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Online Appendix

Appendix I - Notations

1.	Age	X_a
2.	Time	X_t
3.	Year	X_i
4.	based year	Y
5.	Population (total)	N
6.	Cohort	CH
7.	Elderly People 1.	N_{60+}
8.	Elderly People 2.	N_{65+}
9.	Elderly People 3.	N_{70+}
10.	Elderly People 4.	N_{85+}
11.	Elderly People 5.	$N_{65\text{-}85}$
12.	Young People 1.	N_{0_14}
13.	Young People 2.	N_{0_19}
14.	Young People 3.	N_{0_24}
15.	Working-Age Population 1.	N_{15_64}
16.	Working-Age Population 2.	N_{20_64}
17.	Pensioners	P
18.	Workers	W
19.	Full-time equivalent workers	W_F
20.	Non-Workers	NW
21.	Old_Age Pensioners	P_O
22.	Unemployed People	UE
23.	Inactives	IA
24.	People at or above Retirement Age	$N_{RET\text{-}AGE}$
25.	People at or above Min. Age of Eligibility	N_{MINRET_AGE}
26.	Contributors	C
27.	Tax Payers	TP
28.	Beneficiary	B
29.	Population at risk of benefit	$\tilde{B}$
30.	Effective Labour Force	EL
31.	Effective Number of Customers	EC
32.	Healthy Population	HP
33.	Unhealthy Population	UHP
34.	Population with Disabilities	Di
35.	Population without Disabilities	WDi
36.	Population with Bad	BCF

	Cognitive Functioning	
37.	Population with Good Cognitive Functioning	GCF
38.	Pensions	PA
39.	Old Age Pensions	P_OA
40.	Occupational Injury and Disease Related Pensions	P_HA
41.	Early retirement for Labour Market Reason	P_EA
42.	Services for the Elderly (amount)	SA
43.	Unemployment Benefit (amount)	UB
44.	Active Labour Market Policies (amount)	ALA
45.	Family Allowances (amount)	FAA
46.	Family Services (amount)	FSA
47.	Family Benefits (amount)	FBA
48.	Survivors Benefits (amount)	SBA
49.	Income Maintenance Cash Benefits (amount)	CBA
50.	Incapacity Benefits (amount)	IBA
51.	Educational Related Benefits (amount)	EA
52.	Educational Cost	E

53.	Earnings before taxes	W_G
54.	Annual income	y
55.	Life Expectancy	ϵ
56.	Life Expectancy ≤15	$\epsilon_{i\leq 15}$
57.	Life Expectancy in the post retirement period	ε p
58.	Active Life Expectancy	ϵ_1
59.	Money-weighted average age of retiree	A_R
60.	Money-weighted average age of contributor	A_C
61.	GDP	GDP
62.	Tax revenue	t
63.	Pension tax rate	t_P
64.	Pension liabilities	V
65.	Contributions (in pension system)	$\tilde{C}$
66.	Age specific productivity	γ
67.	Age specific consumption	α
68.	Present Value	PV
69.	Discount Rate	r
70.	Government expenditure	E
71.	Revenues	R
72.	Interest payments on the public debt	iD
73.	Public debt	PD

Appendix II - The taxonomy table

The full taxonomy table is too large to be presented on one page. We first show the general structure of the taxonomy and then its three panels, A, B and C separately.

A taxonomy of indicators of economic sustainability and intergenerational fairness

	Cross-sectional				Long-term horizon		
	Partitioning of the population by			Parametric characterisation	Cohort		Population
	Chronological age	+ Other ind. non-economic characteristics	+ Other incl. economic characteristics		Remaining lifetime	Entire lifetime	
Specific public programmes	A			B	C		

General government			
Market economy			
Total economy			

A: Cross-sectional indicators based on partitioning the population

	Cross-sectional		
	Partitioning of the population by		
	Chronological age	+ Other non-monetary characteristics	+ Other incl. monetary characteristics
Specific Public Programmes		**16.** Pension per Worker Ratio **17.** Pension System Dependency Ratio **18.** Pension Cost Dependency Ratio	**40.** Total Current Pension Expenditure **41.** Public Pension Expenditure Ratio **42.** Benefit Ratio **43.** Aggregate Replacement Ratio **44.** Benefit Generosity Ratio
General Government		**19**. Economic Dependency Ratio **20.** Inactive per Active Ratio **21.** Non-Working Aged Dependency Ratio **22.** Real Elderly Dependency Ratio **23.** GDP Adjusted Real Elderly Dependency Ratio **24.** Tax Revenue Adjusted Real Elderly Dependency ratio **26.** Rostock Indicator 2.	**45.** Elderly/Non-Elderly Spending Ratio **46.** Elderly/Non-Elderly Spending Share **47.** Elderly-Bias of Social Spending
Market Economy	**1-5.** Total Age Dependency Ratio **6.** Ratio of the Population Aged 65	**14.**Proportion of the Population in Age Groups that have a Remaining LEXP 15 years or less **15.** Prospective Old Age Dependency Ratio	**50.** Human Capital Specific Old Age Dependency Ratio **51.** Intergenerational Tax Rate

	or over **7-10.** Old Age Dependency Ratio **11.** Ageing index **12.** Parent Support Ratio	**27.**Health Care Need Adjusted Prospective Old Age Dependency Ratio **28.** Health Care Need Adjusted Real Elderly Dependency Ratio **29.** Adult Disability Dependency Ratio **30.** Cognitive-Adjusted Dependency Ratio **31.** Cognitive functioning indicator based on Symbol-Digit test **32.** Ratio of Active Life Expectancy to Total Life Expectancy **33.** Old Age Healthy/Unhealthy Dependency Ratio **34.** Real Adult Disability Dependency Ratio **35.** Real Elderly Disability Dependency Ratio **36.** Health Care Cost Old-Age Dependency Ratio **38.** Education-Weighted Dependency Ratio **49**. Lifecycle deficit	
Total Economy			

B: Cross-sectional indicators based on parametric characterisation

	Cross-sectional
	Parametric characterisation
Specific Public Programmes	**48.** Pension Support Ratio **64.** Turnover Duration **65.** Accumulated Benefit Obligation
General Government	**25.** Fiscal Support Ratio
Market Economy	**37.** Economic Support Ratio **52.**Potential Years of Life **53.** Prospective Age **54.** Population Average Remaining Years of Life Expectancy **55.** Old Age Threshold Based on Remaining Life Expectancy **57.** Prospective Median Age **58.** Remaining Life Expectancy at Median Age **59.** Duration of Working Life **60.** Disability Free Life Expectancy **61** Healthy Life Years **66.** Mean Age of Earnings **67**. Mean Age of Consumption **68.** Lee's Arrow **69.** Miller's Silver Club
Total Economy	**39.** Total Support Ratio

C: Indicators of long-term horizon

	Long-term horizon		
	Cohort		Population
	remaining lifetime	entire lifetime	
Specific Public Programmes	**80.** Social Security Wealth **81.** Contribution Wealth	**71** Intergenerationally equitable retirement age **72**. Projected Benefit Obligation **73.** Benefit/tax ratio **74.** Pay-Back Period **75.** Net Transfer Rate	**63.** Implicit Pension Debt 1. **77.** Implicit Pension Debt 2. **78.** Implicit Pension Debt 3. **79.** Net Pension Liabilities **80.** Social Security Wealth **81.** Contribution Wealth *Implicit education capital* *Implicit Health Capital*
General Government	**62.** Generational imbalance (GI_AGK)	**76.** Implicit Tax	**82.** General Government Fiscal Balance **83.** Intertemporal Public Liabilities **84.** Sustainability Gap **85.** Sustainability Tax Quota **86.** Tax Gap Indicator **13.** Fiscal Imbalance **70.** Generational Imbalance (GI_GS) **56.** Saving Gap
Market Economy			*Consumption deficit*
Total Economy			

Appendix III - List and definitions of indicators

1. Total Dependency Ratio 1
   - Notestein et al. (1944)

$$TDR1 = \frac{N_{0-14} + N_{65+}}{N_{15-64}}$$

2. Total Dependency Ratio (2-5)
   - UN, World Population Prospect

$$TDR2 = \frac{N_{0-19} + N_{65+}}{N_{20-64}}$$
$$TDR3 = \frac{N_{0-19} + N_{70+}}{N_{20-69}}$$
$$TDR4 = \frac{N_{0-24} + N_{65+}}{N_{20-64}}$$
$$TDR5 = \frac{N_{0-24} + N_{70+}}{N_{25-69}}$$

3. Age Dependency Ratio
   - The World Bank

$$ADR = \frac{N_{0-14} + N_{65+}}{N_{15-64}}$$

4. Dependency Ratio
   - UN

$$DR = \frac{N_{0-14} + N_{65+}}{N_{15-64}}$$

5. Total Age Dependency Ratio 1-2 (Age Dependency Ratios)
   - EUROSTAT

$$TADR1 = \frac{N_{0-14} + N_{65+}}{N_{15-64}}$$
$$TADR2 = \frac{N_{0-19} + N_{60+}}{N_{20-59}}$$

6. Ratio of the Population Aged 65 or over (RPOP65+)
   - EUROSTAT

$$RPOP65+ = \frac{N_{65+}}{N}$$

7. Old Age Dependency Ratio 1-2
   - EUROSTAT

$$OADR1 = \frac{N_{65+}}{N_{15-64}}$$

$$OADR2 = \frac{N_{60+}}{N_{20-59}}$$

8. Old Age Support Ratio (OASR)
   - OECD

$$OASR = \frac{N_{65+}}{N_{20-64}}$$

9. Old Age Dependency Ratio (3-7)
   - UN, World Population Prospect

$$OADR3 = \frac{N_{65+}}{N_{15-64}}$$

$$OADR4 = \frac{N_{65+}}{N_{20-64}}$$

$$OADR5 = \frac{N_{70+}}{N_{20-69}}$$

$$OADR6 = \frac{N_{65+}}{N_{25-64}}$$

$$OADR7 = \frac{N_{70+}}{N_{25-69}}$$

10. Potential Support Ratio 1-5
    - UN, World Population Prospect

$$POTSR1 = \frac{N_{15-64}}{N_{65+}}$$

$$POTSR2 = \frac{N_{20-64}}{N_{65+}}$$

$$POTSR3 = \frac{N_{20-69}}{N_{70+}}$$

$$POTSR4 = \frac{N_{25-64}}{N_{65+}}$$

$$POTSR5 = \frac{N_{25-69}}{N_{70+}}$$

11. Ageing Index (AI)
    - UN

$$AI = \frac{N_{60+}}{N_{0-14}}$$

12. **Parent Support Ratio (PSR)**
    - UN indicator

$$PSR = \frac{N_{85+} \times 100}{N_{50-64}}$$

    - PSR is used to assess the demands on families to provide support for their oldest-old members
    - Since the people in the numerator and those in the denominator are not necessarily related by kinship ties, the parent support ratio should be taken only as a rough indicator of changes in the family support system required for the oldest old

13. **Fiscal imbalance (FI)**
    - Gokhale and Smetters (2003)
    - FI is the current level of debt held by the public plus the present discounted value of future expenditures less the present discounted value of future receipts
    - FI can be calculated for the entire government and also for subprograms
    - $FI_t = PVE_t + PVR_t - A_t$

      PVE_t =the present value of projected expenditures under current policies at the end of period t.

      PVR_t =the present value of projected receipts under current policies (all-including future-generations' net payments)

      A_t =current net financial assets

14. **Proportion of the population in age groups that have a remaining life expectancy (RLE) 15 years or less (Prop. RLE15-)**
    - Ryder (1975); Siegel/ Davidson(1984)
    - Sanderson/ Scherbov, Lutz/ Ryder consider the age which RLE equals 15 years as the threshold of elderly dependency

$$Prop.RLE15 = \frac{N_{\epsilon_{i\leq 15}} * 100}{N}$$

15. **Prospective Old Age Dependency Ratio (POADR)**
    - Sanderson/Scherbov (2005)
    - Here the population with RLE15 and less is divided by the population below this age threshold but above age 20; the age range of the working age population is thus slightly shifted upwards to exclude a large student population most of whom are not (fully) active in the workforce, but include young-old people who could potentially work when the age at old-age threshold is higher than 65

$$POADR = \frac{N_{\epsilon\leq 15} * 100}{N_{a\geq 20}^{\epsilon\leq 15}}$$

16. **Pensioner per worker ratio (PWR)**
    - Bongaarts (2004)

$$PWR = \frac{N_{a>65} + P_{a\geq mr|a\leq 64}}{W}$$

17. **Pension System Dependency Ratio (PSDR)**
    - EUROSTAT

$$PSDR = \frac{P * 100}{W}$$

18. **Pension Cost Dependency Ratio (PCDR) 2**
    - Sanderson/Scherbov (2015)
    - The ratio is the number of people at or above the intergenerationally equitable retirement age to people between ages 20 and that retirement age
    - The intergenerationally equitable retirement age is based on three criteria:
        - members of each cohort receive as much in pension payouts as they pay into the pension plan
        - the generosity of the pension system, measured as the ratio of average pension receipt to the incomes of people who pay into the pension system, after the pension tax, is the same for all cohort
        - the pension tax is the same for all cohorts
    - Criterion (1):
    - $\overline{Y_{CH}} \times t_p \times (T_{20} - T_\alpha) = \overline{P_{CH}} \times T_\alpha$
        - $\overline{Y_{CH}}$ =the average annual income of cohort members
        - t_p =the pension tax rate
        - T_{20}=the number of person-years lived from age 20 onward in the cohort's life table
        - T_α =the number of person-years lived from the intergenerationally equitable normal retirement age α onward
        - $\overline{P_{CH}}$ =the average annual pension payment
    - Criterion (2):
    - $\overline{P_{CH}} = \beta \times (1 - t_p) \times \overline{Y_{CH}}$
        - β = generosity of the pension system; the ratio of the annual pension payment to the income of people contributing to the pension system, after the pension tax
    - Combining the two criteria:
        - $\frac{T_\alpha}{T_{20} - T_\alpha} = \frac{t_p}{\beta \times (1 - t_p)}$
    - If β and t_p are fixed, this equation determines the intergenerationally equitable normal retirement age α

$$PCDR = \frac{T_\alpha}{T_{20}}$$

19. **Economic Dependency Ratio (EDR)**
    - OECD

$$EDR = \frac{P + UE}{W_{a \geq 15}}$$

20. Inactive per active ratio (IAR)
    - Vaupel/Loichinger (2006)

$$IAR = \frac{(P + UE + IA) * 100}{W}$$

21. Non-Working-aged Dependency Ratio (NWDR)
    - Tyers/Shi (2007)

$$NWDR = \frac{NW_{a \geq 61}}{W_F}$$

22. Real Elderly Dependency Ratio (REDR)
    - Sanderson/Scherbov (2008)

$$REDR = \frac{N_{\epsilon \leq 15} * 100}{W}$$

23. GDP Adjusted Real Elderly Dependency Ratio (REDR_GDP)
    - Spijker et al. (2015)
    - Real Elderly Dependency Ratio considers everyone in paid employment as equally productive; but REDR_GDP takes the different productivity into account

$$REDR - GDP = \frac{N_{\epsilon \leq 15} * 1000000}{GDP}$$

24. Tax Revenue Adjusted Real Elderly Dependency Ratio (REDR_TAX)
    - Spijker et al. (2015)

$$REDR - TAX = \frac{N_{\epsilon \leq 15} * 1000000}{t}$$

25. Fiscal support ratio (FSR)
    - Miller (2011)
    - FSR is the ratio of the number of taxpayers, weighted by age- specific per capita public transfer outflows, to the number of beneficiaries, weighted by age- specific per capita public transfer inflows.
    - FSR is determined by the population age distribution and the age profiles of per capita taxes paid and benefits received for all in-kind and cash transfer programs, including education, health care and pensions

26. Rostock indicator 2.
    - Vaupel/Loichinger (2006)

$$RI2 = \frac{\sum Wh}{N}$$

27. Health Care Need Adjusted Prospective Old Age Dependency Ratio (POADR5TTD)
    - Riffe et al. (2014), Spijker (2015), Spijker et al. (2015)
    - remaining life expectancy (RLE)=population average at a particular age (cohort level)
    - Time To Death (TTD)=remaining years of life at any age (personal level)

$$POADR5TTD = \frac{N_{\epsilon_{i\leq 15}|TTD<5}}{N_{a\geq 20|\epsilon\leq 15}}$$

28. Health Care Need Adjusted Real Elderly Dependency Ratio (RED5TTD)
    - Spijker et al. (2015)

$$RED5TTD = \frac{N_{\epsilon_{i\leq 15}|TTD<5}}{W}$$

29. Adult Disability Dependency Ratio (ADDR)
    - Sanderson/Scherbov (2010)

$$ADDR = \frac{Di_{a\geq 20} \times 100}{WDi_{a\geq 20}}$$

    - ADDR increase less rapidly than the OADR (Old Age Dependency Ratio) or POADR (Prospective Old Age Dependency Ratio)
    - This ratio is not strictly an Elderly Dependency Ratio

30. Cognitive-Adjusted Dependency Ratio (CADR)
    - Skirbekk/Loichinger/Weber (2012)
    - the indicator is based on age variation in cognitive functioning
    - premise: cognitive ability levels predict individual productivity better than any other observable individual characteristics and they are increasingly relevant for labour market performance
    - method: immediate word recall; standardized question

$$CADR = \frac{BCF_{a\geq 50}}{N_{15-49} + GCF_{a\geq 50}}$$

    - Bad cognitive functioning: recalling fewer than half of the words in the test; Good cognitive functioning: recalling at least half of the words
    - Result: Although continental European countries have a larger population share above the age of 65 than China, the value of CADR is lower in Europe.
      These countries are effectively younger; they have a lower share of seniors with poor cognitive performance.
    - An increase in cognitive performance among successive cohorts has been observed in many countries
    - Improvement can be expected (in Europe); reasons: mortality decline, universal education, improved nutrition, better economic conditions

31. Cognitive functioning indicator based on Symbol-Digit Test
    - Bordone/Scherbov/Steiber (2015)
    - Point of departure: individuals aged 50+ born into more recent cohorts perform better in terms of cognition than their counterparts of the same age born into earlier cohorts.
        - consequence of expansion of education, improvements in medical care, nutrition, visual and technical environments (Flynn effect)
        - cognitive functioning can be considered an important measure of differential ageing across cohorts and population groups
        - good cognitive functioning is one of the central components of successful ageing
    - Symbol-Digit Test (SDT): nine graphical symbols, each assigned to a number between 1 and 9 - the appearance of one of the nine symbols – asking respondents to match it with the correct digit as quickly as possible – the number of correct responses were calculated after 30 sec (SDT30), after 60sec (SDT60) and after 90sec (SDT90)
    - they used other tests
    - results:
        - the better educated have significantly higher scores in all cognitive tests
        - the analysis confirms the presence of a significant Flynn effect, controlling for sex, age and education

32. Ratio of Active Life Expectancy per Total Life Expectancy (ALE/LE)
    - Manton/Gu/Lamb (2006)

$$ALE/LE = \frac{\Sigma \epsilon 1_{a \geq 65 | a \leq 85} \times 100}{\Sigma \varepsilon_{a \geq 65 | a \leq 85}}$$

33. Old-Age Healthy/Unhealthy Dependency Ratio
    - Muszynska/Rau (2012)
    - Decomposition of the OADR into an old-age healthy dependency ratio and an old-age unhealthy dependency ratio
    - research question: whether potential improvement in health and disability could compensate for ageing process

$$HODR = \frac{HP_{a \geq 65}}{N_{15-64}}$$

$$UHODR = \frac{UHP_{a \geq 65}}{N_{a \geq 15 | a \leq 64}}$$

34. Real Adult Disability Dependency Ratio
    - Spijker et al. (2015)

$$RADDR = \frac{Di_{a \geq 20} \times 100}{W}$$

35. Real Elderly Disability Dependency Ratio

— Spijker et al. (2015)

$$REDDR = \frac{Di_{\epsilon \leq 15} \times 100}{W}$$

36. Health Care Cost Old-Age Dependency Ratio

— Sanderson/Scherbov (2015)

— it is assumed that the period of rapidly increasing health care cost begins at five years before death

37. Economic Support Ratio (ESR)

— Cutler/Poterba/Sheiner/Summers (1990), Lee/Mason (2011b)

— economic support ratio is the ratio of cohort sizes weighted by the per capita consumption and labour income in the national economy, respectively

$$SR_t = \frac{\sum_a y_l(a,t_0)\, N(a,t)}{\sum_a c(a,t_0)\, N(a,t)}$$

38. Education-Weighted Dependency Ratio (EWDR)

— Striessnig/Lutz (2014)

— an extension of the conventional total dependency ratio based on the assumption that every person of working age will make the same contribution to the support of the dependent population

— the population is divided into three categories; different weights apply to each of them both with regard to the dependency burden (due to the cost of education) and to differential support that people of working age can supply for those not of working age

$$EWDR = \frac{EWC + PA}{EWW}$$

— EWC=Education-Weighted Children:

— $EWC = (N_{a=0-5} \times E_{a=0-5}) + (N_{a=6-10} \times E_{a=6-10}) + (N_{a=11-18} \times E_{a=11-18}) + (N_{a=19-25} \times E_{a=19-25})$

— Education-Weighted Workforce:

$$EWW = N^{Prim}_{a=16-57} ED1weight + N^{Sec}_{a=19-61} ED2weight + N^{tert}_{a=26-65} ED3weight$$

— $PA = N^{prim}_{a=58+} \times pencost + N^{sec}_{a=62+} \times pencost + N^{tert}_{a=66+} \times pencost$

— all retirees get the same weight (pencost), but the ages of labour market entry and exit are education-specific

39. Total Support Ratio

— Gál/Vargha (2015)

— The effective number of consumers over the effective labour force (both the market economy and the household economy included)

40. Total Current Pension Expenditure (TCPE)
    - EUROSTAT

$$TCPE = \frac{\sum PA * 100}{GDP}$$

41. Public Pension Expenditure Ratio (PPER)
    - Bongaarts (2004)

$$PER = \frac{\sum PA}{\sum W_G}$$

42. Benefit ratio (BR)
    - EUROSTAT

$$BR = \frac{\sum PA}{\sum W_G}$$

43. Aggregate Replacement Ratio (ARR)
    - EUROSTAT

$$ARR = \frac{MePA_{a=65-74}}{MeW_{Ga=50-59}}$$

44. Benefit Generosity Ratio (BGR)
    - Miller/Mason/Holz (2011)

$$BGR = \frac{E}{\tilde{B}} / \frac{GDP}{N_{20-64}}$$

    - BGR is the relative cost of benefits per person at risk
    - potential beneficiaries (persons at risk) are defined by the relevant age for consuming education, pension benefits or health care, respectively
    - in order to facilitate cross-country comparison BGR is measured in relation to the average productivity (GDP) of the working-age population (aged 20 to 64)

45. Elderly/Non-Elderly Spending Ratio (ENSR)
    - Lynch (2006)
    - Elderly spending includes pensions and services for the elderly, adjusted for the number of elderly persons (defined to be those either aged 65 and above or those in formal retirement)
    - Non-elderly spending includes primarily unemployment benefits, active labour market policies, family allowances and family services, adjusted for the number of non-elderly persons (defined to be those aged bellow 65)

$$ENSR = \frac{\frac{\sum PA + \sum SA}{N_{65+}}}{\frac{\sum UBA + \sum ALA + \sum FAA + \sum FSA}{N_{0-64}}}$$

46. Elderly / non-elderly spending share (ENSS)

- Tepe/Vanhuysse (2010)
- The total (non-adjusted) spending share of two clearly pro-elderly programs (pensions and survival benefits) within a larger group of six welfare programs consisting in addition of (non-adjusted) spending on less clearly pro-elderly programs such as incapacity benefits, family programs, active labour market programs and unemployment benefits.
- The ENSS does not include health and education spending, since they cannot be clearly attributed to elderly vs. non-elderly generations

$$ENSS = \frac{\sum PA + \sum SBA}{\sum PA + \sum SBA + \sum IBA + \sum FAA + \sum ALA + \sum UBA} \times 100$$

47. EBISS- Elderly-bias in social spending (EBISS)

- Vanhuysse (2013)
- On the elderly oriented spending side (the numerator), the following public spending programs were included:
  - 1. old age related benefits in cash (pensions, early retirement pensions, other cash benefits)
  - 2. survivors' benefits in cash and in kind
  - 3. disability pensions
  - 4. occupational injury and disease related pensions
  - 5. early retirement for labour market reasons
- On the non-elderly oriented side (the denominator) the following public spending programs were included:
  - 1. family benefits in cash (family allowances, maternity and parental leave, other cash benefits) and in kind (day care/home-help services, other in kind benefits)
  - 2. active labour market programs (employment services and administration, labour market training, youth measures, subsidized employment, employment measures for disabled)
  - 3. income maintenance cash benefits
  - 4. unemployment compensation
  - 5. education spending for all levels of education from early childhood to university
- To adjust for demographic structure, the resulting elderly/non-elderly social spending ratio in each country has been multiplied by the country's old age support ratio (the number of persons aged 20-64 over the number of persons aged 65+)

$$EBISS = \frac{\sum P_O A + \sum SBA + \sum IBA + \sum P_H A + \sum P_e A}{\sum FBA + \sum ALA + \sum IBA + \sum UEA + \sum EA} \times \frac{N_{20-64}}{N_{65+}}$$

- Public health spending has not been incorporated into the EBISS calculations, as it is difficult to allocate precisely which share of health spending goes to which age groups- as the most health spending goes to older citizens in all countries, consequently EBISS underestimates the pro-elderly bias of welfare spending

— the correlation coefficient between the EBISS values and the old age support ratio (in 2007, OECD countries) is negative; EBISS is a consequence of policy choices not of demographic constraints

48. Pension Support Ratio (PSR)

— Pension support ratio is the ratio of cohort sizes weighted by the per capita pension contributions and benefits, respectively.

49. Lifecycle Deficit (LCD)

— Lee (1994b), Lee/Mason (2011a)

— LCD is the difference between consumption and labour income. It is positive in childhood and old age as children and the elderly consume more than they produce, and it is negative in active age when labour income exceeds consumption (making LCD a lifecycle surplus).

— The LCD curve offers a data driven partitioning of the age distribution of population. It separates those cohorts that receive net support from the rest of society from those that provide this support. It is therefore strongly associated with the intuitive definition of childhood, working age and old age.

50. Human Capital Specific Old Age Dependency Ratio (HC_OADR)

— Philipov et al. (2014)

— the indicator is based on multi-state population projections by level of education

$$HCOADR = \frac{N_{65+} adjusted\ for\ education, specific\ median\ gross\ public\ pensions}{N_{20-64} adjusted\ for\ age, education\ and\ gross\ income}$$

— it is assumed that the indicator is strongly linked with other important factors such as economic growth, level of un/employment, economic in/activity, ability to work and health, part time employment, wage and pension differentials by length of working life, pension schemes, saving and spending, consumption patterns, labour-force participation of elderly people, age at retirement and entry into the labour force

51. Intergenerational Tax Rate

— Miller (2010)

— aggregate lifecycle deficit (LCD) for youth and elderly / GDP

52. Potential Years of Life (PYL)

$$PYL = \frac{\sum \epsilon_N}{N}$$

$$PYL = \frac{\sum \epsilon_{CH}}{CH}$$

53. Prospective Age (Standardised Age)
    - Sanderson/Scherbov (2005)
    - forward-looking definition of age – everyone with the same prospective age has the same expected remaining years of life, regardless of the number of years that they have already lived
    - cohort prospective age: the expected number of years of remaining life for people in the same cohort

54. Population Average Remaining Years of Life Expectancies (PARYLE)
    - Lutz (2009)
    - the age-specific remaining life expectancies are weighted by the proportions of the population at each age whose average is then taken to obtain the average remaining years of life of population members

55. Old age threshold based on remaining life expectancy
    - Sanderson/Scherbov (2005)
    - age in which remaining life expectancy equals 15 years (AGE_RLE15)
    - $a_{e=15}$

56. Saving gap
    - The difference between the 'capital formation' and the 'saving' of an economic sector over a given period

57. Prospective Median Age (PMA)
    - Sanderson/Scherbov (2005)
    - the prospective age of median-aged persons

58. Remaining Life Expectancy at Median Age
    - Sanderson/Scherbov (2005)
    - the remaining life expectancy at median-aged persons

59. Duration of working life
    - EUROSTAT
    - The indicator measures the number of years a person aged 15 is expected to be active in the labour market throughout his/her life. This indicator is calculated with probabilistic model combining demographic data (life tables) and labour market data (activity rates for every age groups)

60. Disability-Free Life Expectancy (DFLE); Health-Adjusted Life Expectancy (HALE)
    - OECD
    - Disability-free life expectancy is the average number of years an individual is expected to live free of disability if current patterns of mortality and disability continue to apply
    - it is distinguished: 1.) functional limitation-free life expectancy, 2.) activity restriction-free life expectancy

61. Healthy Life Years (HLY) (Disability-free Life Expectancy)
    - EUROSTAT
    - it measures the number of remaining years that a person of a certain age is still supposed to live without disability
    - the indicator is calculated following the Sullivan method; it is based on prevalence measures of the age specific proportion of population with and without disabilities and on mortality data
    - Activity limitation data includes a global question on activity limitation known as the General Activity Limitation Indicator

62. Generational imbalance (GI_AGK)
    - Auerbach/Gokhale/Kotlikoff (1991)
    - Generational imbalance is the difference between the present value of net lifetime taxes to be paid by the new-born cohort and the corresponding value to be paid by future generations provided that the new-born will run a life-path drawn by the age profile of net taxes in the base year, whereas future generations will have to pay for (or will receive) the accumulating sustainability gap left behind currently living generations.

63. Implicit pension debt (IPD1: accrued-to-date liabilities)
    - Holzmann/Palacios/Zviniene (2004)
    - the present value of future pensions based on eligibilities collected by plan members so far. It gives the cost of closing the system now. No new contributions are expected to be paid in the system, consequently no new eligibilities emerge.

64. Turnover Duration
    - Settergren/Mikula (2006)
    - Turnover duration is a measure of the average amount of time, in years, that the pension system has until it must liquidate a pension obligation earned during the year in question and is calculated as the difference between the earnings-weighted average age of workers contributing to the system and the pension weighted average age of those drawing annuities
    - TD reflects the fertility trends and population growth, wage patterns, labour force participation, retirement patterns and mortality.
    - $TD = A_r - A_c$
    - A_r =benefit-weighted average age of retiree
    - A_c =contribution-weighted average age of contributor
    - $TD = \frac{V}{C}$
    - V (pension liabilities) = the present value of future pension benefits to all persons to whom the system has a liability at the time of evaluation less the present value of future contributions by the same individuals.
    - C = contributions (it depends on the size of population by age, the wage pattern, the average wage, the required contribution rate for a financial stable system

65. Accumulated Benefit Obligation (ABO)
- The present value of total pension benefits based on the assumption that the pension plans is to be terminated immediately, applying the pension formula using existing compensation levels.

66. Mean age of earning (A_{yl})
- Lee (1994a), Lee/Mason (2011 a,b)
- Average age at which goods and services are being produced by workers.
- A_{yl} is determined by the age distribution of the population and the age profile of per capita labour income

67. Mean age of consumption (A_c)
- Lee (1994a), Lee/Mason (2011 a,b)
- Average age at which goods and services are being consumed.
- A_c is determined by the age distribution of the population and the age profile of per capita labour consumption

68. Lee's Arrow

Lee (1994a), Lee/Mason (2011 a,b)
- The arrows describe the way resources are shifted across the lifecycle and forward and backward over time.
- Each arrow is plotted with its tail at the population-weighted average age of earning labour income (or making a transfer) and its head at the average age of consuming (or receiving a transfer). The width of the arrow equals the size of the relevant per capita flow.

69. Silver Club
- Miller (2010)
- the calendar year when the mean age of effective consumers exceeds the mean age of effective workers

70. Generational imbalance (GI_GS)
- Gokhale/Smetters (2003)
- GI measures the amount by which benefits to past and current generations (including prospective benefits of current generations) exceed their tax payments (including prospective tax payments by current generations) in present value.
- $GI_t = PVE_t^{CO} + PVR_t^{CO} - A_t^{CO}$

  PVE_t^{CO} =the present value of projected outlays that will be paid to current generations

  PVR_t^{CO} =the present value of projected tax revenues from the same generation

  A_t^{CO} =current assets

71. Intergenerationally equitable retirement age

— Sanderson/Scherbov (2015)

— The intergenerationally equitable retirement age is based on three criteria:
  - members of each cohort receive as much in pension payouts as they pay into the pension plan
  - the generosity of the pension system, measured as the ratio of average pension receipt to the incomes of people who pay into the pension system, after the pension tax, is the same for all cohort
  - the pension tax is the same for all cohorts

— Criterion (1):

— $\overline{Y_{CH}} \times t_p \times (T_{20} - T_\alpha) = \overline{P_{CH}} \times T_\alpha$
  - $\overline{Y_{CH}}$ =the average annual income of cohort members
  - t_p =the pension tax rate
  - T_{20} =the number of person-years lived from age 20 onward in the cohort's life table
  - T_α =the number of person-years lived from the intergenerationally equitable normal retirement age α onward
  - $\overline{P_{CH}}$ =the average annual pension payment

— Criterion (2):

— $\overline{P_{CH}} = \beta \times (1 - t_p) \times \overline{Y_{CH}}$
  - β = the generosity of the pension system; the ratio of the annual pension payment to the income of people contributing to the pension system, after the pension tax

— Combining the two criteria:
  - $$\frac{T_\alpha}{T_{20} - T_\alpha} = \frac{t_p}{\beta \times (1 - t_p)}$$

— If β and t_p are fixed, this equation determines the intergenerationally equitable normal retirement age α

72. Projected Benefit Obligation (PBO)

— An estimate of the present value of the future liability of an employee's pension. The PBO assumes that the employee will continue to work and make contributions to the pension plan. It also assumes that contributions will increase as the employee's salary also increases.

73. Benefit/tax ratio

— PVB/PVT=present value of lifecycle benefit/present value of lifecycle contributions

74. Pay-Back Periods (PBP)

— the length of time the representative member of a cohort has to wait after retirement to get back contributions

75. Net Transfer Rate (NTR)
    - Net present value of benefits over the present value of life time earnings

76. Implicit tax (IT)
    - Sinn (1997)
    - useful for understanding the general effects of pay-as-you-go pensions for the intergenerational distribution and also for demonstrating the particular impact of ageing on individual who belong to different age-cohorts
    - IT=the difference between life-time contributions and old-age pensions at an individual level, both discounted to net present values of some period t.

77. Implicit Pension Debt 2 (IPD2)
    - Holzmann/Palacios/Zviniene (2004)
    - IPD2- projected liabilities of current workers and pensioners – based on the assumption that pension schemes continue their existence until the last contributor dies, while no new entrants are allowed; both the future contribution of existing members and their new rights are therefore allowed under current rules (closed-group method)

78. Implicit Pension Debt 3 (IPD3)
    - Holzmann/Palacios/Zviniene (2004)
    - IPD3 - open system liabilities – same as IPD2 but it also includes the present value of contributions and pensions of new scheme members

80. Net Pension Liabilities
    - OECD
    - same as the implicit pension debt (IPD3)

81. Social Security Wealth
    - Feldstein (1974)
    - Present value of expected future social security benefits

82. Contribution Wealth
    - Settergren/Mikula (2006)
    - Present value of expected future social security contributions

83. General Government Fiscal Balance (GGFB)
    - Leibfritz et al. (1995), Roseveare et al. (1996) (both OECD)
    - extending the idea of measuring implicit public liabilities to a larger set of activities
    - Aim: To examine the impact of demographic changes; assuming that current government expenditure and revenue policies continue

84. Intertemporal Public Liabilities (IPL)
    - Benz/Fetzer (2006)
    - $$IPL_0 = D_0 + \sum \frac{E_j - R_j}{(1+i)j}$$
    - IPL comprises the present value of the entire public debt that emerged in the past and will arise in the future

85. Sustainability gap (SG)
    - Bonin (2001), Bonin/Patxot (2004)
    - $$SG = \frac{IPL}{GDP}$$
        - The sustainability gap not only refers to the debt that arose in the past, but also takes into account future liabilities
        - The sustainability gap can be separated into two parts: explicit and implicit debt. The explicit debt refers to the current debt and shows which part of the future liabilities is based on the fiscal policy of the past. The implicit debt displays the present value of all future primary deficits and shows which part of these liabilities is to be expected in the future in view of current fiscal policy.

86. Sustainability tax quota
    - Benz/Fetzer (2006)
    - One possibility to restore sustainability is through a proportional increase of all future taxes and contributions and correspondingly in the tax quota i.e. the tax revenue to GDP ratio.
    - Sustainability tax quota measures the required increase in the tax-quota that is needed in order to achieve sustainability
    - $$\theta = \frac{IPL_0}{\sum T_j \frac{1}{(1+i)^j}}$$

87. Tax gap indicator (OECD method)
    - Blanchard et al. (1990)
    - evolution of the ratio of debt to GNP depends on two sets of factors:
        - those reflecting current spending, transfer and tax rules, is the primary deficit
        - those reflecting the inheritance from the past, which is the product of the ratio of accumulated debt to GNP times the difference between the real interest rate and the growth rate; if this difference is positive, a primary surplus is needed to maintain a constant ratio of debt to GNP
    - „a good indicator of sustainability is one which sends clear and easily interpretable signals, when current policy appears to be leading to a rapidly growing debt to GNP ratio"
    - their indicator is defined as the gap between the sustainable tax rate and the current tax rate

- when the indicator is positive, it signals the need for either increases in tax and/or decreases in spending and transfers at some stage in the future
- three indicators are constructed – each associated with a different time horizon
    - short-term gap: is associated with a very short time horizon (namely one year); it can be constructed without the use of forecasts
    - medium-term gap: which relies on projections of activity, government spending and transfers over the following five years
    - long-term gap: which is based on an horizon of 40 years, focusing primarily on the implications of population ageing

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