Sorting Endogenous Types:
The Insurance Role of Education in Labor Markets

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Extended Abstract

Educational attainment has drastically increased during the last century. The increase, however, has not been uniform over time. Indeed, while there was a significant increase in college attainment until the mid-1980s, in recent decades this trend has stopped, with stagnating college enrollment and graduation (Golding and Katz, 2009). At the same time, earnings instability — measured as the variance of the transitory income component — increased until around 1987, particularly for low-skilled workers. But thereafter this trend stagnated, too (Gottschalk and Moffitt, 1994 and 2008).

This paper develops a matching model of the labor market with educational investment that provides a uniform explanation for these two stylized facts. In our model, we take the changes in labor market volatility as given, and investigate the implications for educational choices and sorting. We argue that the decision to invest in education is significantly influenced by labor market volatility that translates into instability of production and ultimately of wages. A non-trivial role of education is to offer insurance against transitory wage shocks, thereby explaining why increases in earnings volatility induce more people to invest in education, whereas stagnating volatility leaves educational choices unaltered.

The following is a short overview of the model. There is a large number of risk averse workers and a large number of firms that are heterogeneous in their productivity. There are two stages in the model: an education investment stage and a matching stage. In the first stage workers simultaneously decide whether to invest in education. Education is costly, and workers are ex-ante heterogeneous in the investment cost. The benefit of obtaining an education is that a worker's skill is drawn from a stochastically better distribution. At the beginning of the second stage, workers observe their skills and also the realization of an aggregate shock on the firms' production function, where technology exhibits complementarities in the attributes of the matched worker-firm pair. Lastly, due to complementarities in production, workers and firms match in a frictionless market in a positively assortative way.

Our model exhibits some features that are non standard in the matching literature but crucial to our problem, such as (i) an endogenous distribution of workers' characteristics, which is a

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mixture of the distribution of those who choose to invest in education and that of those who do not invest, leading to a fixed point problem; (*ii*) risk averse workers; (*iii*) a shock to production whose distribution depends on a parameter that allows for mean preserving spread shifts; (*iv*) we also consider a version of the model where both worker and firm attributes are multi-dimensional.

An equilibrium is a triple consisting of an optimal education choice for each worker as a function of his cost, a matching function that assigns workers to firms in a measure preserving and positively assortative way, and a wage function that clears the market. We analyze the equilibrium for several versions of the model depending on the assumptions regarding the number of worker characteristics (one dimensional and two dimensional) and the transferability of utility (fully transferable and nontransferable). In each version of the model, we proceed as follows. For a given realization of the shock and for given measures of educated and non educated workers, we solve for the equilibrium at the matching stage after the shock is realized, which consists of a matching between firms and workers and a wage function that clears the market. We then proceed backwards to pin down the optimal educational choice for each worker given the wage and matching functions of the second period for each realization of the shock and number of educated workers. We show that the optimal investment decision is a cut-off rule on the cost of educational investment: a worker invests in education if and only if his cost is below the threshold. Since the wage and matching functions in the second period depend on the number of educated workers and thus on this threshold, the equilibrium fixed point problem reduces to finding a cut-off value for the cost of education that rationalizes the wage function assumed by the workers in the first stage. An equilibrium always exists and we provide conditions for its uniqueness.

What is the effect of an increase in the volatility of the shock (more formally, a mean preserving spread in the distribution of the shock) on the number of workers who invest in education? This is our main equilibrium comparative statics question, which is at the heart of our explanation for the stylized facts mentioned above. The answer is not trivial a priori since the curvature properties of the wage function can conflict with the concavity of the worker's utility function due to risk aversion. We provide sufficient conditions under which a more risky shock induces more workers to invest in education. The cleanest intuition comes from the case in which workers' skill characteristics are two dimensional and the shock affects one of the skills. In such a case, investing in education provides 'insurance' in the following sense: although a more variable shock reduces the expected utility of a worker who invested in education, it reduces even more that of a worker who did not invest. The reason is that an educated worker has more of a second skill that serves as a diversification device, thereby mitigating the impact of the shock. Thus, the difference between the expected utility with and without education (which determines the incentives to invest in education), increases in the volatility of the shock, and so does the equilibrium number of educated workers.

So far we have interpreted the shock as an aggregate one whose realization is revealed before matching takes place. But one can easily modify the set up and assume instead that the shock is match specific and revealed after the match forms but before wages are determined. If utility is transferable, then the shock will be fully insured by the risk neutral firm, leaving all results unchanged. But if there is some friction that limits transferability, then the worker bears part of the idiosyncratic risk. As a result, workers with the same skills can have different wages due to different shock realizations, and wages can be decomposed as a sum of a 'permanent component' (due to complementarities) and a 'transitory component' (due to the realization of the shock). This decomposition will be important for our empirical analysis.

All told, the main prediction of the model is that increases in the volatility of earnings (a mean preserving spread shift), boost the incentives to acquire education. This provides a unifying explanation for the two stylized facts that motivate us. Early on, earnings volatility was significantly higher for those without education than for those with education, thereby prompting a large number of workers to invest in education. In the last twenty years, however, wage instability has stagnated or even gone done, strongly reducing the incentives to obtain education (despite the considerable increase in the skill premium).

This paper contributes to two strands of literature, one theoretical and one empirical. First, the analysis enriches the standard frictionless matching model by endogeneizing the distribution of attributes on one side of the market and by analyzing a novel equilibrium comparative statics under uncertainty. Thus, it contributes to the literature on investments before a match (e.g., Mailath, Postlewaite, and Samuleson (2013)) and on matching under uncertainty (e.g., Chade and Eeckhout (2014)). Moreover, in the multidimensional version of our model we use a multi-d notion of assortative matching (Lindenlaub 2014) and provide a closed form solution for a mixture of distributions of educated and non-educated workers (not for commonly used Gaussian distributions).

Second, we contribute to the recent literature on the evolution of US educational attainment. To explain the recent stagnation in college attainment growth, Castro and Coen-Pirani (2014) stress the rise in skill premium and declining ability of learning in recent cohorts; Garriga and Keightly (2013) highlight increased college completion risk; Athreya and Eberly (2013) emphasize the high college completion risk, risk of returns to college education as well as leverage risk. Instead, we propose a new explanation for the first increasing and then stagnating trend of US college attainment, which is based on changes in earnings instability that closely mirror these educational trends.