

A new model dependency ratio for European cities

Gianna Zamaro¹, Geoff Green², Agis Tsouros³, Enrico Chiavon¹

¹Municipality of Udine, Local Health Authority, Italy; ²Centre for Regional Economic and Social Research, Sheffield Hallam University, Sheffield, United Kingdom; ³WHO Regional Office for Europe, Copenhagen, Denmark

Correspondence to: Professor Geoff Green, Centre for Regional Economic and Social Research, Sheffield Hallam University, City Campus, Howard Street, Sheffield S1 1WB.; Email: G.Green@shu.ac.uk

Abstract

Background: Sometimes referred to as 'the demographic time bomb,' the European Union, state and local governments are concerned about the impact of an ageing population on both sustainable economic development and the demand for health and social support services. Seeking to mitigate these pressures, the Organisation for Economic Co-operation and Development (OECD) has developed a policy framework Live Longer: Work Longer and the World Health Organization (WHO) has set a policy framework for Active Ageing which maintains that early life course interventions can reduce levels of disability and dependency in older age. The WHO European Healthy Cities Network (WHO-EHCN) promotes healthy urban planning to encourage healthy lifestyles and maintain older people as a resource in the workplace and to their communities. Our objective is to develop a new model dependency ratio (NMDR) for European cities which synthesises these three policy frameworks.

Methods: Starting from the classic formulation of the dependency ratio (DR), which compares the 'dependent' population segments with the working-age or 'productive' segments, the model is developed in six stages, drawing on data from secondary European and national sources and from primary sources contained in Healthy Ageing Profiles of fifteen (WHO-EHCN) cities.

Results: From an orthodox baseline, the second stage of modelling increases the DR by moving economically inactive people of working age from denominator to numerator. Thereafter, refinements introduced in stages three to six, gradually reduce the DR.

Conclusions: The NMDR challenges the 'demographic time bomb' predicted by orthodox formulations and can be used as a tool by city decision makers.

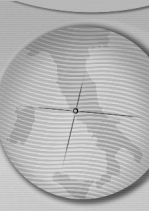
Key words: dependency ratio, healthy cities, employment, healthy ageing, unpaid work

Introduction

Sometimes referred to as 'the demographic time bomb,' the OECD, European Union and Member States worry about the impact of an ageing population on both sustainable economic development and demand for health and social support services. In a Green Paper [1] the European Commission highlighted three trends leading to the 'demographic ageing' of Europe: (a) low birth rates (b) an ageing workforce, and (c) increasing longevity. By the mid- 21st century, these trends are predicted to increase the dependency ratio of the 'non-productive' segment of the population (children and people 65+) to the 'productive' segment of working age. Broadly stated by the United Kingdom government [2] 'the current population can only consume the

output produced by the current population. This means that those who are out of work must consume a share of the output produced by those in work.'

Policy response is at international, European and national levels, with Member States supporting 'the Lisbon agenda (modernization of social protection systems [including later retirement age] increasing the rate of female employment and the employment of older workers), innovative measures to support the birth rate and judicious use of immigration.' [3] Yet much can also be achieved at a local level, in an urban setting, by city governments and their partners. Cities are subject to similar demographic pressures, but with their highly developed civic institutions they are also key agents for finding and implementing



local solutions. [4] Their role will crystallize around a more sophisticated model of dependency than is common currency in national and international arenas.

The World Health Organization (WHO) has sought to break the tie between age and dependency, setting a policy framework for Active Ageing (5) which maintains that early and middle-life course interventions can reduce levels of disability in older age. Traditionally, health promotion focuses on healthy lifestyles, seeking reductions in early onset of noncommunicable diseases. With its more innovative approach to distal determinants of health, the WHO European Healthy Cities Network (WHO-EHCN) promotes city health development planning to maintain older people as a resource in the workplace and to their communities. City governments traditionally care for disabled, often older people, but they also have a critical preventive role.

Though the orthodox formulation of the dependency ratio (DR) has been criticised [6] [7] for the narrow definition of 'economically active', there is no robust alternative formulation accessible to city decision makers. The objective of this article formalizes a new model dependency ratio to serve as a neutral policy-making tool. The New Model Dependency Ratio (NMDR) accounts for both elements (such as current population structure) capable of being forecast with some tolerable degree of accuracy, and less predictable elements (such as employment and immigration) subject to short-run fluctuations.

Methods

The model is developed in six stages, each adding a refinement to the classic formulation (Appendix 1). **First**, as a baseline, city populations of working age are compared with populations of young plus older people. **Second**, an economic dependency ratio is derived by deducting economically inactive people (because of illness/incapacity, unemployment, education and caring duties) from the working age population. **Third**, economically active older people are added into the working population. **Fourth**, the model accounts for the "informal" contribution of people of all ages to the economic and social infrastructure of the city. **Fifth**, a dynamic aspect is added by tracking migration. **Sixth**, a second dynamic element encompasses a "Healthy Ageing" perspective which should compress age related disability and increase autonomy of older people. Finally, the model is simulated for the Italian city of Udine. Other cities can replicate the first five stages of the model by applying local population

data; stage six depends upon assumptions about local policies and strategies.

Results

Stage 1.

Classic formulation of the dependency ratio

Assessing the interdependence of city populations it is necessary first to enumerate age bands then project these forward. Each cohort has certain common characteristics, associated for example with childhood or retirement. Though retirees' attitudes, behaviour, health and well-being are influenced by their own life course, their prospects for an independent and comfortable old age (3rd age) [8] to a more dependent status (4th age) [9] will also depend on their economic and social relationship to younger population cohorts. [10,11]

The total demographic dependency ratio compares the 'dependent' population segments with the working-age or 'productive' segments. It measures potential social support needs, assuming all working-age people provide support to those of dependent ages. [12] This orthodox proposition distinguishes the real economy (where in any time period consumption is balanced by production of goods and services) from an associated financial system in which 'unproductive' segments of the population (for example, retirees) may, through wealth or public promise, exercise a claim on the output of private goods or public services. [13] The classic formulation compares persons under 15 and those 65 and over with the population of working age, historically 15-64 [1].

$$DR = \frac{Pop_{0-14} + Pop_{65-\omega}}{Pop_{15-64}} \quad [1]$$

The total dependency ratio is often split into two: old-age dependency ratio (ODR) and youth dependency ratio (YDR), each characterized by a different kind of 'dependency'. Considering older people, normally with an income, the ODR gives useful information concerning the welfare system; considering young people, the YDR represents the relation between the potentially active persons and those who depend directly on family income. Though the DR has remained constant over the last hundred and fifty years in many European cities, the YDR and ODR have diverged sharply. For example in Udine the DR was constant (1871: 0,51, 1936: 0,50, 2001: 0,50) but the YDR decreased (1871: 0,41, 1936: 0,36, 2001: 0,15)

while the ODR increased (1871: 0,10, 1936: 0,11, 2001 0,34) (Fig. 1).

Age thresholds in the classic formulation are contentious. They reflect productive relations in an era when European populations typically started work aged 15 after elementary education and retired on their 65th birthday, often in poor health and with limited life expectancy. In the modern era the 'productive' cohort has in reality been 'squeezed' by early retirement of older people and by expanding education for younger people, reflecting the needs of a modern, knowledge-based economy [14,15,16,17].

The retirement age of 65 in the classic formulation was not altered despite the average actual age of retirement falling in European states during the last quarter of the 20th century. The threshold of 65 is now more realistic as the European Union and national governments [3] seek to defer retirement and increase labour market participation. However, some economists challenge these policies, maintaining that the burden posed by the non-economically active population and thus the DR, is decreased by productivity growth and technological progress [18].

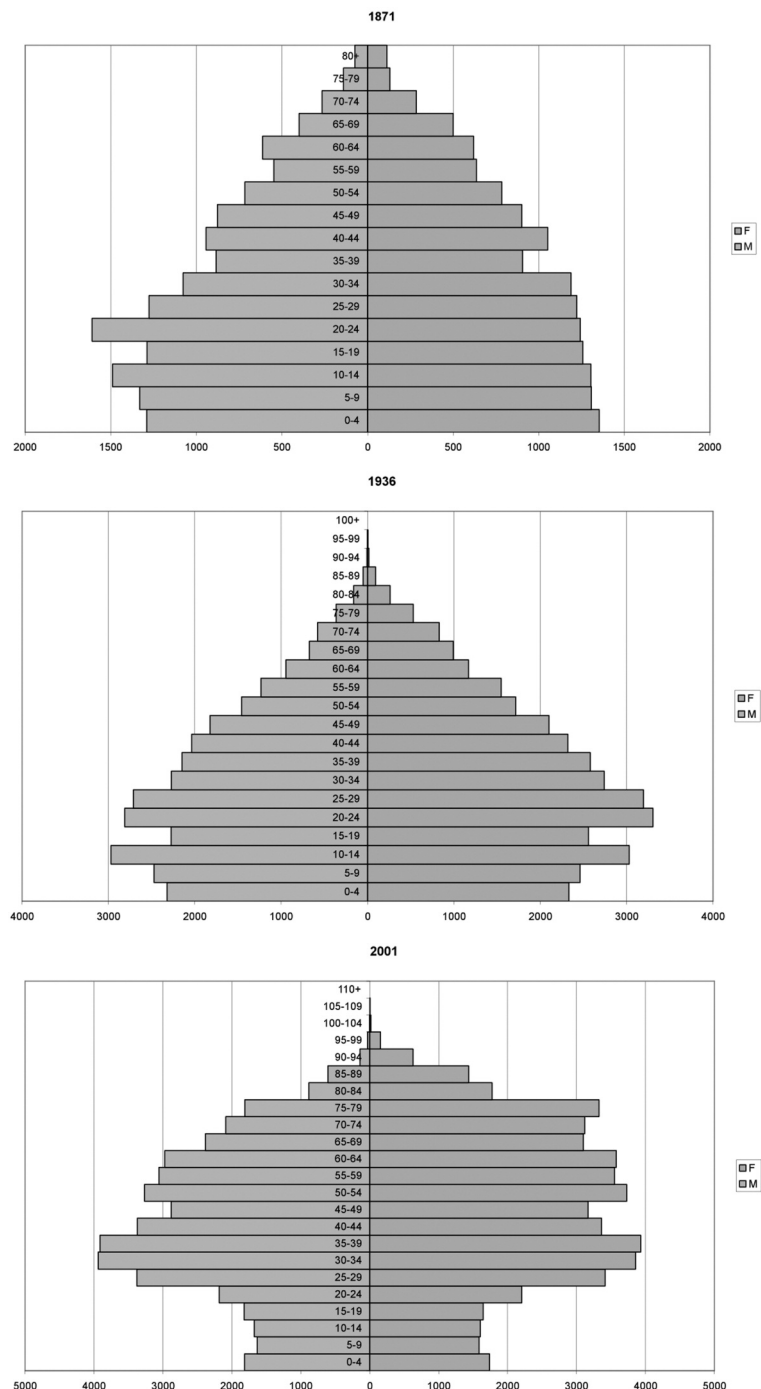
Stage 2.

Economic DR

The classic formulation measures the economic burden carried by a defined 'working age population' between 15 and 64, even though some people included in the 'productive' segment are not working [19]. Not all working-age people actually provide direct or indirect support [20] to the formally dependent segments of the population. Therefore a more appropriate measure is the economic dependency ratio (EDR) [2] calculated as the ratio of the total economically inactive population to those between 15 and 64 who are in formal work.

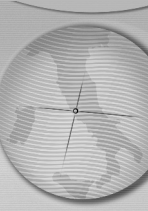
Besides children under 15 and adults over 64, the economically inactive population includes persons who are: students in full time education; caring for home and family; unable to work because of illness or disability; retired. Because at

Figure 1. Age pyramids in Udine, Italy: 1871, 1936 and 2001.



any point in time those in work hand over part of their resources to all those not in work, whether young or old, the EDR gives a more accurate view of the economic burden and consequences for those in work. A higher EDR implies more inactive people dependant on the active population.

$$EDR = \frac{Pop_{0-14} + Pop_{65-w} + Pop_{15-64}^{inactive}}{Pop_{15-64}^{active}} \quad [2]$$



According to International Labour Organisation (ILO) definitions [21] the segment of the population who are unemployed but seeking work are classified as economically active. This definition is used to summarize the economic status of the working age populations of the WHO -EHCN cities of Sunderland and Brighton in the UK (Table 1). However this segment only has productive 'potential' and is allocated to the numerator (rather than denominator) of an 'Effective Economic Dependency Ratio' by the European Commission [22] [see formula 3 and subsequent formulas].

Economic data for these cities highlights a key concern of European countries [3] and local governments - large scale permanent sickness and disability resulting in high levels of economic inactivity, especially for the working age population over 54. In Sunderland, for example, nearly as many men in this age group were classified as permanently sick and disabled (36%) as in employment (43%) and, as in many European cities, disability or incapacity applies to a bigger segment of this age band than unemployment. Definitions of illness and disability vary across European countries and comparison may be facilitated by the International Classification of Functioning, Disability and Health (ICF) developed by WHO [3]. However this protocol has not yet infiltrated labour market classifications of European states, and United Kingdom evidence suggests that the status of permanent illness or disability (attracting state benefits) hides real unemployment [23]. In deprived Sunderland twice as many males are classified as sick or disabled (36%) than in prosperous Brighton (16%) where demand for labour is higher.

Assuming the removal of demand-side barriers to employment, such as age discrimination, then attention turns to the supply-side of the equation, enhancing the skills and maintaining the health of older working age populations. Is poor health endemic in this group or can it be improved? European evidence focused on the workplace [24] suggests that beyond an irreducible core of disability attributable to genetic inheritance and accidental injury, many illnesses are reversible and many disabilities can be accommodated by good employer practice [25]. This holds especially for

Table 1. Economic Status in Sunderland and Brighton, United Kingdom.

Age	Males				Females			
	Sunderland		Brighton		Sunderland		Brighton	
	Age 16-64 %	Age 55-64 %	Age 16-64 %	Age 55-64 %	Age 16-64 %	Age 55-64 %	Age 16-64 %	Age 55-64 %
Economically Active								
Employed	72	43	78	60	65	29	65	46
Unemployed	8	4	5	4	4	1	4	1
Total	80	47	83	64	69	30	71	47
Economically Inactive								
Retired	0	12	0	15	0	38	0	31
Student	7	0	8	0	6	0	10	0
Household duties	1	1	1	1	14	11	12	8
Permanently sick/disabled	8	36	5	16	7	17	4	9
Other	3	4	3	4	4	4	3	4
Total	20	53	17	36	31	70	29	53
	100	100	100	100	100	100	100	100

Source: Nomis, Census 2001. Note at this date the official retirement age in the United Kingdom was 65 for men and 60 for women.

mental health (the biggest cause of early exit from the labour market in the United Kingdom) which is influenced by an individual's position in society and may be treated to improve participation and productivity [26].

Stage 3.

Adding in economically active older people

The Green Paper: Confronting demographic change [1] reports 'the employment rate of 65-74 year olds in the EU was 5.6% in 2003 compared with 18.5% in the USA.' The policy adopted by the European Union (the Lisbon agenda) of increasing the employment rate of older workers will be accomplished not only by bringing effective (actual) retirement ages closer to official retirement ages in Member States (see stage 2) but also by deferring the official retirement age beyond 65. The effect would be to reduce the dependency ratio by decreasing the numerator and increasing the denominator [3].

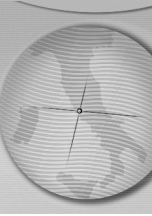
$$EDR = \frac{Pop_{0-14} + Pop_{65-69}^{inactive} + Pop_{15-64}^{inactive}}{Pop_{15-64}^{active} + Pop_{65-69}^{active}} \quad [3]$$

The biggest limitation to deferring age of retirement beyond 65 is incapacity arising from chronic diseases. The assumption behind Live longer: Work longer [27] is that with increasing longevity, functional capacity (both mental and physical) is maintained longer over the life course.

Stage 4.

Adding back 'reproductive' activity

Feminist development economists [28]



challenge the orthodox assumption that only paid employment in the formal economy is productive. Kerry Rittich argues [29] that unpaid work (most often performed by women) has independent economic value, supporting those (traditionally men) in formal paid employment: 'Its domestic location tends to obscure the fact that it is still "real" work.' She characterizes unpaid work as 'reproductive' since it is centred on care of children, who are the future labour force of an economy [30].

However, a distinction should be made in unpaid work, between care which is functional to the reproduction of the next generation of workers and care for incapacitated (often older) people, reflecting the values of civilized society. Both reduce the need for paid work. Stage 4 further reduces the DR by switching unpaid carers (not otherwise in paid work) from numerator to the denominator [4]. In reality lives are more complicated than simply allocating everyone either to the two categories of paid or unpaid work. Many people (principally women

$$EDR = \frac{Pop_{0-14} + Pop_{65-69}^{inactive} + Pop_{15-64}^{inactive} - Pop_{15-69}^{unpaid_work}}{Pop_{15-64}^{active} + Pop_{65-69}^{active} + Pop_{15-69}^{unpaid_work}} \quad [4]$$

with part-time jobs) undertake both paid and unpaid work.

Older people can also be classed as 'active' if the definition extends beyond children to caring for family members, often spouses, who would otherwise require support from paid labour. They also volunteer for work which would otherwise be undertaken by paid labour. For example, retired nurses care voluntarily for sick people in Udine. Developing this analysis a stage further, older people contribute in more diffuse ways (and disproportionately) to the social capital of a society [31].

Stage 5. Migration Dynamic

So far the model DRs assume a closed economy. Stages 5 add a dynamic dimension, reflecting the global economy of large scale migration across national borders and city boundaries. European countries with ageing populations encourage the immigration of skilled workers. These 'economically active' migrants will reduce [32] the DR by

adding to the denominator [5]. Unrecorded immigrants will also add to the active population. All immigrants are highlighted separately, though

$$EDR = \frac{Pop_{0-14} + Pop_{65-69}^{inactive} + Pop_{15-64}^{inactive} - Pop_{15-69}^{unpaid_work} + Migrants^{inactive}}{Pop_{15-64}^{active} + Pop_{65-69}^{active} + Pop_{15-69}^{unpaid_work} + Migrants^{active}} \quad [5]$$

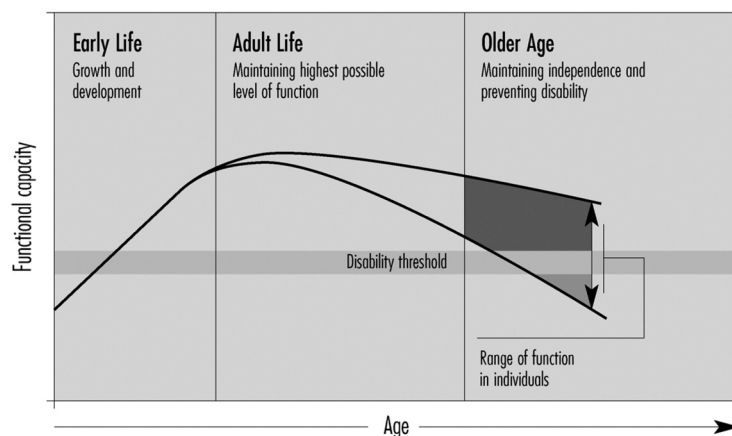
they will assimilate into the main active or inactive populations.

Population forecasts for Vienna, Austria [33] indicate that it has already been 'rejuvenated' by an influx of migrants with the second generation making a contribution to the economy of the city from 2030. Similarly Stockholm, Sweden forecasts [34] an increase in working age population, largely as a result of immigration. Problems arise if skilled immigrants cannot find work and become dependent on the working population via state welfare benefits. Then they switch from denominator to numerator, increasing the DR.

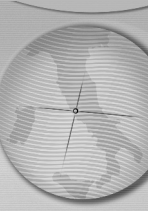
Stage 6. Healthy Ageing Dynamic

A second dynamic is the influence of healthy ageing policies on current and future capacity for work. Previous stages 2-5 have highlighted functional capacity as a crucial determinant of labour market participation, and in turn as critical to the dependency ratio. Active Ageing charts (Fig. 2) the decline of physical functioning from a peak in early adulthood, taking a proportion of a city population through the threshold of dependency in later life. The challenge is to maintain functional capacity at the top end of the range, resulting in both greater participation in the labour market and less dependence on health and social support services; in effect extending the 3rd age and

Figure 2. Functional capacity over the life course.



Source: Kolache & Kickbusch, 1997, cited in Active Ageing, 2002



deferring the 4th age. Evidence to support this proposition is inconsistent [35,36]. Deferring death does not automatically defer the onset of disability [37]. Optimists claim morbidity is compressed [38,39,40]; pessimists dispute this.

$$EDR = \frac{Pop_{0-14} + \downarrow (Pop_{65-69}^{inactive} + Pop_{70-74}^{inactive}) + Pop_{15-64}^{inactive} - Pop_{15-64}^{unpaid_work} + Migrants^{inactive}}{Pop_{15-64}^{active} + \uparrow (Pop_{65-69}^{active} + Pop_{70-74}^{active}) + Pop_{15-64}^{unpaid_work} + Migrants^{active}} \quad [6]$$

[41] Assuming the optimists' point of view is correct, then higher levels of functional capacity will increase the denominator population [6].

The models were tested by simulation for Udine (Appendix and Table 2). The classic formulation gave a DR of 0.53 in 2005. The effective EDR (stage 2) was much higher, but adding in older workers (stage 3), unpaid carers (stage 4) and migrants (stage 5) reduces it. The final formula accounts for increasing numbers of older people but assumes healthy ageing policies will effectively reduce age related disability and increase the proportion of active older people.

Discussion

Our study has developed a new model dependency ratio (NMDR) by focusing on European cities and utilizing cross-cutting evidence from both health and economic policy domains. The classic DR is refined by equating the value of unpaid with paid work, by acknowledging childcare as necessary for the next generation of workers; and by reclassifying healthy older people as a resource to family and society. The NMDR challenges the 'demographic time bomb' predicted by orthodox formulations.

Simulated for the city of Udine, the method can be replicated elsewhere and (in Europe at least) is likely to produce an optimistic scenario.

The Udine simulation indicates that improving the functional capacity of older people [6] is critical to optimistic forecasts of reduced dependency. The orthodox DR remains constant in the medium term (2010–2015) because increased age dependency is offset by a low birth rate and fewer dependent children (Table 2). However the NMDR is forecast to decline primarily because age specific functional capacity is improving.

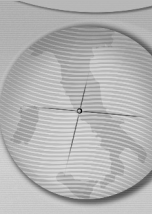
What are the most effective forms of intervention to reproduce this optimistic scenario? During the 20th century one option pursued (especially in the United States of America) was advanced technologies to diagnose earlier and mitigate or manage the disabling effects of chronic diseases. However, a consequence is increased per capita expenditure on health at any given age [42]. Active Ageing advocates another less costly option: preventive measures in early and middle life course to reduce proximal risk factors for noncommunicable diseases, such as: smoking, unhealthy nutrition, physical inactivity, alcohol consumption and stress. WHO-EHCN cities have adopted a social model of health giving equal weight to distal determinants of health such as housing and employment [43]. Cities forecast that this approach will expand the 3rd age and, consequently, compress the 4th age of their populations.

The model is a first attempt and must eventually

Table 2. Simulating the model for the City of Udine, Italy.

Stage	Formula	Comments	An Example: Udine 2005	An Example: Udine 2010	An Example: Udine 2015
1	$DR = \frac{Pop_{0-14} + Pop_{65-69}}{Pop_{15-64}}$	Classic formulation of demographic dependency ratio	0,53	0,54	0,54
2	$EDR = \frac{Pop_{0-14} + Pop_{65-69} + Pop_{15-64}^{inactive}}{Pop_{15-64}^{active}}$	Economic dependency ratio. Total or potential labour force (P_{15-64}) is split up into economic active population (aP_{15-64}) and economic inactive population (iP_{15-64}) ...	1,36	1,38	1,37
3	$EDR = \frac{Pop_{0-14} + Pop_{65-69}^{inactive} + Pop_{15-64}^{inactive}}{Pop_{15-64}^{active} + Pop_{65-69}^{active}}$	.... adding back economically active older people	1,32	1,34	1,33
4	$EDR = \frac{Pop_{0-14} + Pop_{65-69}^{inactive} + Pop_{15-64}^{inactive} - Pop_{15-64}^{unpaid_work}}{Pop_{15-64}^{active} + Pop_{65-69}^{active} + Pop_{15-64}^{unpaid_work}}$	.... adding in unpaid work	0,78	0,80	0,79
5	$EDR = \frac{Pop_{0-14} + Pop_{65-69}^{inactive} + Pop_{15-64}^{inactive} - Pop_{15-64}^{unpaid_work} + Migrants^{inactive}}{Pop_{15-64}^{active} + Pop_{65-69}^{active} + Pop_{15-64}^{unpaid_work} + Migrants^{active}}$	.... adding immigrants	0,77	0,79	0,78
6	$EDR = \frac{Pop_{0-14} + \downarrow (Pop_{65-69}^{inactive} + Pop_{70-74}^{inactive}) + Pop_{15-64}^{inactive} - Pop_{15-64}^{unpaid_work} + Migrants^{inactive}}{Pop_{15-64}^{active} + \uparrow (Pop_{65-69}^{active} + Pop_{70-74}^{active}) + Pop_{15-64}^{unpaid_work} + Migrants^{active}}$	.... healthy aging	0,77	0,73	0,67

DR = dependency ratio (classic formulation); EDR = Economic dependency ratio; Pop = population.



address at least two key lacunae. First is the issue of reconciling orthodox definitions of work (which govern data sources) with the complexity of people's lives. The methodology captures much but not all of this reality, sacrificing for example the additional unpaid work of paid workers to achieve a technically balanced equation. Such extra work could be viewed as an increase in productivity, though consequential stress and ill-health may reduce any gain in the longer term.

The second issue is the quality of public health evidence used in the sixth stage of a NMDR. A health dimension to dependency is already acknowledged by European governments and our insights may be welcomed as refining orthodox models. However, the empirical evidence is disputed: optimists suggesting longevity brings extra years free of disability, with positive implications for both labour market participation and support services; pessimists pointing to more years of disability and an increasing dependency ratio. Both camps would probably agree that increased longevity is associated with an asymmetrical impact on dependency: greater numbers in the oldest age group putting pressure on support services, counterbalanced by higher labour market participation of those of older working age.

Cities have been utilized in this study not only for providing technical insights, but also for their competence for both social care of older people and 'preventive' city health development planning. The final, 'aspirational' stage 6 of the NMDR depends on commitment by politicians and the efficacy of health development programmes administered by officials.

Acknowledgments

This study was built on the experiences of fifteen cities constituting the Healthy Ageing Sub-network of the WHO-EHCN. Thanks in particular to the coordinators who provided background data. Special thanks to Dorothy Engerman, Age Concern Brighton, United Kingdom (who first challenged the orthodox DR in Network meetings), to Bernard Stafford, Department of Applied Economics, University of York, United Kingdom (who provided an economic critique) and to Stefania Pascut of the Udine Healthy City Office, Italy (who assisted with the simulation).

Permissions

Table 1 extracted from Nomis official labour market statistics, Office of National Statistics, a

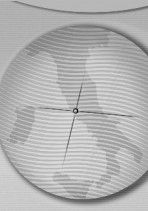
United Kingdom government agency, is reproduced via arrangements with the second author's research institute. Fig. 1 is supplied by the city of Udine. Fig. 2 is extracted from a WHO publication which 'may be freely abstracted and reproduced.'

Key points

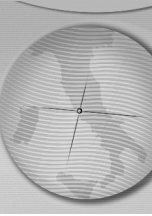
1. Our approach of Healthy Ageing challenges OECD orthodoxy of a 'demographic time bomb' ticking across Europe and in the UK specifically.
2. A new model dependency ratio (NMDR) is developed in six stages as a neutral policy-making tool, accounting both for predictable elements and those subject to short-run fluctuations.
3. The NMDR reduces the orthodox economic dependency ratio (EDR) by accounting for: a) unpaid (principally caring) work, b) older people in employment after formal retirement age, and c) economic (sometimes hidden) migration.
4. The EDR is further reduced by policies to expand the "Third" (healthy less dependent) and compress the "Fourth (more dependent) Age" in European city populations.
5. A simulated NMDR demonstrates a more sustainable scenario than orthodox measures.

References

- 1) European Commission. Confronting Demographic Change: a new solidarity between the generations. The Green Paper on demographic changes. 2005. Available from http://europa.eu.int/comm/employment_social/social_situation/green_paper_en.html [Accessed October 30 2008]
- 2) Department of Work and Pensions. Opportunity Age; Opportunity and security throughout life. The Stationery Office. UK, 2005.
- 3) EU-PROJECT. Measuring Health and Disability in Europe: Supporting Policy Development MHADIE leaflet. 2005. Available from www.mhadie.it/. [Accessed October 30, 2008]
- 4) Green G. Health and governance in European cities. Copenhagen: WHO Regional Office for Europe, 1998.
- 5) World Health Organization (2002) Active Ageing: A Policy Framework. WHO. Geneva. Available from http://whqlibdoc.who.int/hq/2002/WHO_NMH_NPH_02.8.pdf [Accessed October 30, 2008]
- 6) Falkingham J. Dependency and Ageing in Britain: a re-examination of the evidence. *J Soc Policy* 1989;18(2):211-33.
- 7) Vaupel JW, Loichinger E. Redistributing Work in Aging Europe *Science*. 2006;312(5782):1911-13.
- 8) Laslett P. A fresh Map of Life: The emergence of the Third Age. Cambridge, Massachusetts: Harvard University Press, 1991.
- 9) Smith J. The Fourth Age: A Period of Psychological Mortality. Berlin: Max Planck Institute for Human Development, 2001.
- 10) Neugarten BL. Age groups in American society and the rise of the young-old. *Annals of the American Academy of Politics and Social Sciences*, 1974:187-198.
- 11) Suzman RM, Willis DP, Manton KG. (Eds.) The oldest old. New York: Oxford University Press, 1992.
- 12) Kinsella K, Gist YJ. Older Workers, Retirement, and Pensions: A Comparative International Chartbook. Washington D.C.: United States Bureau of the Census, 1995.



- 13) Barr N. Economics of the Welfare State. Oxford, UK: Oxford University Press, 2004.
- 14) Visco I. Immigration, Development and the Labour Market. Paper presented at the International Conference on Migrations: Scenarios for the 21st Century, organised by the Roman Agency for the preparation for the Jubilee. Rome, 2000.
- 15) Lee RD. Intergenerational transfers and the economic life cycle: a cross cultural perspective. In: Mason A., Tapinos G. (eds.). Sharing the wealth: demographic change and economic transfers between generations. Oxford UK: Oxford University Press, 2000.
- 16) Department of Economic and Social Affairs. World Population Ageing: 1950-2050. New York: United Nations, 2001.
- 17) Martin J. Down to Work and Better Jobs. Employment, Labour and Social Affairs. Paris: OECD, 2004.
- 18) Mullan P. Old Misers Article No. 30, 2003. Available from <http://spiked-online.com/>. [Accessed October 30, 2008].
- 19) Bulatao RA. The Value of Family Planning in Developing Countries. Santa Monica USA: RAND, 1998.
- 20) Taeuber CM. Sixty-five Plus in America. Current Population Reports, Special Studies. Washington, D.C.: United States Bureau of the Census, 1992
- 21) International Labour Organization, 2006. Available from <http://www.ilo.org/public/english/employment/strat/kilm/indicators>. [Accessed October 30, 2008].
- 22) Economic Policy Committee. Budgetary Challenges posed by Ageing Populations: the Impact on Public Spending, on Pensions, Health and Long-term Care for the Elderly and Possible Indicators of the Long-term Sustainability of Public Finances. European Commission, 2001.
- 23) Beatty C, Fothergill S, MacMillan RA. Theory of Employment, Unemployment and Sickness. Regional Studies. 2000;34(7):617-30.
- 24) Grammenos S. Illness, Disability and Social Inclusion. Brussels: Centre for European Social and Economic Policy (CESEP). for the European Foundation for the Improvement of Living and Working Conditions. Dublin, 2003.
- 25) Good A, Fitzgerald E. "Understanding Dependency: Challenges for Planners", a National Council on Ageing & older people (NCAOP), Planning for an Ageing Population: Strategic Considerations. Dublin: NCAOP, 2005.
- 26) Whiteford H, Teeson M, Scheurer R, Jamison D. Responding to the burden of mental illness. Commission on Macroeconomics and health. CMH Working Paper Series, Paper No. WG1:12, 2001.
- 27) OECD. Live Longer: Work Longer. Paris: Organization for Economic Cooperation and Development, 2006.
- 28) Elson D. Male bias in Macroeconomics: the Case for Structural Adjustment. In: Elson D (ed) Male Bias in the Development Process. Manchester: Manchester University Press, 1990.
- 29) Rittich K. Feminization and Contingency: Regulating the Stakes of Work for Women in Conagan J, Fischl RM and Klare K (eds) Labour Law in an Era of Globalization: Transformative practices and possibilities. Oxford: Oxford University Press, 2002.
- 30) Palley TI. The Economics of Social Security: an Old Keynesian Perspective. Journal of Post Keynesian Economics 1998;21(1):93-110.
- 31) Grootaert G. Social Capital: The Missing Link? (PDF file) World Bank. SCI Working Paper No.2, 1998.
- 32) Borjas G. The Economic Benefits from Immigration. J Economic Perspectives 1995;19 (2): 3-32.
- 33) Ritter H. Bevölkerungsvorausschätzung 2000 bis 2030. [Population forecast 2000 to 2030]. Vienna: Institut für Demographie der Österreichischen Akademie der Wissenschaften, 2002.
- 34) Stockholm Healthy City Profile. Center for Public Health. Stockholm County Council, Sweden, 2007.
- 35) Victor C. The Epidemiology of Ageing. In: Johnson M L (ed.) The Cambridge Handbook of Age and Ageing. Cambridge: Cambridge University Press, 2005.
- 36) Gjonca E, Marmot M. Patterns of illness and mortality. In: Johnson ML (ed). The Cambridge Handbook of Age and Ageing. Cambridge: Cambridge University Press, 2005.
- 37) Nusselder W, Peeters A. Successful Ageing: measuring the years lived with functional loss. J Epidem Comm Health 2006;60:448-55.
- 38) Oliviera Martins et al. The Impact of Ageing on Demand Factor Markets and Growth. OECD Economics, Department Working Paper No. 420. Paris: OECD, 2005.
- 39) Cutler D. Declining Disability among the Elderly. Health Affairs. 2001;20(6):11-27.
- 40) Manton K, Gu X. Changes in prevalence of chronic disability in the United States, black and non-black population above age 65 from 1982 to 1999. PNAS 2001;98: 6354-9.
- 41) Olshansky SJ, Carnes BA. The quest for immortality. New York: H.H. Norton, 2002.
- 42) Hagist C, Kotlikoff LJ. Health Care Spending: What the Future Will Look Like. National Centre for Policy Analysis, Policy Report No. 286, May 2006.
- 43) Whitehead M. A typology of actions to tackle social inequalities in health. J Epidem Comm Health 2007;



Appendix

HOW THE DEPENDENCY RATIO HAS BEEN CALCULATED AND DEVELOPED THROUGH SIX STAGES IN THE ITALIAN CITY OF UDINE

STAGE 1

WHY:

The first stage comprises the classic formulation of the DR which is generally used in demography and compares city populations of working age to populations of young plus older people. The classic formulation assumes working age starts at 15 after elementary education and finishes at a retirement age of 65. Even if commonly acknowledged, these age bands are still controversial because they do not reflect the modern era, where the 'productive' age band has in reality been 'squeezed' by expanding education for younger people and early retirement of older people.

HOW:

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

The standard formula has been applied which compares the number of people aged 0-14 years plus people aged 65 and over (numerator) to the number of people aged 15-64 (denominator).

Data source: Research and Statistics Department – Municipality of Udine.

STAGE 2

WHY:

The demographic DR ignores an important aspect: not all working-age people actually work and provide direct or indirect support to the formally dependent segments of population. A more accurate view of the economic consequences and burden carried by a defined 'working age population' is given by the economic dependency ratio (EDR) which compares people who are active in the labour force and people who are not, regardless of age. This second stage calculates the ratio between segments of population who are economically inactive and therefore 'dependent' (numerator) and those who are actually active in the labour force (denominator).

HOW:

$$EDR = \frac{Pop_{0-14} + Pop_{15-64}^{inactive} + Pop_{65-\omega}}{Pop_{15-64}^{active}}$$

This stage splits the denominator of the previous stage into two components: the economically active people - actually employed - who make up the labour force and the economically inactive people - because of illness/incapacity, unemployment, education and caring duties. This second group has been deducted from the denominator and added to the numerator. The number has been calculated on the basis of the three-monthly activity rate supplied by the Statistics Department of the Region Friuli Venezia Giulia; the rate refers to the observed data registered in the Province of Udine.

STAGE 3

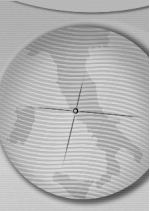
WHY:

As in the previous stage, the demographic DR does not take into account the fact that many people aged 65 and over and demographically considered 'dependent' are instead economically active. As a consequence this stage adds back economically active older people into the working population.

HOW:

$$EDR = \frac{Pop_{0-14} + Pop_{15-64}^{inactive} + Pop_{65-\omega}^{inactive}}{Pop_{15-64}^{active} + Pop_{65-\omega}^{active}}$$

This stage splits the $Pop_{65-\omega}$ in the numerator into two components: people over 65 who are actually inactive and therefore dependent on the working-age population and people over 65 who are still active despite their age. Active



people of this age band are subtracted from the complementary inactive population (numerator STAGE 2) and added to the denominator. The number has been calculated on the basis of the data contained in the Italian Statistical Yearbook 2005 of the Central Statistical Office (ISTAT) and regarding the Labour Force Continuous Survey. The national data have been proportionally calculated at a regional, provincial and finally municipal level.

STAGE 4

WHY:

In a dichotomic view of population which divides it into 'dependent' and 'supporting' segments, it is important to understand where unpaid work could be included. As a matter of fact, unpaid work has independent economic value because it produces the so-called negative opportunity costs (commonly referred to as spare) which can be direct (unpaid work means caring for children, older or incapacitated people and thus reduces the need for paid work) or indirect (more free time for those who are in formal work). Unpaid work can be done for example by carers such as housewives, volunteers and 'badanti', special carers who help older people in all their daily needs. This stage reduces the dependency ratio by restricting the non-productive population in the numerator to children plus adult population who are disabled or unemployed while those of any age who provide care are included in the denominator.

HOW:

$$EDR = \frac{(Pop_{0-14} + Pop_{15-64}^{inactive} + Pop_{65-w}^{inactive}) - Pop_{15-w}^{unpaid_work}}{(Pop_{15-64}^{active} + Pop_{65-w}^{active}) + Pop_{15-w}^{unpaid_work}}$$

This stage focuses again on the numerator, by subtracting people who do unpaid work but are socially useful as well. Specifically, housewives, volunteers and "badanti" have been subtracted from the numerator and added to the denominator. The number of "badanti" has been supplied by the Social and Welfare Services Provider of Udine while the number of housewives has been calculated by using a weighted mean of the number obtained from the data supplied by the Work Local System of Udine and the number obtained from the data given by the Province of Udine. Both data refer to 2001 census (the Registry Office of Udine declares that their data are not completely reliable because information regarding people's occupation is not a compulsory information anymore and there is no evidence on identity cards anymore). As concerns the data referred to the Work Local System of Udine, they have been proportionally calculated taking into account the female population aged 15-64 supplied by the same system but referred to 2005 instead of 2001; then the number of the female population of Udine aged 15-64 has been proportionally re-calculated. The same process has been applied to the data referred to the Province of Udine and to the year 2001. The number of housewives has been estimated through the weighted mean of the two data obtained above. The demographical data regarding the Province of Udine and the municipalities included in the Work System of Udine have been supplied by the Central Statistical Office (ISTAT). The number of volunteers has been calculated as the number of people who are supposed to be inactive but actually take part in voluntary associations (Stage 2).

STAGE 5

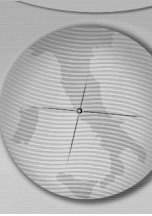
WHY:

A comprehensive understanding of a socioeconomic system means not focusing on a closed economy model but taking into account also dynamic factors and border-line cases such as illegal or temporary immigrants. Immigration could have positive effects and reduce the economic dependency ratio by adding to the denominator if immigrants are skilled workers who provide demographic and economic vitality. On the contrary, immigration could have negative effects when immigrants are irregular, 'non-productive' refugees and family dependents of economic migrants, who will increase the dependency ratio by adding to the numerator. This phenomenon varies from city to city and from country to country. In countries where numerous foreign communities exist, it is much easier for immigrants to find support and accommodation. Moreover, the foreign policy adopted by governments is very important in regulating this process: integrating policies and 'open frontiers' lead to more immigrants but also to a general regularity of migration and possibility of control; on the contrary, more strict criteria of selection (or even the choice to prevent immigration) lead to a reduced number of immigrants but gives incentives to illegal immigration.

HOW:

$$EDR = \frac{[(Pop_{0-14} + Pop_{15-64}^{inactive} + Pop_{65-w}^{inactive}) - Pop_{15-w}^{unpaid_work}] + Migrants^{inactive}}{[(Pop_{15-64}^{active} + Pop_{65-w}^{active}) + Pop_{15-w}^{unpaid_work}] + Migrants^{active}}$$

The fifth stage adds to the DR model the number of immigrants who are 'temporarily present' on the territory. These data have been supplied by the local health agency and other health services providers. The number of illegal immigrants obtained by these agencies has been multiplied by an estimate coefficient, based on the ratio of (a) the number of admissions of temporary immigrants to the local health services in the year when the last 'irregulars' amnesty was in force (2003) to the number of immigrants already regularized. The number obtained has been then divided by four, which is the number of years passed from the previous amnesty, in order to have an annual reference which has finally been multiplied twice (since two years passed from the last amnesty in 2003) by the number of admissions. The per-



centage of active and inactive people has been worked out on the basis of their declarations when admitted to the local health services.

STAGE 6

WHY:

At the present day (year 2005) the sixth stage coincides with the fifth. The general objective is to promote initiatives that could increase the activity rate of people aged 65 and over, enabling them to remain physically, mentally and socially active as much as possible. The challenge is to maintain functional capacity at the top end of the range, resulting in both greater participation in the labour market and less dependence on health and social support services.

This last stage makes a simulation, setting some objectives and accounting for the evolving population structure. In this case the objective has been to shift the third age from 65 to 70 years of age, applying the current activity rate of the working age population to the age band 65-69.

Finally a boundary of time has to be set. Two possible scenarios have been conjectured: an optimistic one, which assumes this changes occur by 2010 and a more realistic one, which assumes they occur by 2015. Yet, pre-setting a time by which objectives will be achieved is functional only to our simulation; the actual achievement of these goals depends mostly on how governments intend to develop and apply their policies and strategies and how much attention they pay to these important issues.

The final formulation of stage 6 does not take into account any increase in the productivity growth and in the population's quality of life but has kept constant the current situation. Otherwise, if productivity significantly increased or the quality of life decreased, a smaller number of active people would be enough to support those who are inactive. Yet, these factors are scarcely influenced by policies but are a result of technological progress and custom.

HOW:

$$EDR = \frac{Pop_{0-14} + Pop_{65-69}^{inactive} + Pop_{70-}^{inactive} + Pop_{15-64}^{inactive} - Pop_{15-}^{unpaid-work} + Migrants^{inactive}}{Pop_{15-64}^{active} + Pop_{65-69}^{active} + Pop_{70-}^{active} + Pop_{15-}^{unpaid-work} + Migrants^{active}}$$

From a methodological and operative point of view, the sixth stage is the more difficult to represent because it tries to re-calculate all the previous stages, making reference to a future period of time (2010, 2015, etc.) and to modify the final formula so as to adapt it as much as possible to the pre-set objectives.

The scenario re-created focuses on the age band 65-69, by subtracting it from the old age and including it in the working ages. A kind of what-if scenario has been conjectured in order to see what could happen in 5, 10 or more years if there was this shift from the fourth to third age. To create this new scenario, some projections have been necessary.

The projections of mere demographic data (city population by sex and one year of age) have been done through the cohort-components method. The disadvantage of this method is that an estimate reliability level (level of confidence) cannot be fixed (although it is much close to reality, unless extraordinary changes such as wars or natural calamities occur) but on the other hand it can be calculated on defined population groups of every size.

From year to year a mortality law, a fertility law and a migration level have been applied to the original population. In this specific projection the guidelines of the Central Statistical Office (ISTAT) regarding Udine and its Province have been used, that means a life expectancy which slightly but gradually increases over the time and a fertility rate which sensibly increases though not reaching the replacement rate. Among all the demographic phenomena migration is the most random but also in this case a slightly increasing migration balance has been applied. The Labour Force Survey supplies projections only for the three following months; therefore any medium-long time projection on a small area (such as a municipal contest) could be in any case too much random. For this reason the current activity rate have been used. The number of housewives has been proportionally re-calculated with reference to the number of women aged 15-64 of 2005 and to those aged 15-70 of the year of projection. The increase of the women's activity rate (which represents their percentage in the labour force) and the decrease in the number of housewives do not influence the dependency ratio because both these elements are included in the denominator, so these changes do not have any effect on the final results. The number of 'badanti' has been re-adjusted to women aged 55-64 of 2005 and to women aged 60-69 of the year of projection. The activity rate of people over 65 (stage 3) has been re-proportioned to people aged over 70 of the year of projection; considering the shift from the third to the fourth age, a 70-year-old person should behave as a 65-year-old one. The number of volunteers and that of immigrants have been kept constant because an estimate of these data is too much random.