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The contribution of rising school quality to U.S. economic growth

Hye Mi You *

Department of Economics, The State University of New York at Buffalo, Buffalo, NY 14260, United States

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ABSTRACT

U.S. public school expenditures per pupil increased by a factor of 9 during the 20th century. This paper quantifies how much U.S. labor quality has grown due to the rise in educational spending. A schooling model and cross-sectional earnings variations across cohorts are exploited to identify the effect of the increased school expenditures on labor quality growth. The findings are that (i) U.S. labor quality increased by 0.4% per year between 1967 and 2000, one-fifth of which is attributable to the rise in educational spending; and (ii) labor quality growth explains one-quarter of the rise in labor productivity.

1. Introduction

During the 20th century, the real spending per pupil in U.S. public elementary and secondary schools increased by a factor of 9. This paper explores how much U.S. labor quality has grown due to the rise in school expenditures. The Bureau of Labor Statistics (BLS) currently measures labor quality growth mainly based on increases in the mean years of schooling but fails to capture the impact of changes in the quality of education. If the increased educational expenditures improved school quality, then the BLS underestimates the growth in U.S. labor quality.

This paper proposes a new way of quantifying the rise in the quality of education with a schooling model in which human capital production depends not only on time in school but also on educational spending. This model as well as cross-sectional earnings variations across cohorts is exploited to identify the growth in school quality. Consider cross-sectional earnings differences between younger and older cohorts with the same years of schooling. The earnings variations reflect three components: (i) the impact of changing selection into different years of schooling; (ii) return to experience; and (iii) the growth in the quality of education. Without a model, these three components cannot be identified simultaneously.

To assess the effect of the changing selection in schooling choice, assume that ability distribution stays constant across cohorts. If years of schooling vary only by ability within cohorts, the cohort-invariant ability distribution can be estimated by the schooling distribution of any single cohort. The impact of the changing selection on the cohort-variations in earnings is then measured by accounting for changes in empirical schooling distribution across cohorts.

* Tel.: +1 716 645 8689.
E-mail address: hyemiyou@buffalo.edu

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Once the selection effect is controlled for, a structural restriction derived from the model is used to disentangle the remaining two components, assuming the same return to experience across cohorts. In the model, optimizing agents choose both time in school and educational expenditures so that their relative marginal product in increasing human capital equals their relative costs. Given the data on individual earnings and educational expenditures, foregone earnings due to delayed experience are the key element in the relative cost of time spent in school. If earnings rise with work experience very rapidly, increasing time in school is relatively more costly than raising educational expenditures. Thus, agents substitute expenditure for time in school until the relative marginal product of expenditure equals its low relative cost. According to the model, the relative marginal product of expenditure for the last year in school equals the expenditure elasticity of human capital. Thus, the low relative marginal product of expenditure represents a low value for the elasticity. This implies little increase in the quality of education, given the rise in school expenditures. By the same mechanism, very flat experience-earnings profiles suggest a substantial rise in education quality, given the same increase in educational spending. This model implication on how the return to experience relates to the rise in school quality provides an additional condition, which identifies the growth in quality of education from the observed earnings variations across cohorts.

The main finding is that U.S. labor quality increased by 0.4% per year between 1967 and 2000, with one-fifth of this explained by the growth in school quality. Given the increased school expenditures per pupil, their contribution to U.S. labor quality growth has been fairly modest. The total labor quality growth explains one-quarter of the growth in U.S. labor productivity for the same period. The estimated rise in labor quality reduces the growth rate of total factor productivity (TFP) measured as a residual. The contribution of growth in TFP to U.S. labor productivity growth is about a quarter, whereas the BLS estimates it to be 40% by ignoring the growth in the quality of education. The estimated impact of the rise in school expenditures on labor quality growth is larger among men, while the baseline estimate changes little with a sample of full-time, full-year (FTFY) workers. I also find that the growth in school quality explains only 10% of the increases in empirical returns to schooling and that a rising skill premium explains the rest.

This paper is related to two strands of literature. One branch includes papers that estimate the effects of various measures of school quality, including school expenditures on student achievement and labor market outcomes at the micro-level. Although the estimates vary depending on the data and method used, most papers did not find strong effects of measured school quality.[1] My study differs from these studies in two ways: (i) it suggests an aggregate measure of labor quality growth due to increased school expenditures; and (ii) it focuses on cohort variations in the quality of education instead of cross-sectional or geographical variations. To this aim, the biggest challenge is to identify the growth in education quality from other earnings variations across cohorts such as return to experience and changing selection in schooling choice. This paper proposes a way of overcoming this difficulty using a schooling model and measures the average impact of increased school expenditures on growth in human capital for cohorts born from the early 20th century to the early 1980s. The estimated impact of school expenditures is modest in line with this micro-literature.

Another related strand of literature is on the role of human capital in economic growth and development. The most widely used method to measure country-level human capital stocks is to multiply the mean years of schooling of the population by the estimated Mincerian return to schooling.[2] However, this method does not allow for differences in the quality of education across countries. To correct this, Bils and Klenow (2000) add teachers' human capital to the standard Mincer-type human capital specification, yet they ignore the role of expenditure in human capital production. Manuelli and Seshadri (2007) and Erosa et al. (2010) explicitly incorporate expenditure as well as time as inputs for human capital production to account for cross-country income differences. The contribution of human capital growth to U.S. real income growth implied by Manuelli and Seshadri (2007) is more than twice my estimate, whereas that suggested by Erosa et al. (2010) is only slightly greater than mine. One explanation is that Manuelli and Seshadri (2007) view that earnings growth with work experience is solely due to human capital investments, excluding the effects of learning-by-doing or technological progress. This framework tends to amplify the differences in human capital accumulated after leaving school across cohorts, overstating the role of human capital in explaining real income growth. In addition, both Manuelli and Seshadri (2007) and Erosa et al. (2010) assume a common wage per unit of labor regardless of education, whereas my study considers different skill prices by education; failing to do so overestimates the impact of rising school spending on labor quality growth. This paper also relates to Rangazas (2002), who examines the impact of the quantity and quality of schooling on U.S. labor productivity growth. A key difference is that my paper proposes a new way of estimating the expenditure elasticity of human capital, instead of taking it from micro-study estimates that vary by the data and method used. Moreover, I control for the rise in skill premium and unobserved heterogeneity correlated with schooling choice to remove upward bias in the estimated growth in U.S. labor quality.

The remainder of this paper is organized as follows. Section 2 describes the growth accounting framework this paper suggests and discusses the BLS's measure of labor quality growth. In Section 3, a schooling model with a Ben-Porath-type human capital production function is introduced. The identification scheme and the estimation procedure are described in Section 4, and the main findings are reported in Section 5. Section 6 concludes the paper.

[1] See, for example, Hanushek (1986), Hanushek et al. (1996), Heckman et al. (1996), and Betts (1995). Dearden et al. (2002) present a survey of previous results.

[2] See, among others Klenow and Rodríguez-Clare (1997) and Hall and Jones (1999).