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Life expectancy and human capital: Evidence from the international epidemiological transition

Casper Worm Hansen*

Aarhus University, Department of Economics and Business, Fuglesangs Allé 4, 8210 Aarhus V, Denmark

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ABSTRACT

Exploiting preintervention variation in mortality from various infectious diseases, together with the time variation arising from medical breakthroughs in the late 1940s and the 1950s, this study examines how a large positive shock to life expectancy influenced the formation of human capital within countries during the second half of the 20th century. The results establish that the rise in life expectancy was behind a significant part of the increase in human capital over this period. According to the baseline estimate, for one additional year of life expectancy, years of schooling increase by 0.17 year. Moreover, the evidence suggests that declines in pneumonia mortality are the underlying cause of this finding, indicating that improved childhood health increases human capital investments.

1. Introduction

What causes some countries in the world to remain underdeveloped and what can be done to help those countries escape economic stagnation and poverty? In an attempt to answer such challenging but relevant questions, one part of the literature has focused on the relationship between the health (life expectancy) and the wealth (GDP per capita) of countries. This literature is typically motivated by a strong positive cross-country correlation between health and wealth – the so-called Preston curve (Preston, 1975) – that is to say, healthier countries are also wealthier countries.

The current paper continues this line of inquiry. A seemingly important mechanism between health and wealth is the human capital channel: healthier individuals, who expect longer lives, have stronger incentives (and are more able) to acquire human capital skills. While a range of micro studies confirm the relevance of the argument, the conclusions in recent macro-empirical studies are less clear: Acemoglu and Johnson (2007) and Lorentzen et al. (2008).[1] Motivated by this puzzle, the paper revisits the relationship between life expectancy and human capital.

To investigate the causal effect of life expectancy on human capital, the analysis exploits a large positive shock to life expectancy, which was a part of the international epidemiological transition,[2] caused by the breakthrough of antibiotics and new intervention techniques (e.g., malaria eradication). More specifically, the identification strategy relies on the interaction between preintervention variation in the mortality from different infectious diseases and time variation occurring from the new medical technologies in the mid-20th century. Utilizing this interaction as a plausible exogenous variation in life expectancy, the strategy compares years of schooling for cohorts of individuals in countries with a higher burden of infectious diseases to cohorts of individuals in countries with a lower burden of infectious diseases before and after the medical advancements.

[1] Micro studies finding a positive effect of health on human capital are: Soares (2006), Bleakley and Lange (2009), Jayachandran and Lleras-Muney (2009), Bleakley (2009), Lucas (2010), Bhalotra and Venkataramani (2012), and Oster et al. (2013).

[2] The international epidemiological transition refers to Omran's (1971) theory of epidemiologic transition regarding the health progresses made in industrialized countries since the 18th century due to, for example, the germ theory of disease. This study, however, focuses on the first stage in the transition, occurring in developing countries since the mid-20th century (e.g., Vallin and Meslé, 2004).

* Tel.: +45 87165264.
E-mail address: cworm@econ.au.dk

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The analysis finds that countries with higher levels of preintervention infectious disease mortality experienced larger increases in schooling years, suggesting that life expectancy had a positive effect on the accumulation of human capital.[3] According to the baseline estimate then for every extra year of life expectancy, years of schooling increase by 0.17 year. In addition, the first-stage results reveal that the new medical technologies were accountable for an increase in life expectancy of about 6.3 years.[4] The implication is that the health shock increased years of schooling by 1.1 years. The analysis also establishes that this conclusion is robust to the potential convergence dynamics of schooling, functional form specifications, and so on.

The evidence suggests that the decline in pneumonia mortality was the main force contributing to the rise in human capital. As the mortality from that disease is concentrated at earlier ages of life, this instigates the argument that childhood health is a particular important factor in the process of human capital accumulation. However, it should be stressed that the baseline finding seems not to be attributable to the large decline in infant mortality observed over the 20th century.

By demonstrating that the effect of health on human capital is positive, the paper delivers new insights to the macro-empirical literature. Deploying the same empirical strategy, Acemoglu and Johnson (2006, 2007), henceforth AJ, find no relationship between average years of schooling in the adult population and life expectancy. The fact that their human-capital variable is only marginally affected by the entry of the new and better educated cohorts of individuals could, however, account for this discrepancy.[5] Moreover, while data availability on schooling restricts AJ to study the relationship in the 1960–2000 period, this paper exploits newer schooling data at the cohort level based on the 5-year age groups from Barro and Lee (2013), allowing a rigorous empirical analysis with data on years of schooling throughout the 20th century.[6]

An assessment of other empirical evidence on the quantitative importance of health improvements on human capital at the country level is mixed. On the one hand, some studies have demonstrated positive correlations (e.g., Zhang and Zhang, 2005; Tamura, 2006; Murphy et al., 2008), and the current paper contributes by establishing a positive link running from health to schooling and hereby supports the conclusions made in that research. On the other hand, the study by Lorentzen et al. (2008), which exploits geographical variables to identify the effect of adult mortality on economic outcomes, finds that mortality has no effect on human capital. Relying on an alternative identification strategy, exploiting the panel data structure to eliminate country fixed effects, and using cohort data on schooling, the analysis here reaches the opposite conclusion: the human capital channel is important in the understanding of how health is related to economic development.

This work also relates to the research of Cervellati and Sunde (2011a,b). Their analysis reveals that the impact of life expectancy on GDP per capita is negative and statistical insignificant before the onset of the demographic transition, whereas after its onset the effect is positive and significant. In Cervellati and Sunde (2009), they argue that the relationship between life expectancy and average years of schooling in the population follows a similar pattern. When considering cohort based data on schooling instead, the evidence presented here indicates that health has a positive effect on human capital for all countries in the AJ sample.[7]

The paper is organized as follows. Section 2 provides a short overview of theories of the human capital channel. Section 3 describes the data. Section 4 outlines the empirical strategy and presents the main findings. Section 5 reports the robustness analysis. Section 6 offers a concluding discussion.

2. A theoretical perspective

The hypothesis under investigation is whether country level health improvements, as measured by changes in life expectancy at birth, have a positive effect on human capital.

Textbook models in economics provide a straightforward link between life expectancy and human capital (i.e., the horizon effect or Ben-Porath mechanism; Ben-Porath, 1967): the benefits from schooling are reaped over a longer period when the working horizon increases, augmenting incentives to obtain human capital skills. One example of a paper which applies this mechanism in its theoretical setup is Boucekkine et al. (2002). On the other hand, Hazan (2009) questions the historical relevance of the basic Ben-Porath mechanism for the U.S. and some European countries. Nevertheless, modifying the mechanism by the introduction of uncertain survival along with perfect annuity markets (Cervellati and Sunde, 2013a) or by introducing imperfect credit markets (Hansen and Lønstrup, 2012) has the potential to alter Hazan's striking conclusion. In addition, although Hazan and Zoabi (2006) theoretically demonstrate that the horizon effect is not of much relevance in parental schooling investments, the authors find that more general health improvements could trigger the quantity quality trade-off as children become more productive in school when their health increases, which induces their parents make further human capital investments in them.

Furthermore, through the accumulation of physical capital or changes in population size, increasing life expectancy potentially causes general equilibrium effects, injecting back into the wage rate and schooling outcomes.[8]

An alternative mechanism is proposed by Albanesi and Olivetti (2010). They present a model based on Barro and Becker's (1989) model of fertility choice extended with maternal mortality where both fertility and parental investments in human capital increase in response to reductions in maternal mortality.

Besides the few arguments presented here, there are possibly several other channels through which rising life expectancy affects the aggregate human capital stock. But it seems as if the theory predicts that life expectancy matters to the acquisition of human capital skills. However, whether the underlying mechanism is the horizon effect or a more general health effect is less clear.

3. Data

This section describes the data used in the analysis. The measure of human capital used as the outcome variable is the average

[3] This conclusion is also consistent with a recent micro-empirical study (Lucas, 2010), which deploys a similar empirical strategy over the same time period. It finds the mid-20th century malaria eradication campaigns in Sri Lanka and Paraguay to have increased educational attainment at the individual level.

[4] In comparison, Jayachandran et al. (2010) find the introduction of sulfa drugs (in 1937) to have increased US life expectancy by 0.38–0.68 year.

[5] As also argued in Weil (2013, p. 181), this finding has the potential to explain why AJ found that the same health shock had *no* effect on GDP per capita, that is, due to the timing of the economic benefits of the medical breakthroughs.

[6] The finding of a positive relationship between life expectancy and human capital also contributes to the macro-theoretical literature, arguing the relation to be vital in understanding the process of economic development (e.g., Boucekkine et al., 2002; Cervellati and Sunde, 2005, 2013b; Hazan and Zoabi, 2006; Soares, 2005; De la Croix and Licandro, 2012).

[7] For a comprehensive overview of economic theories about the demographic transition see Galor (2011a,b).

[8] The direction of such second order effects on schooling is uncertain as it is not clear whether changes in life expectancy have positive or negative general equilibrium effects.