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# Modelling the impact of aging on social security expenditures ☆

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**Abstract**

In this paper, we survey the features of different approaches available in the literature used to study the effects of population aging on Social Security expenditures. We comment on the weaknesses and strengths of each of them, and perform a quantitative analysis by comparing the results they imply in the particular case of the Spanish economy. Finally, we highlight some elements of the modelling strategies on which more evidence is needed for a correct evaluation of the problem at hand.


*Keywords:* Pension expenditures; Aggregate accounting; General equilibrium; Individual life-cycles profiles

## 1. Introduction

During the forthcoming decades in most European countries the demographic scenario will dramatically change. The fall in fertility experienced during the last quarter of the XXth Century and the continuation of the rise in longevity will lead to a significant increase in the proportion of the older population. Thus, Social Security programmes, whose expenditures are very much determined by the size of the older population, will come increasingly under financial stress.

At least since the early 1980s there have been many studies trying to quantify the rise in Social Security expenditures as a result of population aging (see, for instance, World Bank, 1994; Roseveare et al., 1996). Nowadays, the task continues, as many political institutions are concerned by the budgetary implications of demographic changes. Over the years, the methodologies used to yield some quantitative forecasts of the likely evolution of Social Security expenditures have been improved and, nowadays there is a menu of alternative approaches to perform this task.

In this paper, we survey the features of different approaches available in the literature used to study the effects of the aging of the population on the sustainability of the social security system. We group them into three categories

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that we label as: i) aggregate accounting, ii) individual life-cycle profiles, and iii) general equilibrium models. We highlight the weakness and strengths of each of them, and compare their predictions about the evolution of Social Security expenditures for the Spanish case. As it will be made clear, there are some crucial elements of these modelling strategies on which more evidence is needed for a correct evaluation of the problem at hand. Notwithstanding, all of the quantitative exercises we perform conclude that the points of GDP which, under the current pension schemes, would have to be devoted to expenditures in Social Security are significantly higher than current expenditures.

The survey is structured in four more sections. Sections 2–4 present the main features of the three approaches we analyze (aggregate accounting, individual life-cycle profiles, and general equilibrium models, considering both a closed economy and a small open economy). Section 5 comments on the results from each approach when they are applied to study the Spanish situation. Finally, Section 6 contains some concluding remarks, mainly addressed to highlight some elements on which more microeconomic evidence is needed to improve the modelling of the impact of population aging on Social Security expenditures.

## 2. Aggregate accounting

A first approach at performing projections of the financial situation of Social Security consists of making a certain set of assumptions about the evolution of several key demographic and economic variables, and then using accounting identities to infer expenditures and revenues. Under this approach, the behavior of some agents and the functioning of markets is not explicitly modeled, which implies to assume that saving and labor supply decisions will not change despite variations in demographic variables.

Focusing only on pension expenditures, this type of exercises breaks them down into several components. Thus, by definition, pension expenditures are given by the following equation:

$$\text{Pension Expenditures} = \text{Number of pensions} \cdot \text{Average pension}. \tag{1}$$

Typically the number of pensions are projected using population and employment forecasts over the future, where, for earnings-related pension schemes, employment years are converted into pension entitlements. Similarly, using some macroeconomic scenario for wage growth, average pensions into the future are computed by, first, computing the rate of growth of the benefits of new and current retirees and, secondly, taking out the benefits corresponding to exits due to deaths. There are many dimensions in which population and macroeconomic scenarios are enriched to improve the forecasting of Social Security expenditures.

In the next section we discuss the main ingredients needed to perform this type of exercises, that is, demographic and macroeconomic projections. But before discussing them, it is noteworthy that, under the same approach, there is an alternative, simpler way of making projections of Social Security expenditures. By scaling expenditures with respect to GDP[1]:

$$\frac{\text{Pension Expend.}}{\text{GDP}} = \frac{\text{Retired Population}}{\text{Employment}} \cdot \frac{\text{Average pension per retiree}}{\text{Average labor productivity}} = \tag{2}$$

$$= \frac{\text{Retired population}}{\text{Working age population}} \cdot \frac{\text{Working age population}}{\text{Employment}} \cdot \frac{\text{Average pension per retiree}}{\text{Average labor productivity}} \tag{3}$$

it follows that the ratio of pension expenditures to GDP is just the product of three factors: i) a demographic factor — the ratio of the retired population to working age population,[2] ii) a labor market factor — the inverse of the employment rate, and iii) an institutional–economic factor — the ratio of average pension per retiree to average labor productivity,

[1] As done, for instance, in Boldrin et al. (1999).

[2] This ratio is often referred to as the "dependency ratio". If the coverage rate of the pension system — the number of pensions to the eligible population, remains constant, then this dependency ratio is just the quotient between the ratio of the number of pensions to employment and the coverage rate.