Precautionary Demand for Education, Inequality, and Technological Progress

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This paper offers an explanation for the evolution of wage inequality within and between industries and education groups over the past several decades. The model is based on the disproportionate depreciation of technology-specific skills versus general skills due to technological progress, which occurs randomly across sectors. Consistent with empirical evidence, the model predicts that increasing randomness is the primary source of inequality growth within uneducated workers, whereas inequality growth within educated workers is determined more by changes in the composition and return to ability. Increasing randomness generates a “precautionary” demand for education, which we show empirically to be significant.

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1. Introduction

During the last few decades in the United States and many advanced countries, wage inequality has increased significantly. These trends are largely characterized by increasing inequality within demographic, occupational, industrial, and education groups. In addition, rising wage inequality has occurred simultaneously with rising unemployment and non-employment rates in many developed countries. All of these trends are found to be related to the collapse in the relative demand for workers with lower ability or skill.¹

The consensus in the literature is that changes in technology over the past few decades are responsible for the dramatic changes in the structure of wages and employment. The empirical literature suggests that these trends are caused by the increasing importance of cognitive skills in the wage function.² Most of the theoretical literature has focused on the interaction of technology and inequality “between” education groups.³ More recent theoretical work explains inequality within and between groups by relying on changes in the return to ability. For example, Galor and Moav (2000) develop a growth model in
which an ability-biased technological transition generates increasing residual inequality. The mechanism in their model is based on the idea that the state of transition brought about by technological change raises the rate of return to skills. However, all of the previous theoretical work has ignored the evidence that the sources and timing of inequality growth within the various education groups are not equivalent.

This paper, in contrast, generates two different sources of inequality growth within education groups by incorporating the role of ability and adding a new source of inequality based upon the random depreciation of technology-specific human capital. Consistent with existing empirical evidence, the theory argues that the sources of inequality growth are different within educated and less educated workers: increasing randomness is the primary source within less educated workers, while inequality growth within educated workers is determined more by changes in the composition and return to ability.

Indeed, Gottshalk and Moffitt (1994) show that inequality is created differently within education groups. They found that the ‘transitory’ component of inequality, versus the ‘permanent’ component, is much higher for uneducated workers for all periods, and increased by much more for uneducated workers over the 1970s and 1980s. Thus, inequality for educated workers is mainly increasing along predictable ‘permanent’ dimensions such as ability, while uneducated workers are increasingly being tossed around in random ways. This increasing randomness is further demonstrated by the increasing unemployment rates starting in the early 1970s which occurred primarily within the least educated group. These findings suggest that changes in technology during the past few decades have been operating in different ways for educated and less educated workers, and consequently, the risk associated with being uneducated has increased over time. We demonstrate empirically that workers consider this kind of risk when making their schooling decisions.

Motivated by these empirical findings, we develop a model which endogenously generates the patterns of wage inequality (within and between groups) and educational attainments throughout the last few decades. The model is based on the disproportionate effects of technological changes on the depreciation of general versus technology-specific skills, and the resulting precautionary factor in the demand for general education which guards against the higher depreciation risk of technology-specific skills. We assume that individuals, given their level of ability, choose to invest in general skills through education or in technology-specific skills through on-the-job training. Since the return to ability is higher as an educated worker, higher ability individuals choose to invest in general education and workers with lower ability choose to invest in technology-specific skills. However, changes in technology render technology-specific skills obsolete. Consequently, less educated workers, who are relatively more invested in technology-specific skills, will suffer higher rates of human capital depreciation due to technological improvements. Therefore, an increase in the rate of technological progress increases the education premium.

We further assume that technological progress is absorbed into various sectors at different rates. Thus, there exists a variance in the rate of progress across industrial sectors (or jobs). This is a major source of ex-post variability of wages within less educated workers—since they are relatively more invested in technology-specific skills and there is a variance of the depreciation rate of these specific skills across sectors.