Economía Española y Protección Social, VI, Año 2014. 119 - 157

THE SUSTAINABILITY FACTOR AND THE SPANISH PUBLIC PENSION SYSTEM[1]

EL FACTOR DE SOSTENIBILIDAD Y EL SISTEMA PÚBLICO DE PENSIONES ESPAÑOL

"No obstante, la civilización que no hace preguntas, que coloca fuera de su marco el mundo de la inquietud, del criticismo y de la búsqueda, es una civilización paralizada, estancada e inerte".

El imperio. Ryszard Kapuscinski

Alicia de las Heras Camino

Actuary. Home Office. Spain

María Begoña Gosálbez Raull[2]

Actuary. Ministry of Health, Social Services and Equality. Spain

Daniel Hernández González[3]

Actuary. Representative of the Instituto de Actuarios Españoles in the Social Security Committee of the International Actuarial Association. Spain

[1] The authors want to express their gratitude to the Mapfre Foundation for its collaboration in the research project entitled: *Enfoque actuarial para la implantación del factor de sostenibilidad en el sistema público de pensiones en España: nuevos retos para los sistemas complementarios.* (January, 2014).

[2] E-mail: bgosalbez@msssi.es

[3] E-mail: daniel.hernandez@actuarios.org

Abstract

The sustainability factor is a tool for which the main goal is to contribute to the solvency of Social Security. In Spain, it has been articulated by a *Sustainability factor*, based on a life expectancy ratio, and a *Pension Revaluation Index* that replaces the *Consumer Price Index* for revaluation. However, as outlined in this article, the alternatives chosen are not exempt from uncertainty in their practical application nor are they the only possibility of action.

Keywords

Sustainability factor; Pension Revaluation Index; Social Security; Solvency and fairness; Actuarial approach.

Resumen

El factor de sostenibilidad es una herramienta cuyo objetivo prioritario es contribuir a la solvencia de la Seguridad Social. En España se ha articulado mediante un *Factor de sostenibilidad* basado en el cociente de esperanzas de vida y un *Índice de revalorización de pensiones* que sustituye en dicha revalorización al *Índice de Precios al Consumo*. Sin embargo, tal y como se expone en este artículo, las alternativas escogidas no están exentas de incertidumbre en su aplicación práctica ni son la única posibilidad de acción.

Palabras clave

Factor de sostenibilidad; Índice de revalorización de pensiones; Seguridad Social; Solvencia y equidad; Enfoque actuarial.

JEL: G22, H55.

1. Introduction

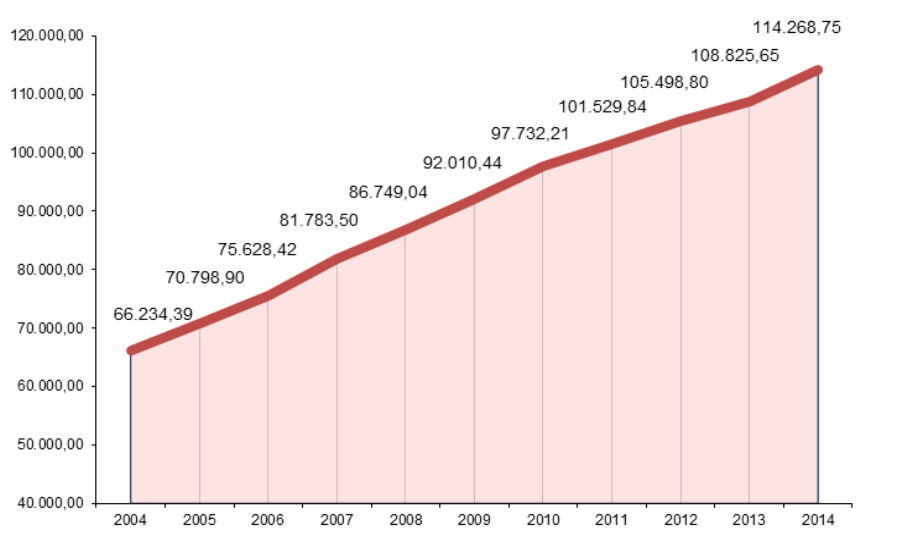
One of the tools that are being used to shore up the solvency of the social-security systems around the world is the sustainability factor. There are multiple alternatives for its realization and they normally link endogenous parameters with variables of adjustment, being applied to a collective with certain intensity. In the Spanish case, the Law 23/2013 of 23 December has established a *sustainability factor* based on a life expectancy ratio which is only applied to initial retirement pensions; it uses the social-security population life tables and will take effect in 2019. A *pension revaluation index* which replaces the *Consumer Price Index* has been also designed and, based on past and future values of some magnitudes of social security, has been applied for the first time in 2014. These tools have undoubted strengths in improving fairness and the solvency of Social Security, but also weaknesses that do not recommend entirely their practical application in Spain: the use of the sustainability factor only to initial pensions from contributory retirement or with a unique "reference age", as well as, in the case of the *Pension revaluation index*, the accused lack of transparency or the use of future estimations in the valuation. In this article, together with an analysis of certain issues that affect the *Sustainability factor* and the *Pension revaluation index* (or *Annual growth factor*) defined by the Spanish law, some alternatives of action that can replace or complement them are shown.

2. A very brief overview of the Spanish social-security system

The Spanish social-security is based on the principles of *universality*, *unity*, *solidarity* and *equality*. Its protective action is articulated in two modes: a contributory, financed mainly by fees attributed in origin to employers and employees, and other non-contributory funded taxes. The funding system is mainly the annual *pay as you go* system. Following are two figures showing

pension expenditure in Spain between 2004 and 2014 and the relationship between income and expenditures of the system during the same period. The estimates show an increase in pension expenditure of 72.52% for the decade 2004 to 2014, while total income has risen 48.67%, with a general deterioration in ratios comparing income and expenses. Because the social-security income are primarily determined by the workforce, it is important to notice that the *employment global rate* has decreased from 44.49% in the last quarter of 2005 to 36.77% in the last quarter of 2013 and that the *unemployment rate* has risen from 8.70% to 26.03% in the same period[4]. Furthermore, Spain is the fourth *OECD* country with the highest life expectancy at birth after Japan, Switzerland and Italy[5], so the length of time in which pensions are paid is getting longer and longer.

Figure 1. Expenditures in Social Security benefits. Millions of €

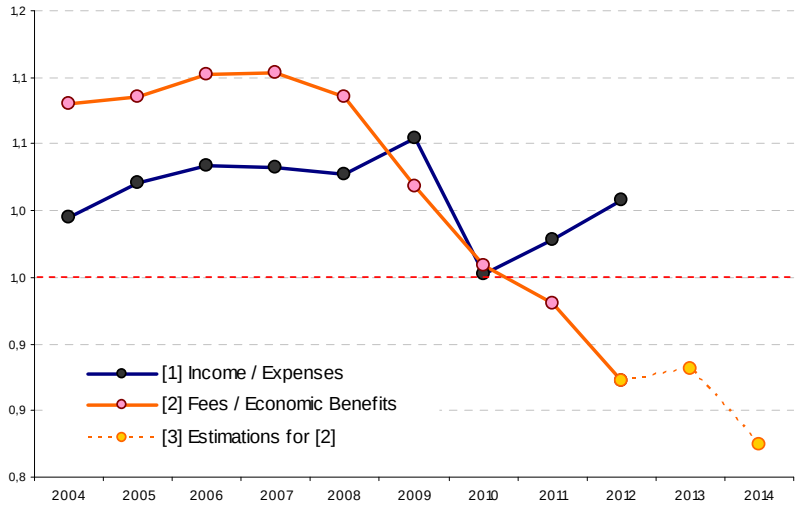


Source: Own elaboration with 2014 Social Security budget; 2013 and 2014 estimations.

[4] Source: *INE* (Spanish National Statistics Institute) (2014): *EPA* (Labour Force Survey) http://www.ine.es/inebaseDYN/epa30308_p2001/epa_resultados_1.htm

[5] Source: *OECD* (2014): *Health at a glance 2013*. *OECD Indicators*, *OECD* Publishing. http://dx.doi.org/10.1787/health_glance-2013-en

Figure 2. Total income and expenses of Social Security in Spain. 2004-2014



Source: Own elaboration with 2014 Social Security budget; 2013 y 2014 estimations.

Hernández González, D. (2011) and (2013) has described an approach to the concept of *individual generosity* through an index at time *t* which compares the contributions to the social-security system on behalf of a person and the benefits provided to that person by the system. According to the assumptions used and the results obtained in these studies, the rate of personal generosity for a pensioner of contributory retirement is less than 1, i.e., in expected terms the system gives more than it receives, with distinctions based on the typology of the pensioner and a system more beneficial for those who have contributed by increasing amounts overtime than for those who have contributed with a stable structure over time (even if with a higher total amount). Overall this would be a generous system for contributory retirement pensioners, which promotes awareness of the imbalance, especially when its assumptions suffer any type of degradation[6].

[6] Furthermore, the 2013 average pension of those who left the system was 819.84€, while the 2013 average pension of those who entered the system was 1,037.25€. Source: 2013 Social Security Budget; data: 2013, August.

Applying a sustainability factor in the Spanish social security is related to a structural deficit and, if the uncertainty stems from cyclical factors, their implementation must be questioned. There is no single voice about this, and it is difficult to reach an accurate and fair diagnosis about where to find the problems of the protection system. The Spanish economy has high unemployment limiting social-security income, a situation that could be classified as cyclical if we only consider the recent past, but also as a structural problem if one looks at the inherent inefficiencies of our economy and labour market in a global world in which the power of decision has been transferred. In any case, if we assume a cyclical character, we cannot forget that more jobs generate more social-security income and more liquidity, but also more potential pensioners and expected payments, not only for Social Security.

We consider that the uncertainty of the Spanish social-security system has structural causes. Therefore, the solvency in the long term should be the main purpose of the *sustainability factor* although, in our opinion, one should not ignore the existence of opportunistic motivations or that other measures have already been taken to strengthen this aim (e.g. raising the legal age of retirement reform, elevating of the number of years of contributions for a full pension, increasing of the number of years listed on the regulatory base, etc.).

Unfortunately, the main goal is no neutral, because it undoubtedly will create some sacrifices from the people (and not always from those generating the imbalance). Balancing the solvency of social security system is relatively easy, just multiplying the amount of the initial pension by a sufficient arbitrary fraction; what is complex is to get a good solvency level combined with sufficient coverage of needs and with fairness, avoiding privileged groups within the system.

3. Some introductory aspects about the sustainability factor

3.1. General definition

A sustainability factor is a tool used to shore up the solvency of the social-security systems. An actuarial approach should be a priority in the analysis and development of this pillar of protection as well as an invaluable aid in the decision-making process. It permits the incorporation of actuarial techniques and the concept of “fairness", but it also means the search of solvency as a permanent capacity of the system to meet its obligations. Meneu Gaya, R. *et al.* (2013) have defined the sustainability factor as an "automatic mechanism to adjust any of the parameters of the pension system to the evolution of some exogenous variable affecting the system". In our opinion, a sustainability factor is an adjustment tool that allows adapting a defined parameter of the pension system to the evolution of different socio-economic or/and demographic variables, and it is applied to benefits linked to long term. Moreover, the concept of "exogenous variable" can be misleading and undefined: for example, the *dependency ratio* could be treated as an "exogenous variable" but it is calculated with variables from the social-security system such as the *number of contributors* and the *number of pensioners*. Therefore, we prefer the concept “adjustment variable”.

Regarding to its functions and goals, the *sustainability factor* is used to contribute to the sustainability of the public pension system beyond the short term, but its application does not have to ensure that solvency itself. The sustainability factor is not certainly a sufficient condition to achieve this goal and it is not strictly “necessary” as a working tool: its effects are necessary but other mechanisms could serve the same purpose, even more efficiently. As additional objectives of the sustainability factor, Meneu Gaya, R. *et al.* (2013) cite the following:

a) Improving actuarial intergenerational equity
b) The distribution of adjustments between groups
c) Smoothing the imbalances caused by the economic cycle

but not all possible designs can achieve these goals or are easily applicable in practice. Regarding the sustainability factor designs, there are different variables that take part of their definition which mainly are:

a) Collective of reference and social benefits
b) System parameters that are affected
c) Adjustment mechanism and adjustment variables
d) Intensity in the adjustment

In other countries the *sustainability factor* has used (directly or indirectly) different mechanisms: the adjustment of the pension-point value to the changes in the *dependency ratio*, in Germany; the *life expectancy ratio* in Portugal, the *ratio of actuarial annuities*, in Finland; the period to reach the full pension and the relationship between life-expectancy and the duration of reference, in France; the pension-point value in line with inflation and income of the system, in Romania; the increase of the pensions with other variables, in Hungary and Estonia; and global options based on the actuarial balance in other countries such as Canada or the United States. In any case, the implementation of a sustainability factor demands, regardless of their design, absolute transparency in its features, being the methodology used and the results obtained totally available.

For analyzing the different endogenous parameters and adjustment variables that are used to design a sustainability factor, especially in the Spanish case, see De las Heras Camino, A.; M.B. Gosálbez Raull and D. Hernández González (2014).

4. First steps of the sustainability factor in Spain

The Spanish Law 27/2011 of 1 August (article 8) explains that:

> In order to maintain proportionality between contributions to the system and the expected benefits and ensure its sustainability, from year 2027 the basic parameters of the system will be reviewed taking into account the differences between the evolution of life expectancy at age 67 in the year in which the parameter is reviewed and life expectancy at age 67 in 2027. Such reviews shall be carried out every 5 years, using for this purpose the forecasts made by the competent official agencies.

Additionally, the Spanish Council of Ministers established a Committee of Experts to develop a report on the sustainability factor, which has been issued on June 7, 2013. Proposed by this Committee, the sustainability factor firstly included *The Intergenerational Equity Factor (FEI*), which acts on the initial contributory retirement pensions, and the *Annual Revaluation Factor (FRA*), which operates as a pension revaluation index. This report should be viewed positively because the Spanish model does not normally use the opinions of technical and professional committees whose members, work and conclusions are public but, in our opinion, the Committee has not got a total technical support to all their conclusions and theoretical developments.

Finally, although the Spanish social-security system is more than a century old, the assumption of sustainability as a principle, albeit indirectly, is quite recent, exactly from the constitutional reform of 2011. The sustainability factor could help reach the desired balance.

4.1 The *Intergenerational Equity Factor* (*FEI*)

The *Intergenerational equity factor FEI* is based on the concept of actuarial equivalence, using life expectancy, a reference age (*x*=65 years old), a reference year *t* and a year of initial application that would be founded between 2014 and 2019:

$$FEI_{x,t+s} = \frac{e_{x,t}}{e_{x,t+s}} = \frac{e_{65,\,t\in[2014,2019]}}{e_{65,t+s}} \qquad [1]$$

$e_{x,t}$ is fixed and the ratio between this variable and estimated life expectancy in the year (*t*+*s*), in which the retirement occurs, is applied to each initial contributory retirement pension. The Committee's goal is to "equally treat people who are going to receive benefits from the pension system for a different number of years as a result of increases in their life expectancy", although they believe that this factor may also contribute to long-term balance. Ultimately, it means the addition of a new factor to the formula for calculating initial-retirement pension:

$$P_{t_0} = FEI_{x,t_0} \cdot \lambda \cdot \left(\frac{\sum_{k=1}^{2}\sum_{j=1}^{12} B_{k,j}^{c}}{n \cdot 14} + \frac{\sum_{k>2}^{n}\sum_{j=1}^{12} B_{k,j}^{c} \cdot \frac{I_{3,1}}{I_{k,j}}}{n \cdot 14} \right) \qquad [2]$$

λ	It depends on the period of contributions to the system and on the relationship between the official retirement age and the real retirement age
$B_{i,j}^{c}$	Contribution Base on month *i* of year *j*
$I_{i,j}$	*Consumer (or Retail) Price Index.* Month *i* and year *j*
n	It depends on the kind of pension and operative law

The greatest value of the *FEI* is the correction of the current imbalance so now, under equal conditions, it makes that similar contributions result in different total benefits depending on the pensioners' year of birth as a consequence of the differences in the life expectancy. The actuarial approach of *FEI* will improve fairness in Spanish social-security system[7]. Additionally, it may lead to think that it allows to add value in terms of its potential impact on the solvency of the system whenever the evolution of life expectancy continues the trend shown so far, which would mean a lower initial pension to the beneficiary than the initial pension calculated without applying the *FEI*. However, with the dual configuration of the sustainability factor designed by the Committee, this effect on the solvency is not as relevant (so it is questionable that the *FEI* is really a sustainability factor; see section 6.3.).

The application of the *FEI* presents a problem: it is only referred to contributory retirement pensions and not to other pensions. At this moment and applying the current legislation, there are not reasonable technical supports for limiting its application to a single group of pensioners (who have contributed the most to obtaining the pension), because the variations in life expectancy affect all pension beneficiaries. This is the reason why this measure will generate inefficiency, inequity and inequality; we propose that the sustainability factor should be applied to all benefits that are expected to be received for a long time, because the durations of all those pensions are affected by differences in life expectancy. It is also necessary to apply the sustainability factor using mortality tables adapted for each kind of benefit.

Moreover, the Committee of Experts proposes an only fixed reference age *t*, something that does not fit the reality of the benefit system and generate inefficiencies in its practical application. Firstly, the current

[7] In terms of intergenerational equity, not in terms of relationship between income and expenditures.

system establishes different ages to receive the retirement pension, among others: 61, 65 or 67 years, but also in line; as described in the preceding paragraphs, for the Spanish Social Security there are other benefits with sensitivity to the medium and long term for which the initial age is not linked to biometric age of the beneficiary. In those cases, it is just required to adjust the sustainability factor to the effective initial age. We defend the determination of the reference age (x_0) according to the initial age of the pensioner (x_i). Other features of the *FEI* are the sensibility to the initial age or to the mortality table that is chosen, and other critical opinions can be seen in Hoyo Lao, A. (2014).

4.2. The annual revaluation factor (*FRA*)

The *Annual revaluation factor FRA* is applied to all pensions using a formula based on the application of moving averages:

$$FRA = \overline{g}_{I,t+1} - \overline{g}_{P,t+1} - \overline{g}_{s,t+1} + \alpha \cdot \left(\frac{I_t^G - G_t^G}{G_t^G} \right) \qquad [3]$$

$\overline{g}_{I,t+1}$ Average annual variation in income. Arithmetic moving average

$\overline{g}_{P,t+1}$ Average annual variation in the number of pensions. Arithmetic moving average

$\overline{g}_{s,t+1}$ Average annual variation in the average pension that is consequence of the "*replacement effect*". Arithmetic moving average

α Correction of budgetary imbalances in the system

I_t^G System income, calculated as a geometric moving average

G_t^G System expenditures, calculated as a geometric moving average

For the Committee of experts the main objective of the *FRA* is to "ensure the balance of Social Security over the business cycle", being a new tool in order to calculate the increases of the social-security pensions. That is, the *Consumer (or Retail) Price Index* would not be the only variable that will be taken into account when the revaluations of contributory social-security pensions are fixed every year.

It is very remarkable that the calculation of the *FRA* implies income and expenditures of the social-security system as reference variables and its application to the entire group of social-security pensioners affected by the revaluation of pensions, although the definition of income and expenditure lacks specificity and clarity regarding the real situation and it is not exempt from criticism; for example, there are social benefits that are not pensions but expenditures for the system. For its effects, it can be noticed that the formula contains the realization of income and expenditures in the past, so that measures with economic impact affecting the system will also have its consequence on the value of the *FRA*. Thus, the impact of the *FEI* on the expenditure will be inversely compensated when the *FRA* is calculated. Nevertheless, if there are upper and lower limits, a smaller value in the initial pension in a given year by applying the *FEI* would have a positive effect on the *FRA,* increasing the numerator of the expression affected by α and also decreasing its denominator, and the smaller initial pension will also have an effect on the series for the *replacement effect*. The formula for the *FRA* has its theoretical basis in the initial equilibrium between income and expenditures in the year *t*:

$$I_t = G_t$$

$$I_t = I_{t-1} \cdot (1 + g_{I,t})$$

$$G_t = G_{t-1} \cdot (1 + g_t) \cdot (1 + g_{p,t}) \cdot (1 + g_{s,t})$$

where, matching expressions and applying arithmetic and geometric moving averages:

$$(1+\bar{g}_{t+1}) = \frac{(1+\bar{g}_{I,\,t+1})}{(1+\bar{g}_{p,\,t+1})\cdot(1+\bar{g}_{s,\,t+1})} \cdot \frac{\bar{I}_t^G}{\bar{G}_t^G} \qquad [4]$$

The experts do not explain how to obtain the partial expressions $(\bar{g}_{s,t+1}, \bar{g}_{p,t+1}, ...)$, and do not support the use of geometric or arithmetic moving averages. After that, the Committee of experts arbitrarily introduces a speed correction α to the ratio between income and expenditures:

$$(1+\bar{g}_{t+1}) = \frac{(1+\bar{g}_{I,\,t+1})}{(1+\bar{g}_{p,\,t+1})\cdot(1+\bar{g}_{s,\,t+1})} \cdot \left(\frac{\bar{I}_t^G}{\bar{G}_t^G}\right)^{\alpha} \qquad [5]$$

Matching [4] and [5], it must be:

$$\left(\frac{\bar{I}_t^G}{\bar{G}_t^G}\right) = \left(\frac{\bar{I}_t^G}{\bar{G}_t^G}\right)^{\alpha}$$

and obviously it is not certain for $\forall\alpha$. In the next step, applying logarithms and using an approximation[8], it is possible to lead [3]. The Committee has also proposed that the calculation of the variables and rates are based on a period minimum of 11 years and maximum of 13 years, with past years (real values) and future years (estimated values) relative to the central year for the calculation, that is, 5 or 6 years prior to and after the central year *t*. For the experts this time period is based on the duration of observed business

[8] $Ln\ \frac{a}{b} = Ln\left(\frac{a+b-b}{b}\right) = Ln\left(1+\frac{a-b}{b}\right) \approx \frac{a-b}{b}$

cycles in Spain, nevertheless they do not explain the methodology and sources used for that conclusion. Furthermore, they proposed a value for the parameter *alpha* in the range [0.25, 0.33], but it has not been proven with a sufficiently reasoned and adequate justification the use of these values. From our point of view, the fact that the formulation contains estimated values is a big risk of instability since the predictions suppose higher politic risks. But also, the sensitivity to the differences between estimates and reality is important enough to not consider these estimated values in the calculation of the *FRA*. An example is presented in the following table:

Table 1. Comparison of initial budget vs real values of the Social Security

	Budget	**Real Values**			
	$I_0=G_0$	Total Income	Var %	Total Expenditure	Var %
2009	125.007,42	119.789,99	-4,17%	113.618,26	-9,11%
2012	120.690,43	123.165,55	2,05%	122.125,65	1,19%

Source: Own elaboration by the Social Security Budget. Millions of euros.

Regarding the values of the *FRA* and their future effect, it is important to point out that those depend on the number of years considered in the estimation. With periods of the past eleven years, an origin of moving averages in year *t-1* and a value for *alpha* of 0.25%, the estimated annual revaluation factor for 2010 would have been of 0.13%, while the variation December *CPI* 2011-2010 stood at 2.38% (see De las Heras Camino, A.; M.B. Gosálbez Raull and D. Hernández González, 2014).

5. The proposal of the Government of Spain

The Law 23/2013, of 23 December, has approved the application of a *Sustainability factor* (*FS*) and a *Revaluation pension index* (*IRP*) in the Spanish pension system.

5.1. The *sustainability factor* (*FS*)

As *FEI*, the *Sustainability factor* (*FS)* also adjusts the intergenerational equity only for contributory retirement pensions. The Government of Spain has established the age of 67 as the base entry age (instead of the age of 65 proposed by the Committee) and its entry into force is planned for established for 2019, with reviews every five years, although we have serious doubts about its real application. According to life tables of retirement population protected by Social Security and e^{*}_{67} as the year-on-year variation in a five-year period of life expectancy of 67 years old, the formula proposed for *FS* in the year *t* is:

$$FS_t = FS_{t-1} \cdot e^{*}_{67} \quad , \quad FS_{2018} = 1 \qquad [6]$$

where e^{*}_{67} would have a different base every five years:

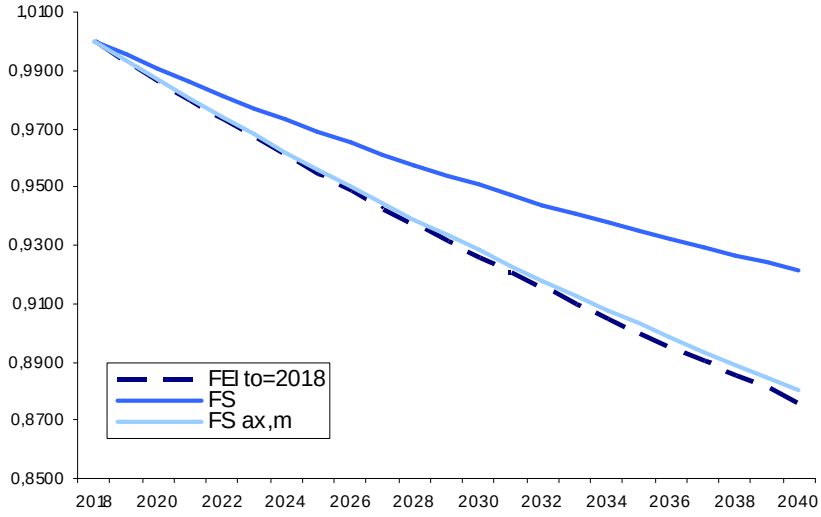
$$e^{*}_{67} = \underbrace{\left(\frac{e_{67,2012}}{e_{67,2017}}\right)^{\frac{1}{5}}}_{2019-2023} \quad \ldots \quad \underbrace{\left(\frac{e_{67,2017}}{e_{67,2022}}\right)^{\frac{1}{5}}}_{2024-2028} \quad \ldots \quad \underbrace{\left(\frac{e_{67,2022}}{e_{67,2027}}\right)^{\frac{1}{5}}}_{2029-2033} \quad \ldots$$

In the years corresponding to the latest year of each five-year interval (2023, 2028 2033, etc.), *FS* is equal to the *FEI* proposed by the Committee of experts with the same life tables, a base year set in 2012 and with an interval of six years of difference concerning the year of calculation, i.e.:

$$FS_{67,\,t_k} = \frac{e_{67,\,2012}}{e_{67,\,t_k-6}} = FEI_{67,\,t_k-6} \quad , \quad t_k = 2023 + 5 \cdot k \;,\; k = 0, 1, 2, \ldots$$

In figure 3 a comparison of values between various sustainability factors is shown. Using in all cases t_0=2018 as year of reference, the *FEI* has been calculated with x_0=65 years, life expectancy data and the methodology contained in the Committee of experts' report. *FS* uses social security tables and x_0=67 years and its own methodology, while another option *FS*($a_{x,m}$) uses also this last methodology but replaces life expectancy by life immediate actuarial annuities (i=2% and m=14) based on demographic projections INE 2012-2051 (Spanish National Statistics Institute).

Figure 3. Comparison between sustainability factors



Source: Own elaboration with data from the Committee of Experts, INE and Social Security.
INE data: http://www.ine.es/daco/daco42/demogra/hipotesis_12_51.xls
Social Security data: http://www.uv.es/pensiones/docs/factor-sostenibilidad/Memoria.pdf

As it can be seen, the *FS* presents smoother values, which imply a minor effect on the initial pension. The *FS* also has a lower incidence in terms of the promotion of early retirement and the postponed retirement

disincentives; it keeps the intergenerational equity adjustment and the actuarial approach linked, but it does so in a way that is less intense than the *FEI*. Moreover, the practical application of the *FS p*roposal does not solve the problems encountered in the analysis of the *FEI* (a single age of entry, the application to only one collective, etc.), which in this case requires us to maintain our previous reservations. In terms of the variation between the alternatives, we should see the principal reason for it; using *INE* demographic projections 2012-2051 for both cases, an example of numerical results is shown in table 2:

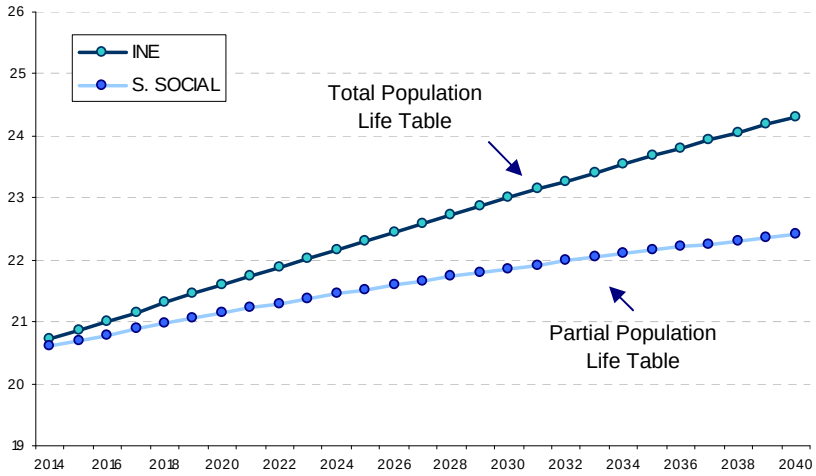
Table 2. Sustainability factor values depending on life tables

Year	e_{67}	$FEI_{2018,t}$	$FS_{2018,t}$	$FS_{2018,t}$
2018	19,6270	1,0000	1,0000	1,0000
2019	19,7690	0,9928	0,9953	0,9924
2020	19,9103	0,9858	0,9907	0,9849
2021	20,0507	0,9789	0,9861	0,9775
2022	20,1902	0,9721	0,9815	0,9701
2023	20,3290	0,9655	0,9769	0,9628
2024	20,4669	0,9590	0,9730	0,9559
2025	20,6040	0,9526	0,9691	0,9492
	INE tables	INE tables	S.S. tables	INE tables

Source: Own elaboration with data from *INE* and Social Security tables. Life expectancy using linear interpolation. Note the difference with life expectancy from the Committee of experts' report.

So, an important effect is driven by the life table that is used in the estimations: if Government's hypothesis and Committee's hypothesis are followed, *FEI<FS*, but if *INE*'s life tables are chosen for both cases, *FS<FEI*. In figure 4, the relationship between life expectancy at age 65 from social security life tables and *INE* projections, highlighting that total population life tables (*INE*) presents higher life expectancy than life tables from a subset population.

Figure 4. Life expectancy at age 65. Social security tables and *INE* projections 2012-2051



Source: Own elaboration with data from *INE* and Social Security database.

5.2. The *Pension Revaluation Index* (*IRP*)

The Government has proposed a new annual *Pension revaluation index IRP*, which tries to maintain the budget balance over the cycle with an identical formula that the one proposed by the Committee of experts [3], but applied for the first time in 2014; its value must be in the interval [0.25%, *Variation of Consumer Price Index* in December of year *t* + 0.50%]. The *IRP* is based on the application of moving averages to eleven values, past and future data merge, with α =0.25 for the first five years.

An improvement of *IRP* versus *FRA* is the more concrete and adjusted definition in terms of expenditures and income which should be computed in the index, being the establishment of the above limits, which are not symmetrical about the value that acts as a pivot, the *variation of the*

Consumer Price Index (CPI) a novelty. The existence of an upper limit that exceeds the parameter of revaluation applied until 2013, *CPI*, allows the *IRP* to have less problems when its constitutionality is questioned but, from the technical point of view, the value of the maximum and minimum limits has not been justified at any time, being therefore arbitrary; a fairer alternative is to use symmetric limits: $IRP \in \left[X - \alpha,\ X + \alpha\right]$ with, for example: $X = \Delta\nabla IPC$. In any case, if the estimations exposed in Hoyo Lao, A. (2014) are accepted and the effect of the rest of reforms of Law 27/2011 of 1 August, with respect to contributory retirement, is considered it might pose a greater limit than that currently proposed one or, at least, raise the upper limit with a certain intensity up to year 2027, in which other measures would be already fully operational and its strength on the spending control would be acting in full capacity.

Establishing maximum and minimum limits in *IRP* allows greater relevance of the participation in solvency of the sustainability factor, *FS.* Not all the intensity of the *FS* can now be included in the revaluation index, giving rise to consequences that will not be fully compensated. Other considerations about the limits of the *IRP* and its consequences can be found at Devesa Carpio, J.E. *et al.* (2013).

Finally, the Government's proposal includes the value of α, parameter of corrective speed of the imbalance between revenue and expenditures, indicating that it will be in the interval [0.25 - 0.33] and its initial value will be 0.25, while past and future moving averages are also used for a period of 11 years. The same criticism that was made about the *FRA*, needs to be made for these two values. The revaluation of contributory pensions in 2014 has been 0.25% - while the index value that supports it has not been published so far-. Furthermore, it is foreseeable that the value of the *IRP* continues decreasing in the long term, limiting revaluations in the coming years because of the lower limit that will be applied, which will

influence not only the containment of expenditure but also the ability of saving and consumption of the pensioners.

6. Lights and shadows of the sustainability factor (*FS* and *IRP*)

6.1. The conceptual system modification

An interesting question would be whether the existing model of the Spanish social security and its main characteristics are changed with the implementation of the *FS* & *IRP*. With such an application there is no change in the financing system, which is still a *pay as you go* system, although it could imply a little change in the benefit system, which partially assumes a trait defined contribution schemes. But in this regard we must make reference to what the technique of the revaluation has been until now: the application of a tool that is based on the same principles of the capitalization of defined-contribution given its multiplicative and cumulative nature.

On the other hand, the actuarial equivalence is already used in the system with the calculation of the “capital cost”, and also collective criteria are applied to individual pensions such as the minimum and maximum limits of pensions or own revaluation. In addition, the value of the pension has not relied on or depends entirely on contributions, so from this perspective, there is nothing new to what is being done before applying the factors. In terms of life expectancy, is already considered the determination of certain ages for retirement while the technical studies which support the measure are also unknown. The rates of accidents at work of Social Security are also based on a principle used in private operations: the risk assessment and the implementation of a premium according to their risk profile based on the activity. Whereas in the compatibility of work and pensions it also demonstrates another feature in this respect since it lost the spirit of the

provision to cover periods in which there are no income to address theoretical needs assimilating the model to an investment against coverage needs.

6.2. Solvency and efficiency of the system. The guarantee of the balance

One of the arguments that both the Government of Spain and the Committee of experts have repeated with respect to the factor of sustainability in the broadest sense (*FS* & *IRP*) is that it guarantees the solvency of the system, statement that must necessarily be nuanced. Factors are sensitive in terms of solvency, but there are limitations to it already in its own articulation, because they focus only on a single benefit, even if it is the most important in terms of the number of beneficiaries and cost.

Still more relevant is that where it mostly affects the search for solvency is in the *IRP*, tool that is based on global variables but which applies to only one of the components of spending, the revaluation, so its effectiveness is limited. Thus, unfavourable deviations in any of the variables that are part of the *IRP* will be taken into account, but only applied to revaluation (according to data of Social Security, on the payroll of December 2012 the revaluation meant approximately 25.37% of the amount of pensions, leaving 67.57% for initial pension and 7.05% for supplements to minimum), and future actions on the most important item of expenditure in pensions, the initial pension, would have some effects that would not be completely absorbed by the proposed factors. Therefore, there is no doubt that the factors as they are conceived will positively affect the solvency of the Spanish social-security system, but we cannot assume that they are its guarantee by itself.

6.3. The sustainability factor: Is it really a sustainability factor?

One of the aspects which should be noticed is the effect caused by the combination of the two factors. Regarding the relationship between *FS* and *IRP* (or between *FEI* and *FRA*), a lower *FS* means a lower initial pension; a lower initial pension means a lower global expenditure; a lower global expenditure means a higher *IRP*; finally resulting into a higher *IRP*, a higher revaluation and a higher expenditure (into the limits).

$$\nabla Fs_t \rightarrow \nabla P_t^i \rightarrow \nabla G_t \rightarrow \nabla G_t^G \rightarrow \Delta \frac{I_t^G - G_t^G}{G_t^G} \rightarrow \Delta IRP_t \rightarrow \Delta G_t$$

This is the reason why the *FS* would be less impacting in terms of solvency. It can be noted that the model is recursive and a lower revaluation at time *t* also contributes to a higher value of *IRP* at time t+1, t+2,… and to a higher revaluation at time t+1, t+2,…(into the limits) which at the same time contributes to a lower *IRP* at time t+2, t+3:

$$\nabla Fs_t \rightarrow \Delta IRP_{t+1} \text{ , } \Delta IRP_{t+2} \text{ , ...} \qquad \Delta IRP_t \rightarrow \nabla IRP_{t+1} \text{ , } \nabla IRP_{t+2} \text{ ,...}$$

As it can be seen, the estimations are really complex.

So regarding the question: *is it really the so called FS a sustainability factor*? Our answer is definitely: *No, it is not*. *FS* is focused on intergenerational fairness and *IRP* is focused on sustainability; *FS* could strictly be a real sustainability factor if it would act by itself, but it is not the adopted solution.

6.4. Technical aspects: life tables, the age of entry and the period of variation, the collective of entrance and the intensity of the adjustment

In terms of life tables required for the calculation of *FS*, there are two alternatives: general population life tables (conducted by *INE*) or beneficiaries life tables (drawn up by social-security system organizations). In our opinion, it is preferable to use beneficiary population tables because of our defence in applying the sustainability factor to different benefits and also to achieve biggest adjustments to the collective of reference, provided that values and all the methodology used are public and accessible at all times, because the application of the principle of transparency is a priority in this respect and these tables should obviously be prepared by social-security actuaries.

Another issue of interest is whether the age of entry x_0 is set at 65 or 67 years old. From our point of view, reinforced by the belief that the sustainability factor must also be applied to different benefits and not only to retirement, the age of entry should be that one which corresponds to the age at the time of access to benefits and not a fixed age that is not coincident with the age of the beneficiary at that moment. Since the Law 27/2011 came into force in 2013 in terms of different reforms affecting the retirement pension, it is not true that delaying the entry into force of the *FS* prevents that the weight of the indicated reforms falls on a generation. From this perspective, the date of entry into force of the factor is indifferent because all generations having access to contributory pension retirement from 2013 will assume the effects of regulatory modifications established by the Law 27/2011, with a greater intensity as time goes by. In this sense, once the need of implementing a sustainability factor is established by law, since the measures that affect the solvency of the social-security system do not have immediate effects, if the goal is to really contribute to the solvency, the most appropriate is its implementation as soon as possible. And, in this respect,

as in others, to separate from the strict literal Law 27/2011 should not be understood as a problem if deficiencies or inadequacies of the legal drafting can be justified.

The application of the sustainability factor *FS* only to the contributory retirement pension is obviously the easier and less compromising solution, but also the most inefficient and unfair; for this reason, it should be interesting for the intensity of the adjustment to incorporate all the groups of beneficiaries who have lifelong vocation. Under this dynamic, *FS* should not be applied to temporary subsidies for death and survival, death grants, coverage of risk during pregnancy or breastfeeding, maternity and paternity allowances or temporary incapacity. It would apply to lifelong widowhood, permanent disability and orphanhood. Regarding the benefits for care of children affected by cancer or other serious illnesses (article 135.*quater* of the social-security law), the age limit which is marked is not the beneficiary of the provision, but the affected by the contingency. The provision itself has a limit set at the age of 18 years and this is where the problem of application of the corresponding age arises. The subsidy is dedicated to cover the reduction in working hours experienced by the person in charge of the care of the child, and it should not be financed within the contributory social-security model, so the application of a sustainability factor to this benefit can be doubted.

There are others benefits - Permanent non-disabling injuries or Partial permanent disability for the usual profession- that are lump-sum compensations that are a one-time payment but that have to be studied taking into account their relationship with Total and Permanent Disability - these can be considered a pension or a lump-sum compensation depending on whether the beneficiary has reached sixty years or not, so it makes the treatment from the theoretical point of view complicate. Even if they are one-time payment benefits, they can become term-benefits through an actuarial-

financial equivalence, because they are referred to likely permanent consequences, therefore the application of the sustainability factor would be advisable.

The non-contributory pensions - disability, retirement and family benefits - have the character of care benefits and their amount and revaluation are set in the laws of State budgets. Some of them have lifetime vocation, but his annual determination influence other criteria as the lack of sufficient contributions to gain access to a contributory pension which makes the implementation of sustainability and revaluation factors less effective because they can be "absorbed" by the decision on the amount of the pension adopted by the legislator. This does not mean that the sustainability factor is not related to these pensions, because if they do not maintain a reasonable distance and balance with the amounts of contributory pensions - in their initial amounts and their revaluation- the direct consequence is that contributions "will be worth" less with time and the lack of interest will increase because there is not a perception of a clear difference between being or not a contributor which means a greater lack of solidarity and inefficiency in the system.

6.5. Transparency, constitutionally and other issues

Coinciding with the opinion of the majority of Actuaries and professionals who have studied from various points of view the sustainability factor in the broadest sense (*FS* & *IRP*), anything that relates to the factor of sustainability must be governed by the principle of transparency. All the arguments, tools, methodologies, estimates and values must be at all times available to the public by accessible media and comprehensive explanatory proceedings, something that, in practice, has unfortunately not been performed. We know the value of the revaluation in 2014: 0.25%, the lower limit, but the value of *IRP* is as unknown as the partial values and the partial

formulas used in its calculation. Curiously, from the private protection sector lots of pages about the transparency of Social Security have been written; unfortunately, in our opinion, not many about its own transparency, although it is true that, at the moment, transparency is not a characteristic of the public model. Other similar additional critics have been made by Vidal Meliá, C. (2013)[9] in the following terms:

> The sustainability factor for Spain is not automatic and is only based on life expectancy in 2027. Decisions that may have to be taken to deal with potential situations of insolvency would therefore not be automatic and would not be based on a full solvency or sustainability indicator (…) The Spanish sustainability factor has no short-term effects (…) There are no predetermined rules, only an imprecise commitment to review the parameters of the system every 5 years (…) the designed mechanism is not transparent because it is unclear how adjustments will be made and who will bear the costs when an adjustment occurs.

and a question from a parliamentary group to the Government of Spain has been sent[10] to clarify the absence of transparency in the *IRP*.

Moreover, the lack of constitutional specificity and the impossibility to find a common definition of the terms "sufficiency" and "adequate pension" have meant that, in the past, we have updated pensions using the Consumer Price Index, not because this was a fair and efficient solution, but because it was the only way to find a solution to the wording given by the Spanish Constitution, and so, not for this reason any other form of

[9] Vidal Meliá, C. (2013): "An assessment of the 2011 Spanish pension reform using the Swedish system as a benchmark". *Journal of Pensions Economics and Finance*. Cambridge University Press.

[10] Official Request (dated January 30, 2014) to the Minister of Employment and Social Security for her attendance to the Committee on Employment and Social Security of the House of Representatives.

revaluation must be unconstitutional, especially when the new formula allows the revaluation of pensions to be above the instrument used so far, the Consumer Price Index.

Following article 50 of the Spanish Constitution, the revaluation of pensions acts to ensure the "economic sufficiency of elderly citizens" but one question is whether we can determine the exact age in which citizens are considered elderly people. Furthermore, as recognized by the Constitutional Court[11], in terms of the protection and care for the elderly *"we cannot forget that the economic resources to achieve the objectives of the legislative action are limited"* and that *"affiliates to Social Security do not have a subjective right to a certain amount of future pensions"* and that our Constitution is not obliged *"to keep all and each of the initial pensions in the planned amount or that each and every one of those already caused have to experience an annual increase".* In summary, the revaluation of pensions is not an acquired right, must not be strictly annual or does not have to affect in the same way to all the collective covered, and is not inexcusably linked to the Consumer Price Index, statements that support the implementation of *IRP*. If the sustainability factor in the broadest sense (*FS* & *IRP*) infringes the Spanish Constitution, the same argument should also be proposed for many other rules - Law 27/2011 for example- that have reformed the system of Social Security through measures with a negative economic impact for the citizens.

Another feature that has to be noted in the analysis of a sustainability factor based on life expectancy *FS* – regardless of Committee or Government's proposals - is the sensitivity of the projections used. Finally, in terms of the practical application of the sustainability factor law, there are

[11] STC 134/1987, de 21 de julio y STC 100/1990, de 30 de mayo.

issues that have not yet been explicitly solved and that are a limit for transparency:

1. Whether the group of pensioners from retirement includes or not disability pensioners in life tables
2. The expressed formula used to calculate the substitution effect.
3. Regarding the rate of variation of prices up to December, calculated according to official data from the *INE*. How will it determine this revaluation and its relationship to the upper limit of the *IRP*? Will it be really and exactly calculated at the revaluation time? Will there be a compensation procedure in other cases?
4. Which macroeconomic variables are going to be considered as basic to estimate revenue and expenditure? What estimation procedure will be used by the Social Security?

7. Other designs

The debate about the sustainability factor has been dealt with from different perspectives depending on the institutions and professionals participating, with too many critics and too few alternative proposals for the design. To improve transparency and knowledge of the real situation of the Social Security, the definition and the calculation of the actuarial balance sheet model should be incorporated into the Spanish model independently of the application of a particular sustainability factor.

7.1. The Intergenerational equity factor "adjusted to the age of entry to retirement"

Using the life expectancy as a variable of adjustment, Hoyo Lao, A. (2014) has proposed an alternative intergenerational equity factor that

"fulfilling the objective to limit the longevity, adapts to different periods - transient or full validity of the reform of 2011 - and situations -such as the advance or delay in access to retirement- and it is also less sensitive to the reference year chosen to link the delivery to the evolution of life expectancy". The proposal is based on the adaptation of the denominator of the factor of intergenerational equity using the same access to retirement age at the time of its recognition, age *i*, which may be different from the age *j* that is linked to the t_0 reference year, that is, *j* is fixed and *i* variable, thus coming up to the expression:

$$FEI_a = \frac{e_{j,t_0}}{e_{i,t_0+s}}$$

and values such as:

Table 3. Comparison between the *FEI* and the FEI_a

Year	FEI	FEI_a
2014		
2015	0,9928	0,9964
2016	0,9858	0,9924
…	…	…
2020	0,9590	0,9847
…	…	…
2025	0,9282	0,9849

Source: Hoyo Lao, A. (2014).

7.2. The sustainability factor and the application of the equation of Kaan

Based on the actuarial collective equivalence principle or equation of Kaan, Sáez de Jáuregui Sanz, L.M. (2013) has proposed a sustainability factor that relates to initial pensions at the moment *t* and *t+r* using the following expression:

$$P_{t+r} = P_t \cdot \frac{(1+e_{x,t})}{(1+e_{x,t+r})}$$

establishing a sustainability factor through ratios of life expectancies added to the unit, which, in practice, would use a value of *r* = 5 to adapt to temporary requirements established by Law 27/2011. Setting the age of departure, *x*, in 67 years, the reference year in 2014, and using the life expectancy corresponding to tables of Social Security that are the basis for the *FS* values of the ratio of this alternative we obtained the following data:

Table 4. The sustainability factor and development of equation of Kaan

Year	Factor	Year	Factor
2018	1,0000	2025	0,9627
2019	0,9961	2026	0,9599
2020	0,9922	2027	0,9572
2021	0,9885	2028	0,9546
2022	0,9849	2029	0,9521
2023	0,9814	2030	0,9497
2024	0,9780	2031	0,9473
2025	0,9747	2032	0,9451
2026	0,9716	2033	0,9429
2027	0,9685	2034	0,9407
2028	0,9655	2035	0,9387

Source: Own elaboration with data from Social Security.

The results are not very different from those obtained by the ratio of life expectancies, but his formula results more logical from an actuarial point of view, which makes it a preferred option against the application of a life expectancy ratio. In the same work and using again the equation of Kaan, the author proposes a sustainability factor based on "an automatically reduction of the pensions´ growth", actual actuarial values and the inflation *c*, using the formula:

$$VAA^{c}_{x,\,t} = VAA^{c-FS}_{x,\,t+5}$$

7.3. The adjustment to the age of entry and the collective reference

Similar to the previous proposals, it is possible to establish an alternative for the sustainability factor *FS* using the age of access to the benefits that allows for adaptation to different alternatives in terms of groups depending on its related benefits. The technical argument is based on an actuarial approach that draws on the search for greater actuarial equity between generations and also benefits. It is therefore the use of a ratio, with life expectancy in the numerator and the denominator, and securing only the reference year but without setting a reference age for everyone in the collective due to its variability. For each benefit *p* would have:

$$FS^{\,p} = \frac{e^{p}_{j,t}}{e^{p}_{j,t+s}} \quad \text{or} \quad FS^{\,p} = \frac{1+e^{p}_{j,t}}{1+e^{p}_{j,t+s}} \quad \text{or} \quad FS^{\,p}_{t} = FS^{\,p}_{t-1} \cdot e^{*p}_{t}$$

This enables the action on different benefits in a more suitable technical and social environment, although it is necessary to obtain mortality tables that correspond to each group for a better fit. This alternative also allows the adaptation of life expectancy at the age of entry to benefits in each moment, even though there may be other approaches in the case of postponed and anticipated retirement respect to the general retirement age. For retirement-pensions that are different from the general retirement age, where perceived benefits during a period other than that corresponding to the general age, the same sustainability factor than the one for general retirement age could be applied, which would benefit the postponed retirement and would strengthen the conditions for early retirement, even though this is something that can be achieved with the application of

equitable and appropriate coefficients, without making new adjustments through the sustainability factor.

7.4. The *Individual generosity index* as a sustainability factor

A global alternative to work with is the concept of "generosity of the system" and the *Individual generosity index* to adjust the variables (see also section 2.). This index is a measure that reflects the relationship between individual contributions to the system Y_s and expected benefits from the system Z_k, relationship that, by simplicity, has been here restricted to contributory retirement pensioners (then, Y_s are real and known values):

$$I^{g}_{t_{RET}} = \frac{\sum_{s=1}^{n}\left(\sum_{r=1}^{m} Y_{s,r}\cdot(1+i_m)^{m-r}\right)\cdot(1+i)^{n-s}}{\sum_{k=0}^{\omega-x-1} Z_k \cdot {}_kE_x \cdot (a^{(12)}_{x+k:1} + a^{(2)}_{x+k:1})}$$

Applying the individual generosity index as a sustainability factor complies with the goal of improving the relationship between the contribution and what is perceived, as well as promoting the solvency of the system and incorporating the life expectancy in the stream of benefits. It is, therefore, of great interest since it acts upon the true contributory effort of individuals during their entire working life and it is his/her individual history what determines any correction, being also adaptable to benefits of a different kind. One of the possibilities of calculation is to set a minimum percentage F_m of charge on the pension and link the generosity index with its complementary value to the unit, allowing the model to add a greater percentage of pension the lower the generosity of the system is to the individual, i.e. the more that the worker has contributed in relation to what

he/she expected to perceive. The use of F_m limits the effect of the index but maintains solidarity as a component in the calculation and prevents the application of high values of discount on the initial pension. We could also set an upper limit of the sustainability factor and/or the individual generosity index thinking about the solvency of the system since the index of individual generosity can be greater than 1, although this limits equity to those who have contributed more than they expect to receive. For example, the resulting formulation for the sustainability factor *FS* through a linear transformation would be:

$$FS = F_m + (1 - F_m) \cdot I^g_{t,RET} \quad , \quad I^g_{t,RET} \leq 1 \ , \ F_m \in [0,1]$$

This design allows savings in expenditure on pension because of the use of $(1 - F_m)$ as a maximum corrective limit. From the employees' perspective, it would be difficult to reach this limit since in order to obtain a contributory retirement benefit they would have had to perform a certain number of quotes, which would always add a percentage to the minimum limit set. Taking into account that the lower the index, the higher the generosity, the following table is an example of the sustainability factor based on a generosity index of 0.90 and 0.60, for different values of F_m:

Table 5. The sustainability factor based on generosity index

F_m	$I^g = 0,90$	$I^g = 0,60$
0,95	0,9950	0,9800
0,85	0,9850	0,9400
0,80	0,9800	0,9200
0,75	0,9750	0,9000

Source: Own elaboration.

The lower, the value of F_m, the more recognized contribution to the system in relation to the expected benefits and the bigger discount on the initial pension. This index is based on an actuarial approach that combines the application of actuarial techniques, the impact on equity and the direction towards balance and solvency; its application is very intuitive: the bigger the gap is between an expected pension and what has been contributed to get it, the bigger the correction that should be applied.

7.5. The current revenue and expenditure of the Social Security

Using the concepts of income and expenditure of social-security system, a sustainability factor that only takes into account the relationship between both can be defined as a corrective and estimated measure for the future situation. For example, the coefficient of income and actual expenditures of each year (including relevant settings for extraordinary items) can be used and a revaluation of pensions by a corrective factor which, respecting the alternative proposed by the Government, uses an interval with minimum and maximum limits can be established. Using the relationship between income and expenses does not require long reporting periods from the past for its calculation, although the inclusion of a greater number of them can provide more information. This model is intuitive, simple and does not need to incorporate future estimates, but should not be forgotten that it is based on an indicator of liquidity and a solvency issue would require using, as more appropriate, the actuarial balance sheet model.

8. Conclusions

The sustainability factor itself is not necessary; what would be necessary would be its effects, and there are other alternatives that can have the same effects. The sustainability factor is not sufficient because it

works only on one part of the expenditures of pensions and it cannot guarantee sustainability only by itself, although it would be positive for it. In our opinion, it does not change the principles of the model, neither the financing, while many of its criticized characteristics are already used in the system. Furthermore, *FS* should be applied to all long time benefits and the real age of entry in the system should also be used. *IRP* has been designed with excessive arbitrariness and should not depend on future estimations.

We believe that the sustainability factor is constitutional and we defend its spirit and theoretical basis, but not its practical application, which does not have the sufficient and necessary transparency. There are other alternatives, for example actuarial annuities, and it is possible to use the individual generosity index as an adjustment variable in order to improve the relationship between amounts paid to the system and from it, to improve the sustainability and to include the life expectancy in the model. In any case, the actuarial balance sheet model for Spanish social-security system must be calculated and implemented as a standard practice because it is an essential tool in decision making and knowledge of the Social Security.

Fecha de recepción del artículo: 25 de marzo de 2014
Fecha de aceptación definitiva: 21 de mayo de 2014

References

[1] Bosch Príncep, M.; D. Vilalta de Miguel; I. Morillo López y O. Roch Casellas (2013): ”Revalorización de las pensiones españolas del 2012 y 2013: una aplicación implícita del factor de sostenibilidad”. *Economía Española y Protección Social*, nº 5. Asociación de Actuarios, Estadísticos y Economistas de la Seguridad Social. Pág. 97-113.
http://www.aaeess.es/descargas/revistas/EEYPS_5_articulo_04-MANUELABOSCH.pdf

[2] De las Heras Camino, A.; M.B. Gosálbez Raull y D. Hernández González (2014): *Enfoque actuarial para la implantación del factor de sostenibilidad en el sistema público de pensiones en España: nuevos retos para los sistemas complementarios*. Fundación Mapfre. Ayudas a la investigación 2012.

[3] De las Heras Camino, A.; M.B. Gosálbez Raull y D. Hernández González (2014): “El factor de sostenibilidad en la Seguridad Social. Una visión actuarial”. *Gerencia de Riesgos y Seguros*, nº 118. Fundación Mapfre. Págs. 28-35.
http://www.mapfre.com/fundacion/html/revistas/gerencia/n118/es/estudio2.html

[4] De las Heras Camino, A. (2013): ”El Factor de Sostenibilidad en la Seguridad Social española. Un análisis de la propuesta del Comité de expertos y la decisión adoptada por el Gobierno”. *Revista CEF (Trabajo y Seguridad Social)* en abierto.
www.laboral-social.com/factor-sostenibilidad-seguridad-social-espanola-analisis-critico.html

[5] De las Heras Camino, A. (2011): “El Factor de Sostenibilidad y el diseño de los actuales Sistemas Públicos de Pensiones”. *Revista de la Red de Expertos Iberoamericanos en Seguridad Social*, vol. 9. Págs. 10-13. http://www.oiss.org/IMG/pdf/N9_Revista_digital_de_la_REI_en_SS.pdf

[6] Devesa Carpio, J.E.; M. Devesa Carpio; R. Meneu Gaya; A. Nagore García; I. Domínguez Fabián; B. Encinas Goenechea (2013): *Observatorio sobre el factor de sostenibilidad*. http://www.uv.es/pensiones/Factor-de-sostenibilidad.html

[7] Hernández González, D. (2013): “La generosidad como herramienta de información individual de los sistemas de seguridad social”. *Anales del Instituto de Actuarios Españoles*. Noviembre. Págs. 177-198. http://www.actuarios.org/espa/web-nueva/publicaciones/anales/2013/177-198.pdf

[8] Hernández González, D. (2011): “La prestación contributiva de jubilación en la Seguridad Social. La generosidad del sistema y su reforma en base a la transformación de las fuentes de financiación”. *Ubicumque sint. In Memoriam. Gregorio González Gómez y Juan Andrés González González*. III Congreso Ibérico de Actuarios. Congreso Internacional, Madrid, Junio.

[9] Hoyo Lao, A. (2014): “El factor de sostenibilidad del sistema público de pensiones y su entrada en vigor: el factor de equidad intergeneracional ajustado a la edad de acceso a la jubilación”. *Economía Española y Protección Social*, nº 6. Asociación de Actuarios, Estadísticos y Economistas de la Seguridad Social.

[10] Meneu Gaya, R; J.E. Devesa Carpio; M. Devesa Carpio; I. Domínguez Fabián; A. Nagore García y B. Encinas Goenechea (2013): "El factor de sostenibilidad: diseños alternativos y valoración financiero-actuarial de sus efectos sobre los parámetros del sistema". *Economía Española y Protección Social*, nº 5, Asociación de Actuarios, Estadísticos y Economistas de la Seguridad Social. Págs. 63-96.
http://www.aaeess.es/descargas/revistas/EEYPS_5_articulo_03-ROBERTMENEU.pdf

[11] Sáez de Jáuregui Sanz, L.M. (2013): "Dos modelos de sostenibilidad en el sistema de reparto de las pensiones de jubilación de prestación definida". *Economía Española y Protección Social*, nº 5. Asociación de Actuarios, Estadísticos y Economistas de la Seguridad Social. Págs. 263-322.
http://www.aaeess.es/descargas/revistas/EEYPS_5_articulo_09-LUISSAEZDEJAUREGUI.pdf

[12] Varios autores (2013): *Informe del Comité de Expertos sobre el factor de sostenibilidad del sistema público de pensiones* y votos particulares emitidos al respecto. 7 de Junio.
http://www.lamoncloa.gob.es/NR/rdonlyres/BA253188-A40C-47C4-9FCC-06D04C65EC26/238803/informesostenibilidadpensiones.pdf

[*] Todos los enlaces están operativos a 15 de mayo de 2014