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## ABSTRACT

This paper assesses the trade-off between acquiring specialized skills targeted for a particular occupation and acquiring a package of skills that diversifies risk across occupations. Individual-level data on college credits across subjects and labor market dynamics reveal that diversification generates higher income for individuals who switch occupations whereas specialization benefits those who stick with one type of job. A human capital portfolio choice problem featuring skills, abilities, and uncertain labor outcomes replicates this general pattern and generates a sizable amount of inequality. Policy experiments illustrate that mandatory specialization generates lower average income growth, lower turnover and marginally lower inequality.

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## 1. Introduction

Every occupation requires a different set of skills. Conversely, many skills are useful, to different degrees, in a wide variety of professions. A literary editor, a corporate lawyer and a marine biologist all apply related skills involving reading, writing and arithmetic but in different amounts. Moreover, some occupations appear to more heavily emphasize a subset of particular skills whereas other professions more or less weigh skills evenly. Engineers, for instance, are likely to be more specialized than sales reps.

Individuals acquire many of these different skills before entering the workforce at which point they face the uncertainty of settling on a trade or profession. A college graduate may, for example, study music but not make it as a musician. Knowing these risks, students will want to balance their efforts in case their initial target occupation does not work out. They will want to choose the composition of their courses to acquire a set of skills based on inherent abilities and on their expected payoffs in prospective professions.

To help assess the impact of occupational matching uncertainty on the range of acquired skills and on earnings dynamics, this paper first establishes panel data evidence linking labor market outcomes with the fit of an individual's acquired skill set in their chosen occupation. The paper then constructs, estimates and assesses a human capital portfolio choice problem for individuals facing an uncertain labor market.

<sup>☆</sup> We have presented previous versions of this work at the Atlanta Fed, the Philadelphia Fed, the Bank of England and the Universities of Essex, Iowa, Hawaii-Manoa, Konstanz, North Carolina, Southern California, Toronto, the Canadian Macroeconomics Study Group, the NBER Macro Perspectives Group, and the Midwest Macroeconomics Meetings. We thank H. He, L. Hendricks, G. Kambourov, B. Kuruscu, G. Moscarini, M. Pergamit, L. Pistaferri, T. Schoellman, R. Shimer, G. Vandembroucke, R. Wolthoff, R. Wright and especially G. Violante (Editor) and an anonymous referee for useful suggestions. This research uses restricted-access data from the National Center for Education Statistics (NCES) and we thank its staff for their help. The views expressed here are those of the authors and cannot be attributed to the Federal Reserve Bank of Atlanta or the Federal Reserve System.

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A precise economic framework is spelled out to discern underlying trade-offs. Students who vary in both their innate abilities to learn and in their potential in distinct jobs will choose their set of skills based on these differences. Coupled with labor market uncertainty, these unobservables will also generate idiosyncratic labor market outcomes. As a result, students targeting the same first occupation are likely to acquire different portfolios of skills to use in their intended job as well as in their back-up plan. The skills portfolio decision problem put forward in this paper is used to identify the roles these different unobserved factors play from detailed information on human capital choices and labor market histories.

The framework adopted here assumes that agents know from the outset their abilities to acquire imperfectly substitutable skills. They also receive an initial signal of their potential 'fit' or prospects in a number of occupations. Given this personal information as well as the expected skill payoffs in each profession, agents choose their human capital portfolio, that is, the amount of each skill they acquire. After investing in training, individuals enter their preferred or primary occupation.

Each occupation values all human capital types but to a different degree. Human capital, expected productivity and the initial fitness signal in that profession determine initial pay. As employment continues in an occupation, an agent's true productivity is at some point fully revealed. Those with good realizations stay in that job permanently and earn their true productivity. Those with poor draws try their second best option again without initially knowing their true quality in the new job. The process repeats itself until the individual settles in an occupation.

This framework reveals a tension between specialization and diversity.<sup>1</sup> Innate talents and idiosyncratic signals of potential provide an incentive for individuals to specialize by acquiring skills that reflect their personal circumstances. Students rationally pursue those subjects in which they show promise and talent. In contrast, the risk of low productivity draws in each occupation provides an incentive to acquire a more widely applicable portfolio of human capital skills.

Using the 1980 High School and Beyond (HS&B) survey which has detailed information from post-secondary transcripts, we quantitatively assess this trade-off between specialization and diversity. For the most part, students in the US begin to specialize after high school as they choose post-secondary institutions and then majors. Minors and elective courses further allow students to tailor a portfolio of skills based on their innate abilities and their career aspirations. Transcripts in HS&B thus give empirical measures of human capital portfolios that are used to find the underlying parameters of the skill distribution, the signals of occupational fit and the technological skill use by occupations.

The HS&B survey also contains labor market histories for individuals' early careers – up to around the age of thirty – that link human capital portfolios to individual earnings and labor market dynamics. Looking at the pattern of earnings, the estimated model performs well. The estimates of the model are based primarily on matching the observed human capital portfolios and the pattern of occupational switching. None the less, simulated data found using these estimates mirror the observed relationship between portfolio concentration, career switches and earnings.

Targeting and hedging in the portfolios appear to affect earnings in similar ways in both the simulated and actual data. The model implies that the realized fit in a profession translates into productivity and hence pay. Agents with more targeted portfolios who remain in an early career choice experience higher earnings and earnings growth. Workers with more versatile portfolios who switch earn more than switchers with specialized portfolios. Those who settle early, that is those who realize better first draws, receive high and rapid growth in earnings. Those who switch encounter an immediate earnings decline. Similarly, those who settle early tend to earn more than those who try several professions. Occupational mobility also declines and the earnings distribution fans out over time.

As the model and data are close along several dimensions of interest, it is natural to consider policies that shape the hedging decision. We find that a European-style education system characterized by mandatory specialization in an occupation generates a lower degree of turnover, lower earnings growth, and lower dispersion of (log) earnings. An alternative system that allows for more breadth and hedging opportunities (the US higher education system) trades off higher growth rates in earnings (and higher education expenditure) for a slightly more unequal income distribution.

These results extend the human capital literature with uncertainty. The early human capital literature developed to understand earnings over the life-cycle, [Becker \(1994\)](#) or [Ben-Porath \(1967\)](#), focused on investments in homogeneous human capital. Subsequent contributions added uncertainty about future rewards. [Levhari and Weiss \(1974\)](#) and [Altonji \(1993\)](#) are two prominent examples. More recently, [Wasmer \(2006\)](#) as well as [Gervais et al. \(2008\)](#) study from a theoretical perspective the trade-off between (more risky) specific and general human capital during periods of aggregate "turbulence".<sup>2</sup>

A parallel literature considers multi-dimensional endowments of abilities which determine self-selection of individuals into different sectors, as in [Heckman and Sedlacek \(1985, 1990\)](#), or occupations, as in [Willis \(1987\)](#). These studies formalize the static [Roy \(1951\)](#) model of comparative advantage and occupation selection.<sup>3</sup> [Keane and Wolpin \(1997\)](#) use a dynamic Roy framework to estimate a structural model of a joint schooling and occupational choice decision. In Keane and Wolpin's framework, individuals have an initial endowment of occupation-specific abilities (including an ability level to accumulate human capital) and they control their schooling and occupational choice to maximize lifetime earnings.<sup>4</sup> See also [Gathmann and Schönberg \(2010\)](#) and [Yamaguchi \(2012\)](#) who extend that literature by redefining occupations as bundles of tasks and

<sup>1</sup> This familiar tension has long been acknowledged and dates back to [Smith \(1776\)](#).

<sup>2</sup> An empirical literature has developed to evaluate the degree of mismatch between occupations and the choice of major or field. [Malamud \(2010\)](#) and [Robst \(2007\)](#) are two examples in this extensive literature. Malamud examines the relationship between the timing of the choice of field and the likelihood of working in an unrelated occupation. Robst explores the wage effects of the distance between field of study and occupation.

<sup>3</sup> [Lazear \(2009\)](#) and [Schoellman \(2010\)](#) are more recent examples of works that share some elements with that earlier literature.

<sup>4</sup> Other studies in the literature of occupational choice include [Sullivan \(2010\)](#) and [James \(2012\)](#).

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