Trends in senior workers' productivity potential

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Abstract:
Education, cognitive skills, health or job experience differ by age. In this context, previous research suggests an inversely U-shaped relationship between age and productivity. As a consequence, only if the senior workers of tomorrow are substantially more competent than in the past, they can substitute for fewer younger workers without hampering countries' economic performance.
This paper highlights past and future trends in senior workers' productivity potential. Based on both a review of existing studies and analysis of new empirical evidence, we study not only human capital endowments by age groups over time, but also investigate whether recent cohorts of senior workers are more productive.
First results show that senior workers' productivity potential has considerably improved during the past three decades, particularly among women. Moreover, panel regressions for 13 countries between 1980 and 2000 identify determinants that can be crucial for closing the productivity gap between senior and prime-age workers.

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1. Topic and motivation

Identifying ways of extending the working life is of paramount importance for ageing countries. For the majority of countries within the EU, increasing retirement ages from the late 50s or early 60s to the late 60s or early 70s will keep the ratio between the economically active and inactive in 2050 similar to the situation in 2010.

However, substantial research about age variation in work performance suggests that performance starts at low levels, rapidly increases until maximum performance is reached between ages 30 and 50 and subsequently levels off again at later ages (see reviews of the age-productivity literature as in McEvoy and Cascio 1989 or Skirbekk 2008a, 2008b). This inversely-U shaped age-performance curve coincides with the fact that several important determinants of work performance such as cognitive skills, education, health or job experience differ by age.

Consequently, only if senior workers in their 50s, 60s and 70s of tomorrow are substantially more competent than a decade or two ago, they can substitute for lacking younger workers without negative consequences for productivity, innovation and economic growth.

The question whether this age-specific productivity potential is higher among more recent generations of senior workers or not has remained largely unanswered. It is therefore of particular interest to investigate performance variation not only by age, but to better understand cohort-changes: Is the productivity potential of senior workers higher or lower as compared to their age counterparts one, two or three decades ago? And what likely future trends can we expect?

In this context, the objective of this paper is to highlight past and future trends in the productivity potential of senior workers. Based on a review of previous literature and own empirical evidence, we show not only how cognitive skills, education, health or job experience differ by age, but also focus on variation between more recent and earlier cohorts of senior workers.

We will provide a number of new analyses and investigations of empirical data, especially related to work experience, education trends and health status of senior workers for six selected countries between 1970 and 2005. Additionally, we run panel regressions for an extended set of 13 countries to analyze how the relative productivity potential of senior workers developed in the past two decades as compared to their prime-age counterparts. Therein, we consider which factors, all above policy levers, drive improvements in this relative potential of senior workers.

2. Theoretical framework: Evolution of senior worker's productivity potential over time

A number of studies identify an inverted U-shaped age-performance curve. This relationship between age and work performance can be attributed to declines in cognitive skills as well as a depreciation of professional knowledge over the life course, hand in hand with lower educational attainments and a lower incidence of life-long-training among more senior workers. Furthermore, senior workers productivity may be hampered by health impairments.

However, in previous empirical research, little consideration has been given to whether productivity potential and its determinants, particularly at higher ages, change over time. This may partly be due to the fact that such studies tend to be based on cross-sectional data which does not allow a cohort perspective. However, already in the 19th century, Quetelet (1874) suggested that human abilities improve for every subsequent generation.

More recent studies confirm Quetelet's considerations: There is evidence that cognitive abilities (measured by IQ tests) have improved for young men at least since World War I (Flynn 1987, Tuddenham 1948). Cognitive skills have been found to increase also for

individuals aged 50-79 during the last two decades (Romeu Gordo 2006), based on analysis of US data (Health and Retirement Study).

Possible reasons are growth in educational attainment and on-the-job training (Lutz et al. 2007, Riphahn and Trübswetter 2006). Mental exercise and learning has been shown to benefit cognitive functioning – also at older ages (Ball et al. 2002, Schaie and Willis 1986). These studies find that older persons who exercise the use of memory, speed and reasoning abilities can improve the functional level.

Additionally, improved health levels among elderly and a decreasing importance of physical strength for the accomplishment of job-related tasks enhance the productivity potential among the elderly over time. In this context, Costa (2000) finds a decrease of chronic disease rates by 66 % from the early 1900s to the 1970s and 1980s among men aged 50-74 years, and Romeu Gordo (2005) points out a continued disability decrease in the 1990s. Furthermore, Costa (2000) argues that 29 % of the observed decline in chronic disease rates in the 20th century was caused by a shift to non-manual and a reduction in the physical load, and that this shift was responsible for 75 % of the decline in back problems.

Trends in education and job experience of senior workers are further determinants of work performance. As for education, the OECD (1998) forecasts increases of the labour force aged 45 to 64 years with a tertiary education in all countries until 2015 as compared to 1995, amounting to 10 percentage points or more in some countries (i.e. Korea, Spain, Mexico).

3. Research methods and data

3.1 A three-dimensional measure of senior workers productivity potential

Our objective is to provide novel empirical results on cohort changes in age-specific, work capacity measures for senior workers aged 55-69 years on country level over the past decades. We focus on senior age groups 55-59, 60-64 and 65-69 years. Gender differences will be discussed and accounted for when applicable. Note that the analysis is based on aggregate measures, i.e. the productivity potential in countries' senior generation rather than individual potential. According to our theoretical considerations, we suggest to evaluate senior workers' productivity potential along three dimensions:

1. *Knowledge and skills as provided by education.* Education as acquired in academic or other educational institutions is not only knowledge per se. It also fosters knowledge adoption over the life course. As a consequence, the higher the share of those who at least completed first level of tertiary education in the respective age-sex population group, the higher the productivity potential in this dimension.
   A new international dataset developed by the International Institute for Applied Systems Analysis (IIASA) and the Vienna Institute for Demography (VID) provides data on educational attainment by age and sex between 1970 and 2000 for 120 countries (for details see Lutz et al., 2007). Earlier dataset have not differentiated by detailed age groups. We use this data to assess the productivity potential of senior workers originating from formal education and its evolution over time.

2. *Knowledge and skills as provided by recent work experience:* Senior workers with recent work experience should, on average, possess a comparatively higher stock of up-to-date knowledge. Meanwhile, their unemployed or otherwise inactive counterparts face higher risks of knowledge depreciation.
   To account for recent job experience, we compute the share of men and women who have been in employment during the past five years for the three age groups of senior workers from 1975 to 2005 (forward projection based on OECD Labour Force

Statistics). We adopt a cohort approach and assume that, for example, the higher employment rates in age group 50-54 years in period 1975-1979, the higher is the productivity potential as residing in recent work experience of this then 55-59-year-old cohort in period 1980-1984.

3. Finally, *health* can be conceived as a moderating factor in productivity potential in the sense that health impairments severely hamper the productivity-enhancing effect of knowledge, skills and motivation provided by senior workers. However, there is no sufficiently long cross-country time series data on work-relevant health conditions or risk factors such as sedentary jobs, alcohol and tobacco use physical exercise or obesity readily available.
   We therefore suggest a novel indicator based on mortality data provided by the World Health Organization (WHO). It accounts for the incidence of deaths in the five years succeeding the currently observed period for each of the three groups of senior workers. The idea behind this backward projection is that workers dying during working life or shortly after leaving the labour force can be assumed to have suffered from severe pre-existing conditions already in the years before death actually occurs. This would have certainly lowered their productivity potential through health impairments, sick-leave or even long-term disability.

For six countries, job experience can be calculated for the period 1975-2005, educational attainment and work relevant health status for the period 1970-2000. Thus, the time horizon is 30 years, spanning three generations of 10-year cohorts of workers. The countries chosen provide an suitable mixture of different 'regimes' with respect to workforce ageing, i.e. Japan, Germany and Spain with fast workforce ageing in the past decades, countries with moderate workforce ageing due to more favourable fertility rates such as France and Sweden as well as the United States with a relatively young workforce and slow ageing.

3.2 Econometric analysis: Drivers of senior workers' relative productivity potential

From a policy perspective, the key question is not only which countries have performed particularly well regarding improvements in senior workers' productivity potential, but (i) in how far senior workers become increasingly suited to substitute for younger workers and (ii) why some countries are better able to make effective use of their senior workforce. Answering these questions calls for an empirically-based identification of country-specific factors (demographic situation, economic development, institutional factors, etc.) that are associated with rapid improvement of the relative productivity potential of senior workers.

In this section, we run panel regression models with the *relative* productivity potential of the three before-specified groups of senior workers covering ages 55-69 years *as compared to* their counterparts in the prime years of their career (35-49 years). We rely on the same dimensions of productivity potential for health and work experience, and evaluate productivity potential with respect to improved human capital and skills, better health and increased levels of recent work experience.

However, since the main period of formal education and training ends, on average, in the mid twenties, educational attainment of senior workers is in effect exogenously determined until 2015. We therefore include educational attainment of senior workers as exogenous explanatory variable.

Explaining improvements in senior workers relative productivity potential as compared to their younger counterparts implies for econometric analysis in which we primarily have to account for determinants that specifically may reduce the gap between senior as compared to prime-age workers.

As the relative health status and relative recent work experience of senior workers' in countries do not evolve independently from each other but are jointly determined, we estimate a two-equation model by a two stage least square (2SLS) procedure. Analysis is performed for 13 countries[3] and for single years between 1985 and 2000. Results are displayed separately for the three age groups of senior workers (55-59, 60-64, 65-69 years) as well as by sex (male, female, total).

4. Preliminary results and expected findings

Moving along our three dimensions – education, work-relevant health status and recent job experience –, descriptive results show that senior workers have been catching up in the last three decades (see also Figures 1 to 3, Appendix):

- Educational attainment has considerably risen between 1970 and 2000 in each of the three senior age groups. More concretely, the share of senior workers with an academic degree has increased by up to 20 percentage points, e.g. for 55-59 year-old men in the US or 55-59 year-old Swedish women.
- The share of senior workers disposing of recent job experience has remained relatively stable for men, but increased substantially for women, in some countries by up to 10 percentage points (e.g. Germany for women aged 55-59 years or Sweden for women aged 55-59 and 60-64 years).
- Finally, according to our health indicator, male senior workers today are roughly twice as likely to suffer from severe pre-existing conditions that subsequently lead to premature death than women. However, for both sexes, physical health has improved considerably over the past decades, especially in countries with formerly high levels of health impairments among senior workers (e.g. Germany in age group 65-69 years).

With regard to the regression results, we expect educational attainment in the respective age cohort to boost both recent labour market experience as well as health status. Furthermore, we believe these two dimensions of productivity potential are strongly interrelated. We also attempt to quantify the magnitude of that relationship. Moreover, with respect to the issue of decreasing returns to scale, it seems to be intuitive that the smaller the gap between the productivity potential of senior as compared to prime-age workers, the more difficult it will get to further reduce it.

Finally, in all likelihood, countries such as Japan or Germany who have experienced pronounced workforce ageing for a long period are outperforming countries for which workforce ageing is a rather new or only future phenomenon, as appropriate policy measures to improve senior workers' productivity potential may not have been implemented, yet.

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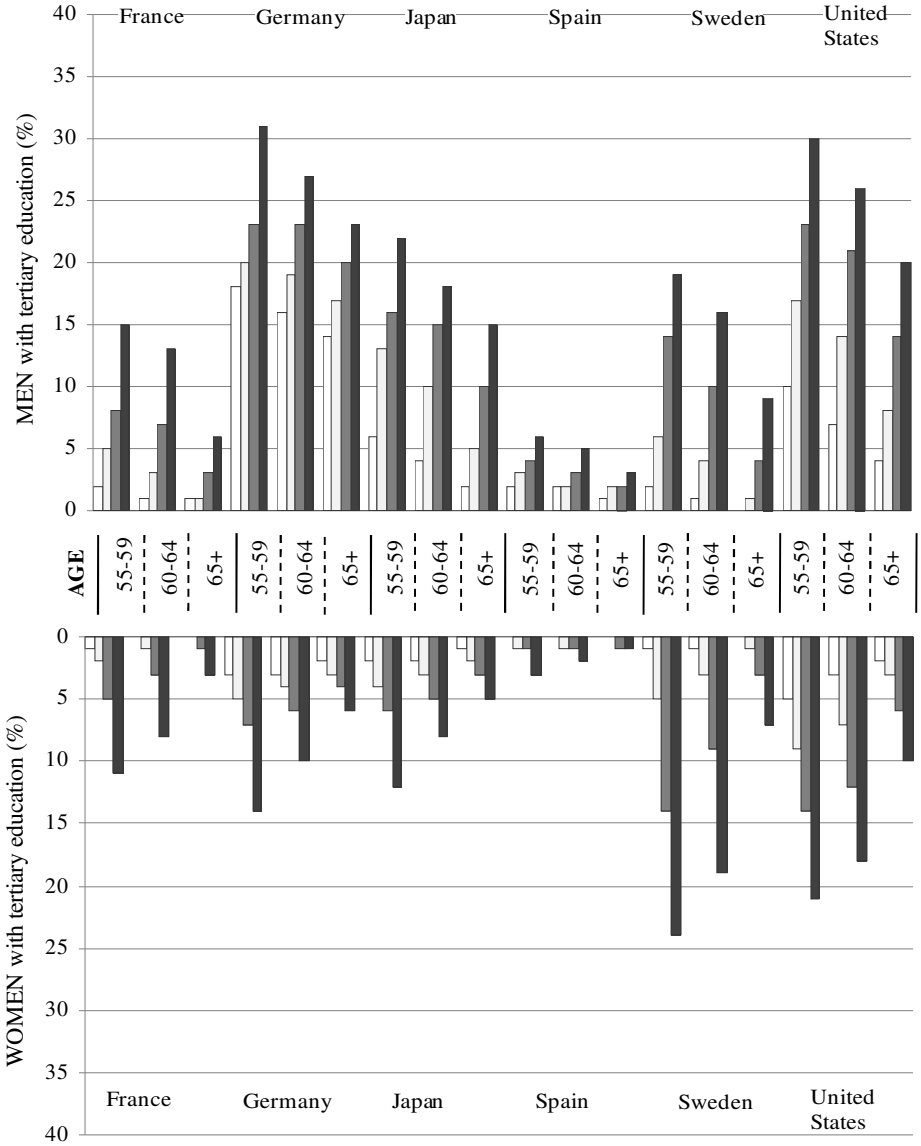
Appendix

Figure 1. Educational attainment of senior workers, 1970-2000, by age and sex

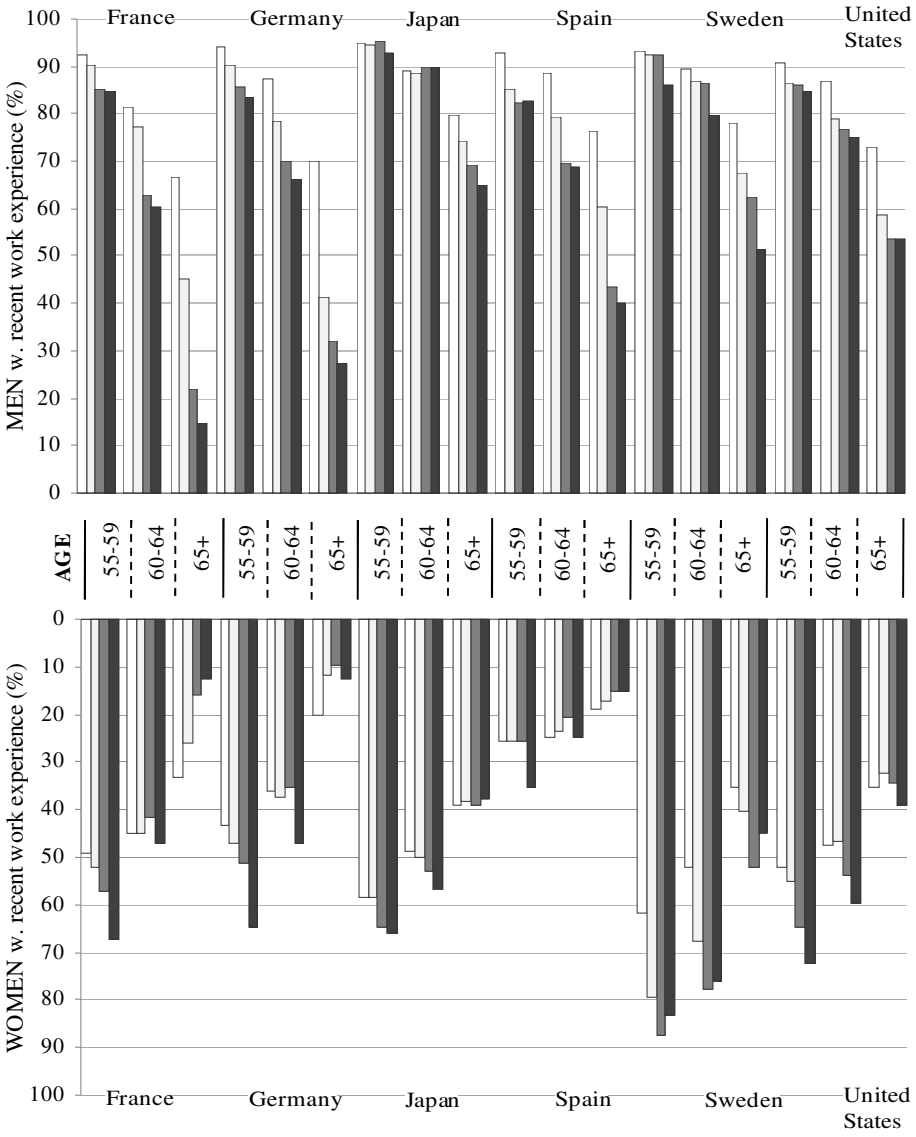


Educational attainment of MEN (upper part of graph) or WOMEN (lower part of graph) as measured by the respective population share with tertiary education (%)

1970 1980 1990 2000

Source: Own calculations based on VID/IASA (2008) data.

Figure 2. Recent work experience of senior workers, 1975-2005, by sex and age



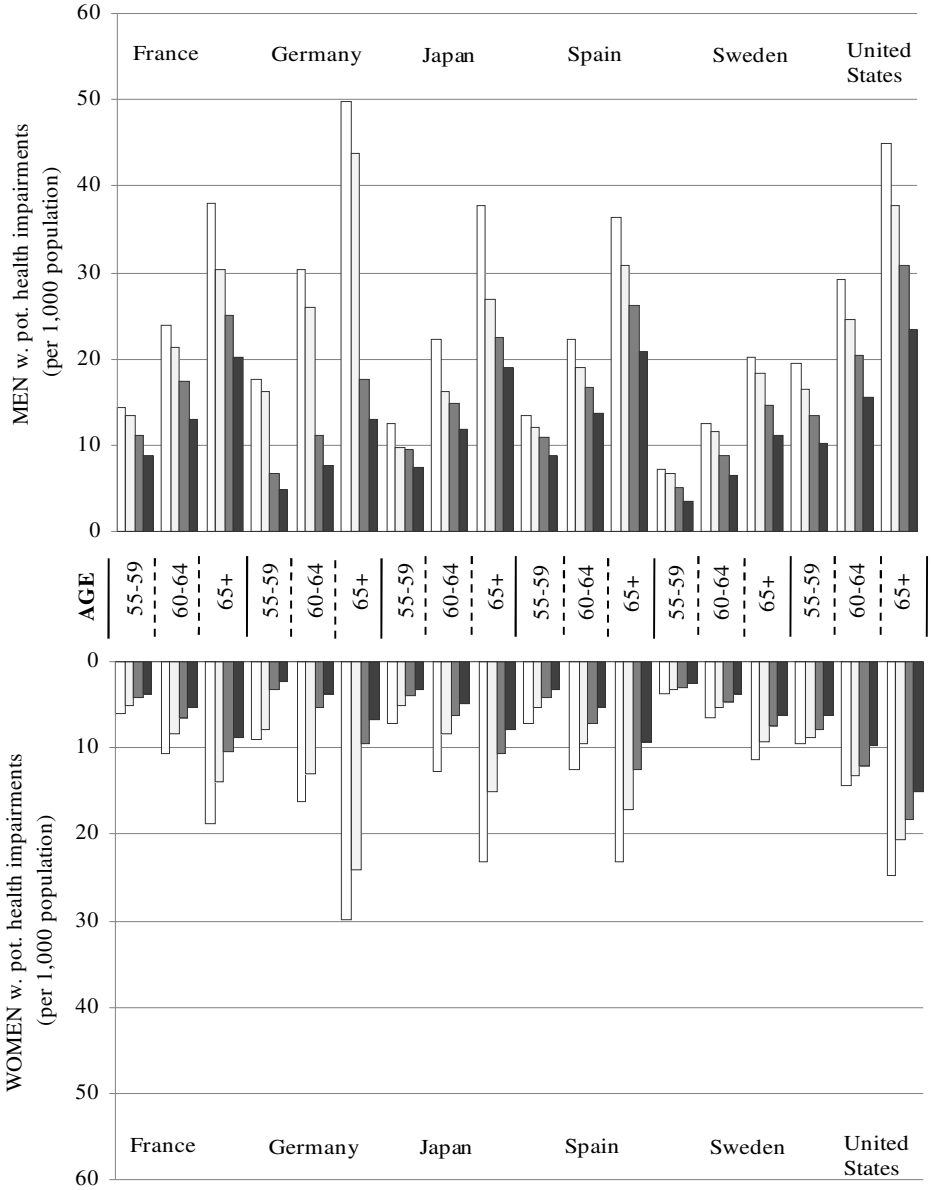
MEN (upper part of graph) or WOMEN (lower part of graph) with recent work experience (last 5 years) as measured by the employment rate of the cohort observed 5 years before the respective year.

1975* 1985 1995 2005

*1977 data for Spain, women, 55-59 and 60-64 years as no earlier date available

Source: Own calculations based on OECD Labour Force Statistics (2006)

Figure 3. Health status of senior workers, 1970-2000, by age and sex



MEN (upper part of graph) or WOMEN (lower part of graph) with potential work-relevant health impairments as measured by the death rate for diseases with severe pre-existing conditions of the cohort observed 5 years after the respective year (deaths per 1,000 population)

1970 1980 1990 1999*

*as 2000 data for some countries not available

Source: Own calculations based on WHO Mortality Database, ICD 7th – ICD 10th (2008)