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## **Synthesis of pension system parametric assessment**

**Keywords:** *old age security, cohesive testing, public pension, pension indicators, international standards.*

**Abstract:** Population aging and last decade economic circumstances are the factors the pension systems should overcome for maintaining either appropriate level of benefit amount for decent life in the developed countries or minimum subsistence allowances in developing and poor countries, hence many public pension systems worldwide are experiencing difficult economic period as its economy is in the period of financial crisis which affected to the social budget sustainability. Private pension scheme are making its low records worldwide but trying to keep necessary minimum level accrued rights for asset holders and it is clear that the asset holders, means insured people, need to wait till the stormy period of financial crisis is over. Public pension PAYG scheme with its redistribution nature is still being the main bearer of the role of the old age income security. How to keep a national public pension system sustainable? The only prescription how to do it is a periodical renovation by testing the public pension scheme on (i) soundness and effectiveness within national financial and economic system, (ii) appropriateness of its organization and administration, (iii) compliance of parameters with international standards. The listed measures allow to look into a pension system more closely and especially to the pension main indicators which play various roles in the providing of the system vitality. Being steadily studied separately, each indicator can be easily discussed and described. But when we try to synthesize multifactor analysis, then we are limited only by narrative conclusions and reports. To obtain more calculable and tangible results, and in order to make the analysis more attractive, in the research, it is applied empirical quantitative approach of econometrics as a tool that mediates between factor analysis and decision making for explaining old age security national indicators behavior. Paper is suggesting analytical system for assessing national pension system by applying new techniques of (i) the pension indicators evaluation and (ii) its values synthesis for the following indicators: existence of

first public and funded pillars, inflation adjustment rules, salary growing adjustment, system adequacy and affordability, dependency ratio, length of service, retirement age.

As an evaluation base there will be used international social security standards which are composed to cohesive pension model (CPM) which consists of selected standardized indicators and its evaluation techniques. The model is tested to each pension system indicator and calculates its digital values. The values are resulted in the Cohesive Testing System index of the particular national pension system by applying CTS formula which is a linear equation. CTS index determines how a national pension system fit to international standards and ranges a pension system in accordance with common denominators which mainly based on ILO Social Security standards (ILO Convention 102 “Social Security Standards”, 1952) in retirement age, amounts of persons protected, length of service, and also based on World Bank recommendations on various pension indicators especially on social contribution rates, retirement age and pension pillars.

As it is defined in the conclusion, the CTS indices’ results are very similar with the results of many traditional researches and pension systems rankings, hence the Cohesive Testing System may take his place in the ranking systems as specific technique of old age security parametric analysis based on international standards.

## **Introduction**

Pensions are still remain the main long term income replacement social benefit which perfectly reflects the social security main formula – the simple Fisher model which is a rational consumer choice over the citizen’s life cycle (Barr N., 2001, pp.11-12). Over the time, and out of this macroeconomic question the old age security in the era of market and social changes becomes vitally important.

The main objective of the paper is to improve a public pension parametric analysis technique which is crucial for its further maintenance.

The research suggests standard mechanism of whole pension system parametric assessment and synthesis which makes a decision-making process more qualitative. The article presents the methodology of Cohesive Testing System (CTS) which is a new method of national pension systems indexing based on international standards of pension security.

The paper discusses two major methods of CTS system:

- Cohesive Pension Model (CPM);
- CTS Formula.

In the conclusion the CTS methods will be applied to the set of public pension systems of selected countries. Main pension indicators’ values of the selected countries have been picked out from various articles and

OECD statistical tables and quoted results and conclusions pertaining to the researched scope of pension systems.

## **Methodology**

### **a) Cohesive Pension Model**

Variety of pension parameters depends on policy choices but all of them aim at the goal of the income replacement in old age and the main composition of parameters of the pension systems and its behavior, in turn, falls under the more or less unique rules. Cohesive pension model of international standards is considered as a “scientific instrument” (Jos Berghman, 1986, pp.34-39) which is used for assessment of national old age security system.

Not always the similar parameters may be appropriate for comparison each other in various countries. It’s important to find common denominator and in our case these are international social security standards and quasi comparative method which compares different variables with common pattern.

Cohesive Pension Model is designed as one of the important step of CTS system and consists of coherent international standards for the examined parameters of the pension insurance and on the next step the CPM is compared set of national pension parameters and reach CTS index. CPM is a set of international standards for the following basic parameters:

- qualitative parameters are scored “Yes” or “No” based on the pension pillars and methods of pension benefits indexation;
- quantitative parameters are replacement rate, contribution rate, amount of persons protected or dependency rate, length of service, retirement age and other quantitative parameters of national pension system which may be measured by scores based on its values.

The dependent variables in the formula are numbers of mentioned parameters in the Table 1 and each of them has their own rate in accordance with its values.

**Table 1. CTS set of indicators and its evaluation techniques.**

N	Items	Variable in CTS formula	Mean	Low values	High values
1	First pillar	k1	Yes/No	0(No)	20(Yes)
2	Second pillar	k2	Yes/No	0(No)	5(Yes)
3	Inflation adjustment	k3	Yes/No	0(No)	5(Yes)
4	Salary growing adjustment	k4	Yes/No	0(No)	10(Yes)
5	Adequacy (replacement rate)	k5	Rate	0 if $x < 40$	$10 + (x - 10)$
6	Affordability (Contribution rate)	k6	Rate	0 if $x > 30$	$10 - (x - 20)$
7	Amounts of persons protected (dependency ratio)	k7	Rate	0 if $x > 40$	$10 + (40 - x)$
8	Length of service	k8	Rate	0 if $x < 30$	$10 + (x - 30)$
9	Retirement age	k9	Rate	0 if $x < 60$	$10 + (x - 60)$

The result of final calculations is CTS index of national pension system which determines how close the national pension system parameters to CPM harmonized international standards.

CTS index allows decision makers and reformers to estimate the current situation and also to understand how to refine the system and how to increase the cohesion rate. The high cohesion means that pension system is compliant with international social standards and does have an indication of sustainability of a national old age security system due to assumption that CTS rating considers how much the main indicators are coherent with economic theory of social security and classical pension equation  $sWL=PN$ , where “s” is a pension contribution rate, “W” is an average real wage, “L” is number of workers, “P” is average pension, “N” is a number of pensioners (Barr N., 2001, pp.96-100).

#### b) CTS Formula

The data (metrics) we have discussed above are processed by our multi-factor cohesive linear variables statistic formula.

Statistical processing of the results is carried out using the factorial analysis with post comparison of values with international standards.

The formula is an ordinary linear equation with number of indicators and strengthened by adding a square root index of total value of quadratic equation of the  $k$  variables which were explained in detail within the

previous chapter. Values of those variables have predefined intervals of scores as it is described in the Cohesive Pension Model in the Table 1 above.

The CTS quadratic equation is of the form:

$$c = \sqrt{\sum k_i^2}$$

where,

c - CTS index;

k - digital value of the metrics which represents pension indicator. Here  $k=0$  as lower value and higher value of the indicator is calculated by using of the evaluation techniques in the Table 1;

i - sequential number of indicator.

## Paragraph

Based on the methodology described above, further we will go through the indicators and how CTS scores each of them.

a) Pension pillars.

Pension pillars are the major indicators within CTS system. Classical definition of the first pillar is a pension system which organized publicly and by the principle pay-as-you-go (Nicolas Barr, 2001, pp 89-95), thus mainly covers major part of population and second pillar is various types of funded pension schemes. CTS considers that PAYG scheme is more reliable and can withstand pressures and overloads and more isolated from external shocks as it was shown during the recent 2008-2009 financial crisis and main reason of the relative stability is in the redistribution of social contributions.

On the contrary, the fashion of the latest decade, funded pension scheme, is experiencing hard times due to risky nature of the pension assets which are to be managed through unstable market. Since the recent financial crisis the funded pillars were diminished in certain extend in some countries we studied. Many countries now are restructuring of the management of pension assets and some countries significantly shrinking funded pension scheme parts due to uncertainty, lack of information and risks (or any of

combination of these three factors) of financial market and its possible impact to actuarial insurance as adverse selection and moral hazard (Nicolas Barr, 2001, pp 13, 91-93, 100-122). CTS treats funded pillar as a supplementary scheme and considers that PAYG is more appropriate pension scheme due to its stability, coverage, endurance and sustainability. Base on the opinion concluded above, the “first pillar” indicator, or public pension security system is reputed to be a guarantee of income security in old age and CTS scores a presence of national public pension system with 20 score and, in turn, funded system is evaluated with lower rate of 5 score.

b) Benefits adjustment.

Research shows that mainly the pension adjustment techniques rely on economic situation of countries. Most popular techniques are simple adjustment of pension amount to CPI index but as a consequence, the real value of the pensions will be gradually diminishing every year. On the contrary, wage growth indexation which is financially reasonable and viable is not used by many countries. Some countries invented hybrid techniques of pension adjustment when calculation is based on combination of “wage”, “contribution”, and even on other factors like sustainability. Few of them use annual or one off compensations, for instance, a compensation due to pension reforms which might cause actuarial decline of pension amounts.

Pension adjustment based on customer price index (inflation) is a minimum level of pension amounts indexation, whereas wage based indexation allows to reach more higher level of benefit adjustment and CTS evaluates the former pension adjustment technique with score 5 and latter one with 10.

c) Pension benefits adequacy.

Adequate replacement rate, first of all, protects low-income workers from the old age poverty (OECD, 2011, p.118) and the low income groups of insured people gain more from the public pension scheme than average and higher earners.

Pension adequacy is one of the major parameter of CTS and 40 percent of replacement rate which is a minimum promulgated by ILO Convention 102 “Social Security (Minimum Standards) Convention, is considered by CTS as a minimum threshold. The value that lesser than the replacement rate threshold is not regarded as an appropriate level of pension. Developing countries now is struggling to obtain the minimum standards but still it is remaining high plank. Usually, developing countries where ILO standards are not ratified establish own national standards which are smaller than the

ILO minimum standards. European Union average varies around 60 percent and some countries traditionally pay more. Most recent European member States still have low level replacement rates of public pensions. World Bank experience generally stipulates that for employee with full service length as an initial target of retirement income replacement (net of tax) from public pension insurance systems would be about 40 percent of the real earnings to maintain subsistence levels of income in retirement taking into account a general trend that the replacement rate of low income workers is higher than those who get high salary and by the opinion of World Bank experts the replacement rates above 60 percent is not viable when it is kept over the long period as it would require higher contribution rates and negative effect to economy (Holzmann Robert and Hinz Richard, 2001, pp.55-57). Based on the World Bank position and also the on articles 28 and 67 of the ILO Convention 102, CTS evaluates with 10 score the adequacy is equal to 40 percent and adjusted by each additional value above 40 percent.

d) Pension system affordability.

Pension system affordability or social contribution rates refer to the economic and financial capacity of the business, individuals and whole society and uses contribution rate indicator which is balancing the social security equation by N.Barr (2001)  $sWL=PN$  regarding old age security. Mainly, contribution rates are actuarial instrument used by countries and apparently the rates depend on the budget of the public pension fund and CTS, on the contrary, calculates its “degree of actuarial fairness” (Eliza Baroni, 2007, pp.13-28) and regarding the formula, it refers to the link between pension contributions and pension benefits and it can be equated as  $(sWL/PN)-1=0$  and any nonzero probability does not provide actuarial fairness of the pension system. According to the equation the contribution rate is direct proportional to pension fund ( $s=PN/WL$ ) and it obviously means that the more contributions the more pension fund. On the other hand, the contribution rate is in the inverse proportion to wages and labour force (WL) and it says about economic pressure to employers and employees, hence, high contributions negatively affect wages and entire state budget. It is consistent to the

World Bank indications, and CTS takes into consideration the 10 percent of pension contribution rate as a standard and “comfortable minimum” threshold for national economy and the rates higher than 20 percent of wage bill causes “direct” and also “indirect” costs of high social contributions through budget burden and higher incentives for evasions accordingly (Robert Holzmann and Richard Hintz, 2001, pp.55-57). It



makes CTS establish the indicator's score with maximum reasonable threshold of 20 percent of contribution rate and further adjustment within the interval of 10-30.

e) Dependency ratio.

Dependency ratio will show the potential

Regarding dependency ratio standard, CTS applies ILO Convention 102 method of defining the norm of pension system coverage among active employees or among whole inhabitants. In accordance with Article 27 of the ILO Convention 102 a pension system should cover minimum not less than 20 percent of inhabitants or 50 percent of all employees. Also, it needs to be kept effective proportion of active population which is not less than approximately 2,5 active workers who pays social contributions to 1 pensioner (calculation was made in accordance with a statement in ILO Convention 102 where 50 percent of all employees is approximately 1/2 and CTS starts its assessment from 40 percent as minimum required dependency ratio) (ILO Convention 102, 1952). In our research it is used an economic old age dependency ratio which matters when a research deals with pension system sustainability (Woss J., 2011, pp.66-68). The formula of the economic old age dependency contains inactive population related to active population.

f) Length of service.

CTS treats length of service indicator standard by taking into account the requirement of the Article 29 of the ILO Convention 102 "a qualifying period which may be 30 years of contribution" (ILO Convention 102, 1952) and also minimum qualifying period which gives right citizens to be entitled to the state pensions. At the same time CTS is not concerning with various early retirement schemes which practically lead to additional deductions from pension amounts per pre-retirement periods (years, quarters or months) and this technique is actually grading and adjusting pension rights in accordance with the length of socially contributed service of citizen. Service length of 30 years will be scored as minimum rate 10 and every incremental year will increase the score accordingly.

g) Retirement age.

The ages are "situated between 60-65", but some countries establishes "flexible retirement age" an one can be retired "in a larger time span" (Pieters Danny, 2006, 51-58) and, according to this, CTS retirement age concept is: the more (lengthy) pension age the better a pension system and person as well as society would gain more from longer employment period.

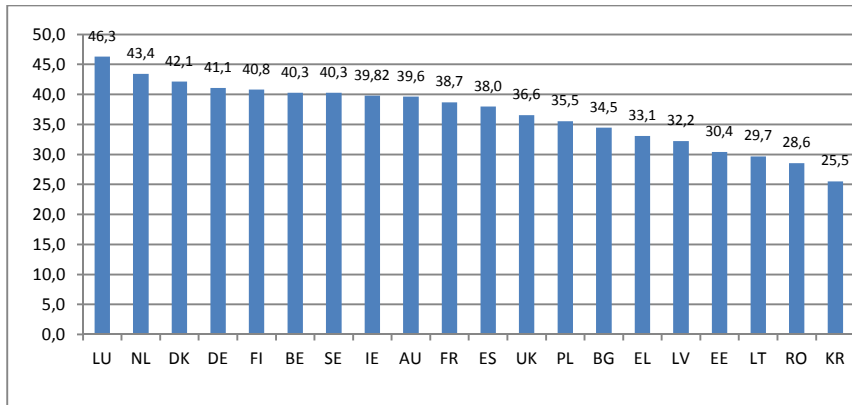
Though, in the Article 26 of the ILO 102 social security standards establish “65 years or such higher ... with due to the working ability of elderly persons in the country concerned” (ILO Convention 102, 1952), CTS flexible retirement age concept establishes 60 years as a necessary minimum and lesser retirement age is scored as zero and in turns score will be higher as the higher the retirement age will be beyond that minimum.

### **Conclusion**

For cohesive testing, there were analyzed the old age security systems of selected countries by using open statistical databases (Eurostat database, 2014 and Pension watch, 2012) and applying CPM Model and CTS Formula. It resulted in CTS indices (see table below) and the following findings:

- Luxembourg, Netherlands, Denmark are leading the cohesive testing system range. Big group of continental countries Belgium, Germany, Austria, France and also Finland and Sweden composes stable CTS rates (which is considered to be 36,00 an higher).
- Post crisis measures of Ireland pension system which has tightened national pension system conditions brought necessary achievements and, as a result, Irish pension system is rated accordingly due to increased retirement age and length of service along with good perspectives in dependency ratio which may provide financial sustainability of public pension system in the future.
- Financial crisis dropped Greek pension system CTS rate by causing understandable negative effects to its adequacy.

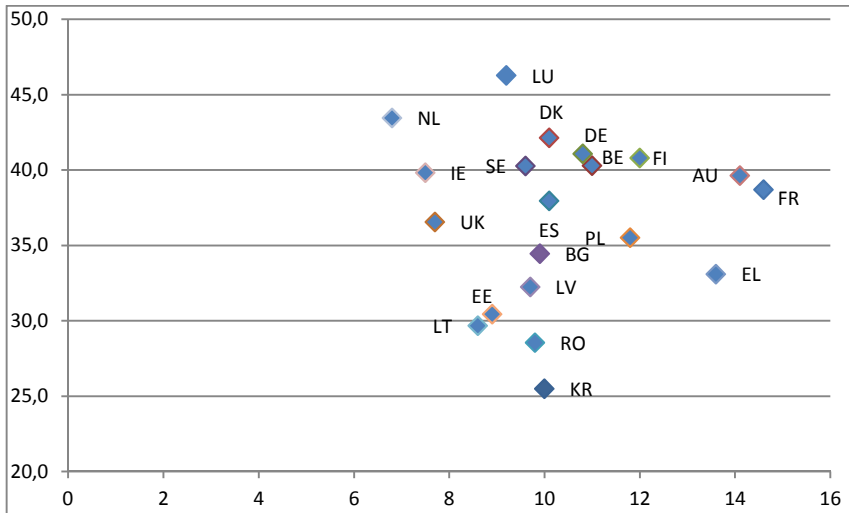
**Chart 1. CTS index table**



- All indicators of EU recent new members Lithuania, Estonia, Latvia, Romania led by Bulgaria are quite low than studied countries with stable CTS rate. CTS brought these countries up the rare because of relatively high dependency rates, low service length which resulted in inadequate pension amounts level.
- CTS calculations consider that universal pension system of United Kingdom is too liberal by having low level of required length of service and retirement age which resulted in low replacement although there is appropriate level of dependency of pensioners to active population (i.e. dependency ratio).
- Kyrgyzstan which is a single representative of Central Asia in the research, has a pension system which was updated during the post soviet period and poor economy affects pension system efficiency and CTS is equal to 25,5 is quite low.

CTS rates and public pension system expenditures dispersion shows that there is no correlation between them generally (correlation rate 0,014), which means that, in general, CTS rate doesn't depend on rates of pension expenditures in GDP.

Chart 2. CTS index table



However, when we make analysis of various groups of countries separately, then we can observe a distinct dependency between the CTS rate and expenditures.

We ranged the pension systems in accordance with CTS rates and composed two groups of countries. First group contains CTS ratios less than 36,0 and represents mainly countries that join EU recently and their GDP size is lesser than other EU member states within studied scope. Second group consists of the EU developed Member States from both Atlantic and Continental Europe.

First group of researched pension systems' CTS rates depend on public pension expenditures and positive correlation, which is equal to 0,74, shows significantly high level dependency. It means that these countries' pension systems quality still relies on expenditures.

On the contrary, the rest of the studied countries, which are represented by EU developed Member States, have negative correlation rate -0,39 between CTS and pension expenditures and it means that in some developed countries a direct budget subsidies, in most cases, are not able to improve its CTS rates, and pension systems require more rational restructuring.

Based on the research we can make the following conclusions:

- A pension system synthesized CTS index helps to make comparative study in terms of international standards as well as to define an international rate of the pension system;
- The CTS results are logical and it generally fits with the main conclusions of other recent comparative researches of the EU Member States pension systems, but synthesized CTS index which composed from separately calculated values of pension indicators is more effective and results are more tangible, so that allows to look into the detailed indicators by using its digital values and, in turn, it simplifies analysis;
- CTS is economic index of a pension system and considers how much the main indicators are coherent with economic theory of social security which based on the classical equation  $sWL=PN$ , where “s” is a pension contribution rate, “W” is an average real wage, “L” is number of workers, “P” is average pension, “N” is a number of pensioners.
- Correlation of CTS indices and pension expenditures (in GDP) may show how far the expenditures are effective and consequently may define whether it should be done a rational restructuring of the pension system or it simply depends on budget subsidies.

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