

Health Capacity to Work for Older Adults

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Abstract: Governments in many countries have responded to population aging by raising the retirement age. These measures rely on the assumption that workers can remain productive past their current retirement age. We provide the first systematic assessment of health capacity to work at older ages for 20 countries in Eastern Europe and Central Asia. Using two complementary methods, we estimate additional years of work capacity (AYWC): a mortality-based approach comparing each country against its own reference trajectory, and a health-based approach using health indicators from the Survey of Health, Ageing and Retirement in Europe (SHARE). The mortality-based estimates range from 1.7 to 7.7 additional years where mortality has improved faster than participation has risen, to -5.3 to -0.6 years where participation has already outpaced the mortality gain. The health-based estimate is 3.94 years over ages 65 to 74, with a 95 percent bootstrap interval of 3.55 to 4.31 years. Our results suggest that workers in many countries of the region have additional capacity to extend their working careers, though the size and sign of that capacity depend materially on how the base year is chosen.

Keywords: Aging, Mortality, Labor supply, Europe and Central Asia.

JEL: J14, J26, J11

1. Introduction

The Europe and Central Asia (ECA) region faces unprecedented demographic changes that will reshape its societies and economies in the coming decades. Population aging and decline will fundamentally alter labor markets, healthcare systems, and economic growth prospects. By 2060, the global working-age population is projected to decline by more than 10 percent, with a much more severe contraction of 35 percent or more in many European countries (OECD 2023), where each retiree is projected to be supported by fewer than two working-age people. The financial sustainability of publicly funded pension systems could be endangered if not reformed. Policymakers respond to these challenges by raising the pension age (despite strong voter opposition) and implementing reforms to retain older workers in the labor market (Jürges et al. 2017). Prolonging working lives may help cover the higher costs of pensions and healthcare systems imposed by increased longevity. Many developed countries are seeking to align the retirement age with life expectancy (OECD 2023).¹

The longer and healthier life expectancy achieved over recent decades has shifted the view of aging from a period of physical and mental decline to one that recognizes the potential for productive contributions by older individuals beyond traditional retirement years. That shift assumes that older adults are healthy enough, or, to put it differently, have the capacity to work beyond the current retirement age. A body of literature indicates that poor health is the main driver of early retirement (Christensen and Kallestrup-Lamb 2012). But at the same time, not everyone who retires from work does so for health reasons.

This paper contributes to the literature on the health capacity to work of older adults. To our knowledge, this is the first systematic assessment of health capacity to work at older ages for 20 countries in Eastern Europe and Central Asia. We rely on two approaches that use mortality and a series of health indicators to measure the capacity to work at older ages (Milligan and Wise 2015; Cutler et al. 2013). We compare results across 20 countries in Eastern Europe and Central Asia, based on data from 1990 to 2023.² Our analysis focuses on individuals aged 50-70 years because

¹ The concept of “prospective age” introduced by [Sanderson and Scherbov \(2005\)](#) considers people “old” when they have 15 years or less of remaining life expectancy.

² Our countries are: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Montenegro, North Macedonia, Poland, Romania, Russian Federation, Serbia, Tajikistan, Türkiye, and Ukraine.

this is the period during which the work-to-retirement transition occurs in most countries in our sample.

We find that, first, when considering health for the measures of dependency—that is, using the Health-Adjusted Dependency Ratio—several countries have smaller levels of dependency (Albania, Bosnia and Herzegovina, Croatia, Türkiye, among others). Others have larger rates of dependent population (Bulgaria, Belarus, Moldova, Romania, Russia, Serbia, and Ukraine, among others).

Secondly, our mortality-based estimations of additional capacity to work yield heterogeneous results across countries, consistent with previous within-country estimations. Azerbaijan, Georgia, Kazakhstan, Tajikistan, Türkiye and Ukraine show positive additional years of work capacity under all three base years, ranging from 1.7 to 7.7 years. Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Moldova, Montenegro and Serbia are negative under all three, from −5.3 to −0.6 years. Negative results are mainly associated with greater labor force participation at older ages, despite a slight decrease in mortality.

Health capacity to work estimations using a multinomial logit model for Bulgaria, Croatia, Poland and Romania show around 3.9 years of additional work capacity over ages 65 to 74. Incorporating the currently retired population would imply an increase of self-reported disabled people not in retirement, but through age 69 disability rates would not exceed what the model already predicts before retirement age; only at ages 70 to 74 would they rise materially.

The paper is organized as follows. The next section reviews the literature on assessing health capacity to work. Section 3 describes our data and empirical methodology. Section 4 presents a descriptive analysis of the main trends in mortality and Labor Force Participation. Section 5 presents the main results of both our methods. Section 6 concludes with policy implications and a proposal for future research.

2. Literature review

The relationship between retirement and health has been studied extensively. A theoretical model developed by Mitchell and Fields (1984) suggests that increases in earnings would lead to later retirement, whereas higher pensions or Social Security benefits would induce earlier retirement. Wolfe (1985) develops a Grossman-type model of investment in health, where rising productivity

can lead to both improved health and earlier retirement, thereby explaining the simultaneous decrease in the average retirement age and improvements in post-retirement health.

Empirical evidence suggests that health conditions influence retirement behavior. Disney et al. (2006) find that health shocks earlier in the career increase the likelihood of retirement among workers aged 50 or older. Blundell et al. (2023) construct a health index that captures both subjective and objective health measures and find that health accounts for up to 15 percent of the variation in employment among individuals aged 50 to 70 in the UK and the US.

Socioeconomic inequalities also shape the relationship between health and retirement. Hofäcker and Naumann (2015) report that labor force participation beyond retirement age is higher among less-educated workers, primarily due to financial need. This pattern is especially pronounced after the delay in public pension benefits, which previously provided early exit opportunities. This disparity among workers contributes to social inequality in retirement decisions.

Not all retirement decisions are driven by age-related disabilities or poor health; instead, they are often influenced by the availability of pension options at earlier ages. Raising the early retirement age was associated with an almost 10 percentage-point increase in employment among men and an 11 percentage-point increase among women in Austria (Staubli and Zweimüller 2013). Manoli and Weber (2016) also find that a 1-year increase in the early retirement age is associated with a 0.4-year increase in the average age at job exit. In the Netherlands, Rabaté et al. (2024) report that a reform of the retirement age has clear and large effects on employment. Similarly, Hernaes et al. (2013) find that the early retirement program in Norway reduced the age of retirement. The systematic literature review by Pilipiec et al. (2021) suggests that raising the retirement age is associated with higher labor force participation and higher preferred and expected retirement ages.

Several authors estimate the capacity to work at older ages, or what participation in the labor market would be at later ages if people worked at the same rate as those with similar health do (or did). Two such studies form methodological foundations for the current analysis. The approach developed by Milligan and Wise (MW) (2015) uses mortality as a measure of health. This research builds upon the concept of healthy life expectancy and the fact that mortality rates are comparable across countries and within countries over time. MW calculate a measure of mortality-equivalent ages over time to summarize improvements in health between the base year (1977) and the comparison year (2007). The capacity to work is then approximated by assuming that employment

at each mortality level in 2007 was the same as in 1977. The difference between these employment levels yields the gain in years of employment. According to their results, in 2007, American men aged 55-69 would have worked 3.71 additional years, or 47 percent more, if they had worked at the same level as men with similar mortality rates did in 1977. Similarly, using the U.S. as a base, French men aged 55 to 69 would work 4.6 years longer if they worked as much as American men at the corresponding mortality levels.

The method developed by Cutler, Meara, and Richards-Shubik (CMR) (2013) examines whether increases in the eligibility age for public pensions lead more people to work at older ages and how this varies across demographic groups. The model estimation consists of two steps: First, they use a Multinomial Logit model to predict the probabilities of labor force participation, retirement, and disability for individuals aged 59-61, using a health index as the main explanatory variable. Then, the parameters estimated in the first step are used to predict labor force status for the 62-64 age group. The approach assumes that people aged 62-64 have only marginally worse health than those aged 57-61 and are otherwise identical to people aged 59-61. As such, under similar working conditions, people aged 62 and older would have a labor force participation rate approximately 15 percentage points higher if they worked at the same rate as younger cohorts with comparable health levels.

The MW and CMR methods have been used to estimate health capacity to work in Germany (Jürges et al. 2017), Denmark (Aaskoven et al. 2024), and Spain (García-Gómez et al. 2017). Wise (2017) consolidates estimates for 12 countries across North America, Europe, and East Asia. All studies find a strong negative relationship between mortality and employment rates as age increases. They also find a consistent upward trend in mortality at older ages, accompanied by a decline in labor force participation during the 1980s and 1990s, followed by a plateau after the turn of the century. The results of this compilation suggest additional work capacity among individuals aged 60 to 69, which varies by socioeconomic and educational groups. Additional work capacity estimated using the MW method ranges from 19 to 75 percent (equivalent to 1.6 to 7.7 years of additional work), whereas for men aged 65 to 69, it ranges from 31 to 83 percent, with an average of 62 percent (Table 1).

Table A1 in the Appendix widens the compilation in Table 1 beyond the twelve countries of the Wise volume. These studies find additional health capacity to work among older adults, with MW

estimates ranging from 1.6 to 7.7 years of additional years of work capacity (AYWC), and CMR estimates from 42 to 84 percent higher participation, though one study reports its CMR result as a gap in percentage points rather than a percentage. Covering both developed economies and emerging markets, the estimates shown in Table A1 suggest that the phenomenon of unutilized work capacity is widespread.

3. Data and Methodology

Our analysis relies on data drawn from several sources. Mortality and demographic data are obtained from the World Population Prospects (United Nations Population Division 2024). Labor force participation statistics come from ILOSTAT (2024). Self-assessed health data are derived from Waves 1 to 9 of the Survey of Health, Ageing and Retirement in Europe (SHARE) (Börsch-Supan et al. 2013), which captures individuals' own perceptions of their health status, including data on mobility limitations and limited activities of daily living; mental health problems; chronic conditions; and risk behaviors. Other relevant socioeconomic variables—such as Gross Domestic Product (GDP), poverty rates, and related measures—are obtained from the World Bank (2025). We focus our analysis on the sample of male workers.³

The participation series are not uniform in kind across countries, and each estimate rests on two observations, one in the base year and one in the final year.⁴ Table A5 records the source of every observation the estimates use, together with the adjacent-year movements larger than ten percentage points that are candidates for a break in the series. There are eighteen such movements, seven of them in Azerbaijan, whose series moves by more than forty percentage points in both 1999-2000 and 2006-07; estimates for Azerbaijan should be read with that in mind. The comparison years are also not common across countries. Seven series end before 2023—

³ [García-Gómez et al. \(2017\)](#) argue that their focus on male workers in the analysis of the health capacity to work is explained by fact that the increase in female participation rates is mainly driven by cultural changes regarding the role of women in society, and not by changes in the incentives provided by the social security schemes.

⁴ Of the country-years the mortality-based estimates use, 51 come from labor force surveys, 11 from censuses, 4 from other household surveys, and 3 from establishment surveys; none is an ILO-modelled estimate, and every observation in the extract carries a reported source code. What is modeled in these numbers is our construction, not the source's: single-year rates are apportioned linearly out of the five-year bands ILOSTAT publishes, participation is taken to decline linearly to zero above age 62, and values are interpolated and extrapolated across years.

Tajikistan's in 2016 and Ukraine's in 2017 are the shortest—so those countries are compared at an earlier final year, against that year's mortality.⁵

We use two approaches to estimate health capacity to work. The first approach is based on the methodology developed by Milligan and Wise (2015) for calculating mortality-equivalent ages over time. The first step of this methodology is to determine the mortality equivalent age (MEA^a). It is calculated by finding the age in year T at which the mortality rate is equal to the mortality rate at age a in a base year t (MEA^a such that $m_T^{MEA^a} = m_t^a$). For example, if in 1990 mortality at age 60 was 1 percent, the MEA^{60} in 2023 is the age at which mortality is 1 percent. Mortality-equivalent ages are then calculated for ages 50 to 70. This methodology assumes that health conditions at similar mortality levels imply a similar capacity to participate in the labor force.

For the second step, two values of Labor Force Participation (LFP) are used to determine the potential capacity to work of 2023 with respect to a base year (t) for all ages $a = 50, \dots, 70$. LFP at age a in the base year is compared with LFP at MEA^a in the current year to obtain health-capacity to work at a given age a (HCW^a):

$$HCW^a = LFP_t^a - LFP_T^{MEA^a}, \quad (1)$$

where superscripts denote age, subscripts denote year, and HCW^a measures the difference in LFP between individuals with equivalent mortality levels in different years. In the third step, we aggregate additional work capacities between ages 50 and 70:

$$AYWC = \frac{1}{100} \sum_{a=50}^{70} HCW^a, \quad (2)$$

where $AYWC$ stands for Additional Years of Work Capacity. This measure is interpreted as the number of years individuals would work more if they worked as much as individuals with the same mortality levels.

Three models are estimated using different values for the base year t : one for the longest period available from 1990 to 2023, or the closest year available; a second for the 2000-2023 period, or the closest year available; and the third one using as a base the year with the highest value of LFP between 1990 and 2010. This last model gives the largest gap between current and past

⁵ Nine series begin materially late. Montenegro's begins only in 2011, so it has no 1990 or 2000 base year and is compared over a twelve-year window against the thirty years available for most countries.

participation levels; because the base year is chosen on participation itself, Section 5 reports it alongside three alternative rules for choosing it.

The Milligan and Wise (MW) method relies on demographic statistics available for most countries in our sample and comparable across countries and over time. However, additional years of life are not necessarily a reliable measure of increased work capacity. Even with improvements in mortality, incapacitating health conditions, disease, and disability are prevalent at ages over 60. While changes in healthy life expectancy are present in most countries, they are not directly related to changes in mortality.

The method developed by Cutler, Meara, and Richards-Shubik (CMR) aims to overcome these limitations. It models individual decisions about labor-market participation as a function of health-related outcomes. An individual chooses among four states: participate in the labor market (W), retire (R), go on disability (D), or select an alternative scenario (O) (e.g., to become a homemaker). Formally, individual i derives utility from choosing state j :

$$U_{ij} = V_{ij}(\mathbf{h}_i, \mathbf{X}_i) + \varepsilon_{ij}, \quad j \in \{W, R, D, O\}, \quad (3)$$

where V_{ij} is the systematic component of utility and ε_{ij} captures unobserved preference heterogeneity. Under the assumption that V_{ij} is linear in parameters:

$$V_{ij} = \beta'_j \mathbf{X}_i + \gamma'_j \mathbf{h}_i, \quad (4)$$

where $\mathbf{h}_i$ is a vector of health indicators that includes, among others, information about self-reported health, mobility limitations, limited activities of daily living, mental health, chronic conditions, and risk behaviors. In the estimated model, these enter through a single summary measure rather than one by one: a health index, entered as its weighted percentile from 1 to 100.⁶ $\mathbf{X}_i$ is a set of demographic characteristics, while β'_j and γ'_j are the state-specific parameters. No age term enters the model: age affects the predicted probabilities only through the ages on which the model is fitted, and none of the regressors listed in Table A3 is a function of age. The individual selects the optimal labor force state j_i^* that maximizes utility:

⁶ The index is the first principal component of self-assessed health, mobility limitations, activities and instrumental activities of daily living, ten chronic conditions (heart attack, stroke, high cholesterol, lung disease, cancer, hypertension, arthritis, diabetes, Alzheimer's disease and osteoporosis), body-mass category, smoking, years of education, marital status and the EURO-D depression score, extracted with the SHARE individual weights. Nine of those components—self-assessed health, mobility limitations, the two activity-of-daily-living measures, body-mass category, smoking, the EURO-D depression score, years of education and marital status—are also entered as separate regressors, so each enters the equation twice: once on its own and once inside the index.

$$j_i^* = \underset{j}{\operatorname{argmax}} \{U_{ij}\} \quad (5)$$

The probability that individual i chooses state j is:

$$P(j_i^* = j) = P(U_{ij} > U_{ik} \text{ for all } k \neq j) \quad (6)$$

Assuming that the error terms ε_{ij} are independently and identically distributed according to a Type I Extreme Value distribution, probability (6) could be estimated by the multinomial logit:

$$P(j_i^* = j) = \frac{\exp(z_{ij})}{\sum_{k \in \{W, R, D, O\}} \exp(z_{ik})}, \quad z_{iW} \equiv 0 \quad (7)$$

Where z_{ij} is the systematic component of utility from equation (4), and the normalization shown in (7) identifies the three remaining states relative to labor-market participation (the complete list of variables included in (7) is available in Table A2 of the Appendix).

The model is estimated using a sample of men aged 50-64, the group closest to when retirement decisions are typically made. Then, using the estimated parameters, the labor force participation state is predicted for men aged 65 to 74. This extrapolation assumes that the decision to retire or participate in the labor market is determined entirely by health, rather than by other factors. The gap between predicted and observed outcomes yields additional health-related capacity to work. The model is fitted on ages 50 to 64 and used to predict ages 65 to 74, ten years beyond the oldest age it has seen; the Cutler, Meara and Richards-Shubik study on which the method is based extrapolates three years rather than ten. With no age term in the model, the predicted probabilities for a 74-year-old man differ from those for a 55-year-old man only through his health and demographic characteristics, and not through his age.⁷ We report the specification without an age term, which is the one estimated throughout; adding one lowers the estimate to 0.61 years in one case.

The MW method is applied to 20 of the 23 countries in the ECA region (Kosovo, Turkmenistan, and Uzbekistan are excluded due to data limitations). The CMR method is applied to only four countries—Bulgaria, Croatia, Poland, and Romania—because the SHARE data, which are necessary for this analysis, are available only for these countries. We report a country-level

⁷ Estimated with a linear age term, the additional work capacity over 65 to 74 falls from 3.94 years to 0.61; with age dummies held at the top of the estimation window it is 2.79 years.

estimate only where a country contributes at least 200 observations to the estimation sample; that threshold is a convention we adopt for this paper rather than one taken from the literature.

4. Descriptive results

4.1. Trends in mortality

Mortality improved significantly from 1990 to 2023. Figure 1 shows changes in mortality-equivalent age over time for Poland and Georgia, two representative countries.⁸ In Poland, the mortality rate of a 64-year-old man in 2010 was the same as the mortality rate of a 60-year-old man in 1992.⁹ Compared to 1992, the mortality equivalent age increased to 66.4 years in 2023. Many countries in our sample experienced an almost monotonic increase (except during the COVID-19 years) in the mortality equivalent age, similar to that of Poland. However, some countries experienced more erratic trends. In Georgia, for example, the mortality equivalent age increased slightly in the early 2000s but then fluctuated around the 1999 level thereafter.

Table 2 shows the mortality equivalent age when 1990 (or the closest year with available information) is used as the base year. The mortality rate declined from the early 1990s to 2023 in all countries in our sample except Moldova, where it rose by 11.0 percent, and Belarus, Georgia and Montenegro, where it was flat or marginally higher. Mortality declined the most in Türkiye (45.7 percent), Kazakhstan (42.3 percent), Croatia (41.7 percent), and Poland (37.2 percent). In these countries, the mortality-equivalent age reached 66 or 67 years, so that 60-year-old men in the base year—1988 in Poland, 1990 in Türkiye, 1991 in Croatia and 2002 in Kazakhstan—had the mortality of 66- and 67-year-olds in 2023. When considering 2000 as the base year (Table 3), all countries show a decrease in mortality, except for Montenegro. Kazakhstan and Russia have the largest decrease in mortality by over 40 percent, with mortality-equivalent ages of 67 and 68, respectively.

4.2. Trends in Labor-Force Participation

The period from 1990 to 2023 is characterized by an increase in Labor-Force Participation among older individuals. Figure 2 depicts the LFP for males aged 60-64 in ECA countries. In Central and

⁸ For some countries, mortality estimates are available only for selected years. For these countries, the earliest available mortality estimates are used. For example, Poland's earliest mortality estimate is for 1992, while Georgia's is for 1999.

⁹ All countries in our sample experienced drop in mortality equivalent age in 2019-2021 related to COVID-19 pandemic.

Eastern Europe, the LFP increased across most countries, from approximately 39 percent in 1990-2000 to approximately 59 percent in 2020-2023. Meanwhile, countries in Central Asia experienced a slight decrease, from approximately 58 percent to 55 percent, indicating minor changes and overall stability in labor force participation.

The regional averages conceal opposite country experiences. In some countries the decline in mortality over the past 30 years has been accompanied by a parallel decline in participation among individuals aged 50 and older. In other cases, improvements in health outcomes have been followed by stagnation in labor participation. Moreover, in some countries, we observe increases in both mortality and LFP.

A measure to explore this improvement in health and its relationship with age is the Health-Adjusted Dependency Ratio (HADR). HADR is an alternative measure to the Old Age Dependency Ratio (OADR) that defines the dependent population as the number of adults (aged 20 or older) who have the same or higher aging-related disease burden as the global average 65-year-old, and compares it to those in better health (supporting population) (Skirbekk et al. 2022).

Table 4 lists the OADR, HADR, and the difference for countries in our sample. The difference between the two measures underscores that, despite their correlation, age and health are not equivalent concepts, and differences in health at older ages can affect the capacity to work in specific populations. For instance, Croatia and Albania have OADRs more than 10 percentage points higher than their HADRs, indicating that a large share of the population classified as “dependent” by age criteria is in good enough health that they would not be considered dependent when health status is taken into account. The opposite holds for Bulgaria and Moldova, where OADR underestimates the population dependency ratio by more than 15 percentage points relative to their HADR. Worse health conditions, even among working-age individuals, may increase the burden of dependency and imply reduced capacity to work in these countries. Across the 20 countries, the gap between the two ratios is positively correlated with the additional years of work capacity estimated in Section 5 when 1990 is the base year, but not under the other two base-year rules, and the association is suggestive rather than established.¹⁰

¹⁰ The correlation is $r = 0.50$ ($p = 0.03$, $n = 20$) on the 1990 base, $r = 0.13$ ($p = 0.58$) on the 2000 base and $r = 0.03$ ($p = 0.91$) on the year of maximum labor force participation; adjusting the smallest of the three p-values for the three comparisons gives 0.08.

5. Health capacity to work in ECA

5.1. Mortality-based Health Capacity to Work

We use the MW methodology to estimate the health capacity to work of the male population in countries of the ECA region. The methodology uses mortality as a proxy for health. Milligan and Wise (2015) argue that mortality has an advantage over other health measures: it is comparable within countries over time and across the countries; mortality data are available for an extended period for most countries in our sample; and mortality is highly correlated with health indicators, including functional capacity measures and comprehensive health indexes (Halliday et al. 2020).

Figure 3 shows two typical relationships between mortality and the LFP. The left panel demonstrates higher levels of male LFP in Poland during 1988-1992 than in 2022-2023 at the same level of mortality. For example, the LFP of 60-year-old males in the early 1990s was about 53 percent at a mortality of 2.6 percent. The age with a similar mortality during 2022-2023 was 66 years, with an LFP of 42.6 percent (a difference of about 10 percentage points). In Moldova (right panel in Figure 3), the relationship is reversed, with a shift resembling an upward trend in the relationship between mortality and LFP. The LFP rate in the 1990s is lower than in 2022-2023 for almost all ages. The LFP of a 60-year-old male was approximately 56 percent in the 1990s and 84 percent in 2022-2023, despite slightly higher mortality rates in the 1990s (2.8 percent) than in 2022-2023 (2.7 percent).

The main challenge in estimating the AYWC is that a range of factors unrelated to individual health may influence the LFP. These factors play a more prominent role during the transition to a market economy, which most countries in our sample underwent in the 1990s. This period was marked by sharp declines in economic growth, enterprise closures, layoffs, and high unemployment. In many countries, the LFP across all age groups during these crisis years was lower than in the later, more stable years, resulting in a negative capacity-to-work. To mitigate this problem, we use two approaches: first, we set 2000 as the base year for comparing LFP levels. By 2000, most countries in the region had already completed their transition and entered a relatively stable period of economic growth. In the second approach, we use the year with the highest LFP level between 1990 and 2010 as the comparison year.

For 2000-2001 and 2022-2023, Poland exhibits a pattern similar to Moldova, with declining mortality accompanied by increasing LFP. Poland's own comparison against 1988-1992, in the left

panel of Figure 3, runs the other way: participation at the same level of mortality is about ten percentage points lower now than then. So where a country's transition resembles Poland's from the early 1990s, older individuals have better health and less work is being done at each level of mortality than before. The same comparison for all twenty countries in the sample is shown in Figure A1.

Table 5 summarizes the changes in LFP levels by mortality rates for the countries in our sample, in the closest year to 1990 with available data, and in 2023. Almost all countries experienced a decrease in mortality at age 60 between the initial and final years, which corresponds to a mortality equivalent age (MEA) exceeding 60. LFP at age 60 generally increased between the initial and final years, with the largest jump registered in Bulgaria, where LFP increased from 29.9 percent to 77 percent; in Moldova, from 50.9 percent to 82.2 percent; and in Romania, from 31.9 percent to 61.7 percent. In Bulgaria and Romania, this increase is observed, even though their MEA increased by only 0.4 and 1.5 years, respectively, relative to the base of 60, whereas in Moldova, the MEA even decreased by 1.2 years. Conversely, LFP at age 60 declined by between 9.6 and 11.7 percentage points in Tajikistan, Georgia, and Ukraine. In the case of Georgia, this was accompanied by an increase in mortality at age 60; while for Ukraine and Tajikistan, mortality decreased, with MEA increasing to 61.6 and 61.8 years, respectively. Overall, LFP at the same mortality level as age 60 in the initial year increased in half of the countries, while it decreased in the other half.

Some of these results change when comparing 2000 to 2023 ([Table 6](#)). While gains in mortality are maintained and MEA remains over 60 years in all countries except Montenegro, LFP decreased relative to 1990 in most former Soviet countries, including Belarus, Kyrgyzstan, Moldova, Russia, Ukraine, and North Macedonia. This results in smaller or even negative HCW values.

[Table 7](#) shows that the maximum level of LFP for most countries was reached between 2004 and 2010. In recent years, the LFP rate at age 60 averaged 66.6 percent, and the MEA in 2023 was above 60 in all countries except Albania, Armenia, Georgia, and Montenegro. The difference between LFP at age 60 in the base year and LFP at the mortality-equivalent age in 2023 is the single-year HCW measure, as defined in equation (1). This measure is negative in 6 countries in our sample (Moldova, Bosnia and Herzegovina, Albania, Serbia, Bulgaria, and Montenegro), whereas it is positive for the remaining 14. This is largely due to the comparison being made with

relatively recent years, during which modest improvements in mortality were achieved, and because the MEA is close to the comparison age of 60.

This comparison between the LFP at a given age during the final period and the LFP at its mortality-equivalent age during the initial period is replicated for all ages between 50 and 70. For that, we compare the LFP at age a during the initial period against the LFP at age MEA^a at the final period, where MEA^a is the age at which mortality in the final period is the same as mortality at age a during the initial period. The difference between these levels of LFP ($LFP_T^{MEA^a}$ and LFP_t^a) yields the estimated additional work capacity for each age. To reduce the effect of macro-shocks on LFP, the initial period t is set at three periods: 1990, 2000, and the period between 1990 and 2010, with the highest LFP level.

Figure 4 shows the results of this exercise for Türkiye and Russia using 1990 as the base year. As expected, the LFP decreases with age, and more rapidly after 60. However, health improvements mean that if older workers in Türkiye worked at the same rates as previous cohorts with comparable health levels, their LFP would be higher than currently observed. The red bars on the figure represent estimated additional work capacity. On the other hand, an increase in mortality between two periods may result in further loss of work capacity. This is the case in Russia, where, if those cohorts had worked at the same rate as their mortality-equivalent ages in previous years, they would have lower LFP than observed.

These results are more moderate when 2000 is used as the base year. In this case, Türkiye's additional work capacity remains positive, albeit lower, and for Russia, it becomes positive starting at age 55. This increase in capacity to work is also present when using a year of maximum LFP as the base year (1992 for Türkiye and 2007 for Russia). In Türkiye, additional work capacity is present across all age groups, with individuals aged 65-70 showing an increase of up to 37 percentage points. Russia also shows a positive additional work capacity of 15-28 percentage points among individuals aged 60-70. Figure A2 shows the same age profile for all twenty countries under each of the three base-year rules.

The sum of the red bars in these figures yields the gain in years of employment if people worked as much at each level of mortality in the final year as they did in the base year (AYWC in equation 2), which is the additional time the average individual would spend in the labor market. [Figure 5](#)

shows this indicator for all ECA countries included in the sample for the three base years. Using 1990 as the base year ([Figure 5.a](#)) Armenia, Azerbaijan, Croatia, Georgia, Kazakhstan, Poland, Tajikistan, Türkiye, and Ukraine have a positive AYWC of between 0.3 and 4.3 years. On the other hand, Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Kyrgyzstan, Moldova, Montenegro, North Macedonia, Romania, Russia, and Serbia experienced a decline in AYWC ranging from -5.3 to -0.5 years.

Using 2000 as the base year ([Figure 5.b](#)), Kyrgyzstan, Romania, and Russia join the group of countries with positive AYWC, while for Croatia and Poland, this measure becomes negative. When using Maximum LFP as the base year ([Figure 5.c](#)), most countries have positive AYWC, with an average of 1.0 years across the 20 countries in our sample.

The base year is a choice, so we recompute the AYWC under four rules for choosing it: the year of maximum LFP at ages 60-64, which is the rule used above; the year maximizing a three-year centered moving average of that series; the year of maximum prime-age (25-54) male LFP; and the year of maximum GDP per capita. Table A7 reports the mean under each rule. The first three rules all select the base year on labor force participation in one form or another and agree with one another. The only rule that selects on a variable other than participation reverses the sign of the regional average.¹¹ Restricting the estimates to countries whose base-year and final-year participation are both survey observations, rather than censuses or establishment surveys, leaves 16 of the 20 countries under the maximum-LFP rule and lowers the mean from 1.00 to 0.82 years. Under the 2000 rule it leaves 14 countries and lowers the mean from 0.39 to 0.07 years. Under the 1990 rule, only five countries survive, too few for the restricted mean for that rule (0.12 years) to carry weight: three quarters of the 1990-base sample depends on at least one non-survey observation. Table A6 reports the restricted estimates.

Finally, an additional mortality-based HCW measure was estimated. The MW can be used to compare differences in the mortality-employment relationship across countries over time and between countries in the same period (Milligan and Wise 2015). MW compares cross-sectional LFP and mortality in two countries, the United States and France, to estimate the HCW of France if it were to operate at the same level as the United States. We replicate this estimation using the

¹¹ For six countries the year chosen by the third or fourth rule has no mortality data, and the nearest year with data is used, as elsewhere in the estimation.

countries in our sample, with Poland as the base country. As such, instead of comparing LFP and mortality to their levels in 1990 or 2000, we compare current LFP and mortality to their levels in Poland. Poland was selected because it has reliable statistics and moderate mortality and labor outcomes relative to other ECA countries, neither an outlier nor an extreme case.

As such, the results of AYWC of ECA countries, when compared to Poland, also split the region roughly in half ([Figure 6](#)). Nine countries (Albania, Azerbaijan, Bosnia and Herzegovina, Croatia, Montenegro, North Macedonia, Tajikistan, Türkiye, and Ukraine) have positive HCW. Croatian, Albanian, and Turkish individuals would work more than 3 years longer if they worked at the same rates as Polish workers, given the same level of mortality. Armenia, Belarus, Bulgaria, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Romania, Russia and Serbia are negative, with Armenia, Belarus, Moldova and Russia more than three years below Poland. The values underlying Figures 5 and 6, with their sensitivity bands, are reported in Table A4.

5.2. Health-based HCW

Where the MW method compares participation at equal mortality across periods, the CMR method predicts labor force status from observed health. It compares workers on either side of the retirement threshold and assumes that differences in their labor force participation reflect pension availability rather than health differences, allowing us to predict participation in the absence of retirement benefits.

To predict the labor market status of individuals in post-retirement age, we first model the relationships among LFP, retirement, and disability decisions, controlling for health-related variables, in a sample of individuals aged 50 to 64 (pre-retirement age). These estimates are then used to predict the labor force status of individuals aged 65 to 74 years (post-retirement). A multinomial logit regression is fitted to model the probabilities of four employment statuses: participation in the labor market, retirement, disability, and a residual category covering everyone not in any of the first three.

Table 8 presents the results of the HCW estimation based on LFP by age group for the aggregate of the four countries. Details on the results of the parameters, fitting, and number of observations are available in Table A3 of the Appendix.

Table A3 reports the estimated coefficients. Self-assessed health is measured against the omitted category, excellent health, and its coefficients behave as expected: relative to a man in excellent health, worse self-assessed health raises the probability of being disabled sharply and of being retired only slightly. Mobility limitations and the two activity-of-daily-living measures act in the same direction. The index enters with the expected sign in the disability equation and is small and imprecisely estimated in the others. The coefficients in Table A3 should not be interpreted one at a time as the effect of a particular health measure, for the reason given in the note to that table.

The LFP estimate based on health variables indicates additional working capacity among men aged 65 to 74. The gap between predicted and observed participation is 39.6 percentage points at ages 65 to 69 and 39.1 points at ages 70 to 74. Summed over those two bands, and counting each band as five years, this is 3.94 additional years of work capacity, with a bootstrap confidence interval of 3.55 to 4.31 years. The three bands from 50 to 64 lie inside the estimation window, where the gap measures fit rather than unused capacity, and they are excluded from this figure. In-sample, the model without an age term misses the observed employment rate by -12.2 points at ages 50-54, -3.4 at 55-59 and +12.9 at 60-64 - a gradient a model with no age term cannot represent as anything but misfit. Adding a linear age term collapses these three gaps to +0.2, -0.3 and +0.2 points and gives an AYWC(65-74) of 0.61 years. Holding age at the window's top band with age dummies fits the in-sample bands exactly and gives 2.79 years, against the 3.94 years the no-age-term specification reports.

In the second section of the table, the dependent variable is the share of the population that is retired. According to this estimate, retirement rates for men aged 65 to 69 would be 60.6 percentage points lower than observed, and for men aged 70 to 74, 74.2 points lower. This means that if health variables, as we measure them, were the determinant of retirement, rather than factors like pension entitlements and regulations around retirement age, the share of retirees aged 65 to 74 would be around 22 percent instead of the observed 82 to 96 percent. That difference does not all translate into labor-force participation. At ages 65 to 69, the 60.6-point reduction in retirement is matched by 39.6 points more participation, 12.8 points more disability, and 8.2 points more in the residual category. At ages 70 to 74, the 74.2-point reduction is matched by 39.1, 23.2, and 11.9 points, respectively. About two-thirds of the reduction at ages 65 to 69, and just over half at ages 70 to 74, would reach the labor force; the remainder would move into disability or out of the labor force

altogether. Over ages 65 to 74, the reduction is equivalent to 6.74 fewer years of retirement, against 3.94 more years of work, 1.80 more years of disability, and 1.00 more years in the residual category, which together account for the whole of the reduction.

Finally, the observed incidence of disability decreases with age, as people who would be classified as disabled go into retirement instead and are no longer classified as disabled. This rapid decrease in disability incidence for ages 65 and older is paired with a prediction of higher rates of disability if the additional work capacity at these ages were to be employed.

The predicted series rises more gently. Predicted disability is 16.1 percent at ages 50 to 54 and 17.7 percent at 55 to 59, rising to 19.1 percent at 60 to 64. At 65 to 69, it is 18.7 percent—below the level the model predicts for men still of working age and under three points above the youngest band. Only at 70 to 74 does it rise materially, to 26.1 percent. The share reporting a disability or drawing a disability pension would increase if retirement decisions at 65 to 74 resembled those at 50 to 64. Up to age 69, though, it would not exceed what the model already predicts before retirement age.

Table 9 reports the health-based estimates country by country and sets them against the mortality-based estimates for the same four countries. The pooled estimate is largely Poland's: Poland supplies about half the pooled sample.¹² The two methods also do not describe the same countries in the same way. Among the three countries with estimable health-based figures, the health-based estimates lie between 3.3 and 4.8 years, while the mortality-based estimates for all four countries range from -5.3 to 2.3 years and change sign with the base-year rule. Only two of the three estimable countries have even one mortality-based band that overlaps the health-based interval, and neither overlaps under all three rules. A sensitivity band and a confidence interval are different statements, so the comparison cannot adjudicate between the two methods. What it shows is that they do not rank these countries alike, and that the pooled health-based figure rests disproportionately on Poland.

¹² Poland entered SHARE in 2006 and the other three countries in 2015 or 2017, so Poland supplies 1,472 of the 3,024 observations the pooled model is fitted on, 49 percent. Bulgaria supplies 133, fewer than the 200 this paper treats as the minimum for a country-level estimate; its model could not be estimated, and it is excluded from Panel A's AYWC column.

6. Discussion and Conclusions

The issue of additional work capacity in populations of countries with improving health and mortality rates is widely documented in the empirical literature. What has been left out of the discussion is the case of countries with smaller improvements or stagnation in their life expectancy and health outcomes, as is the case for several countries in the ECA region. This study explored this question and found diverging results. One group of countries shows additional capacity to work at older ages. Our results indicate that older groups in these countries have additional capacity to work, and their decision to retire may be motivated by factors other than health issues or disease. Six countries show additional capacity under all three base-year rules: Azerbaijan, Georgia, Kazakhstan, Tajikistan, Türkiye and Ukraine. Croatia and Poland are positive on the 1990 base but negative on the 2000 base, at -0.37 and -2.25 years. A second group—Moldova, Bulgaria and Serbia—saw smaller gains in mortality but did not reduce participation at older ages. In these countries, the gains in capacity appear to be taken up already, and in some cases more than taken up: men now work at higher mortality-equivalent ages than they did in the base year.

If health-related variables are used to predict labor outcomes, such as labor force participation, retirement decisions, and disability, a substantial additional work capacity is observed across the four countries in our sample. The employment of this additional work capacity would mean the reduction of retirement rates and an increase of disability incidence in the economically active population, but through ages 65 to 69 no larger than what the model already predicts for men aged 50 to 64. This means there is a population in health good enough to extend their working life. At ages 70 to 74, predicted disability does rise materially, to 26.1 percent.

A key takeaway from these results is that, despite an increasingly aging population, additional working capacity is not guaranteed. Countries' ability to expand their working pool among older individuals depends heavily on current participation levels and on health outcomes that influence morbidity and mortality. Measures such as raising retirement ages or reducing incentives to retire can help address population aging in countries with a demographic and economic structure that has unused labor capacity. However, they are unlikely to further increase participation in economies where older labor is already deployed unless they are accompanied by larger comparative gains in healthcare and in the prevention of risk factors that increase disability and mortality.

Retirement age reforms are unlikely to succeed without a broad set of complementary policies, including: (i) investments in occupational health and workplace adaptations that accommodate age-related functional limitations; (ii) retraining and lifelong learning programs to help older workers transition from physically demanding to less strenuous occupations; (iii) reforms to disability insurance that protect those unable to work without creating incentives to exit earlier; and (iv) partial pensions and gradual retirement schemes that allow older workers to reduce work hours without leaving the workforce.

These findings are a relevant basis for further discussion, as population aging looms over the economies of countries in the region, alongside recent declines in mortality and increases in life expectancy. These results can inform policy decisions, such as pension and entitlement reforms, and underscore the importance of public investment in health improvement.

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Table 1. Health-Capacity to Work Estimates by Country

Authors	Country	Reference Years	Health Capacity to Work	
			MW Method, years	CMR Method, %
Chapter 1 (Jousten and Lefebvre)	Belgium	1983-2012	4.4	77
Chapter 2 (Milligan and Schirle)	Canada	1976-2011	5.3	52
Chapter 3 (Bingley, et al.)	Denmark	1995-2010	1.6	67
Chapter 4 (Blanchet, et al.)	France	1977-2012	7.7	55 – 82
Chapter 5 (Jürges, et al.)	Germany	1970-2009	6.5	84
Chapter 6 (Brugiavini et al.)	Italy	1977-2010	7.3	73
Chapter 7 (Usui et al.)	Japan	1995-2010	2.2	55
Chapter 8 (Kalwij et al.)	Netherlands	1981-2010	3.47	79
Chapter 9 (García-Gómez et al.)	Spain	1976-2010	7.08	59 – 61
Chapter 10 (Johansson et al.)	Sweden	1985-2009	3.17	68 – 77
Chapter 11 (Banks et al.)	United Kingdom	1995-2013	2.0	57
Chapter 12 (Coile et al. 2017b)	United States	1977-2010	4.2	31 - 34

Source: Authors' elaboration with results from Wise (2017).

Note: The MW Method measures HCW in the number of additional years individuals would work on average; while the CMR Method does so in the share of additional Labor Force Participation for men aged 65 to 69.

Table 2. Trends in mortality rates and mortality equivalent age for ECA countries (Base 1990)

Country	Initial year	Final year	Mortality at age 60		% change in Mortality	MEA	Years gained	Percentage Points gained
			in initial year	in final year				
Albania	2002	2023	0.011	0.009	-21.1%	63	3.2	5.3
Armenia	1997	2021	0.024	0.022	-8.6%	61	1.2	2.1
Azerbaijan	1999	2022	0.027	0.017	-34.6%	65	5.2	8.6
Bulgaria	1992	2023	0.021	0.019	-7.5%	60	0.4	0.7
Bosnia and Herzegovina	2001	2023	0.018	0.015	-17.8%	62	2.0	3.4
Belarus	1989	2023	0.024	0.024	0.4%	60	0.0	-0.1
Georgia	1999	2022	0.022	0.023	0.6%	60	-0.1	-0.1
Croatia	1991	2023	0.022	0.013	-41.7%	66	6.2	10.4
Kazakhstan	2002	2022	0.036	0.021	-42.3%	67	6.6	11.0
Kyrgyzstan	1989	2022	0.027	0.021	-20.8%	62	2.3	3.9
Republic of Moldova	1989	2023	0.025	0.028	11.0%	59	-1.2	-2.0
North Macedonia	1991	2023	0.017	0.013	-22.2%	62	2.4	4.0
Montenegro	2011	2023	0.015	0.015	2.2%	59	-1.1	-1.8
Poland	1988	2023	0.025	0.016	-37.2%	66	5.7	9.6
Romania	1992	2023	0.023	0.022	-7.1%	62	1.5	2.5
Russian Federation	1989	2023	0.028	0.024	-15.8%	63	2.9	4.8
Serbia	2006	2023	0.020	0.017	-14.5%	62	1.7	2.9
Tajikistan	2003	2016	0.023	0.019	-15.5%	62	1.8	3.0
Türkiye	1990	2023	0.023	0.013	-45.7%	67	6.6	11.1
Ukraine	1989	2017	0.026	0.022	-12.2%	62	1.6	2.6

Source: Authors' elaboration with data from the World Population Prospects (UN Population Division, 2024).

Table 3. Trends in mortality rates and mortality-equivalent age (2000 as the Base Year).

Country	Initial year	Final year	Mortality at age 60		% change	Mortality equivalent age	Years gained	% Points gained
			in initial year	in final year				
Albania	2002	2023	0.011	0.009	-21.1%	63	3.2	5.3
Armenia	1997	2021	0.024	0.022	-8.6%	61	1.2	2.1
Azerbaijan	2000	2022	0.026	0.017	-33.1%	65	4.9	8.2
Bulgaria	2000	2023	0.021	0.019	-7.5%	60	0.4	0.7
Bosnia and Herzegovina	2001	2023	0.018	0.015	-17.8%	62	2.0	3.4
Belarus	1999	2023	0.035	0.024	-31.5%	65	5.4	9.0
Georgia	2000	2022	0.023	0.023	-1.2%	60	0.2	0.3
Croatia	1998	2023	0.020	0.013	-34.4%	65	5.0	8.4
Kazakhstan	2002	2022	0.036	0.021	-42.3%	67	6.6	11.0
Kyrgyzstan	2002	2022	0.033	0.021	-34.8%	64	4.4	7.4
Republic of Moldova	2000	2023	0.030	0.028	-6.0%	61	0.8	1.3
North Macedonia	1999	2023	0.020	0.013	-31.4%	64	4.2	7.0
Montenegro	2011	2023	0.015	0.015	2.2%	59	-1.1	-1.8
Poland	2000	2023	0.022	0.016	-28.0%	64	4.4	7.4
Romania	2000	2023	0.023	0.022	-4.8%	61	1.0	1.7
Russian Federation	2000	2023	0.040	0.024	-40.3%	68	8.4	13.9
Serbia	2006	2023	0.020	0.017	-14.5%	62	1.7	2.9
Tajikistan	2003	2016	0.023	0.019	-15.5%	62	1.8	3.0
Türkiye	2000	2023	0.019	0.013	-33.9%	64	4.5	7.4
Ukraine	1999	2017	0.033	0.022	-32.8%	65	5.5	9.1

Source: Authors' elaboration with data from the World Population Prospects (UN Population Division, 2024).

Table 4. Old-Age and Healthy-Age Dependency Ratios Comparison in ECA countries

Country	Last Year	Old-Age Dependency Ratio	Health-Adjusted Dependency Ratio ^a	Difference (pp) ^b
Albania	2021	22.7	12.6	10.1
Armenia	2021	18.7	16.7	2.0
Azerbaijan	2021	10.3	11.6	-1.4
Bulgaria	2021	34.0	49.9	-15.8
Bosnia and Herzegovina	2021	31.4	23.2	8.2
Belarus	2021	24.0	35.9	-11.8
Georgia	2021	23.5	25.8	-2.3
Croatia	2021	34.8	23.6	11.1
Kazakhstan	2020	12.1	13.6	-1.4
Kyrgyzstan	2021	8.3	7.3	1.0
Republic of Moldova	2021	22.6	37.9	-15.3
North Macedonia	2021	25.3	30.5	-5.1
Montenegro	2021	26.2	28.7	-2.5
Poland	2021	28.1	25.5	2.6
Romania	2021	29.9	38.2	-8.3
Russian Federation	2021	23.6	28.8	-5.1
Serbia	2021	34.3	43.8	-9.5
Tajikistan	2016	4.9	5.5	-0.6
Türkiye	2021	13.8	10.1	3.7
Ukraine	2017	23.2	33.0	-9.8

Source: Authors' elaboration with data from the World Population Prospects (UN Population Division, 2024). The health-adjusted dependency ratio is re-estimated following the method of Skirbekk et al. (2022) rather than reproduced from that study: the health-adjusted old-age threshold is the age at which a country's ageing-related disease burden reaches that of the global average 65-year-old, and the ratio is the population at or above that threshold relative to the supporting population aged 20 or older.^a

Note: differences are computed before rounding and may not equal the difference of the rounded columns.^b

Table 5. Trends in mortality rates and Labor-Force Participation for ECA Countries (Base 1990)

Country	Initial year	Final year	Mortality at age 60 in		Mortality Equivalent Age in Final Year	LFP at age 60		LFP at Final Year's MEA during Final Year	Dif. (HCW)
			initial year	final year		in initial year	in final year		
Albania	2002	2023	1.1%	0.9%	63.2	59.7%	85.8%	72.2%	-12.57
Armenia	1997	2021	2.4%	2.2%	61.2	80.9%	77.2%	73.7%	7.25
Azerbaijan	1999	2022	2.7%	1.7%	65.2	49.6%	50.1%	21.1%	28.52
Bulgaria	1992	2023	2.1%	1.9%	60.4	29.9%	77.0%	75.5%	-45.60
Bosnia and Herzegovina	2001	2023	1.8%	1.5%	62.0	37.7%	59.9%	47.2%	-9.48
Belarus	1989	2023	2.4%	2.4%	60.0	58.6%	72.3%	77.4%	-18.71
Georgia	1999	2022	2.2%	2.3%	59.9	82.7%	71.8%	71.1%	11.60
Croatia	1991	2023	2.2%	1.3%	66.2	39.6%	56.0%	28.1%	11.53
Kazakhstan	2002	2022	3.6%	2.1%	66.6	64.3%	69.6%	35.4%	28.97
Kyrgyzstan	1989	2022	2.7%	2.1%	62.3	50.8%	69.1%	59.9%	-9.12
Republic of Moldova	1989	2023	2.5%	2.8%	58.8	50.9%	82.2%	83.9%	-32.98
North Macedonia	1991	2023	1.7%	1.3%	62.4	38.8%	66.1%	52.4%	-13.65
Montenegro	2011	2023	1.5%	1.5%	58.9	50.0%	70.6%	76.4%	-26.37
Poland	1988	2023	2.5%	1.6%	65.7	61.0%	71.2%	47.0%	13.93
Romania	1992	2023	2.3%	2.2%	61.5	31.9%	61.7%	53.0%	-21.10
Russian Federation	1989	2023	2.8%	2.4%	62.9	53.0%	69.5%	56.8%	-3.88
Serbia	2006	2023	2.0%	1.7%	61.7	44.5%	71.9%	68.0%	-23.50
Tajikistan	2003	2016	2.3%	1.9%	61.8	67.8%	56.1%	51.6%	16.16
Türkiye	1990	2023	2.3%	1.3%	66.6	59.6%	53.5%	29.5%	30.08
Ukraine	1989	2017	2.6%	2.2%	61.6	50.5%	40.9%	27.3%	23.22

Note: Dif. (HCW) is the single-year health capacity to work measure of equation (1): labor force participation at age 60 in the initial year minus labor force participation at the mortality-equivalent age in the final year. A positive value means participation at that level of mortality was higher in the initial year than it is now, and so measures unused capacity; a negative value means the initial year's participation has already been exceeded.

Source: Authors' elaboration with data from the World Population Prospects (UN Population Division, 2024) and ILOSTAT (2024).

Table 6. Trends in mortality rates and Labor-Force Participation for ECA Countries (Base 2000)

Country	Initial year	Final year	Mortality at age 60 in		Mortality Equivalent Age in Final Year	LFP at age 60 in		LFP at Final Year's MEA during Final Year	Dif. (HCW)
			initial year	final year		initial year	final year		
Albania	2002	2023	1.1%	0.9%	63.2	59.7%	85.8%	72.2%	-12.57
Armenia	1997	2021	2.4%	2.2%	61.2	80.9%	77.2%	73.7%	7.25
Azerbaijan	2000	2022	2.6%	1.7%	64.9	88.7%	50.1%	25.5%	63.16
Bulgaria	2000	2023	2.1%	1.9%	60.4	35.1%	77.0%	75.5%	-40.33
Bosnia and Herzegovina	2001	2023	1.8%	1.5%	62.0	37.7%	59.9%	47.2%	-9.48
Belarus	1999	2023	3.5%	2.4%	65.4	44.1%	72.3%	43.1%	0.98
Georgia	2000	2022	2.3%	2.3%	60.2	82.6%	71.8%	72.4%	10.15
Croatia	1998	2023	2.0%	1.3%	65.0	30.3%	56.0%	31.2%	-0.92
Kazakhstan	2002	2022	3.6%	2.1%	66.6	64.3%	69.6%	35.4%	28.97
Kyrgyzstan	2002	2022	3.3%	2.1%	64.4	65.7%	69.1%	49.9%	15.78
Republic of Moldova	2000	2023	3.0%	2.8%	60.8	61.9%	82.2%	82.0%	-20.18
North Macedonia	1999	2023	2.0%	1.3%	64.2	43.2%	66.1%	42.2%	1.05
Montenegro	2011	2023	1.5%	1.5%	58.9	50.0%	70.6%	76.4%	-26.37
Poland	2000	2023	2.2%	1.6%	64.4	36.9%	71.2%	50.6%	-13.78
Romania	2000	2023	2.3%	2.2%	61.0	57.6%	61.7%	50.1%	7.52
Russian Federation	2000	2023	4.0%	2.4%	68.4	50.2%	69.5%	25.7%	24.53
Serbia	2006	2023	2.0%	1.7%	61.7	44.5%	71.9%	68.0%	-23.50
Tajikistan	2003	2016	2.3%	1.9%	61.8	67.8%	56.1%	51.6%	16.16
Türkiye	2000	2023	1.9%	1.3%	64.5	52.0%	53.5%	36.6%	15.48
Ukraine	1999	2017	3.3%	2.2%	65.5	44.8%	40.9%	15.4%	29.39

Note: Dif. (HCW) is the single-year health capacity to work measure of equation (1): labor force participation at age 60 in the initial year minus labor force participation at the mortality-equivalent age in the final year. A positive value means participation at that level of mortality was higher in the initial year than it is now, and so measures unused capacity; a negative value means the initial year's participation has already been exceeded.

Source: Authors' elaboration with data from the World Population Prospects (UN Population Division, 2024) and ILOSTAT (2024).

Table 7. Trends in mortality rates and Labor-Force Participation for ECA Countries (Max LFP as a Base)

Country	Initial year	Final year	Mortality at age 60 in		Mortality Equivalent Age in Final Year	LFP at age 60 in		LFP at Final Year's MEA during Final Year	Dif. (HCW)
			initial year	final year		initial year	final year		
Albania	2009	2023	0.8%	0.9%	58.9	70.4%	85.8%	86.4%	-16.00
Armenia	2010	2021	2.2%	2.2%	59.9	79.5%	77.2%	79.0%	0.46
Azerbaijan	2006	2022	2.4%	1.7%	63.9	88.1%	50.1%	28.1%	59.99
Bulgaria	2009	2023	2.1%	1.9%	60.5	56.4%	77.0%	75.7%	-19.30
Bosnia and Herzegovina	2010	2023	1.7%	1.5%	61.5	40.5%	59.9%	53.3%	-12.82
Belarus	1999	2023	3.5%	2.4%	65.4	44.1%	72.3%	43.1%	0.98
Georgia	2004	2022	2.0%	2.3%	58.0	87.1%	71.8%	69.6%	17.56
Croatia	2010	2023	1.7%	1.3%	62.5	50.3%	56.0%	44.6%	5.64
Kazakhstan	2008	2022	3.3%	2.1%	65.5	74.5%	69.6%	39.4%	35.15
Kyrgyzstan	2006	2022	3.5%	2.1%	65.2	70.8%	69.1%	43.2%	27.60
Republic of Moldova	2010	2023	2.8%	2.8%	60.1	77.3%	82.2%	81.4%	-4.10
North Macedonia	2010	2023	1.9%	1.3%	64.1	58.4%	66.1%	41.6%	16.79
Montenegro	2014	2023	1.4%	1.5%	58.8	51.4%	70.6%	76.0%	-24.53
Poland	1992	2023	2.6%	1.6%	66.4	45.5%	71.2%	39.8%	5.68
Romania	1997	2023	2.6%	2.2%	63.8	62.1%	61.7%	44.8%	17.23
Russian Federation	2007	2023	3.5%	2.4%	66.3	56.9%	69.5%	35.1%	21.79
Serbia	2008	2023	1.9%	1.7%	61.2	49.1%	71.9%	66.5%	-17.40
Tajikistan	2004	2016	2.2%	1.9%	61.6	66.6%	56.1%	50.8%	15.86
Türkiye	1992	2023	2.2%	1.3%	66.4	60.8%	53.5%	28.6%	32.24
Ukraine	1998	2017	3.3%	2.2%	65.4	58.3%	40.9%	15.4%	42.92

Note: Dif. (HCW) is the single-year health capacity to work measure of equation (1): labor force participation at age 60 in the initial year minus labor force participation at the mortality-equivalent age in the final year. A positive value means participation at that level of mortality was higher in the initial year than it is now, and so measures unused capacity; a negative value means the initial year's participation has already been exceeded.

Source: Authors' elaboration with data from the World Population Prospects (UN Population Division, 2024) and ILOSTAT (2024).

Table 8. Health-Based Estimations of LFP

Age group	Sample ^a	State	Observed (%)	Predicted (%)	Gap (pp)	95% CI (pp)
50-54	in sample	Employed	76.8	64.6	-12.2	[-15.6, -8.4]
50-54	in sample	Retired	4.2	14.9	+10.7	[+8.2, +13.2]
50-54	in sample	Disabled ^b	15.7	16.1	+0.4	[-2.2, +2.9]
50-54	in sample	Other	3.3	4.4	+1.1	[-0.8, +2.7]
55-59	in sample	Employed	61.1	57.7	-3.4	[-6.3, -0.5]
55-59	in sample	Retired	12.2	16.9	+4.7	[+2.4, +6.9]
55-59	in sample	Disabled	17.5	17.7	+0.2	[-1.9, +2.2]
55-59	in sample	Other	9.2	7.7	-1.5	[-3.4, +0.5]
60-64	in sample	Employed	33.3	46.2	+12.9	[+9.9, +15.7]
60-64	in sample	Retired	34.1	20.8	-13.3	[-15.9, -10.4]
60-64	in sample	Disabled	19.5	19.1	-0.4	[-2.7, +1.5]
60-64	in sample	Other	13.1	13.9	+0.8	[-1.0, +2.9]
65-69	out of sample	Employed	5.4	45.0	+39.6	[+35.2, +44.1]
65-69	out of sample	Retired	82.4	21.8	-60.6	[-66.6, -54.0]
65-69	out of sample	Disabled	5.9	18.7	+12.8	[+9.6, +16.4]
65-69	out of sample	Other	6.3	14.5	+8.2	[+2.7, +13.6]
70-74	out of sample	Employed	0.7	39.8	+39.1	[+35.1, +43.2]
70-74	out of sample	Retired	95.9	21.7	-74.2	[-78.8, -69.5]
70-74	out of sample	Disabled	2.9	26.1	+23.2	[+18.9, +28.0]
70-74	out of sample	Other	0.5	12.4	+11.9	[+8.3, +15.1]
65-74	out of sample	Employed, total (years)			+3.94	[+3.55, +4.31]
65-74	out of sample	Retired, total (years)			-6.74	[-7.17, -6.24]
65-74	out of sample	Disabled, total (years)			+1.80	[+1.47, +2.18]
65-74	out of sample	Other, total (years)			+1.00	[+0.61, +1.36]

Note: Sample of Bulgaria, Croatia, Poland and Romania; men only. The model is estimated on ages 50 to 64 and used to predict ages 65 to 74, so the Sample column marks which rows lie inside the estimation window: an in-sample gap is what the model failed to fit, not capacity that could be used, and only the out-of-sample rows carry the paper's headline.^a Observed shares are read from the exclusive employment-status categorical, the same variable the model is estimated on; an earlier version of this table read three overlapping indicator flags, under which 542 of 17,059 men counted in more than one state and the columns did not sum to 100. Disability counts receipt of a disability pension as well as self-reported disability.^b The four states are those of equation (3) and sum to 100 percent in every band, observed and predicted alike. Gaps are predicted minus observed. Intervals are 95 percent percentile bootstrap confidence intervals, 1,000 replications, individuals resampled within country and wave. Total (years) is the gap summed over ages 65 to 74, each band spanning five years; the four states sum to zero there, as the accounting identity requires. The data are drawn from the Survey of Health, Ageing and Retirement in Europe (SHARE). The Total (years) rows carry no Observed or Predicted percentage because a summed gap across bands has no single observed or predicted share; only the Gap and its interval are reported there.

Source: Authors' elaboration.

Table 9. Health-based and mortality-based estimates of additional work capacity, by country
Panel A. Health-based (CMR) estimates and the samples they rest on

Country	SHARE waves	Men aged 50–64	Estimation sample	AYWC 65–74 (years)	95% CI
Bulgaria	7, 8, 9	696	133	not estimable ¹³	—
Croatia	6, 7, 8, 9	2,795	1,166	4.77	[4.35, 5.20]
Poland	2, 4, 6, 7, 8, 9	5,038	1,472	4.38	[4.01, 4.73]
Romania	7, 8, 9	1,193	253	3.33	[2.52, 4.10]
All four, pooled	2, 4, 6, 7, 8, 9	9,722	3,024	3.94	[3.55, 4.31]

Panel B. Mortality-based (Milligan–Wise) estimates for the same countries

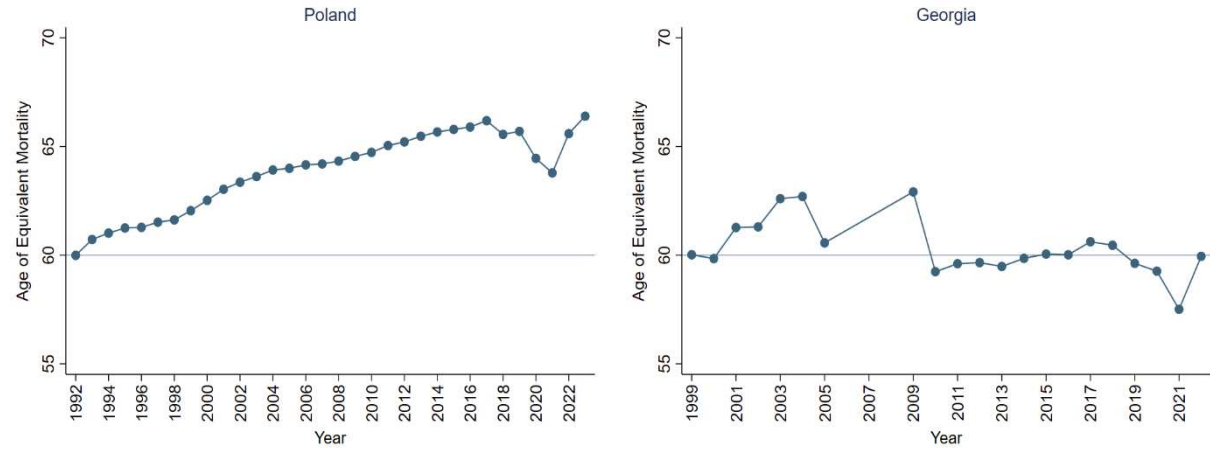
Country	Base 1990	Base 2000	Maximum LFP	MW bands overlapping the CMR interval
Bulgaria ^a	-5.34 [-7.93, -2.74]	-4.96 [-7.38, -2.33]	-2.61 [-5.15, -0.07]	n/a
Croatia	2.32 [1.24, 3.34]	-0.37 [-1.10, 0.15]	0.26 [-1.00, 1.55]	0 of 3
Poland	2.03 [-0.67, 4.70]	-2.25 [-5.09, 0.55]	0.55 [-2.24, 3.35]	1 of 3
Romania	-2.44 [-4.65, -0.24]	0.34 [-1.80, 2.45]	2.34 [0.26, 4.37]	1 of 3

Note: Panel A reports the health-based (CMR) multinomial-logit estimate of additional years of work capacity over ages 65 to 74, fitted separately for each country on men aged 50 to 64 and predicted forward. “Men aged 50–64” counts the observations in the age window; “estimation sample” counts those the model was fitted on after listwise deletion of missing regressors, and it is the latter the estimate rests on. Confidence intervals are 95 percent percentile intervals from 1,000 bootstrap replications. Panel B reports the mortality-based (Milligan–Wise) estimate for the same countries under each of the three base-year rules, with its sensitivity band in brackets, alongside the number of those bands that overlap the country's CMR interval. A sensitivity band is not a confidence interval: it shows how far the estimate moves when its inputs are moved by a plausible amount, so overlap here is weak evidence of agreement and its absence is not proof of conflict. Poland enters SHARE in 2006, Croatia in 2015, and Bulgaria and Romania in 2017, which is why Poland contributes almost half the pooled sample. Panel B still reports Bulgaria's mortality-based estimates, which do not depend on the health-based model; its overlap cell reads “n/a” because there is no health-based interval to compare against.^a

Source: Authors' calculations. Panel A uses the Survey of Health, Ageing and Retirement in Europe, waves 2 to 9; Panel B uses the mortality and labor-force participation series described in Section 3.

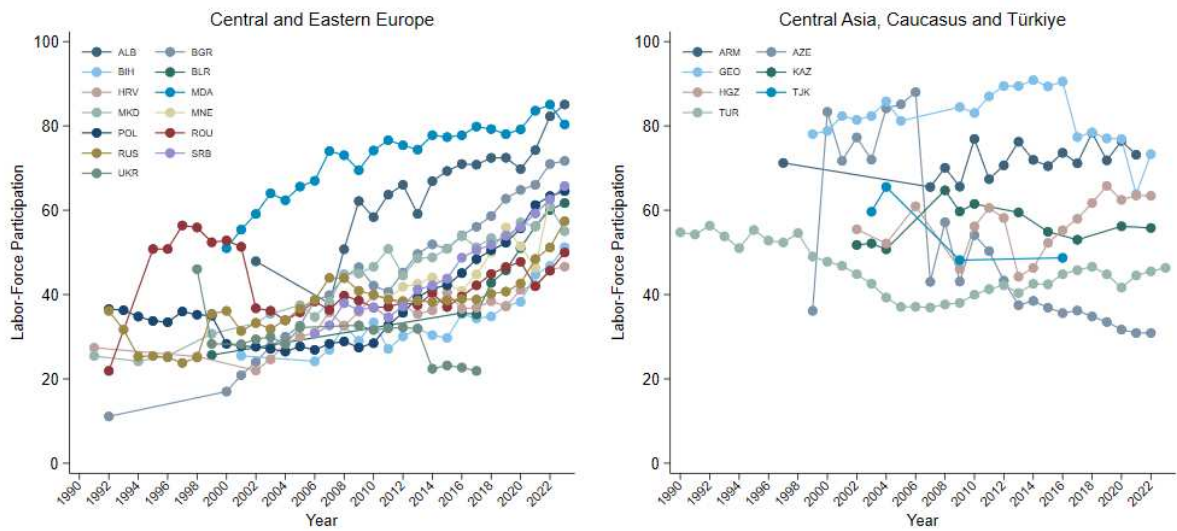
¹³ Bulgaria's model is fitted on 133 observations, below the 200 this paper treats as the minimum for a country-level estimate; its “Other” outcome held a single observation on that sample, which no choice of covariates repairs.

Figure 1. Mortality-equivalent age. Poland and Georgia



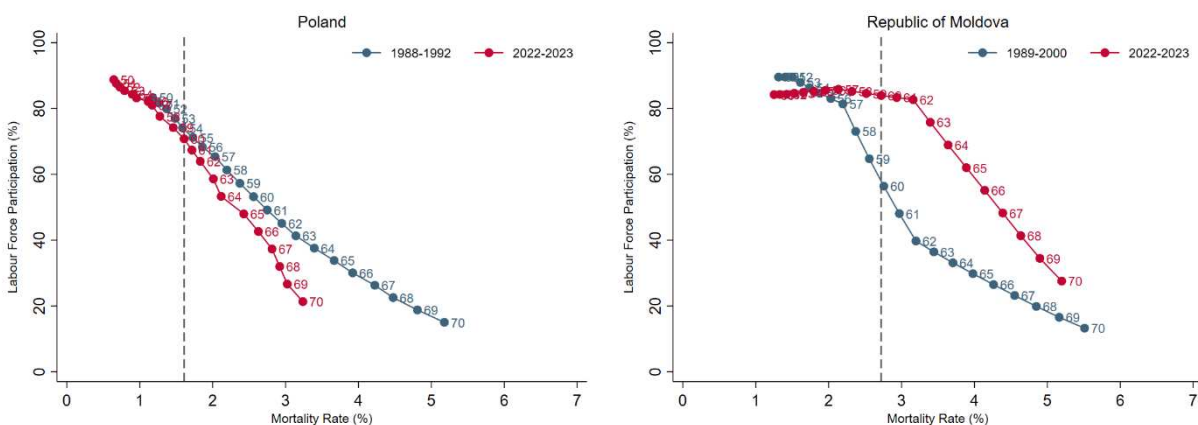
Source: Authors' elaboration.

Figure 2. Labor-Force Participation for Age 60-64 Males in ECA Countries



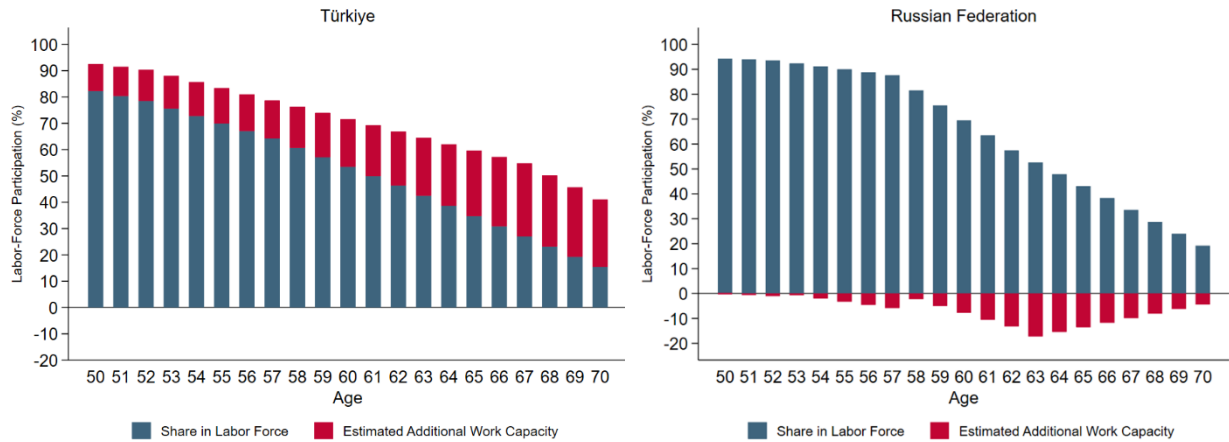
Source: Authors' elaboration with data from ILOSTAT (2024).

Figure 3. Mortality and LFP, Poland and Moldova (Base year 1990)



Source: Authors' elaboration with data from the World Population Prospects (UN Population Division, 2024) and ILOSTAT (2024).

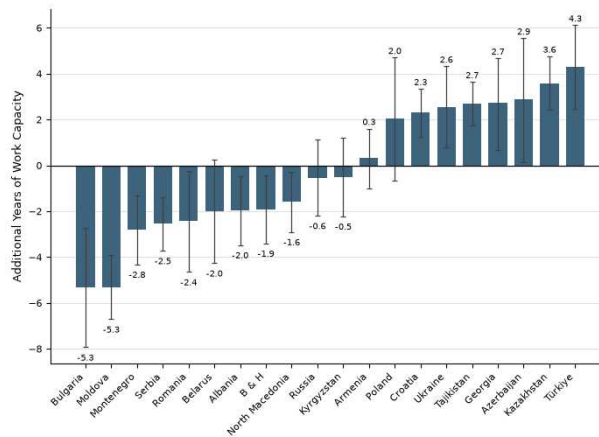
Figure 4. Estimated Additional Work Capacity for Türkiye and Russia (base year 1990)



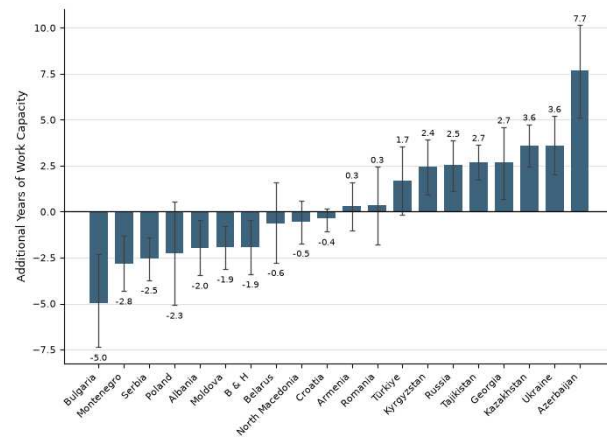
Source: Authors' elaboration.

Figure 5. Additional Years of Work Capacity for ECA Countries

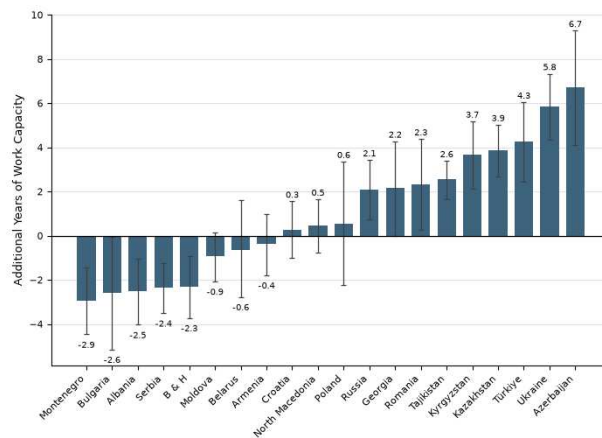
a. 1990 as base year



b. 2000 as base year



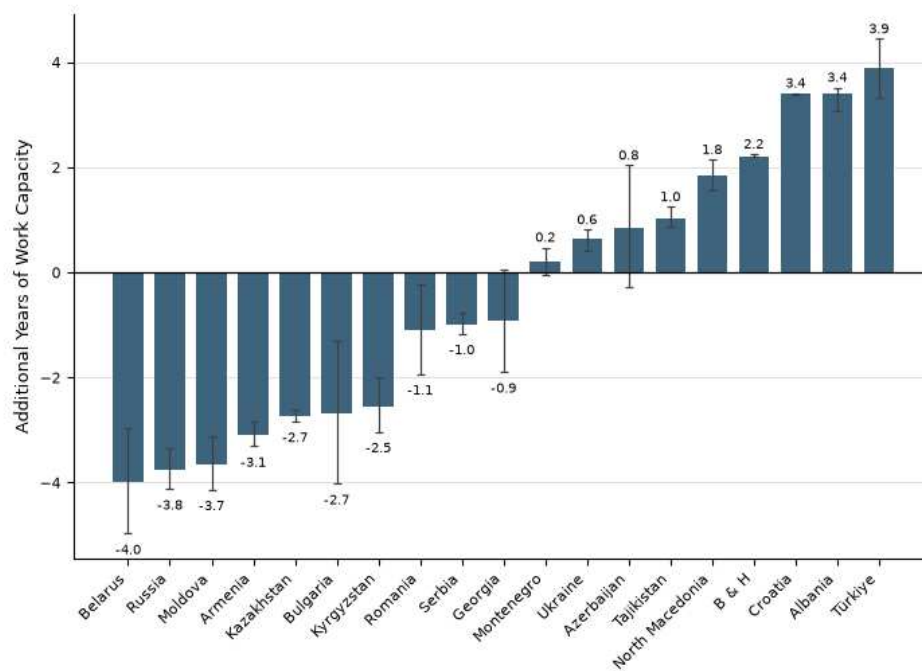
c. Max LFP as base year



Note: Panels a, b and c take 1990, 2000 and the year of maximum labor-force participation as the base year. Whiskers are sensitivity bands, not confidence intervals; the underlying values are reported in Table A4.

Source: Authors' elaboration.

Figure 6. Additional Years of Work Capacity for ECA Countries compared to Poland



Note: Whiskers are sensitivity bands, not confidence intervals; the underlying values are reported in Table A4.

Source: Authors' elaboration.

Appendix A. Descriptive Statistics and Full Regression Results

Table A1. International Health Capacity to Work Estimates by Country

Country	MW Estimate	MW Unit	CMR Estimate	CMR Unit	Age ^a	Years	Source
United States	3.7 years AYWC vs 1977; 49% employment at 0.015 death rate	years; %	18 pp gap (HS or less, 65-69); 22 pp gap (any college, 65-69)	pp	55-69; 65-69	1977-2007	Milligan and Wise (2015); Cutler et al. (2013)
Canada	5.3 years AYWC	years	52%	%	55-74	1976-2011	Milligan and Schirle (2017)
United Kingdom	2.0 years AYWC	years	57%	%	55-74	1995-2013	Banks et al. (2017)
Belgium	4.4 years AYWC	years	77%	%	55-69	1983-2012	Jousten and Lefebvre (2017)
Denmark	1.6 years AYWC	years	67%	%	55-69	1995-2010	Bingley et al. (2017)
France	7.7 years AYWC; 4.5% employment at 0.015 death rate	years; %	55-82%	%	55-69	1977-2012	Blanchet et al. (2017)

Germany	6.5 years AYWC	years	84%	%	55-69	1970-2009	Jürges et al. (2017)
Italy	7.3 years AYWC	years	73%	%	55-69	1977-2010	Brugiavini et al. (2017)
Japan	2.2 years AYWC	years	55%	%	55-69	1995-2010	Usui et al. (2017)
Netherlands	3.47 years AYWC	years	79%	%	55-69	1981-2010	Kalwij et al. (2017)
Spain	7.08 years AYWC	years	59-61%	%	55-69	1976-2010	García-Gómez et al. (2017)
Sweden	3.17 years AYWC	years	68-77%	%	55-69	1985-2009	Johansson et al. (2017)
Japan	~20 pp gap at same mortality (1980 vs 2020)	pp	Large capacity; 1/3 aged 65-69 can work full-time	free text	50-75	1980-2020	Oshio et al. (2024)
Republic of Korea	Substantial MW gap documented	free text	Substantial CMR capacity; varies by education	free text	40+	2000-2020	Lee et al. (2024)
Indonesia	Mortality insufficient to explain employment patterns	free text	Varies by job type (physical vs cognitive demands)	free text	Older ages	2000-2020	Suriastini et al. (2024)
Thailand	Significant mortality decline documented	free text	Heterogeneous capacity by sector	free text	40+	2005-2020	Zhao et al. (2024)
Malaysia	MW method applied with 20-year span	free text	CMR method applied	free text	40+	2000-2020	Mansor et al. (2024)
China ^b	31.2 million workers excess capacity (ages 45-69)	free text	42.4% (men 60-64); 37.6% (women 60-64)	%	45-69	2011-2015	Hou et al. (2021)
Denmark	Uses composite health index from SHARE + registers	free text	Significant heterogeneity by education and gender	free text	55+	2004-2015	Aaskoven et al. (2024)

Notes: AYWC = Additional Years of Work Capacity; pp = percentage points. MW Method measures excess capacity as additional years individuals would work if they matched employment rates of those with the same mortality in a base period. CMR Method measures excess capacity as the percentage by which employment of older workers could increase if they worked as much as younger workers in similar health. The NBER 12-country study (Wise 2017) covers: Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, UK, and US. Asian Development Review 2024 special issue covers: Japan, Korea, Indonesia, Thailand, Malaysia, PRC, and Vietnam. The Age column reports each study's own age range as that study defines it; the ranges are not harmonized across studies and are not comparable with one another.^a Where a study applies the CMR method it does so for men aged 65 to 69, except as the Age column states otherwise. The MW Unit and CMR Unit columns give the unit of the estimate beside them: years of additional work capacity, percent of employment, or percentage points; “free text” marks a study whose reported result is qualitative and therefore not expressed in any of these units. For China, the CMR estimate is 42.4 percent for men aged 60 to 64 and 37.6 percent for women of the same ages; because this paper's estimates are for men, 42.4 percent is the figure comparable with the rest of the column.^b

Source: Authors' compilation from cited sources.

Table A2. Descriptive statistics of variables used in the Health-Based HCW Models

Variable	Age Group				
	50-54	55-59	60-64	65-69	70-74
Employed	0.768	0.611	0.333	0.054	0.007
Retired	0.042	0.122	0.341	0.824	0.959
Disabled	0.157	0.175	0.195	0.059	0.029
Other	0.033	0.092	0.131	0.063	0.005
Self-Assessed Health	3.229	3.320	3.367	3.423	3.696
Mobility Limitations	0.324	0.355	0.395	0.415	0.563
Impairments in Activities of Daily Living (ADL)	0.035	0.049	0.076	0.047	0.053
Impairments in Instrumental Activities of Daily Living (IADL)	0.064	0.108	0.129	0.079	0.193
Heart Attack	0.064	0.093	0.126	0.166	0.230
Stroke	0.024	0.029	0.048	0.068	0.084
Cholesterol	0.100	0.109	0.147	0.170	0.167
Lungdisease	0.015	0.028	0.047	0.044	0.078
Cancer	0.007	0.013	0.038	0.029	0.054
Hypertension	0.272	0.303	0.372	0.429	0.503
Arthritis	0.076	0.054	0.060	0.071	0.082
Diabetes	0.045	0.096	0.087	0.149	0.150
Alzheimer	0.008	0.004	0.009	0.004	0.005
Osteoporosis	0.005	0.002	0.009	0.003	0.003
Underweight	0.011	0.003	0.007	0.015	0.009
Overweight	0.414	0.432	0.476	0.472	0.430
Obese	0.257	0.250	0.265	0.266	0.257
Smoking	0.703	0.652	0.613	0.639	0.566
Education	11.465	11.352	10.637	10.466	10.414
Married	0.737	0.767	0.748	0.843	0.804
PCA Health Index	-0.370	-0.185	0.080	0.138	0.710
PCA Health Index Percentile	46.052	48.936	52.295	54.392	63.472
Observations	525	1,159	1,340	1,284	1,079

Note: Men aged 50 to 74 in Bulgaria, Croatia, Poland and Romania, by five-year age band; means, weighted with the SHARE individual weights. The four labor-force states are read from the exclusive employment-status categorical, the same variable the model is estimated on, and therefore sum to one in every band and agree with Table 8. An earlier version of these rows was built from three overlapping indicator flags, under which a man receiving a disability pension while still employed counted in two states at once. The Health Index is the first principal component of the health, behavior, and demographic variables listed in Section 3, and the percentile is its weighted rank from 1 to 100; the estimated model uses the percentile.

Source: Authors' elaboration.

Table A3. Health-Based HCW multinomial logit Regression Results

VARIABLES	Robust, pweighted ^a			Cluster-robust, G = 4 ^b		
	Retired	Disabled	Other	Retired	Disabled	Other
Self-Assessed Health: Very Good	-0.013 (0.569)	1.660* (0.934)	0.066 (0.724)	-0.013 (0.395)	1.660 (1.337)	0.066 (0.363)
Self-Assessed Health: Good	0.130 (0.601)	2.186*** (0.556)	0.534 (0.797)	0.130 (0.675)	2.186* (1.159)	0.534 (0.432)
Self-Assessed Health: Fair	0.183 (0.649)	2.898*** (0.626)	0.028 (0.919)	0.183 (0.633)	2.898** (1.177)	0.028 (0.224)
Self-Assessed Health: Poor	0.419 (0.697)	3.326*** (0.679)	-0.248 (1.090)	0.419 (0.770)	3.326*** (1.198)	-0.248 (0.749)
Mobility Limitations	0.089 (0.251)	0.273 (0.263)	0.496 (0.509)	0.089* (0.053)	0.273*** (0.095)	0.496*** (0.059)
ADL	0.126 (0.518)	-0.359 (0.412)	0.449 (0.877)	0.126 (0.510)	-0.359 (0.388)	0.449 (0.670)
IADL	1.364*** (0.408)	1.878*** (0.385)	0.817 (0.593)	1.364*** (0.159)	1.878*** (0.323)	0.817*** (0.277)
Health Index (PCA, per ten percentile points)	0.075 (0.081)	0.277*** (0.088)	-0.071 (0.165)	0.075** (0.037)	0.277*** (0.039)	-0.071*** (0.009)
Underweight ^c	-0.606 (1.424)	0.227 (0.993)	— —	-0.606* (0.311)	0.227 (0.455)	— —
Overweight	0.455** (0.217)	0.234 (0.244)	-0.304 (0.379)	0.455** (0.183)	0.234*** (0.089)	-0.304 (0.448)
Obese	0.176 (0.257)	-0.227 (0.257)	-0.281 (0.388)	0.176 (0.347)	-0.227*** (0.066)	-0.281 (0.233)
Smoking	-0.140 (0.189)	-0.393* (0.205)	-0.001 (0.327)	-0.140 (0.128)	-0.393*** (0.095)	-0.001 (0.116)
Depression Scale (EURO-D, 0–12)	-0.052 (0.053)	-0.077 (0.052)	0.056 (0.085)	-0.052 (0.077)	-0.077*** (0.014)	0.056 (0.108)
Education	-0.044 (0.036)	-0.066* (0.038)	-0.344*** (0.059)	-0.044*** (0.014)	-0.066** (0.026)	-0.344** (0.141)
Married	-0.139 (0.213)	-0.241 (0.248)	-0.130 (0.370)	-0.139 (0.608)	-0.241 (0.338)	-0.130 (0.111)
Wave period: 2009–2015	-1.295*** (0.303)	-0.956*** (0.308)	-0.626 (0.602)	-1.295*** (0.038)	-0.956*** (0.080)	-0.626*** (0.107)
Wave period: 2016 or later	-1.387*** (0.186)	-0.412** (0.197)	-0.124 (0.376)	-1.387*** (0.042)	-0.412*** (0.122)	-0.124*** (0.046)
Country: Croatia	1.012*** (0.359)	1.028** (0.454)	2.289** (1.112)	1.012*** (0.037)	1.028*** (0.084)	2.289*** (0.064)
Country: Poland	-0.200 (0.319)	0.697* (0.422)	2.228** (1.069)	-0.200 (0.154)	0.697*** (0.094)	2.228*** (0.056)
Country: Romania	1.734*** (0.336)	0.805 (0.510)	4.637*** (1.049)	1.734*** (0.091)	0.805*** (0.056)	4.637*** (0.083)
Constant	-0.691 (0.717)	-4.645*** (0.788)	-1.316 (1.410)	-0.691*** (0.203)	-4.645*** (1.487)	-1.316 (1.318)
Observations (unweighted)	3,024	3,024	3,024	3,024	3,024	3,024
Clusters	—	—	—	4	4	4

Note: Multinomial logit on men aged 50 to 64 in Bulgaria, Croatia, Poland and Romania; Employed is the base outcome. N = 3,024, the unweighted count, which is the sample size the inference rests on; estimates are probability-weighted using the SHARE individual weights, so the weighted and unweighted counts differ and only the

unweighted one bounds the precision. Two standard-error constructions are shown for every coefficient. The left block is heteroskedasticity-robust and probability-weighted.^a The right block clusters on country, where $G = 4$.^b The clustered block is reported for completeness and is not the preferred one: with four clusters the cluster-robust variance matrix has rank at most $G - 1 = 3$, so the joint Wald test is not estimable, and the resulting standard errors are smaller than the robust ones—the known downward bias at very small G rather than greater precision. A wild cluster bootstrap over four clusters has a support of sixteen points and cannot resolve a p -value finely. Self-Assessed Health is measured against the omitted category, Excellent; the wave-period dummies are measured against 2008 and earlier; the country dummies against Bulgaria. The ten individual chronic-condition indicators used in an earlier version have been replaced by a principal-component health index, because eleven of their cells were empty and three coefficients exceeded 20 in absolute value; the twelve EURO-D indicators are likewise replaced by the continuous score and five year dummies by three wave periods. ****The model contains no age term****: none of the regressors above is a function of age, and equation (4) is stated accordingly. Nine of the index's own components—self-assessed health, mobility limitations, the two activity-of-daily-living measures, body-mass category, smoking, the EURO-D depression score, education and marital status—are also entered as separate regressors, so each appears twice, once alone and once inside the index; regressing the index on them returns an R -squared of 0.865, and the index's variance inflation factor is 7.4, the largest in the model. Collinearity inflates the standard errors without biasing the predictions, and the estimate reported in Section 5.2 is a prediction. The health index is entered per ten percentile points. The Underweight $\times$ Other cell contains zero observations; the coefficient is not identified and is omitted.^c *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' elaboration.

Table A4. Additional Years of Work Capacity by Country, under Three Base-Year Rules and Against Poland

Country	Base 1990	Base 2000	Max LFP	vs Poland ^a
Albania	-1.95 [-3.47, -0.47]	-1.95 [-3.47, -0.47]	-2.52 [-4.04, -1.05]	3.41 [3.09, 3.52]
Armenia	0.32 [-1.01, 1.61]	0.32 [-1.01, 1.61]	-0.38 [-1.79, 0.98]	-3.10 [-3.31, -2.84]
Azerbaijan	2.88 [0.15, 5.55]	7.67 [5.13, 10.14]	6.73 [4.12, 9.28]	0.84 [-0.27, 2.04]
Belarus	-2.00 [-4.26, 0.25]	-0.64 [-2.77, 1.61]	-0.64 [-2.77, 1.61]	-4.00 [-4.97, -2.95]
Bosnia and Herzegovina	-1.91 [-3.40, -0.45]	-1.91 [-3.40, -0.45]	-2.32 [-3.73, -0.91]	2.21 [2.22, 2.25]
Bulgaria	-5.34 [-7.93, -2.74]	-4.96 [-7.38, -2.33]	-2.61 [-5.15, -0.07]	-2.68 [-4.02, -1.29]
Croatia	2.32 [1.24, 3.34]	-0.37 [-1.10, 0.15]	0.26 [-1.00, 1.55]	3.39 [3.37, 3.41]
Georgia	2.73 [0.69, 4.67]	2.71 [0.69, 4.61]	2.16 [-0.03, 4.27]	-0.91 [-1.90, 0.06]
Kazakhstan	3.59 [2.43, 4.76]	3.59 [2.43, 4.76]	3.87 [2.66, 5.02]	-2.74 [-2.83, -2.61]
Kyrgyzstan	-0.49 [-2.22, 1.23]	2.43 [0.91, 3.92]	3.68 [2.13, 5.18]	-2.54 [-3.03, -1.99]
Montenegro	-2.81 [-4.32, -1.32]	-2.81 [-4.32, -1.32]	-2.94 [-4.47, -1.43]	0.20 [-0.04, 0.48]
North Macedonia	-1.57 [-2.90, -0.30]	-0.54 [-1.72, 0.58]	0.46 [-0.77, 1.65]	1.84 [1.56, 2.14]
Poland	2.03 [-0.67, 4.70]	-2.25 [-5.09, 0.55]	0.55 [-2.24, 3.35]	— (base country)
Republic of Moldova	-5.31 [-6.71, -3.92]	-1.92 [-3.12, -0.77]	-0.95 [-2.08, 0.14]	-3.66 [-4.13, -3.13]
Romania	-2.44 [-4.65, -0.24]	0.34 [-1.80, 2.45]	2.34 [0.26, 4.37]	-1.10 [-1.93, -0.23]
Russian Federation	-0.56 [-2.19, 1.11]	2.54 [1.14, 3.88]	2.08 [0.72, 3.42]	-3.75 [-4.12, -3.36]
Serbia	-2.54 [-3.72, -1.40]	-2.54 [-3.72, -1.40]	-2.37 [-3.51, -1.23]	-0.99 [-1.17, -0.78]
Tajikistan	2.70 [1.73, 3.64]	2.70 [1.73, 3.64]	2.55 [1.64, 3.39]	1.04 [0.86, 1.25]
Türkiye	4.31 [2.47, 6.11]	1.70 [-0.17, 3.56]	4.26 [2.45, 6.04]	3.89 [3.34, 4.44]
Ukraine	2.56 [0.78, 4.32]	3.60 [2.03, 5.21]	5.83 [4.32, 7.33]	0.64 [0.40, 0.81]

Source: Authors' elaboration. Each figure is the additional years of work capacity summed over ages 50 to 70, computed as in equation (2). Figures in brackets are sensitivity bands, not confidence intervals: ILOSTAT publishes no sample size for these cells, so the band is obtained by moving each labor-force-participation value by plus or minus the country's residual standard deviation around a fitted trend and the mortality-equivalent age by one year, the interpolation step. Poland is the base country of the final column and has no value of its own.^a

Table A5. Provenance of the Labor-Force Participation Observations Used in the Mortality-Based Estimates

Country	1990 rule	2000 rule	Max-LFP rule	Final year	Series span	Moves >10 pp ^a	ILO break flags ^b
Albania	2002 (LFS)	2002 (LFS)	2009 (LFS)	2023 (LFS)	2002-2023	2	1
Armenia	1997 (LFS)	1997 (LFS)	2010 (LFS)	2021 (OTHER SURVEY)	1997-2021	1	3
Azerbaijan	1999 (CENSUS)	2000 (LFS)	2006 (LFS)	2022 (LFS)	1999-2022	7	0
Belarus	1989 (CENSUS)	1999 (CENSUS)	1999 (CENSUS)	2023 (LFS)	1989-2023	0	0
Bosnia and Herzegovina	2001 (OTHER SURVEY)	2001 (OTHER SURVEY)	2010 (LFS)	2023 (LFS)	2001-2023	0	5
Bulgaria	1992 (CENSUS)	2000 (LFS)	2009 (LFS)	2023 (LFS)	1956-2023	0	0
Croatia	1991 (CENSUS)	1998 (LFS)	2010 (LFS)	2023 (LFS)	1991-2023	0	0
Georgia	1999 (OTHER)	2000 (OTHER)	2004 (OTHER)	2022 (OTHER SURVEY)	1999-2022	2	2
Kazakhstan	2002 (LFS)	2002 (LFS)	2008 (LFS)	2022 (LFS)	2002-2022	0	0
Kyrgyzstan	1989 (CENSUS)	2002 (LFS)	2006 (LFS)	2022 (LFS)	1989-2022	2	1
Montenegro	2011 (LFS)	2011 (LFS)	2014 (LFS)	2023 (LFS)	2011-2023	1	0
North Macedonia	1991 (CENSUS)	1999 (LFS)	2010 (LFS)	2023 (LFS)	1991-2023	0	1
Poland	1988 (CENSUS)	2000 (LFS)	1992 (LFS)	2023 (LFS)	1950-2023	0	1
Republic of Moldova	1989 (ESTABLISHMENT)	2000 (LFS)	2010 (LFS)	2023 (LFS)	1989-2023	0	0
Romania	1992 (CENSUS)	2000 (LFS)	1997 (LFS)	2023 (LFS)	1956-2023	1	1
Russian Federation	1989 (CENSUS)	2000 (LFS)	2007 (LFS)	2023 (LFS)	1989-2023	1	1
Serbia	2006 (LFS)	2006 (LFS)	2008 (LFS)	2023 (LFS)	2006-2023	0	4
Tajikistan	2003 (OTHER SURVEY)	2003 (OTHER SURVEY)	2004 (LFS)	2016 (LFS)	2003-2016	0	0
Türkiye	1990 (LFS)	2000 (LFS)	1992 (LFS)	2023 (LFS)	1955-2023	0	0
Ukraine	1989 (CENSUS)	1999 (ESTABLISHMENT)	1998 (ESTABLISHMENT)	2017 (LFS)	1979-2017	1	0

Source: Authors' elaboration from the ILOSTAT extract underlying the estimates. Each base-year cell gives the year the rule selects and the kind of source the observation comes from. No series in the extract is an ILO-modeled estimate: every observation carries a reported source code. "Moves >10 pp" counts adjacent years in the male 60-64 series whose participation changes by more than ten percentage points, a candidate series break; there are 18 in total, seven of them in Azerbaijan (1999-2000, 2000-01, 2003-04, 2006-07, 2007-08, 2008-09 and 2009-10), and none of the eighteen coincides with a break ILOSTAT itself flags.^a The final column counts the observations ILOSTAT marks as a break in series, which the estimation does not use.^b

Table A6. Additional Years of Work Capacity Restricted to Survey-Observed Country-Years

Country	Base 1990 ^a	Base 2000	Max LFP ^b
Albania	-1.95	-1.95	-2.52
Armenia	excl.	excl.	excl.
Azerbaijan	excl.	7.67	6.73
Belarus	excl.	excl.	excl.
Bosnia and Herzegovina	excl.	excl.	-2.32
Bulgaria	excl.	-4.96	-2.61
Croatia	excl.	-0.37	0.26
Georgia	excl.	excl.	excl.
Kazakhstan	3.59	3.59	3.87
Kyrgyzstan	excl.	2.43	3.68
Montenegro	-2.81	-2.81	-2.94
North Macedonia	excl.	-0.54	0.46
Poland	excl.	-2.25	0.55
Republic of Moldova	excl.	-1.92	-0.95
Romania	excl.	0.34	2.34
Russian Federation	excl.	2.54	2.08
Serbia	-2.54	-2.54	-2.37
Tajikistan	excl.	excl.	2.55
Türkiye	4.31	1.70	4.26
Ukraine	excl.	excl.	excl.
Mean (retained countries)	0.12 (n = 5)	0.07 (n = 14)	0.82 (n = 16)

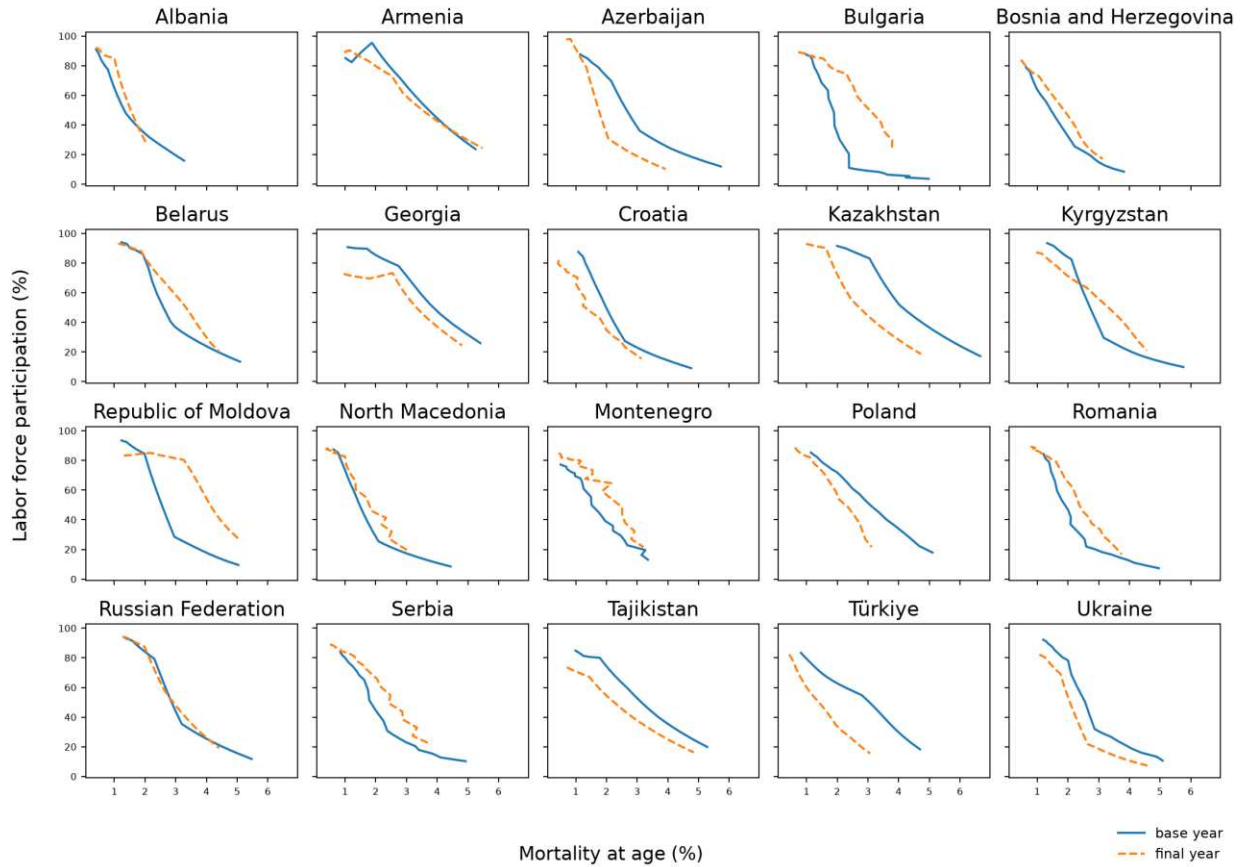
Source: Authors' elaboration. An estimate is retained only when both observations it rests on—labor force participation in the base year and in the final year—come from a labor force survey; “excl.” marks an estimate dropped because at least one endpoint is a census, an establishment survey, or another kind of source, as recorded in Table A5. Under the 1990 rule only 5 of the 20 countries survive the restriction, so the mean for that column is reported as a limitation rather than as an estimate: what it establishes is that three quarters of the 1990-base sample rests on at least one non-survey observation, not a corrected figure.^a Under the maximum-LFP rule, where 16 countries survive, the mean falls from 1.00 to 0.82 years.^b

Table A7. Additional Years of Work Capacity under Four Rules for Choosing the Base Year

Rule for choosing the base year	Mean AYWC (years)	Countries positive (of 20)
Maximum LFP at ages 60-64 (rule used in the text)	1.00	12
Maximum of a three-year centred moving average of that series	0.81	12
Maximum prime-age (25-54) male LFP	0.91	12
Maximum GDP per capita	-0.44	8

Source: Authors' elaboration. Selecting a single year's maximum also inflates that year's participation, which is the quantity every subsequent comparison is measured against. The first two rules read the same series and differ only in whether it is smoothed before the maximum is taken, and the unsmoothed rule raises base-year participation by 1.3 percentage points per age on average, equivalent to 0.28 years of AYWC; applying the rule to 1,000 series drawn around each country's fitted trend puts the median inflation at 1.8 percentage points.

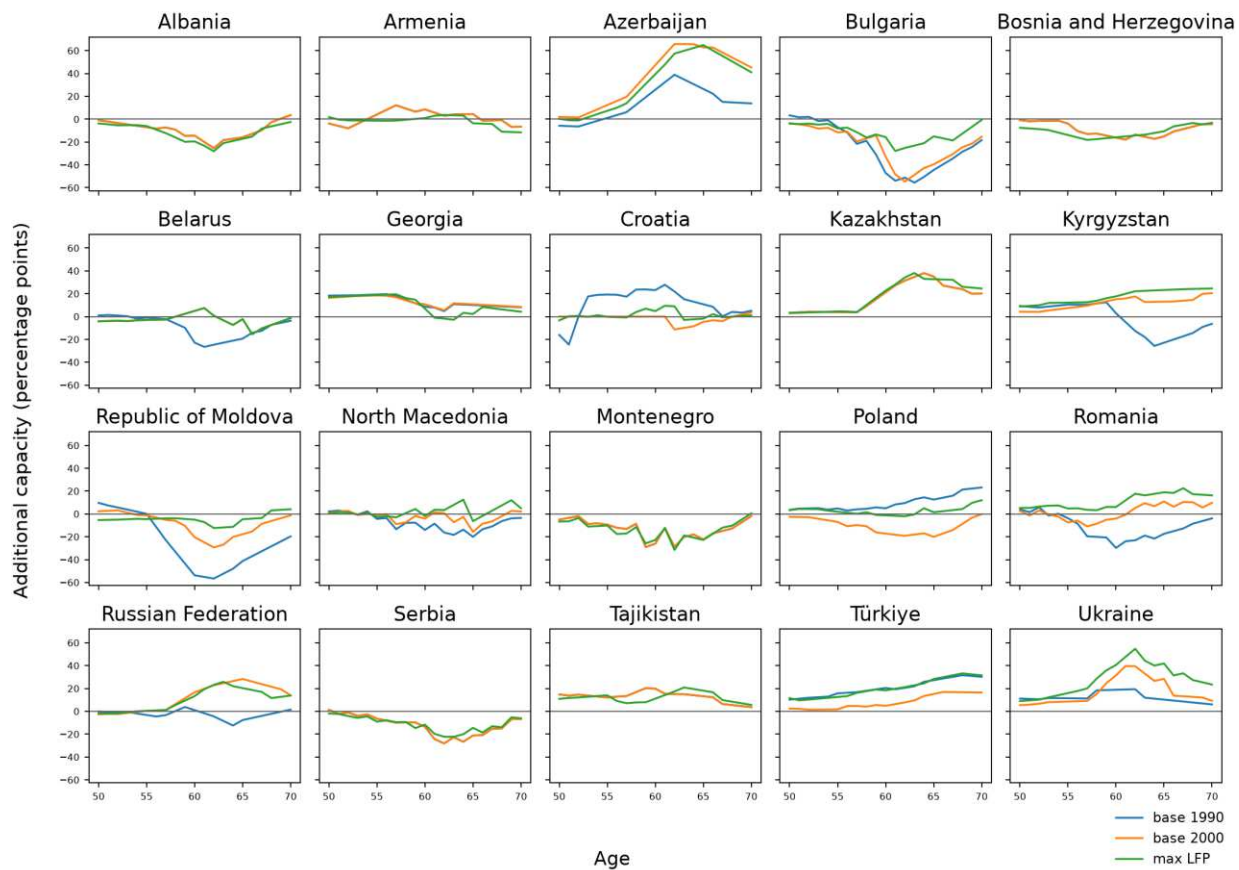
Figure A1. Labor-Force Participation against Mortality, All Twenty Countries



Note: Each sub-plot shows labor-force participation against the mortality rate at ages 50 to 70, with the solid line for the base year (the year nearest 1990 with data) and the dashed line for the final year. Where the later line lies below the earlier one at the same mortality, men at a given level of health work less than they used to.

Source: Authors' elaboration.

Figure A2. Estimated Additional Work Capacity by Age, All Twenty Countries



Note: Each sub-plot shows the additional work capacity at each single year of age from 50 to 70, in percentage points of participation, under each of the three base-year rules. Zero is drawn because the sign differs across countries.

Source: Authors' elaboration.