The Development of Early Skills: Self-Productivity and Cross-Fertilization

Jason Thomas[1], Heide Jackson[2], & Katsuya Oi[1]
[1]Pennsylvania State University
[2]University of Wisconsin-Madison

Introduction

The long term consequences of early development have been well documented with research showing effects on high school completion, adult employment, and adult earnings (for a review see Almond and Curry (2011)). This evidence underscores the importance of early life as a time for intervention and investment, as well as the need for understanding early developmental processes. To this end, Cunha and Heckman (2007) have developed a model of human capital formation that identifies several key features of the developmental process – "dynamic complementarity" and "self-productivity." The former concept refers to the notion that returns to investments at time t increase with the capabilities developed previously at, say, time $t-1$. The other key feature of development, "self-productivity," refers to the notion that capabilities developed by time $t-1$ enhance capabilities at later stages of development (e.g. at time t). An interesting corollary is that one dimension of development (e.g. non-cognitive or social skills) fosters the develop of different dimensions of development at later stages of life (e.g. cognitive skills).

This paper offers simple tests of the process of "self-productivity" using several different longitudinal data sets that contain repeated measures of cognitive and non-cognitive skills. More specifically, we propose a simple model with non-linear effects and estimate the model using data from the 1958 National Child Development Study (NCDS), the 1970 British Cohort Survey (BCS), and the children of the women in the 1979 National Longitudinal Survey of Youth (NLSY79). To the extent that we find empirical support for the model developed by Cunha and Heckman (2007), the implications of the model – namely, the importance of early and continued investments in early life – should receive attention in the policy arena.

Data & Methods

The data used in our analyses come from three different sources. The first source is the National Child Development Study (NCDS), which follows a 1958 birth cohort in the United Kingdom (U.K.) with later observations at ages 7, 11, 16, 23, 33, 42, 46, and 50. The information includes repeated measures on dimension reading and math scores, as well as indicators of social skills. Second, we use information from the 1970 British Cohort Study,

which also follows a birth cohort from the U.K. with similar measures as those collected in the NCDS; although, the ages at observation differ – birth, 5 years, 10 years, 16 years, 26 years, 30 years, and 38 years. Finally, data from the children of women in the 1979 National Longitudinal Survey of Youth are also used in the analysis. This final source includes scores on examinations in reading comprehension and math (at ages 7 and 11) as well as measures of behavioral problems (also measured at ages 7 and 11). In each data set, we also have information on family background and education attainment, the latter being our outcome of interest.

To test the concept of "self-productivity" we propose a basic regression framework in which we model educational attainment as a function of family background and measures of both cognitive and non-cognitive skills measured at two points in time. The concept of "self-productivity" and that of cross fertilization implies nonlinear effects that we model using interactions terms as follows:

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\begin{aligned}
\text{Ed} \;=\; & \alpha + \beta_1 \text{FB} + \beta_2 \text{C}_1 + \beta_3 \text{NC}_1 + \beta_4 C_2 + \beta_5 \text{NC}_2 \\
& \gamma_1(\text{C}_1 * \text{C}_2) + \gamma_2(\text{NC}_1 * \text{NC}_2) + \gamma_3(\text{C}_1 * \text{NC}_2) + \gamma_4(\text{NC}_1 * \text{C}_2),
\end{aligned}
$$

where Ed is education, FB is family background, C_1 and C_2 are the first and second measures of cognitive skills, and similarly for NC_1 and NC_2 and the measures of non-cognitive skills. All estimated coefficients for the measures of cognitive and non-cognitive skill, as well as the interaction terms, are hypothesized to be positive. Statistically significant effects of both main and interaction terms provide empirical support for "self-productivity", with the interaction terms γ_3 and γ_4 capturing the cross fertilization of cognitive and non-cognitive skills. (Simpler models may be required if the correlation between the repeated measures is too high.)

References

Almond, D. and J. Curry. 2011. *Handbook of Labor Economics, Volume 4b*, chap. Human Capital Development before Age Five. Elsiver, pp. 1315–1486.

Cunha, F. and J. Heckman. 2007. "The Technology of Skill Formation." *American Economic Review* 97:31–47.