Delta x'_{it}\beta + \Delta u_{it}$$

This removes the correlation between the lagged dependent variable and the error term, but the bias caused by inclusion of the lagged dependent variable remains as by construction is correlated with the new error term (Nickell, 1981)[62].

One solution to this problem is the GMM procedure suggested by Arellano and Bond (1991), which uses the lagged *level values* of two periods or more as valid instruments for the

[61] Since y_{it} is a function of α_i , then $y_{i,t-1}$ clearly depends on α_i. Thus, the composite error term $\varepsilon_{it} = \alpha_i + u_{it}$ is correlated with the lagged dependent variable as an explanatory variable, violating the classical linear model assumption that the error term and explanatory variable are uncorrelated.

[62] $\Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2}$ where $y_{i,t-1}$ is correlated to $\Delta u_{it} = u_{it} - u_{i,t-1}$.

transformed lagged dependent variable. Moreover, this procedure allows controls for potential endogeneity of explanatory variables by using the so-called 'internal instruments' – lags of the explanatory variables as instruments for their contemporaneous values[63].

Consistency of the GMM estimator can be tested by the Sargan test of over-identifying *restrictions*, which is asymptotically distributed as χ^2 under the null of instrument validity. The failure to reject the null hypothesis gives support to the model.

One of disadvantages of this methodology is that GMM difference estimators may be subject to a large downward finite-sample bias, particularly when the number of time periods available is small (Blundell and Bond, 1998).

5.3. ESTIMATION RESULTS

In the first part of the empirical analysis, I replicate the estimation done by Disney (2005) adding one more data point and using somewhat differently constructed pension design variables using more reliable data sources. In particular, to calculate effective contribution rate series I have used original pension expenditures data instead of estimated support ratios; I have cross-validated few data sources to construct replacement rate series, which in turn were used to construct internal rate of return; information on the indexation formula in each country again needed for IRR construction was carefully collected from a

[63] For 'weakly exogenous' or predetermined variables (can be affected by current and past realisation but are uncorrelated with future realisations of the error term), all their lagged levels are used as instruments. For endogenous regressors, the lagged levels dated *earlier* may be used as instrumental variables.

number of sources, such as EC-ISG reports, OECD Pensions at a Glance publications and World Bank's Pensions Panorama. Finally, I have used improved household saving dataset.

Firstly, to avoid multicollinearity I endeavour to examine just the effect of public pension component on saving, I start estimating the model as derived in Chapter II – '*Variant 1'*, and then estimating '*Variant 2'* of the model, which is the exact replicate of Disney (2005). In the second part, the effect of private pension component on saving is tested. Finally, I endeavour to investigate the effect of the overall pension design on saving, using PCA index and 'Bismarck' dummy variables.

Below is a brief account of the effect of explanatory variables on saving and the expected coefficient signs.

'Pension variation' is a variable that measures intragenerational redistribution of the pension system. Its overall effect on household saving is expected to be positive. In particular, while in redistributive systems low income earners have less incentive to save, higher income earners have a higher incentive to save. As most of private saving is usually done by higher-income earners, one may expect an overall positive effect of the degree of redistribution in the pension programme on household saving (Disney, 2005).

Pension tax is a similar variable to pension variation, used in '*Variant 2'* of the model, and it is calculated as the product of pension variation and the effective contribution rate. This variable captures the absolute 'tax component' of the contribution rate.

The internal rate of return is a rate at which the present value of the stream of contributions is equal to the present value of the stream of pension. A higher IRR means that the public system offers a higher 'return' on its pension contributions, hence predicting a higher displacement relative to other forms of private savings. Therefore, the expected coefficient on household saving for this variable is negative.

The contribution rate for public old-age pension – *in the* 'standard' models*,* contributions to public pensions (PAYG financing) are likely to offset private saving, therefore the coefficient sign is expected to be negative.

Private pension assets is a variable that includes pension assets managed by all types of financing vehicles, both mandatory and voluntary pension saving. The expected sign on pension funds assets is positive, while the magnitude depends on the displacement effect.

GDP growth – Income growth should raise savings, however, there can also be an effect moving in the opposite direction – anticipated future income increases may increase present consumption. Therefore, the predicted coefficient sign is ambiguous.

Demographics – According to the simple LCH, working age people are savers who dissave in retirement. Consequently, a significant decline in saving rates could result from the rise in old-age dependency ratios. Therefore, a negative coefficient of the old-age dependency ratio on household saving might be expected.

Borrowing constraint (financial liquidity) – The extent to which individuals can dissave depends on their ability to borrow. Therefore, the expected sign on the financial liquidity variable is negative.

***Public balance/saving* –** In terms of the 'Ricardian equivalence' hypothesis, public and private saving are perfect substitutes. Forward-looking agents fully internalise the fact that government borrowing implies higher future debt servicing, implying agents will save in anticipation of the tax burden. On the other side, a government surplus implies higher taxes, which may crowd-out private savings. Therefore, the expected coefficient sign on public surplus (deficit) is negative (positive).

5.3.1. Public pension design and household saving

In this section, I replicate the empirical model as in Disney (2005), adding data for the 2000s. Nonetheless, the overall number of observations just slightly increases – from 63 observations in Disney (2005) to 69 observations. The reason is the process of constant improvement and revision of the household saving data, in which some historical data that were previously available have been removed, presumably due to the reliability and quality reasons. In particular, in the most recently published database, data for Greece, Ireland, Spain, and Portugal are not available for the 1970s[64].

[64] For example, data for Greece used in Disney (2005) amounted to 22.1 in the 1970s, 21.3 in 1980s and 18.3 in 1990s. In the latest OECD database, data for Greece are available only from 1995, and the average for that decade amounts to 9.8. The data revisions were obviously significant.

I start with the linear version of the theoretical model, dubbed '*Variant 1'* in section 3, but I firstly only estimate the model for public pension variables in order to avoid possible multicollinearity (Table IV-4).

The estimation is performed for a number of specifications. First, I start with fixed effects estimators, since these are the most appropriate for small country-level sample as they control for unobserved heterogeneity. A disadvantage is that fixed effect estimators capture only the impact of variables that vary over time, and pension design variables show a significant degree of between-country variation. Therefore, random effects estimators are further employed (both with and without time dummies), followed by Hausman test to check whether it is safe to use them. Thirdly, I use GLS weighted by population (and controlled for country fixed effects and time effects), in order to replicate Disney (2005) as closely as possible. Finally, I use a dynamic specification estimated with the GMM Arellano-Bond (1991) procedure to model the saving inertia and to control for possible endogeneity between GDP variables and saving.

However, none of the findings are significant nor in line with the predictions of the theoretical model. The effect of IRR, except for the GLS specification, is negative but not significant[65]. The coefficient of contribution rate is surprisingly positive, though not significant. The pension variation appears to have a negative effect on household saving, for some specifications (random effects and GLS) even significant.

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[65] Results for IRR also vary depending on the particular proxy used. Variables IRR1 and IRR3, which take into account wage growth, give a negative coefficient, while variables IRR2 and IRR4, constructed to isolate the effect of wage growth, a positive coefficient (though again not significant).

Table IV-4 Public pension design variables and household saving in OECD countries – *Variant 1*

Dependent variable: Household Saving Rate (HSR)	**FE**		**RE**		**GLS**		**GMM**	
	Coefficient (standard errors)	t- ratio (p-value)	Coefficient (standard errors)	z value (p-value)	Coefficient (standard errors)	z value (p-value)	Coefficient (standard errors)	t-ratio (p-value)
HSR lagged (t-1)							0.41 0.29	1.39 (0.181)
Pension design variables								
Internal rate of return	-0.38 (0.48)	-0.79 (0.434)	-0.05 (0.34)	-0.15 (0.165)	-0.65 (0.33)	-1.97 0.013)	-1.13 (0.80)	-1.40 (0.178)
Pension variation	-14.46 (14.32)	-1.01 (0.319)	-22.65 (9.16)	-2.47 (0.013)	-14.69 (8.06)	-1.82 (0.068)	-34.55 (20.23)	-1.71 (0.105)
Contribution rate	0.23 (0.33)	0.72 (0.479)	-0.08 (0.21)	-0.38 (0.702)	0.15 (0.19)	0.82 0.413	0.26 (0.58)	0.44 (0.662)
Control variables								
GDP per capita	$-1e^{-5}$ $(1e^{-4})$	- 0.05 (0.958)	$1e^{-3}$ $(1e^{-4})$	0.84 0.401	$-1e^{-4}$ $(1e^{-4})$	-1.23 (0.217)	$-5e^{-6}$ $(4e^{-4})$	0.01 (0.991)
GDP growth	0.40 (0.63)	0.64 (0.524)	-0.23 (0.56)	-0.41 (0.679)	0.88 (0.42)	2.11 (0.036)	1.95 1.25	1.55 (0.138)
Old-age dependency	-0.97 (0.25)	-3.76 (0.001)	-0.72 (0.21)	-3.37 (0.001)	-0.90 (0.16)	-5.59 (0.000)	0.02 (0.032)	0.77 (0.453)
Financial liquidity	-0.04 (0.02)	-2.41 (0.020)	-0.04 (0.02)	-2.88 (0.004)	-0.04 (0.01)	-2.70 (0.007)	-0.58 (0.47)	-1.22 (0.238)
Government consump.	-0.41 (0.41)	-1.00 (0.325)	-0.25 (0.26)	-0.99 (0.322)	-0.60 (0.23)	-2.68 (0.007)	-0.65 (0.66)	-0.99 (0.335)
Number of observations	69		69		69		28	
F/Wald-test (Prob>F/chi2)	8.91 (0.0000)		68.91 (0.0000)		954.92 (0.0000)		...	
Hausman /Sargan (Prob>chi2)	...		10.21 (0.1768)		...		4.61 (0.5947)	

NOTE: GLS weighted by population; country effects included; GMM Arellano-Bond (1991) procedure controls for GDP growth endogeneity. For internal rate of return variable IRR3 (see Appendix and Chapter III for details).

Regarding control variables, the impact of the financial liquidity variable is negative, small but significant, in line with the intuition. Old-age dependency exerts a negative and significant effect on household saving. The negative coefficient of government consumption is significant only in the GLS specification.

Due to the multicollinearity problems, '*Variant 2*' of the model, seems to be more convenient since the contribution rate does not enter separately in the equation, though it is still taken into account via the pension tax variable. Another reason to estimate this version of the model is to replicate Disney (2005) in the same form as in that paper.

Table IV-5 Public pension variables and household saving in OECD countries – Variant 2

Dependent variable: Household Saving (%GDI)	**FE**		**RE**		**GLS**	
	Coefficient (standard errors)	*t*- ratio (p-value)	Coefficient (standard errors)	*Z* ratio (p-value)	Coefficient (standard errors)	*Z* ratio (p-value)
Pension variables						
IRR	-0.56 (0.47)	-1.20 (0.236)	0.03 (0.34)	0.10 (0.922)	-0.85 (0.32)	-2.63 (0.009)
Pension tax	-0.26 (1.03)	-0.25 (0.806)	-1.45 (0.76)	-1.91 (0.057)	-0.77 (0.65)	-1.18 (0.238)
Control variables						
GDP per capita	$-3e^{-5}$ ($2e^{-4}$)	-0.15 (0.885)	$-1e^{-4}$ ($1e^{-4}$)	0.84 (0.401)	$-1e^{-4}$ ($1e^{-4}$)	-1.13 (0.260)
GDP growth	0.13 (0.56)	0.23 (0.817)	-0.44 (0.54)	-0.81 (0.420)	0.65 (0.38)	1.66 (0.096)
Old-age dependency	-0.94 (0.23)	-4.13 (0.001)	-0.64 (0.19)	-3.32 (0.001)	-0.91 (0.15)	-5.87 (0.000)
Financial liquidity	-0.05 (0.02)	-2.78 (0.008)	-0.05 (0.01)	-3.00 (0.003)	-0.05 (0.01)	-3.14 (0.002)
Government consumption	-0.13 (0.34)	-0.38 (0.706)	-0.21 (0.26)	-0.83 (0.406)	-0.43 (0.21)	-2.09 (0.037)
Number of observations	69		69		69	
F(Wald)-test	9.72 (0.0000)		59.03 (0.0000)		908.27 (0.0000)	
Hausman - chi2 (Prob>chi2)	...		12.37 (0.0542)		...	

NOTE: GLS weighted by population; country effects included; for internal rate of return variable IRR3 (see Appendix and Chapter III for details).

Nonetheless, the results are still not as expected and differ significantly from the results obtained by Disney (2005). In particular, although IRR appears to have a negative effect on household saving in two specifications – fixed effects estimators and GLS, where the effect is statistically significant – the coefficient on pension tax is negative throughout all specifications. The results for pension tax variable are not statistically significant, except in random effect specification where significant at 90% level. However, since the Hausman test does not allow to reject the null, meaning it is not safe to draw conclusions from random effect specification, we can conclude that coefficient for pension tax variable overall is not significant.

When it comes to control variables, as previously, the variable old-age dependency is negative and significant as expected, as well as financial liquidity. Controlling for country effects in several specifications[66], a few countries have significant dummy variables. Those with a significant positive effect in all specifications are Belgium, France, the Netherlands and Sweden, while New Zealand has a significant negative effect. There is no indication why these particular countries are specific when it comes to household savings.

All specifications were performed controlling for time-effects as well, without much difference in results (presented in the Appendix to this Chapter).

Regressions on alternative measures of saving, such as gross domestic and national saving, and net national saving, were run for various specifications and for both 'Variants' of the

[66] GLS in both variants control for country effects. Also, results for the first column of both tables are alternatively estimated with the country dummies coefficient, i.e. LSDV estimators (instead of FE).

model. In general, results are not significant apart from fixed effects regression of Variant 1 on gross domestic saving, where old-age pension contribution appears to exert a significantly negative effect on gross domestic saving, in line with intuition and the model. The coefficient for pension variation is again negative and significant at 10% level. Results are attached in the Appendix to this Chapter.

Overall, the results obtained in all specifications are not in line with the theoretical model predictions, and are counter-intuitive when it comes to the relationship between pension system design and household saving. In addition, they are surprisingly different to the results obtained in Disney (2005), a study that was basically replicated. This deserves further explanation.

As regards the difference in result in Disney (2005), a few factors can explain the disparity – the revision of the household saving data, differently constructed pension design variables, the different set of control variables, as well as different 'weighting' variable in GLS specification[67]. Inclusion of 2000s data does not seem as the reason for different results.

Due to the process of constant improvement and revision of household saving data, the datasets differ substantially – the new and old data overlap with only 48 observations with the coefficient of correlation less than 0.8. Consequently, if the 'Disney (2005)' dataset, including both pension design variables and controls, is applied to the new set of household

[67] Population instead of civilian employment, which was in Disney (2005). One reason for using population is data availability and more importantly, for saving relationship it is more appropriate to weight with population (or overall employment rather than civilian).

saving data (for 1970s, 1980s and 1990s) using the same estimation methodology, results are not significant.

In addition, the approaches for pension design variables construction differ, the major difference being the construction of the effective contribution rate and RR, which is in turn used for IRR construction. That is the reason why the correlation between the variables from 'Disney' dataset and the one constructed as explained in Chapter III stems from less than 0.6 for IRRs, 0.7449 for effective contribution rate and 0.8827 for pension tax. If pension design variables constructed in Chapter III are applied to 'Disney' household saving dataset, together with 'Disney` set of control variables and using same estimation methods, the results are again not significant. Consequently, the reason for different results cannot be the inclusion of 2000s data, but rather the difference in pension design variables and household saving data.

Furthermore, the descriptive analysis already indicated counter-intuitive results, with the household saving rates being higher for 'Bismarck countries'. The explanation may lie in the complexity of household saving behaviour with the influence of many determinants exerting opposite effects. All those effects may drastically blur the relationship between a pension system and saving.

In particular, one may argue that in Anglo-Saxon countries, which are the exponents of the 'Beveridge' pension model, wealth effects associated with the holding of stocks appear much more important than in continental Europe, and the shocks affecting asset prices have a greater effect on household consumption (Oddonat and Reiu, 2003). Ludvig and Slok (2002: 29) suggest that 'there is a clear evidence that the impact from changes in stock prices is bigger in economies with market-based financial systems than in economies with bank-based financial systems'.

In addition, mortgage markets tend to be larger and more flexible in the Anglo-Saxon economies than in Japan and continental Europe, with the exception of the Netherlands, again a 'Beveridge' country (Calza *et al.,* 2007). 'In continental Europe re-financing of mortgages is more costly and home ownership is often much lower' (Gros, 2007: 10). In relation to that, the role of housing wealth could be very important in explaining the differences in saving patterns between countries, and partly within time. Countries that experiences housing market booms are those where financial market and mortgage market deregulation occurred (Agnello and Schuknecht (2011)). Housing wealth, in turn, can have significant impact on savings. Skiner (1989) suggested that housing prices have an important impact on long-run capital accumulation, though the saving effects are moderated in the presence of a bequest motive. Klyuev and Mills (2006) show that U.S. households react to an increase in their net worth by reducing their saving rate. They also showed that 'home equity withdrawal' has a negative impact on household saving, at least in the short run. Therefore, it can be argued that 'Beveridge' countries that typically experienced housing market booms and hence the wealth gains due, which themselves have origins in mortgage market deregulation, exhibited declines in saving. On the other side, 'Bismarck' (continental Europe) countries typically have lower home ownership rates and have not experiences booms in housing markets, which might in part explain higher level of private savings along with public.

Admittedly, above explained factors can primarily explain the cross-section variation in savings patterns. Within–country variation in mortgage markets should be condition with time dummies, and therefore one could argue that the above explanation does not hold for fixed-effect estimators. Still, since pension design variables` variation is mainly cross-country, and changes in pension design in the country does not happen too often, and when it does takes a long time to shows its effect, within (fixed)effects estimators are in generally not ideal to investigate saving-pension design relationship.

5.3.2. Private pensions and saving

In this section, the effect of private pension component on saving, proxied by private pension assets (stock as a share of GDP) will be estimated, again using a few estimation methods.

The findings are not significant, and even when they are as in case of GLS weighted with population, they are counter-intuitive. Estimates in column 3 imply a significant, though not large, negative effect of increase in private pension funds on the household saving rate, suggesting that an increase in private pension assets as a share of GDP by 1 percentage point would lead to a decrease in the household saving rate by 0.08 percentage points.

Table IV-6 **Effect of private pensions on household saving**

Dependent variable: Household Saving (%GDI)	**FE**		**RE**		**GLS**		**GMM**	
	Coefficient (standard errors)	*t* ratio (p-value)	Coefficient (standard errors)	*Z* ratio (p-value)	Coefficient (standard errors)	*Z* ratio (p-value)	Coefficient (standard errors)	*Z* ratio (p-value)
HSR lagged (t-1)							0.34 (0.28)	1.21 (0.225)
Private pension component								
Private pension assets	0.01 (0.03)	0.45 (0.651)	-0.02 (0.02)	-0.72 (0.009)	-0.08 (0.01)	-6.64 (0.000)	-0.03 (0.05)	-0.53 (0.596)
Control variables								
GDP per capita	$9e^{-5}$ ($1e^{-4}$)	0.55 (0.584)	$8e^{-5}$ ($1e^{-4}$)	0.56 (0.575)	$4e^{-6}$ ($1e^{-4}$)	0.04 (0.972)	$-2e^{-4}$ ($4e^{-4}$)	-0.55 (0.580)
GDP growth	0.02 (0.56)	0.03 (0.891)	-0.52 (0.54)	-0.95 (0.340)	-1.29 (0.61)	-2.11 (0.035)	2.30 (1.37)	1.68 (0.093)
Old-age dependency	-0.82 (0.20)	-4.15 (0.000)	-0.66 (0.18)	-3.73 (0.000)	-0.67 (0.14)	-4.75 (0.000)	-0.34 (0.38)	-0.89 (0.375)
Financial liquidity	-0.05 (0.02)	-2.85 (0.007)	-0.04 (0.02)	-2.35 (0.019)	-0.02 (0.02)	-0.98 (0.326)	-0.01 (0.03)	-0.26 (0.792)
Government consumption	0.20 (0.40)	0.49 (0.626)	-0.24 (0.26)	-0.93 (0.353)	-0.39 (0.21)	-1.89 (0.059)	-0.54 (0.70)	-0.78 (0.436)
Number of observations	69		69		69		28	
F/Wald-test (Prob>F/chi2)	10.98 (0.0000)		53.89 (0.0000)		133.37(0.0000)		...	
Hausman /Sargan (Prob>chi2)	...		0.61 (0.9963)		...		9.32 (0.3162)	

NOTE: GLS weighted by population, country effect not included. When country dummy is included, the coefficient on private pension assets remains negative and statistically significant, financial liquidity variable becomes significant; GMM Arellano-Bond (1991) procedure controls for private pension funds and GDP growth endogeneity.

One of the possible specification problems – the reverse causality between private pension assets and saving, via the income growth channel – is controlled for by the GMM estimation. Nonetheless, the results are neither significant nor positive.

The regressions on other saving measures – such as gross domestic saving and gross and net national saving, do not shed any more light on the analysis. In particular, the results are not significant for fixed effects (or random effects) estimators for any of the listed variables, while they become negative and significant for the population-weighted GLS and Arellano-Bond GMM specification.

A similar explanation used for public pension design regressions could also be applied here. The correlation between financial liquidity variable and private pension assets suggests that the countries with developed private pensions are those with developed financial markets, in which households are more inclined to take on debt and therefore save less. In addition, the wealth effect is not controlled for, and the countries with large pension assets are very likely to be the ones that are experiencing housing and stock market wealth effects, hence this may distort the results.

5.3.3. Bismarck vs. Beveridge systems and saving

Due to the high correlation between a number of pension variables required to model the overall pension system design and saving, in particular between the 'pension variation' or 'pension tax' variables and the 'private pension assets', the effects of private pensions and the public pension component were estimated separately. In the following analysis, I will try to estimate the overall effect of a pension design on saving. To solve the problem of multicollinearity, the saving will be regressed on the PCA composite indices .

The principal component analysis was performed on a number of pension system variables such as RR, IRR, pension variation, pension tax private pension funds, pension expenditures and couple/single ratio. Two indices – Bismarck and Beveridge were extracted (for details see Chapter III).

Table IV-7 **Principal component '*Bismarck index*' on household saving**

Dependent variable: Household Saving (%GDI)	**FE**		**RE**		**GLS**	
	Coefficient (standard errors)	*t*-ratio (p-value)	Coefficient (standard errors)	*z*-ratio (p-value)	Coefficient (standard errors)	z-ratio (p-value)
Pension design variables						
'Bismarck index'	1.93 (1.41)	1.36 (0.180)	1.28 (0.60)	2.14 (0.033)	2.30 (0.41)	5.58 (0.000)
Control variables						
GDP per capita	$1e^{-4}$ ($1e^{-4}$)	1.06 (0.296)	$1e^{-4}$ ($1e^{-4}$)	0.99 (0.321)	$2e^{-5}$ ($1e^{-4}$)	0.21 (0.835)
GDP growth	0.38 (0.60)	0.64 (0.528)	-0.12 (0.55)	-0.22 (0.823)	-0.18 (0.72)	-0.25 (0.801)
Government consumption	-0.05 (0.43)	-1.07 (0.292)	-0.27 (0.25)	-1.09 (0.277)	-0.25 (0.23)	-1.08 (0.278)
Dependency	-0.89 (0.19)	-4.49 (0.000)	-0.84 (0.19)	-4.38 (0.000)	-0.90 (0.17)	-5.43 (0.000)
Financial liquidity	-0.05 (0.02)	-2.51 (0.016)	-0.04 (0.02)	-2.72 (0.006)	-0.03 (0.02)	-1.54 (0.124)
Number of observations	69		69		69	
Wald test	11.68 (0.0000)		62.72 (0.0000)		110.28 (0.0000)	

NOTE: GLS weighted by population.

I present findings for the 'Bismarck index' in Table IV-7. The results are in line with the results obtained in the previous section – they are not convincing though there is an indication of higher household saving in countries with the Bismarck pension model.

When the 'Beveridge index' is employed, the results are the mirror image – negative signs and the same significance as with the 'Bismarck index'. Though not intuitive, these results are in line with the findings obtained in the previous sections.

The results change when the PCA indices are regressed on the overall economy aggregates, such as domestic and national saving. In Table IV-8, the fixed effects estimation is reported for 'Bismarck index' regressed on gross domestic and national saving, as well as net national saving aggregate. The coefficient for the 'Bismarck index' is negative for all three dependent variables, while statistically significant only for gross domestic saving as dependent variable.

Coefficients obtained by random effects estimation are also negative, though not significant. Since the Hausman test suggested that it is not safe to use the random effect in these regressions, these results are not reported.

These somewhat more intuitive results could be interpreted as in line with the issues explained in the previous sections – methodological problems concerning household saving data, which do not exist on the higher aggregate levels, as well as the problem of inadequately controlling for borrowing constraints and wealth effect, again more pronounced at household level.

Table IV-8 **Principal component index on saving, fixed effect estimation**

Dependent variable	Gross domestic saving		Gross national saving		Net national saving	
	Coefficient (standard errors)	*z*-ratio (p-value)	Coefficient (standard errors)	*z*-ratio (p-value)	Coefficient (standard errors)	z-ratio (p-value)
Pension design variables						
'Bismarck index'	-3.83 (1.46)	-2.62 (0.011)	-0.52 (0.87)	-0.59 (0.555)	-0.06 (0.92)	-0.07 (0.942)
Control variables						
GDP per capita	$3e^{-4}$ ($1e^{-4}$)	1.92 (0.060)	$2e^{-4}$ ($8e^{-5}$)	2.63 (0.011)	$1e^{-4}$ ($1e^{-4}$)	1.04 (0.304)
GDP growth	0.32 (0.59)	0.54 0.593	0.20 (0.32)	0.61 (0.542)	0.10 (0.38)	0.28 (0.782)
Government consumption	-0.28 (0.49)	-0.58 0.565	-0.84 (0.26)	-3.16 (0.003)	-0.93 (0.31)	-2.96 (0.005)
Old-age dependency	-0.39 (0.27)	-1.48 (0.145)	-0.27 (0.13)	-2.07 (0.044)	-0.44 (0.16)	-2.70 (0.009)
Financial liquidity	-0.02 (0.02)	-0.88 (0.384)	-0.02 (0.01)	-1.42 (0.162)	-0.01 (0.01)	-0.58 (0.565)
Number of observations	84		80		82	
Wald test	5.79 (0.000)		9.91 (0.0000)		9.59 (0.0000)	

6. Conclusion

In this chapter, I have attempted to empirically test the relationship between the pension system design and household saving. In particular, I wanted to test the theoretical model derived in Chapter II that predicts higher household saving for countries with a lower contribution rate, higher redistribution within the public system and greater importance of private pension savings i.e. systems that could be classified as 'Beveridge'; and lower household saving for countries with a public system that mimics private systems - meaning higher contribution rate and lower private pension assets, i.e. those that can be classified as 'Bismarck'.

The empirical strategy regarding the impact of public pension design on household saving closely follows work in Disney (2005), with somewhat differently calculated public pension design variables and with data for the 2000s. I also tested the impact of private pension component on household saving. Finally, the overall design of the pension system was estimated using composite indices obtained with the principal component analysis.

The findings were acquired using a number of estimation methods, such as fixed, two-way fixed and random effects, GLS estimators weighted with population (both with and without time dummies), as well as the dynamic panel specification estimated by Arellano Bond (1991) GMM procedure, have not confirmed the predictions of the theoretical model. Moreover, the findings are counter-intuitive and opposite to the results obtained by Disney – the study I have tried to replicate in one part of the analysis.

Namely, the results are not significant, and often opposite to the model predictions. The coefficient of the contribution rate is surprisingly positive, while the pension variation and pension tax appear to have a negative effect on household saving, contrary to the model predictions. The results from the private component analysis are also insignificant, but even when significant they are counter-intuitive. Finally, the analysis of the overall pension system design on saving, using the 'Bismarck index' is in line with the previous results –

findings are not convincing, though there is an indication of higher household saving in countries with the Bismarck pension model.

As regards the difference in result in Disney (2005), a few factors can explain the disparity – the revision of the household saving data, differently constructed pension design variables, the different set of control variables, as well as different 'weighting' variable in GLS specification. Inclusion of 2000s data does not seem as the reason for different results.

In addition, the explanation for the obtained results may lie in the complexity of household saving behaviour characterised by the influence of many determinants exerting opposite effects. Those effects may drastically blur the relationship between a pension system and saving. In particular, one may argue that in Anglo-Saxon countries, which are the exponents of the 'Beveridge' pension model, wealth effects associated with the holding of stocks appear much more important than in continental Europe, and the shocks affecting asset prices have a greater effect on household consumption (Oddonat and Reiu, 2003). Furthermore, mortgage markets tend to be larger and more flexible in the Anglo-Saxon economies than in Japan and continental Europe, with the exception of the Netherlands, again a 'Beveridge' country (Calza *et al.,* 2007). In continental Europe re-financing of mortgages is more costly and home ownership is often much lower' (Gros, 2007: 10). In relation to that, the role of housing wealth could be very important in explaining the differences in saving patterns between countries, and partly within time. Countries that experiences housing market booms are those where financial market and mortgage market deregulation occurred (Agnello and Schuknecht (2011)). Housing wealth, in turn, can have significant impact on savings. Therefore, it can be argued that 'Beveridge' countries that typically experienced housing market booms and hence the wealth gains due, which themselves have origins in mortgage market deregulation, exhibited declines in saving. On the other side, 'Bismarck' (continental Europe) countries typically have lower home ownership rates and have not experiences booms in housing markets, which might in part explain higher level of private savings along with public.

Admittedly, above explained factors can primarily explain the cross-section variation in savings patterns. Within–country variation in mortgage markets should be condition with time dummies that are included in analysis as well, and therefore one could argue that the above explanation does not hold for fixed-effect estimators. Still, since pension design variables` variation is mainly cross-country, and changes in pension designs does not happen very often, and when it does it takes a long time for effects to become evident, within (fixed) effects estimators are generally not ideal estimators to investigate saving-pension design relationship.

In addition, household saving data – despite the constant improvement in quality, may still have measurement problems.

All of these point out that, despite the importance of the effect of pension system design on saving for policy makers, due to the number of problems with modelling household saving – measurement issues, complexity of saving behaviour and various saving determinants exerting opposing effects – it is still not trustworthy to rely on the empirical analysis of saving behaviour.

Appendix

Table IV-9 Variable List and Sources

VARIABLE	DESCRIPTION	SOURCE
Dependent variables		
Household Saving Rate	Net household saving rate as % of household disposable income	OECD statistics (Economic Outlook database); AMECO database
Alternative dependent var:		
Gross Domestic Saving	GDP less final consumption expenditure (total consumption)as a % of GDP	World Development Indicators (WB)
Gross National Saving	Gross savings are the difference between gross national income and public and private consumption, plus net current transfers (% of GDI)	World Development Indicators (WB)
Net National Saving	(% of GDP)	OECD statistics (National Accounts
Pension Design Variable		
Effective pension contribution	Effective contribution rate for old-age pension, calculated as the ratio of the ratio of old age pension expenditure and wage bill in the economy.	Own calculations based pension expenditures and *Compensation of employees: total economy* from National Accounts, drawn from an AMECO database
Pension variation	Coefficient of variation between RRs for 4 household levels: 67% and average, single and couple.	Blöndal and Scarpetta (1999) and European Commission
Pension tax	Pension variation multiplied by the average effective contribution rate	Effective contribution rate and pension variation variables
IRR-Internal rate of return	Actual internal rate of return	Own calculation based on, effective contributions, RR (Chapter 1), AMECO database for earnings growth, UN for life expectancy
	Assumption of no wage growth during employment	
	Actual wage growth during employment , assumption that first cohort started contributing in the 1950s	
	Assumption of no wage growth during employment, assumption that first cohort started contributing in the 1950s	
Private pension assets	Total private pension assets	Own compilation/calculation based on

		Global Pension Statistics, extended with Institutional Investors data, cross validating the data for the years where both sources are available. For historical data additional sources – Davis (1993), country papers, and information on countries' pension systems
Control variables		
GDP per capita	GDP per capita (constant 2000 US$) (	World Bank (WDI database)
GDP growth	GDP growth (annual %) (	
Budget balance	General government final consumption expenditure (% of GDP)	
Dependency ratio	Age dependency ratio, old (% of working-age population)	
Financial liquidity	Domestic credit to private sector (% of GDP)	

Table IV-10 Summary statistics – between and within variation

Variable		Mean	Std. Dev.	Observations
Household saving rate	overall	8.15	6.55	N = 69
	between		5.60	n = 21
	within		3.67	T-bar = 3.28
Old-age contribution rate	overall	12.30	6.04	N = 84
	between		5.34	n = 21
	within		3.00	T = 4
Pension Variation	overall	0.18	0.14	n = 21
	between		0.14	T = 4
	within		0.03	N = 84
Pension Tax	overall	1.63	1.21	T = 4
	between		1.17	N = 84
	within		0.39	n = 21
IRR1	overall	5.14	2.25	N = 84
	between		1.79	n = 21
	within		1.41	T = 4
IRR2	overall	3.09	1.64	n = 21
	between		1.45	T = 4
	within		0.82	N = 84
IRR3	overall	5.92	2.77	T = 4
	between		1.87	N = 84
	within		2.08	n = 21
IRR4	overall	3.69	1.91	N = 84
	between		1.50	n = 21
	within		1.21	T = 4
Private Pension Assets	overall	34.68	37.4	N = 84
	between		30.7	n = 21
	within		22.1	T = 4

Table IV-11 Correlation matrix

	HSR	IRR2	IRR3	Contr. rate	PV	Pension Tax	Assets	GDPpc	GDP growth	Private cred	Depend.	GovCons
Household Saving (HSR)	1											
IRR2	0.27	1										
IRR3	0.37	0.81	1									
Contribution rate	0.04	-0.14	-0.24	1								
Pension variation (PV)	-0.28	-0.27	-0.29	-0.67	1							
Pension Tax	-0.36	-0.34	-0.39	-0.46	0.89	1						
Private pension assets	-0.36	-0.21	-0.43	-0.45	0.64	0.57	1					
GDPpc	-0.22	-0.03	-0.30	-0.22	0.23	0.25	0.58	1				
GDP growth	-0.18	0.16	0.23	-0.44	0.34	0.18	0.17	0.03	1			
Private credit	-0.20	0.07	-0.25	-0.16	0.19	0.17	0.52	0.65	-0.06	1		
Dependency	-0.20	-0.24	-0.37	0.59	-0.45	-0.23	-0.13	0.23	-0.40	0.11	1	
Government Consump	-0.17	-0.11	-0.09	-0.02	0.05	0.16	0.04	-0.04	-0.13	-0.26	0.32	1

Table IV-12 Fixed effect estimation of the effect of public pension variables on gross domestic saving (variant 1)

GrossDom5	Coef.	Std. Err.	t	P>t
IRR3	0.0752	0.5246	0.14	0.887
CV2	-31.6678	17.0021	-1.86	0.068
OldAgeContr	-1.3099	0.2899	-4.52	0.000
GDPpc5	0.0006	0.0002	2.92	0.005
GDPgrowth5	0.0072	0.5514	0.01	0.99
CreditPriv5	-0.0243	0.0212	-1.15	0.256
Dependency5	0.2175	0.3197	0.68	0.499
GovConsump5	-0.2986	0.4353	-0.69	0.496
_cons	36.5357	12.1579	3.01	0.004
No. of observations	82			
F(8,53)	7.5			
Prob > F	0			

Table IV-13 Public pension variables and household saving in OECD countries – Variant 2 (with time dummies)

Dependent variable: Household Saving (%GDI)	FE		RE		GLS	
	Coefficient (standard errors)	*t*- ratio (p-value)	Coefficient (standard errors)	*Z* ratio (p-value)	Coefficient (standard errors)	*Z* ratio (p-value)
Pension variables						
IRR	-0.33 (0.67)	-0.50 (0.619)	-0.24 (0.49)	-0.51 (0.612)	-0.91 (0.47)	-1.92 (0.055)
Pension tax	-0.45 (1.08)	-0.42 (0.679)	-1.79 (0.76)	-2.35 (0.019)	-0.98 (0.67)	-1.46 (0.143)
Control variables						
GDP per capita	$-2e^{-4}$ ($3e^{-4}$)	0.74 (0.461)	$-2e^{-4}$ ($1e^{-4}$)	1.71 (0.088)	$-2e^{-5}$ ($1e^{-4}$)	0.17 (0.866)
GDP growth	0.15 (0.57)	0.28 (0.783)	-0.65 (0.57)	-1.15 (0.249)	0.74 (0.41)	1.80 (0.072)
Old-age dependency	-0.88 (0.23)	-3.71 (0.001)	-0.51 (0.19)	-2.56 (0.011)	-0.91 (0.15)	-5.87 (0.000)
Financial liquidity	-0.04 (0.02)	-1.97 (0.056)	-0.02 (0.02)	-1.26 (0.208)	-0.05 (0.01)	-3.06 (0.002)
Government consumption	0.09 (0.41)	0.22 (0.824)	-0.09 (0.26)	-0.37 (0.709)	-0.33 (0.27)	-1.23 (0.218)
Time dummies						
1980s	-2.00 (1.68)	-1.19 (0.241)	-2.62 (1.45)	-1.81 (0.071)	-1.35 (0.86)	-1.56 (0.119)
1990s	-1.69 (2.99)	-0.56 (0.576)	-3.35 (2.29)	-1.46 (0.144)	-1.79 (1.81)	-0.99 (0.323)
2000s	-3.78 (4.53)	-0.83 (0.409)	-6.68 (3.22)	-2.07 (0.038)	-2.358 (2.469)	-0.95 (0.340)
Number of observations	69		69		69	
F(Wald)-test	7.81 (0.0000)		59.91 (0.0000)		943.61 (0.0000)	
Hausman - chi2 (Prob>chi2)	...		19.39 (0.0221)		...	

NOTE: GLS weighted by population; country effects included; for internal rate of return variable IRR3 (see Appendix and Chapter III for details).

V CONCLUSION

1. OVERVIEW OF THE THESIS

The objective of this thesis has been to examine the effect of pension system design on saving. This relationship is of great interest to policy makers, since in the era of ongoing pension system reform around the world, the impact of particular pension models on saving has usually been one of the arguments for choosing a particular reform model.

I started the investigation of the pension design – saving relationship analytically. In Chapter II PENSION SYSTEM DESIGN AND SAVING: TWO-PERIOD PARTIAL EQUILIBRIUM MODEL, I examined the relationship using the two-period two-generation partial equilibrium household sector Samuelson-type of OLG mode. The contribution of this Chapter is a derivation of the household saving rate using risk-aversion logarithmic utility function, based on the two-period budget constraints problem set in Disney (2005), and further augmenting it by the mandatory funded pension programme and displacement coefficient. Additional contribution is numerical simulations of the model.

The model predicts that household saving as a share of income is unambiguously negatively affected by the size of the PAYG public pension system – the higher the payroll tax for financing it, the lower the savings. Household saving also depends on design of a public pension system. In particular, the closer is the internal rate of return from the earnings related component to the market interest rate, implying the public pension system more closely mimics private pension programmes, the lower is the savings ratio. Furthermore, the higher the 'intragenerational redistribution' in the system, the system is on average expected to have a positive effect on household saving.

When it comes to a mandatory funded programme, the effect of this component on private saving is expected to be positive, but the magnitude depends on the displacement coefficient – the higher the displacement coefficient, the lower the effect of a funded programme and vice versa. In the case of restricted pension fund investment policies, displacement is reduced.

I illustrated the model predictions with numerical simulations, using 'reasonable' general parameters – a 5% market interest rate and 4% discount rate. For the baseline scenario the contribution rate for the PAYG programme is set at 16% of gross wage; the contribution rate for the mandatory individual account component to 2.5%, with the rate of return slightly lower than the market interest rate (due to conservative investment policies of pension funds), and displacement coefficient of 0.3 as in Samwick (1998).

Varying the level of the contribution rate for the PAYG programme, simulations showed the significant effect of the scale of the PAYG system on the saving ratio – with a contribution rate of 22%, the saving ratio is as low as 27% compared to 33% with the 'baseline' contribution rate and a 49% saving ratio in case where the PAYG system does not exist.

Variations of the internal rate of return in the earnings related component show that the magnitude of the impact is actually rather small – with a 3.5 percentage point decrease in the IRR, the increase in the saving ratio is only 0.2 percentage points. When it comes to ‘intragenerational redistribution’, simulations again show a very small effect – for example, in a highly redistributive system (with the ‘Bismarckian factor’ 0.2), the saving ratio is only 0.0015 percentage points higher than it would be in the earnings-related system that provides the IRR of 4% to its beneficiaries. Nonetheless, assuming the contribution rate is a positive direct proportional function of the ‘Bismarckian factor’, the effect of ‘intragenerational redistribution’ becomes significant – the saving ratio increases from around 31% in a ‘Bismarck-style’ programme, to almost 47% in a highly redistributive ‘Beveridge-style’ programme.

Prior to getting on the empirical analysis of the effect of the pension system design on saving, it was important to define a set of measures of the design of a pension system, and to test empirically whether it still makes sense to regard pension models as Beveridge vs. Bismarck, as it has been done in the analytical Chapter II, following Disney (2005; 2006a), Lindbeck and Persson (2003), Pestieau (1998; 1999), Casamatta et al. (2000).

Chapter III PENSION SYSTEM DESIGN: MEASUREMENT AND CONVERGENCE first deals with the measurement issue. There are various indicators of ‘pension system design’ measured in the literature, though there are no ready available datasets. Section 2 of this Chapter describes and measures various pension indicators and explains in detail what the pension indicators are, how they are calculated and what are the data sources. This set of indicators is later used in the empirical analysis of pension system design and saving.

As the proposed indicators overlap and correlate, I have also performed the factor and principal component analysis to identify commonalities on indicators in line with typology of pension programmes – Beveridge vs. Bismarck, and to create composite indices that can be later used in the empirical analysis.

The focus of the empirical analysis of this Chapter is to answer the question whether there have been convergences in the design of pension systems around the world or are pension models still influenced by their historical paths.

Pension systems around the world originated with the choice between two models – Bismarck, with the aim to provide income maintenance, or Beveridge, aiming to alleviate poverty across the whole old-age population. At the end of the 1950s, countries could be quite easily classified according to the original pension policy that prevailed at the time into 'Bismarck' or 'Beveridge. However, further evolution of pension systems and the latest developments – the retrenchment policies caused by growing pension deficits and by the issue of aging population, as well as the European Union's 'Open Method of Coordination' – all these together brought the question whether the convergence in pension models occurred, or historical origins are still important.

I have tested empirically the 'convergence hypothesis' in section 3 of Chapter III, using a number of estimation methods. Firstly, I have pursued a Disney (2000a) type of Tobit estimation to test whether 'Bismarckian' countries tend to hinder the development of private pension arrangements – a form of 'crowding out' hypothesis, using a longer data series and a slightly different set of variables. The results of the Tobit modelling of private pension assets on a 'Bismarck dummy' and control variables suggested a strong impact of historical origins on the volume of private assets in a country. The results were robust to choice of sample and to specification – whether on cross-section or panel data.

Then I used Bonoli`s (1997) 'two-dimensional approach', who classifies welfare regimes according to two dimensions of social policy, and apply it to the pension models. I looked if countries still tend to group as 'Bismarck' and 'Beveridge' according to the pairs of pension policy dimensions. This approach, matching combinations of series of pension indicators such as pension variation and private assets, or pension variation and RR, suggests that countries still broadly cluster as 'Bismarck' and 'Beveridge', notwithstanding policy pressures towards uniformity. An analysis of difference in means between the two groups of countries – Bismarck and Beveridge - confirms this conclusion.

I have also used Johnson`s (1999) approach to investigate whether there has been a convergence, looking at the coefficient of variation of pension indicators across countries over time – if the coefficient decrease, a convergence happened. This procedure is analogous to that used to capture 'sigma convergence' stemming from the Barro and Sala-i-Martin (1995) growth literature. I have looked at the coefficient of variation of all pension indicators described in section 2 of Chapter III. The only variable where one could see significant decrease in the CV of an indicator across countries over time was private pension assets. Nonetheless, this is still the variable with the greatest variation between countries, since in the 1960s, the differences between countries regarding private pension were enormous with some countries having near-zero assets. Many indicators, after the initial decrease in variation that happened in the 1970s, have seen a steady increase in variation, for example, in effective contributions and pension expenditure. Thus, using this approach, the conclusion again was that no overall convergence occurred for pension design parameters.

Finally, to give a statistical underpinning to these findings, I formally test the 'convergence hypothesis' by testing the stationarity of the difference of selected pension indicators for the 'Bismarck' and 'Beveridge' groups. This is a method that has been used in the literature testing convergence of various topics, for example by Harvey (2002) for economic growth, Affinito and De Bonis (2008) for convergence of the banking sector, etc.

I chose to test two long time series – *private pension assets* and *pension expenditure*, for two reasons: the first is data availability and the second is that these two series depict well the private-public mix in models of pension provision. Just by visual inspection of the both data series, it was already obvious that series do not converge. The formal ADF test for private pension assets series confirms no convergence – since the computed ADF test-statistics (65.74481) for are greater than the critical value 'tau' (1.60). A similar result stands for the series of public expenditure on old-age pensions. The ADF test confirms no convergence, i.e. slight divergence given the coefficient of 1.0085. The ADF test-statistic (108.5666) is greater than the critical value 'tau' (0.92), hence the null cannot be rejected.

Consequently, despite a convergence in pension policy goals and in an outcome as reflected by the total or average replacement rate, no convergence in pension models could be found. The results from this Chapter suggest that pension systems around the world are still very diverse and influenced by the original policy choice i.e. historical paths.

Findings of this Chapter have a few important implications. Firstly, the analysis shows how the pension policy work is hampered by the lack of consistent pension variables dataset. It is of great importance to improve pension data and build longer series. Admittedly, this is very difficult task since pension systems are complex, aiming at various goals that need to be measured. There has been significant endeavour recently both by European Commission and OECD to build the pension data series, but there is still scope for further improvements.

When it comes to the lack of measured convergence, these findings have important policy implications. Despite the increased possibilities to exchange knowledge and disseminate policy ides across national boundaries, pension systems are still heavily influenced by their historical origins, which are in turn often related to some other factors, such as type of financial system, level of financial market development, labour market flexibility, etc. This means that 'one size fits all' policy recommendations are not suited for pension reform policies, which especially needs to be born in mind when considering radical changes such as moving to completely new type of pension system.

Finally, finding from this Chapter confirms that any analysis of household behaviour, such as retirement saving behaviour, which gives a primary role of program design, still makes a lot of sense. In particular, analysis of different behaviour between ‘Bismarck’ and ‘Beveridge’ countries are, despite policy transfers, still applicable. This analysis of retirement saving was pursued in the forthcoming chapter.

In Chapter IV PENSION SYSTEM DESIGN AND SAVING: EMPIRICAL EVIDENCE I have empirically investigated the effect of pension system design on saving rates. The empirical strategy regarding the impact of public pension design on household saving closely followed work in Disney (2005), with somewhat differently calculated public pension design variables and with data for the 2000s. I also tested the impact of private pension component on household saving. Finally, the overall design of pension system was estimated using composite indices obtained with the principal component analysis.

The findings obtained using a number of estimation methods, such as fixed, two-way fixed and random effects, GLS estimators weighted with population (all without and including time dummies), as well as the dynamic panel specification estimated by Arellano Bond (1991) GMM procedure, have not confirmed the predictions of the theoretical model. Moreover, the findings are counter-intuitive and do not confirm the results obtained by Disney – the study I have tried to replicate in one part of the analysis.

Namely, the results are not significant, and often opposite to the model predictions. The coefficient of the contribution rate is surprisingly positive, while the ‘pension variation’ and ‘pension tax’ appear to have a negative effect on household saving, contrary to the model predictions. The results from the private component analysis are also insignificant, but even when significant they are counter-intuitive. Finally, the analysis of the overall pension system design on saving, using the 'Bismarck index' is in line with the previous results – the findings are not convincing, though there is an indication of higher household saving in countries with the Bismarck pension model.

This certainly does not mean that the pension system design is not important for saving behaviour. As regards the difference in result in Disney (2005), a few factors can explain the disparity – the revision of the household saving data, differently constructed pension design variables, the different set of control variables, as well as different 'weighting' variable in GLS specification. Inclusion of 2000s data does not seem as the reason for different results.

The explanation for the obtained results may lie in the complexity of household saving behaviour characterised by the influence of many determinants exerting opposite effects. Those effects may drastically blur the relationship between a pension system and saving. In particular, one may argue that in Anglo-Saxon countries, which are the exponents of the 'Beveridge' pension model, wealth effects associated with the holding of stocks appear much more important than in continental Europe, and the shocks affecting asset prices have a greater effect on household consumption (Oddonat and Reiu, 2003). In addition, mortgage markets tend to be larger and more flexible in the Anglo-Saxon economies than in Japan and continental Europe, with the exception of the Netherlands, again a 'Beveridge' country (Calza *et al.,* 2007). In relation to that, the role of housing wealth could be very important in explaining the differences in saving patterns between countries, and partly within time. Countries that experiences housing market booms are those where financial market and mortgage market deregulation occurred (Agnello and Schuknecht (2011)). Housing wealth, in turn, can have significant impact on savings. Therefore, it can be argued that 'Beveridge' countries that typically experienced housing market booms and hence the wealth gains due, which themselves have origins in mortgage market deregulation, exhibited declines in saving. On the other side, 'Bismarck' (continental Europe) countries typically have lower home ownership rates and have not experiences booms in housing markets, which might in part explain higher level of private savings along with public.

Admittedly, above explained factors can primarily explain the cross-section variation in savings patterns. Within–country variation in mortgage markets should be condition with time dummies, and therefore one could argue that the above explanation does not hold for fixed-effect estimators. Still, since pension design variables` variation is mainly cross-country, and changes in pension design in the country does not happen too often, and when it does takes a long time to shows its effect, within (fixed)effects estimators are in generally not ideal to investigate saving-pension design relationship.

Finally, household saving data – despite the constant improvement in quality, may still have measurement problems.

All of these point out that, despite the importance of the effect of pension system design on saving for policy makers, due to the number of problems with modelling household saving – measurement issues, complexity of saving behaviour and various saving determinants exerting opposing effects – it is still not trustworthy to rely on the empirical analysis of saving behaviour. This may be seen as a support of the belief that pension policy should focus on its, already multiple, primary objectives rather than secondary objectives such as increased saving and financial market development as a channels for economic growth.

2. LIMITATIONS AND SCOPE OF FURTHER RESEARCH

The greatest set of limitations in this thesis concerns the empirical investigation of the effect of pension system design on saving in Chapter IV. As explained in section 4 of this Chapter, the empirical analysis of saving is challenging due to the problems of saving data availability and quality. Additionally, saving modelling is hampered by endogeneity problems, saving inertia, and the complexity of saving behaviour.

First of all, there is a large number of saving motives that affect household saving. The effect of some variables is even ambiguous from the theoretical viewpoint. Accordingly, there are a great number of variables that can impact on saving behaviour, such as a number of household characteristics, as well as public policies and institutions. Consequently, modelling saving behaviour is quite complex as there are many of potentially important determinants of saving, for some of which it is often difficult to find proxies and available data, especially for the ‘70s and ‘80s and for a larger set of countries. In relation to that, multicollinearity issues will usually plague a saving model with a great number of explanatory variables, which are needed to understand saving behaviour.

Some authors point to the complexity of household saving behaviour and to the influence of 'many opposing effects'. For example, Börsch-Supan and Lusardi (2002: 26) show how the down-payment ratio exerts a conflicting effect on household saving compared to the public pension system replacement rate, which may lead to misunderstanding of the relationships. Similarly, Horioka and Yin (2010) argue that borrowing constraints are more important than social safety nets as a determinant of household saving.

In addition, saving data generally suffer from low quality since they are defined as a residual. Household saving rates suffer from some additional measurement issues, such as the treatment of durable goods, treatment of pensions, issue of household consumption of public services, the problem of capital gains and losses. Moreover, there are problems of sector disaggregation, such as the fact that not all countries distinguish non-profit institutions serving households (NPISH) that should be included in the household sector; the scale of unincorporated enterprises, which are by definition included in the household sector but vary significantly across countries, etc.

Despite constant improvement in household saving data, they are still plagued with problems. This is a reason why many authors suggest using whole economy aggregates. However, since the theory explains how pension programmes affect *households'* decisions, the *household saving rate* for the dependent variable is by far the most preferable measure.

Indeed, the results of the empirical analysis of pension system design on household saving rates are rather confusing. They do not confirm the theoretical model, and are actually counter-intuitive.

The reason might be the complexity of saving behaviour and the multiple factors affecting saving decisions that need to be controlled for. In particular, it is essential to isolate the effects of *financial market development* and *borrowing constraints,* as well as *the wealth effect* on household saving, which are presumably the factors that blur the relationship between social security and saving.

However, it is quite challenging to find adequate proxies, in particular longer time series across countries. Moreover, a major shortcoming of the following empirical analysis is the inability to control for wealth effects on saving. A desirable proxy for household wealth could be, for example, 'household financial assets from balance sheets' that can be found at the EUROSTAT, yet the data are available only from the mid '90s and for EU countries[68]. Another possible proxy could be share prices as a measure of unrealised stock market wealth, but this variable is available only for most recent decades. In a nutshell, a proxy for households` unrealised gains i.e. wealth effect, for such a long time frame and a considerable number of countries, is to my knowledge not possible to obtain.

Jappelli and Pagano (1994) investigate the relationship between household saving and liquidity constraints using a measure specifically designed to capture liquidity of the

[68] Even for the most recent decade, data for the UK are missing.

household sector, such as the *maximum loan to value ratio* and *consumer credit (as % of net national product).* These controls seem to be most appropriate when it comes to household saving, nonetheless, such data are not available for the sample of 21-OECD countries spanning four decades.

The scope of potential further research mainly lies in the attempt to model the wealth effect and borrowing constraints more appropriately. As the data are not available, developing a dataset of 'saving control indicators' that would include adequate indicators for borrowing constraints and wealth, would complement the set of pension design indicators developed in this thesis and be of great value added for modelling household saving behaviour and its response to pension design more appropriately.

In addition, modelling household saving behaviour and the effect of pension design using a cross-country cross-section dataset may improve the analysis. That way, both heterogeneity of households as well as public policies and institutions can be captured.

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VII APPENDIX

»Pillar« and »Tier« Terminology

Pillar terminology is typically used for pension classifications, but the meanings may differ, depending on the institution using it.

The commonly used three-pillar terminology by **the World Bank terminology:** 1st pillar - a relatively small, publicly managed, pay-as-you-go, defined benefit pillar; 2nd pillar - a mandatory, funded, defined-contribution (individual account), privately managed pillar; 3rd - voluntary, privately managed pillar.

The ILO suggests **'tier', instead of 'pillar' terminology**: 1st tier – a minimum anti-poverty pension, universally available but means tested, financed directly from general revenues; 2nd tier – a mandatory public PAYG social insurance pension providing an adequate replacement rate; 3rd – a fully funded defined contribution scheme, privately managed, supplementing the public scheme (includes both occupational and individual schemes).

OECD terminology[69]**:** 1st pillar - publicly managed pension schemes with defined benefits and pay-as-you-go finance, usually based on a payroll tax; 2nd pillar - privately managed pension schemes which are provided as part of an employment contract; 3rd pillar - personal pension plans in the form of saving and annuity schemes.

[69] „Revised taxonomy for pension plans, pension funds and pension entities', OECD (2002), as in Maintaining Prosperity in an Ageing Society.

The European Commission (EC) has endorsed a similar **terminology** to the OECD:[70] 1st pillar - basic public mandatory program, usually financed on a PAYG basis; 2nd pillar - occupational schemes; 3rd pillar - individual savings and insurance for old-age based on an individual contract between a person and institution (e.g. life insurance companies, banks, etc).

The recent evolution of pension systems in Europe has further complicated the existing classification, introducing the '*tier'*, but with a different meaning than in ILO classification.

Zero tier: means-tested social assistance for the elderly in need (social pension); *1st tier* - traditional PAYG programs within the first pillar; *2nd tier* – funded mandatory schemes, financed through contributions within 1st pillar.

This classification somewhat differs from the OECD terminology used in **Whitehouse's** publications[71]. Such framework consists of only two mandatory (statutory) tiers: *1st tier* – redistributive part, designed to ensure that pensioners achieve some absolute, minimum standard of living; 2nd *tier* – pension insurance component is designed to achieve income replacement.

[70] Natali, D., Basic Glossary for the Analysis of Pension System, Observatoire social europeen, 2004.

[71] OECD (2005) and (2007), *Pensions at a Glance: Public Policies across OECD Countries;* WHITEHOUSE, E. (2007), *Pension Panorama*, World Bank.

Different data sources and methodology for average replacement rates: further analysis and description

A. Blöndal and Scarpetta - 26 OECD countries: 1961-1995

Blöndal and Scarpetta (1999) provide historical replacement rates for OECD countries for 1961, 1975 and 1995. They constructed the *expected gross RR at the age of 55* – the RR that a 55-year-old, who started working aged 20, could expect to receive on retiring at the standard retirement age. As the statutory retirement age differs considerably among countries, it means that career profiles vary as well. In the 1990s, for more than half of the observed countries, the standard retirement age was 65 for males, meaning that RRs were calculated most often for 45 years service[72]. However, normal retirement age ranged from a low of 60 in a few countries to a high of 67 in some Nordic countries.

In addition to a single average worker, Blöndal and Scarpetta calculated replacement rates for low income earners (66% of average earnings) and for couples.

They used the publication *Social Security Programs around the World* as the main source for pension rules. They did not use the actual information on revalorisation – that is, how nominal earnings were uprated in the pension calculation. They assumed that all countries revalue previous earnings in line with changes in average earnings. This is mostly a realistic

[72] Assuming first age of receipt of pension equals retirement age. Of course, this is not always the case, especially where there is no 'retirement test'; see for example the analysis of Disney and Smith (2002). 'The Labour Supply Effect of the Abolition of the Earnings Rule for Older Workers in the United Kingdom,' Economic Journal, vol. 112(478), pages C136-C152

assumption, however, in the case where this is not the actual situation, Blöndal and Scarpetta`s RRs are overestimated. Pension income taken into account for their calculations includes public pension benefits and mandatory occupational pensions.

Table VII-1 Gross replacement rate for average earner (single and with dependent couple), OECD: 1961-95

	1961		1975		1985		1995	
	Single	*Couple*	*Single*	*Couple*	*Single*	*Couple*	*Single*	*Couple*
High-income OECD countries								
Australia	12	18	20	33	22	37	24	41
Canada	17	33	38	40	38	44	39	49
Japan	26	26	48	49	46	49	44	49
New Zealand	18	33	26	43	32	51	39	58
Norway	16	24	52	61	51	60	51	60
Switzerland	19	30	37	55	36	54	35	52
United States	28	43	35	52	38	58	42	63
Average	***19***	***30***	***37***	***48***	***38***	***50***	***39***	***53***
Ratio couple/single	***1.52***		***1.30***		***1.34***		***1.36***	
EU-15								
Austria	80	80	80	80	80	80	80	80
Belgium	60	75	60	75	60	75	60	75
Denmark	23	34	27	41	32	46	36	54
Finland	24	31	56	60	58	60	60	60
France	40	60	50	75	58	70	65	65
Germany	60	60	55	55	55	55	54	54
Greece	..	..	78	80	98	100	117	120
Ireland	23	39	17	29	21	34	24	39
Italy	37	40	62	62	71	71	80	80
Luxembourg	..	..	79	69	85	85	91	91
Netherlands	20	31	31	45	30	44	30	42
Portugal	80	80	70	84	75	84	80	84
Spain	..	..	50	50	75	75	100	100
Sweden	44	55	67	80	67	78	66	77
United Kingdom	20	33	21	33	30	41	39	50
EU-15 average	***43***	***52***	***54***	***61***	***60***	***67***	***65***	***71***
Ratio couple/single	***1.21***		***1.14***		***1.12***		***1.09***	
EU-10								
Czech Republic	..	..	..	..	..	..	38	50
Estonia	..	..	..	..	..	..	..	..
Hungary	..	..	..	..	..	..	51	51
Latvia	..	..	..	..	..	..	..	..
Lithuania	..	..	..	..	..	..	..	..
Poland	..	..	..	..	..	..	..	..
Slovak Republic	..	..	..	..	..	..	..	..
Slovenia	..	..	..	..	..	..	..	..

Source: Blöndal and Scarpetta (1999); Disney (2004).

Table VII-1 presents RRs for OECD countries from Blöndal and Scarpetta. It shows the overall trend, which was an increase until the mid-90s. It also presents RRs for couples, which are relatively higher in other high-income OECD countries than in EU-15. In addition, while the difference between RRs for couples and singles stays stable in other OECD countries, it is diminishing in EU-15 countries. As mentioned, some RRs are overestimated from Blöndal and Scarpetta, such as in Belgium, Portugal and Spain, since in these countries valorisation is/was actually done with CPI or a combination of CPI and wage growth.

B. European Commission/Social Protection Committee (SPC) and Indicators Sub-Group (ISG)

Since 2004, the European Commission (Social Protection Committee and Indicators Sub-group-ISG) has been publishing its report on *Current and Prospective Theoretical Pension Replacement Rates*. Thus far, three reports have been published: in 2004, 2006 and 2009.

According to SPC-ISG, the *replacement rate* is defined as the ratio of pre-retirement income (benefit in the first year of retirement/income) to earned income during the year preceding retirement.

In a number of EU member states, there are several statutory pension schemes for different groups of employees (civil servants, private sector, farmers, self-employed, etc.). Calculations were conducted for the *most prevalent scheme* (EC/SPC-ISG, 2004).

Under the SPC-ISG methodology, replacement rates are calculated at the moment of pension take-up, i.e. *current replacement rates*. This means that, for example, the RR for

2005 is the replacement of income for someone who is exiting the labour market in 2005 and becoming a pensioner. Reports also provide calculations of the *prospective RR* (for those retiring in 2010, 2030 and 2050, and in the latest Report for those retiring in 2046). The prospective RR indicates the pension outcome under current legislation, which includes announced changes that will be implemented at some time in the future.

The RR is calculated for a base hypothetical worker, a *single person with 40 years' career length* (i.e. he/she started to work at 25 and retired at 65) with constant average earnings. In addition to this base case, replacement rates for alternative hypothetical cases of a worker characterised by a low earnings profile (a constant 67% of average earnings) are calculated. Both reports provide two additional rising age-earnings profiles – one starting at 100% rising to an average of 200% earnings at the end of career, and the other with earnings rising from 80% to 120%.

The *pension income* taken into account for the calculations includes pension benefits from the first pillar (in EU terminology meaning statutory, i.e. mandatory schemes, regardless of whether the system is PAYG or funded, private or public) and the second pillar (in EU terminology = private occupational schemes). *Gross replacement rates* for the first and second pillar are available separately, while *net replacement rates* are presented only for the total amount – both 1st and 2nd pillar altogether.

Macroeconomic assumptions are specific to each country. The unique common assumption as regards the rate of returns on private funded pension, which was conservatively assumed at 2% (net of charges) in 2004 calculations, but it was changed to 2.5% in the 2006 report. Hence, an increase in the anticipated real rate of return causes a reported increase in the RR from 2004 to 2006 reports in countries where funded schemes exist. This again complicates to a certain extent the comparison between two time points. Nonetheless, the portion of mandatory funded components within the first-pillar is rather small – only recently (since the second half of the 1990s) have some EU accession countries, as well as Sweden, introduced mandatory funded components into their pension systems. That reform will significantly affect the prospective RR (in around 20 years' time).

Table VII-2 presents gross current and prospective RRs for EU-25 countries. It shows that overall there is a declining trend in RRs by 2046. Among EU-15 countries, the largest decreases can be seen in Denmark, Finland, France, Germany, Italy, and Portugal. The decline in RRs is less pronounced in EU-8 (and EU-10). This is due to the introduction of mandatory private pension systems, which are envisaged to replace partly the benefits from social security[73]. Hence, the decrease would be even more evident if mandatory funded components introduced in most of EU-8 countries (Estonia, Lithuania, Latvia, Hungary, Poland and Slovakia) during the 1990s were not included in RR calculations.

[73] This type of reform was typically led by the World Bank and other international financial institutions.

Table VII-2 Current and prospective gross replacement rates for EU-25: 2002-2050 (average earner, I pillar)

	2002/03[a)]	2004/05[b)]	2006[c)]	2046[c)]	2046/2006[c)]
EU-15					
Austria	74.3	64.1	68.0	68.6	0.9
Belgium	36.5	39.0	39.8	39.5	-0.8
Denmark	41.7	45.1	45.1	34.7	-23.1
Finland	57.6	56.6	63.8	51.5	-19.3
France	65.0	66.2	66.2	50.2	-24.2
Germany	44.6	43.0	43.0	34.0	-20.9
Greece	108.0	105.0	105.0	92.9	-11.5
Ireland	31.4	31.0	36.0	34.2	-5.0
Italy	79.6	78.9	80.2	63.0	-21.4
Luxembourg	89.5	90.8	90.8	90.1	-0.8
Netherlands	32.6	29.6	29.6	31.2	5.4
Portugal	72.3	74.8	74.8	54.7	-26.9
Spain	88.6	90.5	90.5	82.0	-9.4
Sweden	57.0	53.0	50.5	39.5	-21.8
United Kingdom	16.6	17.0	35.9	33.1	-7.8
EU-15 average	***59.7***	***59.0***	***61.3***	***53.3***	***-13.1***
EU 10					
Czech Republic	..	61.0	60.7	45.0	-25.9
Hungary	..	65.8	63.5	76.5	20.5
Poland	..	63.2	63.2	47.5	-24.8
Slovak Republic	..	49.4	49.4	50.4	2.0
Slovenia	..	64.0	64.0	59.7	-6.7
Latvia	..	60.8	60.8	49.7	-18.3
Estonia	..	32.7	33.0	41.6	26.1
Lithuania	..	40.0	41.0	41.6	1.5
EU-8 average		***54.6***	***54.5***	***51.5***	***-5.4***
Cyprus	..	46.0	54.0	60.1	11.3
Malta	..	72.2	65.3	57.8	-11.5
EU-10 average		***55.5***	***55.5***	***53.0***	***-4.5***

Source: EC/SCP-ISG report 2004, 2006, 2009.
a) EC/SPC-ISG report 2004
b) EC/SPC-ISG report 2006
c) EC/SPC-ISG report 2009
NOTES: RR=income during the first year of retirement/income during the year preceding retirement. A worker covered by the most general scheme, 40 years career length, single male.

In some of the countries, the decline in prospective RR is due to the introduction of life expectancy into the pension formula. On the other side, the EC methodology fixes the number of years in service to 40 and hypothetical RRs appear to be decreasing, even though the intention of policy makers is actually to prolong the working years.

C. APEX METHODOLOGY (OECD PENSIONS AT A GLANCE AND WB PENSIONS PANORAMA)

The second source of data is a tool recently developed by Edward Whitehouse – the *APEX model* (Analysis of Pension Entitlements across Countries). Data on various earnings levels calculated by the APEX methodology are published in the OECD publication '*Pensions at a Glance'* (2005, 2007, 2009 and 2011), as well as in the *W*orld Bank`s *'Pensions Panorama'* (2006).

The replacement rate is defined by Whitehouse as the ratio of pension benefit as a share of individual lifetime-average earnings (re-valued in line with economy-wide earnings growth). Since under the baseline assumptions workers earn the same percentage of economy-wide average earnings throughout their career, lifetime average re-valued earnings and individual final earnings are identical. Therefore, there is no difference between the OECD and EC definition for the baseline case – flat lifetime earnings. The difference in definitions is apparent in rising career profiles, which are not used in this thesis.

The APEX methodology provides only *prospective (expected)* RRs, reflecting future entitlements under today's parameters and rules for current workers *just entering the labour market at the age of 20* and retiring after a full career i.e. at the statutory retirement age. Hence, the replacement rates may be dubbed the 'expected RR at the age of 20'.

Since the statutory retirement age varies across countries, the length of full career varies as well (40 years for retirement at 60; 45 years for retirement at 65); though in most cases it is 45 years of service). The Pensions at a Glance 2005 publication, as well as the Pensions Panorama (2007) study, report RRs for those entering the labour market in 2002; Pensions at a Glance 2007 reports RRs for those entering the labour market in 2004, and so on. Pensions at a Glance 2007 provides also a version of an RR at 25, which can be considered more realistic bearing in mind that nowadays workers get longer education. The RR at 25 is therefore comparable to the ISG methodology (in most cases it is 40 years of service).

In addition to the single average earner, RRs are calculated for various *earnings levels* – at 0.5, 0.75, 1.5 and 2 times average (mean) earnings. These provide rich information in order to analyse whether the pension system is of the Bismarck/Beveridge type.

In addition, since the latest 2011 issues, Pensions at a Glance has been providing single/couple RRs.

Replacement rates include *all mandatory* pension schemes for private sector workers, regardless of whether they are public or private. This includes mandatory private personal DC pensions, recently introduced in some countries (such as Hungary, Sweden, Poland, etc.), since these schemes are mandatory for all new labour-market entrants. This is equivalent to 1st pillar in the EC-ISG terminology. Systems with near-universal coverage are also included, provided they cover at least 90% of employees. For example, such a degree of coverage of occupational plans is achieved through centralised collective bargaining in the

Netherlands and Sweden. In Canada, Denmark, the United Kingdom and the United States, there is a broad coverage of voluntary occupational pensions and these play an important role in providing retirement incomes. However, coverage is significantly below 90%, so they have not been included in the main results (OECD, 2005). The Denmark occupational scheme is included in the 2007 report; as it is thought that coverage increased to above 90%. That is the reason why the RR for Denmark is significantly higher in the 2007 report than in 2005. The latest issues of the publication (2009 and 2011) provide separate RRs for both public and private mandatory schemes.

Both *gross* and *net* RRs are calculated and presented in Pensions at a Glance, as well as in Pensions Panorama.

Unlike in EC-ISG, the calculation of the RR for all countries is based upon a *single set of economic assumptions*. Although it is not a realistic assumption, it ensures that the outcomes of different pension regimes are unaffected by different economic conditions (OECD, 2005). Real earnings are assumed to grow 2% in real terms, while the real rate of return on DC schemes (net of administrative fees) is assumed at 3.5 percent per year. These assumptions are the same for both years (2002 and 2004).

Table VII-3 presents prospective RRs for EU-25 and other developed OECD countries from the APEX source.

Table VII-3 Gross Prospective Replacement Rate

	2002	2004	2006			2008		
	Total	*Total*	*Total*	*Public*	*Private*	*Total*	*Public*	*Private*
High-income OECD countries								
Australia	40.0	43.1	41.5	14.6	26.9	47.2	11.8	35.4
Canada	42.5	43.9	44.5	44.5	..	38.9	38.9	..
Japan	50.3	34.4	33.9	33.9	..	34.5	34.5	..
New Zealand	37.6	39.7	38.7	38.7	..	38.7	38.7	..
Norway	52.6	59.3	59.3	51.9	7.4	53.1	46.1	7.0
Switzerland	58.2	58.4	58.3	35.6	22.7	57.9	34.5	23.4
US	40.3	41.2	38.7	38.7	..	39.4	39.4	..
Average	***45.9***	***45.7***	***45.0***	***36.8***	***19.0***	***44.2***	***34.8***	***21.9***
EU-15								
Austria	78.3	80.1	80.1	80.1	..	76.6	76.6	..
Belgium	37.3	40.4	42.0	42.0	..	42.0	42.0	..
Denmark[a)]	43.3	75.8	80.3	22.9	57.4	79.6	28.9	50.7
Finland	71.5	63.4	56.2	56.2	..	57.8	57.8	..
France	49.4	51.2	53.3	53.3	..	49.1	49.1	..
Germany	45.8	39.9	43.0	43.0	..	42.0	42.0	..
Greece	84.0	95.7	95.7	95.7	..	95.7	95.7	..
Ireland	30.6	32.5	34.2	34.2	..	29.0	29.0	..
Italy	78.8	67.9	67.9	67.9	..	64.5	64.5	..
Luxembourg	101.9	88.3	88.1	88.1	..	87.4	87.4	..
Netherlands	68.3	81.9	89.3	30.2	59.1	88.1	29.2	58.9
Portugal	66.7	54.1	53.9	53.9	..	53.9	53.9	..
Spain	80.1	81.2	81.2	81.2	..	81.2	81.2	..
Sweden	64.8	62.1	61.5	37.8	23.7	53.8	31.1	22.7
United Kingdom	37.1	30.8	30.8	30.8	..	31.9	..	..
Average	***62.5***	***63.0***	***63.8***	***54.5***	***46.7***	***62.2***	***54.9***	***44.1***
EU-8								
Czech Republic	44.4	49.1	49.7	49.7	..	50.2	50.2	..
Estonia	51.6	..	..	..	..	45.0	22.5	22.5
Hungary	75.4	76.9	76.9	50.7	26.2	75.8	44.4	31.4
Latvia	58.2	..	..	..	..	..	..	..
Lithuania	53.4	..	..	..	..	..	..	..
Poland	56.9	61.2	61.3	30.0	31.3	58.9	28.7	30.2
Slovak Republic	48.6	56.7	56.4	24.0	32.4	57.6	26.0	31.6
Slovenia	..	..	..	..	..	62.4	62.4	..
Average	***55.5***	***61.0***	***61.1***	***38.6***	***30.0***	***58.3***	***39.0***	***28.9***

Source: OECD pension model (APEX).

a) Data not comparable – in 2002 occupational scheme not included.

b) Data for Malta and Cyprus not available.

D. CWE DATASET OF 18 OECD COUNTRIES: 1971–2003

This dataset is a part of the Comparative Welfare Entitlements Dataset (CWED) developed under the project ‘Welfare State Entitlements: A Comparative Institutional Analysis of Eighteen Welfare States’ conducted by Lyle Scruggs (2004). The dataset covers 18 OECD countries spanning from 1960 for gross RR and 1971 for net RR[74].

The *replacement rate* is defined as the first (entry) pension as a share of the average national wage in the same year. This differs from previous sources where the first pension is compared to the last wage. However, it is possible to calculate RRs according to the usual definition based on the available dataset.

The CWED provides the *current gross* and *net* RR at the year of statutory retirement – usually these are for 65 years olds who started working aged 21. Since the statutory retirement age differs considerably among countries, the length of career varies as well.

This source provides *two types* of the replacement rate: the ‘minimum’ pension, payable regardless of work history; and the ‘standard’ pension, payable to someone earning the APW wage in each year of their working life.

Data are provided for RRs for *single earners* and *couples*, for one type of earner – the worker on average earnings. Only public pensions are included, while private, mandated saving plans and occupational plans are excluded.

[74] Net RR data are not calculated, however data on net pension benefit and net wages are available since 1961, and therefore one can calculate net RR. Gross RRs are calculated by the author.

Table VII-4 Gross RR, OECD-18 countries (1970-2002)

	1970		1975		1885		1995		2002	
	Single	*Couple*	*Single*	*Couple*	*Single*	*Couple*	*Single*	*Couple*	*Single*	*Couple*
High-income OECD countries										
Australia	0.19	0.34	0.20	0.34	0.24	0.39	0.24	0.41	0.23	0.38
Canada	0.22	0.37	0.29	0.50	0.39	0.58	0.42	0.61	0.39	0.57
Japan	0.14	0.20	0.29	0.40	0.47	0.68	0.44	0.70	0.41	0.65
New Zealand	0.21	0.39	0.26	0.44	0.31	0.52	0.32	0.49	0.31	0.48
Norway	0.29	0.42	0.31	0.41	0.47	0.56	0.50	0.58	0.52	0.61
Switzerland	0.18	0.29	0.36	0.53	0.34	0.50	0.36	0.54	0.35	0.52
United States	0.33	0.50	0.35	0.53	0.37	0.55	0.44	0.66	0.47	0.70
Average	***0.22***	***0.36***	***0.30***	***0.45***	***0.37***	***0.54***	***0.39***	***0.57***	***0.38***	***0.56***
Ratio couple/single	***1.59***		***1.52***		***1.47***		***1.47***		***1.46***	
of which EU-15										
Austria	0.74	0.74	0.67	0.67	0.75	0.75	0.77	0.77	0.78	0.78
Belgium	0.60	0.75	0.54	0.68	0.61	0.76	0.58	0.73	0.53	0.66
Denmark	0.31	0.42	0.25	0.39	0.29	0.52	0.42	0.59	0.41	0.58
Finland	0.30	0.37	0.27	0.33	0.45	0.50	0.56	0.60	0.58	0.58
France	0.40	0.40	0.50	0.62	0.48	0.64	0.46	0.60	0.41	0.53
Germany	0.52	0.52	0.54	0.54	0.54	0.54	0.49	0.49	0.46	0.46
Ireland	0.21	0.36	0.23	0.40	0.30	0.48	0.29	0.46	0.32	0.53
Italy	0.59	0.62	0.56	0.56	0.62	0.62	0.70	0.70	0.81	0.81
Netherlands	0.31	0.44	0.31	0.44	0.36	0.51	0.31	0.42	0.34	0.47
Sweden	0.37	0.49	0.44	0.56	0.65	0.78	0.61	0.72	0.57	0.67
United Kingdom	0.21	0.33	0.24	0.36	0.31	0.44	0.40	0.52	0.45	0.58
Average	***0.41***	***0.49***	***0.41***	***0.50***	***0.49***	***0.59***	***0.51***	***0.60***	***0.52***	***0.60***
Ratio couple/single	***1.19***		***1.22***		***1.22***		***1.18***		***1.17***	

*Source:*CWED

Data quality and comparability/compatibility of sources

<u>Macroeconomic assumptions,</u> which are only relevant for prospective (expected) RRs, are in the APEX (OECD) model are *fixed* for all countries. Although this is not realistic, it is convenient from the point of view of the pension system design analysis since it isolates only the effect of the pension system. On the other side, outcomes of different pension system solutions, such as valorisation, are very sensitive to the average macroeconomic environment – wage growth in particular, so from that perspective, fixed assumptions for all

countries can be considered a limitation. Conversely, the assumptions used in EC calculations differ significantly across member states, which reflect reality, though reducing international comparability though and blurring effects of the pension system design.

The real rate of return is assumed higher in the APEX methodology (3.5% net of charges) compared to EC (2-2.5%); due to this difference, RRs in countries with funded parts of pension systems could be higher in APEX reports. Furthermore, for countries that have a funded component, a minor increase in RRs in the EC 2006 report are due to the increase in the assumed rate of return (from 2% to 2.5%).

In addition, prospective RR calculations are sensitive to the projections of life expectancies.

Career lengths are different – EC replacement rates are based on fixed 40 years' career length for every country; in the APEX methodology, as well as Blöndal and Scarpetta and the CDEW, the career length varies from country to country (span from 40-47 for various countries, most often being 45). Thus, according to APEX methodology, countries that have a lower statutory retirement age may appear as less generous (France for example). On the other side, for countries with a lower statutory retirement age, in case they apply bonus for those working longer, RR is overestimated according to the EC methodology (for example, Hungary and the Czech Republic).

Table VII-5 sums up all differences in methodologies of these four sources.

Table VII-5 **Comparison of methodology for RR calculations, various sources**

	EU	APEX	Blondal and Scarpetta	CWED
Years available	2004 Report: 2002, 2010/`30/`50 2006 Report: 2004, 2010/`30/`50 2009 Report: 2006, 2046	2005 Report: 2002 2007 Report: 2004 2009 Report 2011 Report	1975 1985 1995	1971-2003
Type of RR	Current, Expected (2004 Report); Current, Expected (2006 Report); Current, Expected (2009 Report)	Expected	Expected at 55	Current
Started working at		20 (2005 Report); 20 (and 25) (2007 Report)	20	21
Career length	40	Varies (depending on statutory retirement age) - between 40 and 45, *usually 45*	Varies (depending on statutory retirement age) - between 40 and 45, *usually 45*	Varies (depending on statutory retirement age) - between 40 and 45, usually 45
Earnings level	67% and 100% of average (2004 and 2006 Reports); 100% average, 67% only for prospective (2009 Report)	50%, 75%, 100%, 150%, 200% and 250%	66% and 100% of average	100% average
Household compositions	Single (male) worker	Single (male/female) worker; Single worker; Couple (2011 Report)	Single worker; Worker with a dependent	Single worker; Worker with a dependent
Pension schemes included as income	1st pillar: statutory pension schemes, regardless of whether they are funded or pay-as-you-go financed. 2nd pillar: occupational schemes, i.e. pension schemes linked to the employment status. Gross RR is calculated separately for 1st and 2nd pillar.	1st pillar: all mandatory pension schemes for private sector workers, regardless of whether they are public or private. 2nd pillar system with near-universal coverage also included; Separate RR for public and private provisions	1st pillar: statutory pension schemes, regardless of whether they are funded or pay-as-you-go financed. 2nd pillar: only mandatory occupational schemes	Only public system provision
Macro assumptions				
Inflation	2%	2.5%	…	…
Earnings growth	1.6% - 2.1% (2004 Report); 1.6%-5.4% (2006 Report); 1.2-2.8% (2009 Report)	2%	…	…
Real rate of return	2% (2004 Report); 2.5% (2006 and 2009 Reports)	3.5%	…	…

Ceiling on contributions

Most countries do not require high-income workers to contribute to the pension system on their entire earnings. The rationale for ceiling is the view that higher-income earners can save individually if they want to reach a higher replacement rate (Whitehouse, 2006). Limits are usually set on both the contribution base and pension benefits (Whitehouse, 2005). If these limits are not matched, there is redistribution.

Table VII-6 Ceiling on pensionable earnings to public scheme (% of average earnings)

	2002	2004	2006	2008
High-income OECD				
Australia	no	no	no	no
Austria	164	147	146	142
Belgium	129	117	118	118
Canada	100	104	104	104
Denmark	no	no	no	no
Finland	no	no	no	no
France	128	101	99	102
Germany	164	151	149	154
Greece	325	275	325	309
Ireland	no	no	no	no
Italy	357	370	367	337
Japan	175	150	149	149
Luxembourg	240	215	231	195
Netherlands	no	no	no	no
New Zealand	no	no	no	no
Norway	219	219	188	111
Portugal	no	no	no	no
Spain	189	165	164	159
Sweden	132	132	111	110
Switzerland	116	108	106	104
United Kingdom	156	115	105	119
United States	262	190	240	253
Average	***190***	***171***	***173***	***164***
EU-8				
Czech Republic	no	no	no	none
Estonia	1000	..	..	none
Hungary	220	220	220	217
Latvia	700	..	..	..
Lithuania	500	..	..	..
Poland	245	230	250	250
Slovak Republic	300	300	300	300
Slovenia	..	..	..	157
Average		***250***	***257***	***231***

Source: Pension at Glance, various issues

Table VII-6 presents the ceilings on pensionable earnings in OECD-22 and EU-8 countries, during the 2000s. In general, one may say that there is a decreasing trend in pensionable ceilings. There is no ceiling on public pension programmes in typical Beveridge systems, such as Australia, Denmark, New Zealand, the Netherlands. In EU-8 countries, the ceiling is slightly higher. This is probably because earnings are on average quite lower in EU-8 countries, so it is hard to expect even from a relatively higher income earner to voluntarily save enough for old age.

Pension variation with 'Pension at Glance' data

Table VII-7 presents the coefficient of variation for four and three income levels. The *coefficient of variation for three income levels* (50%, 75% and average) seems the best choice for comparative analysis, since the CV based on four income levels is not adequate for a number of countries being below 150% of average earnings.

Countries like the UK, Ireland, Denmark, New Zealand, Canada, and Australia – typical Beveridge countries – are characterised with a high coefficient of variation. There was a decrease in redistribution among some EU-15 countries such as Belgium, Denmark, France, and Portugal during the 2000s[75]. New EU member states do not have redistributive systems, except for the Czech Republic.

[75] It just needs to be noted that CV is sensitive to very small variations in RR, which sometimes may occur due to errors in RR calculations. Therefore, small increases/decreases, of a few percentage points, should not be taken into account (for example, an increase in CV in the Netherlands, Switzerland etc).

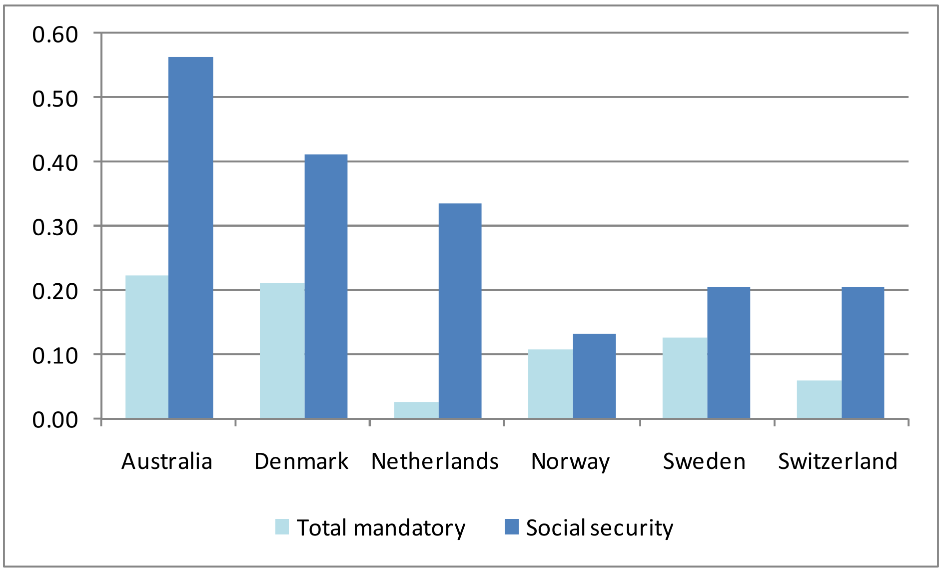
Table VII-7 Coefficient of variation, OECD data

	4 income levels - 0,5;0,75;1 and 1,5				3 income levels - 0,5;0,75 and 1			
	2002	2004	2006	2008	2002	2004	2006	2008
High-income OECD countries								
Australia	0.31	0.32	0.30	0.28	0.25	0.25	0.24	0.22
Canada	0.38	0.38	0.38	0.38	0.27	0.28	0.28	0.28
Japan	0.20	0.20	0.20	0.20	0.16	0.17	0.17	0.17
New Zealand	0.46	0.46	0.46	0.46	0.35	0.35	0.35	0.35
Norway	0.14	0.11	0.12	0.17	0.11	0.06	0.06	0.11
Switzerland	0.15	0.18	0.19	0.19	0.04	0.04	0.04	0.06
United States	0.17	0.18	0.17	0.16	0.14	0.15	0.13	0.14
Average	***0.26***	***0.26***	***0.26***	***0.26***	***0.19***	***0.19***	***0.18***	***0.19***
of which EU-15:								
Austria	0.00	0.01	0.02	0.03	0.00	0.00	0.00	0.00
Belgium	0.30	0.25	0.24	0.26	0.28	0.21	0.19	0.21
Denmark	0.42	0.29	0.26	0.26	0.33	0.23	0.22	0.21
Finland	0.06	0.06	0.09	0.07	0.07	0.07	0.10	0.08
France	0.29	0.14	0.10	0.12	0.29	0.13	0.09	0.08
Germany	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ireland	0.46	0.46	0.46	0.46	0.35	0.35	0.35	0.35
Italy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Luxembourg	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06
Netherlands	0.00	0.01	0.03	0.03	0.00	0.01	0.03	0.03
Portugal	0.24	0.14	0.08	0.09	0.26	0.16	0.09	0.09
Spain	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sweden	0.15	0.11	0.11	0.12	0.16	0.13	0.12	0.13
United Kingdom	0.37	0.36	0.36	0.36	0.31	0.28	0.26	0.27
Average	***0.16***	***0.13***	***0.12***	***0.12***	***0.14***	***0.11***	***0.10***	***0.10***
EU-8								
Czech Republic	0.33	0.24	0.32	0.32	0.24	0.24	0.24	0.24
Estonia	0.07	..	..	0.14	0.06	..	..	0.12
Hungary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Latvia	0.05	..	..	..	0.05	..	..	..
Lithuania	0.16	..	..	..	0.14	..	..	..
Poland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slovak Republic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slovenia	..	..	..	0.02	..	..	..	0.02
Average	***0.09***	***0.06***	***0.08***	***0.08***	***0.07***	***0.06***	***0.06***	***0.07***

Source: Own calculations based on Pensions at a Glance (2005, 2007, 2009 and 2011).

When only public pension system is analysed, we can see that redistribution of public systems in countries such as Denmark and Australia and the Netherlands is even higher, and in Switzerland and Sweden considerable[76]. Figure VII-1 shows pension variation for both public and total mandatory pension programs, in countries where there is a difference.

Figure VII-1 Coefficient of variation - 3 income levels, for total mandatory and social security programmes (where different)



Source: Own calculations based on Pensions at a Glance (2009; 2011).

Private pension data

There are a few ways how pension assets may be administered. According to the OECD classification (OECD 2005b and 2007b), in view of financing vehicles, private pension plans can be classified in the following way:

Pension funds (autonomous) are the pool of assets forming an independent legal entity with the exclusive purpose of financing pension benefits. Pension funds take the form of either a

[76]This is possible since the 2009 Pensions at a Glance issue separates RRs for public and private pension component. In the first issues of Pension at Glance, replacement rates included pension benefit from all mandatory pension schemes, regardless of whether they are public or private.

special purpose entity with legal personality (trust, foundation, corporate entity) or a legally separated fund without legal personality, managed by pension fund management company.

Book reserves (non-autonomous) are sums entered in the balance sheet of the plan sponsor as reserves or provisions for pension benefits. Some assets may be held in separate accounts with the purpose of financing benefits, but are not legally separated. All of the assets, liabilities, transactions, and other events of the pension fund are combined with the corresponding items of the employer operating the scheme (IMF, GFS).

Pension insurance contracts – An insurance contract that specifies pension plan contributions for which the pension plan benefits will be paid when the members reach a specified retirement age or on earlier exit of members from the plan.

Other type of financing vehicle could be institutions such as investment companies, banks, etc. Personal pension plans, like individual retirement accounts (IRAs) in the US, personal registered retirement saving plans in Canada, personal pension trusts in Korea, mutual funds like the Mutual Pension Provident entities in Spain, and bank managed pension plans, as in Denmark and Iceland, are included in this category.

Table VII-8 Pension fund assets (% of GDP), decade averages

Country	1960s	1970s	1980s	1990s	2000s
High-income OECD countries					
Australia	13.8	18.8	27.8	59.4	92.2
Canada	11.2	22.4	41.2	89.7	100.0
Japan	0.1	4.5	16.2	20.1	18.9
New Zealand	7.8	11.6	15.4	15.5	12.2
Norway	12.4	19.9	35.1	45.2	43.4
Switzerland	36.6	46.1	64.7	92.5	119.8
United States	22.2	32.3	54.9	104.0	124.4
Average	***14.8***	***22.2***	***36.5***	***60.9***	***73.0***
EU15					
Austria	0.0	0.8	4.1	9.8	15.4
Belgium	0.0	1.7	4.6	8.5	13.8
Denmark	12.7	20.3	42.1	81.8	125.2
Finland	3.6	10.4	17.6	41.0	66.3
France	0.0	0.3	2.1	5.1	8.3
Germany	2.9	6.9	10.1	14.2	15.7
Greece	0.0	0.0	0.0	0.0	0.0
Ireland	9.3	26.6	47.8	74.2	81.3
Italy	0.0	0.0	1.0	3.5	4.6
Luxembourg	0.0	0.0	0.0	0.0	0.5
Netherlands	21.3	38.0	67.7	99.9	128.3
Portugal	0.0	0.0	0.3	7.5	18.1
Spain	0.0	0.0	0.0	2.6	9.6
Sweden	1.8	5.6	11.5	22.2	43.6
United Kingdom	15.0	21.1	52.6	82.5	84.7
Average	***4.4***	***8.8***	***17.4***	***30.2***	***41.0***
EU-8					
Czech Republic	0.0	0.0	0.0	0.0	3.4
Hungary	0.0	0.0	0.0	0.5	6.9
Estonia	0.0	0.0	0.0	0.0	2.0
Latvia	0.0	0.0	0.0	0.0	0.9
Lithuania	0.0	0.0	0.0	0.0	0.4
Poland	0.0	0.0	0.0	0.0	7.0
Slovak Republic	0.0	0.0	0.0	0.0	1.0
Slovenia	0.0	0.0	0.0	0.0	0.0
Average	***0.0***	***0.0***	***0.0***	***0.1***	***2.7***

Source: OECD Global Pension Statistics, OECD Institutional Investors Statistics, Davis (1994), OECD (1998).

Bismarck dummy

Bismarck dummy is assigned to countries according to the original pension policy model (Table III-1 in the introduction of Chapter III). Since there were some borderline cases, such as US, Japan, Switzerland, it is not straightforward to assign dummy variable. Therefore, we use three variations – 'Bismarck 1', 'Bismarck 2' and 'Bismarck 3' dummy. In general, Bismarck 2 gives strongest results.

Table VII-9 Bismarck dummy - countries assigned value 1

Bismarck 1	Bismarck 2	Bismarck 3
Austria	Austria	Austria
Belgium	Belgium	Belgium
France	France	France
Germany	Germany	Germany
Greece	Greece	Greece
Italy	Italy	Italy
Luxembourg	Luxembourg	Luxembourg
Portugal	Portugal	Portugal
Spain	Spain	Spain
Japan	Japan	
US		