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Gerald Eisenkopf

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Tracking and Incentives

A comment on Hanushek and Woessmann (EJ, 2006)

Gerald Eisenkopf

University of Konstanz &

Thurgau Institute of Economics

Post Box D131

78457 Konstanz

Gerald.eisenkopf@uni-konstanz.de

Abstract

This paper discusses the incentive effect of tracking policies in education. The results contradict the argument by Hanushek and Woessmann (2006), that differences-in-differences estimations capture the full impact of tracking. Such estimations capture the gain in education between the measurements but neglect the gains before the first measurement. In a standard incentive theory framework these gains and their variance differ systematically between tracking and comprehensive systems. In a selective educational system, most students will provide more effort in early education. Signaling considerations enhance this line of argument. As a result, educational tests alone do not reveal the efficiency and distributional aspects of educational policies sufficiently.

Keywords: Tracking – Selection – Educational Policy – Tracking – Selection

JEL-Codes: D02 – I21 – I28

1. Introduction

Tracking or selection policies in education arouse great controversy in many countries. Hanushek and Woessmann (2006, p. 66) claim that ”[t]he impact of tracking can (...) be estimated by comparing the average achievement gain in tracked countries to that in untracked countries.” To identify this impact they use differences-in-differences estimations across various comparable performance tests to compare educational progress in secondary education in countries with different tracking policies. This paper argues that this approach neglects student incentives induced by tracking. Therefore, the chosen econometric method is not suitable to identify the *entire* impact of tracking. It biases the results on absolute performance in favor of comprehensive schooling. On the other hand it underestimates changes in inequality of outcomes in selective educational systems. Moreover, the strong focus on educational tests to identify efficient outcomes in education is questionable. These tests provide information on observable output but ignore private costs. Note also that recent empirical contributions have questioned the suitability of the approach and the robustness of its results (Waldinger, 2006, Manning and Pischke, 2006).

2. Gaps in marginal educational productivity and Incentives

Differences-in-differences require that the first measurement point is not affected by the prospective treatment. In the case of tracking in schools this is not the case. Many children (and/or their parents) have clearly an incentive to get into a top-track school. Changes in marginal productivity after selection are one motive why effort provision in primary education depends on the selection policy. Consider the following simple setup, which is similar to a bonus payment scheme. Assume two schools enrolling all students in the economy, a student population with mass of unity and a two period educational production. The objective of a policymaker is to maximize educational output after period 2 ($Q_2 = q_2(Q_1, \theta, S, e_2) + \epsilon_2)$. This output is a function of educational output in period 1 (Q_1), student ability $\theta,$ student effort in period 2 ($e_2 \geq 0$) and a school parameter $S \in (\bar{s}, c, \underline{s})$. For simplicity these school parameters are exogenous. Effort is associated with a convex cost function $C(e_2)$. The expression $\bar{s}$ ($\underline{s}$) is associated to the school which selects the most (least) able students in case of tracking. In case of comprehensive schooling, the parameter is c for each school. The following relation holds: $\bar{s} > c > \underline{s}$, otherwise either comprehensive schooling or tracking would obviously be inefficient. The ability θ is uniformly distributed

between $\underline{\theta}$ and $\bar{\theta}$ ($\bar{\theta} > \underline{\theta} > 0$). All inputs are complementary. The random variable ϵ_2 follows the symmetric, single peaked distribution function $F(\epsilon_2)$ with $F'(\epsilon_2) = f(\epsilon_2)$.
Educational output in period 1 is $Q_1 = q_1(\theta, S, e_1) + \epsilon_1$, with $S = c$. Here, student effort follows the convex cost function $C(e_1)$. The distribution functions $F(\epsilon_1)$ and $F(\epsilon_2)$ are iid. Finally assume that selection depends on objective not relative criteria. Any student with $Q_1 > \hat{Q}$ can enroll at school with the parameter $\bar{s}$. Let $\hat{Q}$ be equal to the expected output of a student with average ability $\hat{\theta} = \frac{\bar{\theta}+\underline{\theta}}{2}$. Now the policy makers can decide if tracking is introduced in period 2 (secondary education) and students decide about effort supply in both periods. Student utility increases linearly in individual educational output.
Effort supply in period 2 increases in ability as high ability students have a higher marginal productivity. In case of selection these differences in effort supply increase because students with a higher ability will also more likely face a better schooling parameter than their less able fellow students. As a consequence, the benefits for the high ability people increase with selection $E(Q_2|\theta = \bar{\theta}, S = \bar{s}) > E(Q_2|\theta = \bar{\theta}, S = c)$ while the low ability people lose out $E(Q_2|\theta = \underline{\theta}, S = \underline{s}) < E(Q_2|\theta = \underline{\theta}, S = c)$. This result is observed by Hanushek and Woessmann (2006). However, the output gap in period 1 in the case of a tracking policy increases as well. The decision problem for a student with ability θ in period 1 in the tracking scenario is

$$\max_{e_1} Pr(Q_1 > \hat{Q})(E(Q_2)|S = \bar{s}) + \left(1 - Pr(Q_1 > \hat{Q})\right)\left(E(Q_2)|S = \underline{s}\right) - C(e_1). \tag{1}$$

with the resulting first order condition

$$\begin{aligned} f(Q_1 - \hat{Q})\left[(E(Q_2)|S = \bar{s}) - \left(E(Q_2)|S = \underline{s}, e_2 = e_2^{\underline{s}}\right)\right] \\ + Pr(Q_1 > \hat{Q})\frac{\partial\left(E(Q_2)|S = \bar{s}, e_2 = e_2^{\bar{s}}\right)}{\partial e_1^T} \\ + \left(1 - Pr(Q_1 > \hat{Q})\right)\frac{\partial\left(E(Q_2)|S = \underline{s}\right)}{\partial e_1^T} = C'(e_1^T) \end{aligned} \tag{2}$$

Here e_1^T describes the optimal effort supply in period 1 in the tracking scenario while $e_2^{\bar{s}}$ ($e_2^{\underline{s}}$) represents the optimal effort supply in period 2 in case of successfully passing (failing to pass) the selection threshold. This effort supply can be compared to effort supply in a comprehensive schooling system. In this case a student's decision problem in period 1 is

$$\max_{e_1}(E(Q_2)|S = c) - C(e_1). \tag{3}$$

with the first order condition:

$$\frac{\partial\left(E(Q_2)\middle|S = c, e_2 = e_2^c\right)}{\partial e_1^C} = C'(e_1^C) \tag{4}$$

Now, the following conditions hold

$$\left(e_1^C\middle|\theta = \underline{\theta}\right) > \left(e_1^T\middle|\theta = \underline{\theta}\right) \tag{5}$$

$$\left(e_1^C\middle|\theta = \overline{\theta}\right) < \left(e_1^T\middle|\theta = \overline{\theta}\right) \tag{6}$$

if $\left(f(Q_1 - \hat{Q})\middle|\theta = \underline{\theta}\right)$ and $\left(f(Q_1 - \hat{Q})\middle|\theta = \overline{\theta}\right)$ are sufficiently close to zero. The probability of passing the selection threshold is very low for students with a very low ability, hence they are very likely to have secondary education in the lower track with the resulting lower marginal productivity. Very able student on the other hand are very likely to meet better conditions in period 2 in the tracking scheme, hence they have a higher incentive to provide effort in primary education. Since all conditions are the same in the comprehensive and the tracking regime, a first result can be established.

Result 1: The variation in educational output in period 1 is strictly larger in a selective educational system than in a comprehensive one.

Therefore, an estimation of differences in differences does not fully capture the larger educational inequality in selective systems.

On the other hand, the differences in differences do not fully capture the impact of tracking on overall educational performance. Suppose that the expected marginal productivity in secondary education for a student with average ability $\hat{\theta}$ is identical in the tracking and in the comprehensive system. Then, it is clear that this average student provides higher effort in period 1. The term $f\left(Q_1 - \hat{Q}\right)\left[\left(E(Q_2)|S = \bar{s}\right) - \left(E(Q_2)\middle|S = \underline{s}, e_2 = e_2^{\underline{S}}\right)\right] > 0$ makes the difference. Given a symmetric distribution of abilities this inequality implies the following result

Result 2: The overall educational output in period 1 is strictly larger in a selective educational system than in a comprehensive one.

3. Signaling Incentives

Labor market signals are another argument why selection has an impact on overall performance in the pre-selection period. Selection is likely to provide costless information about 'raw' ability to future employers. Once selection has taken place, the signaling incentives are lower in the selective system. Students know that they are either within the top students or that they are not. This selection signal is also informative for future employers and restricts their beliefs accordingly. Students from the lowest track of education in Germany (the “Hauptschule”) get often summarily rejected from private companies offering vocational training. Hence, under *ceteris paribus* conditions, students in countries with tracking should perform better before selection takes place but students in secondary education catch up in secondary education. Given the standard set-up of signaling models e.g Spence 1973) it is surprising that signaling considerations rarely appear in papers on educational institutions. De Fraja and Landeras (2006) have shown that signaling activities can have a serious impact on the outcome of educational policies. Future research should work out in detail how signaling activities affect equilibrium outcomes and efficiency of tracking policies.

If signaling and private inputs play a key role for incentives it is even questionable to base an efficiency analysis of educational institutions on performance tests alone. Signaling activities constitute an overinvestment in education. Myopic decision making or positive externalities of education may balance this argument but the students’ workload or parental private investments should clearly be a part of any welfare analysis.

4. Conclusion

This short paper has sketched the incentive effect of tracking policies in education. The results contradict the argument by Hanushek and Woessmann (2006), that differences-in-differences estimations can capture the full impact of tracking. These estimations capture the gain in education between the measurements but neglect the gains before the first measurement. In a standard incentive theory framework these gains differ systematically between tracking and comprehensive systems. In a selective educational system, most students will provide more effort in early education. Signaling considerations support this line of argument. Observable performance measures reveal quite a lot of information about educational institutions but they are (not yet) sufficient to identify optimal selection policies.

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THURGAU INSTITUTE
OF ECONOMICS
at the University of Konstanz

Hauptstr. 90
CH-8280 Kreuzlingen 2

Telefon: +41 (0)71 677 05 10
Telefax: +41 (0)71 677 05 11

info@twi-kreuzlingen.ch
www.twi-kreuzlingen.ch