STRATIFIED OR COMPREHENSIVE? SOME ECONOMIC CONSIDERATIONS ON THE DESIGN OF SECONDARY EDUCATION

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Most secondary school systems in the developed world consist of an initial period of exposure to the same curriculum followed by diversification of curricula into separate tracks. In Europe, there are vocational and general or academic tracks, with allocation into tracks often based on previous performance and/or ability tests.[1] Vocational education is directly related to a specific occupation, with a substantial part of the curriculum devoted to learning practical skills to be used immediately upon graduation. General education has no immediate connection with any occupation, but provides basic knowledge that can be used to learn different occupations.

Table 1 is based on Hannan, Raffe and Smyth (1996) and classifies countries according to the degree of standardization and stratification of secondary education. Standardization is low in North America relative to Europe. Tracking starts relatively early, after primary school, in Germany and the Netherlands and later on in France and Italy. In the United States secondary schools are comprehensive but it is common practice to separate students into different courses or course sequences (tracks) based on their level of achievement or proficiency as measured by some set of tests or course grades (Gamoran 1987). In Japan, stratification starts at the post-compulsory stage in upper secondary education, with elite schools at the top and vocational schools at the bottom of the hierarchy.

This heterogeneity in the structure of secondary education raises questions about the relative efficiency and equity of alternative school designs. Some economists and sociologists view stratification as a mechanism of class reproduction and social exclusion. Their view is based on evidence from several countries that tracking impedes equality of educational and occupational opportunity. According to Shavit and Müller (1998) lower–class students are placed in lower tracks and have fewer chances of attending university and finding access to high prestige occupations.

Table 1

Stratification and standardization of secondary education in Europe and North America

	Low standardization	High standardization
Low stratification	USA, Canada	Japan, Scotland, Ireland, Sweden, England
Intermediate stratification	Spain	France, Finland, Italy, Israel
High stratification		Germany, Austria, Switzerland, Denmark, Netherlands

Source: Hannah, Raffe and Smith (1996).

Efficiency is also an issue, and international differences in school design have recently been associated by economists to differences in economic performance. Krueger and Kuman (2002), for instance, have argued that the emphasis placed by Europe on specialized, vocational education may reduce the rate of technological adoption and lead to slower economic growth than in the United States, where the schooling system provides more general and comprehensive education. The broad idea pursued here is that general education is more suitable to induce technical change. Since general education is more flexible and versatile than vocational education, it also encourages organizational change and the adoption of high performance holistic organizations in production (Aghion, Caroli and Penalosa 1999).

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[1] See Shavit and Müller (1998) and Green, Wolf and Leney (1999).

While the effects of school design on technical and organizational change are certainly important, it is also important to ask whether and how these changes can affect in turn school design. The timing of tracking changed in several European countries after the Second World War. In the UK there was a shift in the mid-1960s from selection at 11 to selection at 16. In Germany, where tracking by ability starts relatively early, reforms in the 1970s increased compulsory education from 8 to 9 years, in an effort to make the system more comprehensive (Müller, Steinmann and Ell 1998). In France, direct orientation to apprenticeships after two years of lower secondary school was abolished in the 1980s (Goux and Maurin 1998). All these reforms have gone in the direction of delaying tracking. Moreover, the fraction of the population in vocational secondary education to that in general secondary education has continually declined in most of post-war Europe.

Technical progress leads to skill depreciation, and the degree of obsolescence is likely to be higher the more specialized and tied to a specific set of techniques skills are. While skills learnt in vocational schools can be easily transformed into the corresponding occupations in the labor market, they are less flexible and transferable than general skills. Therefore, rapid technical progress should discourage vocational, relative to general and more versatile, education. As argued by Aghion, Caroli and Penalosa (1999) organizational change is skill biased. Non-hierarchical firms rely on direct, horizontal communication among workers and on task diversification as opposed to specialization. They hence require multi-skilled agents, who can both perform varied tasks and learn from other agents' activities. One clear implication of organizational change is the relative demand shift toward more general and versatile skills (upskilling), which are better provided by general education.

In order to think of the effects of technical and organizational change on efficient school design, we need to ask what are the economic factors shaping the optimal timing of school tracking. In a recent paper, my co-authors and I have characterized with a stylized model the optimal timing as the outcome of the trade-off between the advantages of specialization, which call for early tracking, and the costs of early selection and technical obsolescence, which call instead for later tracking (Brunello, Giannini and Ariga 2004).[2] We have also used the model to study how relative demand shifts toward more general skills and changes in the rate of technical progress affect the optimal tracking time as well as the allocation of students to vocational and general tracks.

Tracking is associated to selection, and the key factor in the selection process is perceived ability. In Germany, "… the decision about school track is taken by both parents and the local educational authorities … but children's measured ability remains the most important factor determining the selection process. This takes the form of a primary school recommendation for a secondary school track, generally based on a pupil's marks in the core subjects of German and mathematics …" (Schnepf 2002).[3] In a world of imperfect information, selection conveys information about individual ability to the labor market.

Tracking also leads to ability grouping, with higher-achieving students being separated from lower-achieving students. It is still an open issue whether separating students into different tracks leads to better educational outcomes than mixing students of different ability. Epple, Newlon and Romano (2002) briefly review the empirical literature and conclude that, relative to the outcomes of mixed classes, students assigned to low tracks are hurt by tracking while those assigned to high tracks gain. As shown by Hoxby (2001), peer effects have distributional effects but no efficiency implications if individual outcomes, such as human capital, are affected linearly by the mean of peers' outcomes in that variable. Efficiency implications can only be drawn from models which are either nonlinear in peers' mean achievement or in which other moments of the peer distribution matter (Hoxby 2001).

When peer effects are non-linear, tracking has a positive "specialization" effect. In the absence of a countervailing factor, however, positive specialization would lead to immediate tracking. There are several balancing factors on can think of. In an environment characterized by uncertainty about labor market outcomes, one such factor is the option value of waiting: by delaying the tracking time the government can reduce the risk of producing at school on obsolete set of competencies.

[2] See also Brunello and Giannini (2003).
[3] Stratification by ability in Germany starts at age 10, when pupils are allocated to the general track (Gymnasium) or to the vocational track (Hauptschule and Realschule).

Another factor is obsolescence, which reduces the value of skills as new techniques and blueprints are introduced. It is plausible that this reduction is more significant for vocational than for general and more versatile skills. Yet another factor is that the allocation of individuals to tracks is affected by noise in the selection process, and that the relative importance of noise is higher the earlier the selection takes place.

Misallocation due to imperfect testing reduces both the quality of the signal offered by schools to the labor market and the peer effects in human capital formation. As remarked by Judson in 1998[4] "... innate ability is measured with difficulty and with increasing clarity as education proceeds. Any test given will be a noisy signal, and the less education the person has had, the noisier the signal will be. Before primary school it is very difficult to discern levels of talent, but identification of talent is easier after a few years of primary school, still easier after high school, and so on..." (p. 340). The earlier selection is carried out, the higher the risk of misallocating individuals to the wrong track. We call this the "noise" effect of tracking. The trade-off between the positive "specialization" and negative "noise" and obsolescence effects generates an endogenous optimal tracking time.

In our paper, we focus on the German institutional setup and study how the optimal tracking time and the relative share of graduates from general schools vary with changes in the size of the peer effect, the noise in the selection process, the rate of technical progress and the upskilling of labor from less to more general and versatile tasks. We simulate a calibrated model to investigate the effects of the following experiments: a) a 25 percent decline in the rate of productivity growth, a proxy of the rate of technical progress, which corresponds to the decrease experienced by (West) Germany between the early 1980s and the late 1990s (Gust and Marquez 2002); b) a 10 percent increase in the relative demand shift towards more general and versatile skills, captured by the increase in the German wage bill share of non-production workers between 1970 and 1990 (Berman and Machin 2000); c) a 10 percent increase in the size of the peer effect; d) a 10 percent increase in the noise parameter regulating the allocation process. The results are reported in Table 2. The figures in the table are percentage deviations from the baseline solution.

[4] See also Bedard (1997).

Table 2

Simulation results: Percentage deviations from the baseline

	Deviation in the optimal tracking time from the baseline	Deviation in the optimal size of the vocational track from the baseline
–25 % reduction in productivity growth	–16.10	0.70
10 % increase in the demand for skilled labor with broad competencies	–12.90	–13.10
10 % increase in the size of the peer effect	–29.03	2.80
10 % increase in the size of the selection noise	38.71	–2.10

It turns out that the optimal tracking time is affected negatively by the decline in the rate of productivity growth, and by the relative demand shift toward more general and versatile jobs. In more detail, we find that a 25 percent reduction in productivity growth triggers a 16.1 percent decline in the optimal tracking time. We also find that a 10 percent increase in the demand for skilled jobs reduces tracking time by 12.9 percent. If we simulate the combined effect of these two changes, we obtain that the optimal tracking time should decline by 22.6 percent.

Starting from four years of comprehensive school before selection into tracks, which corresponds to the German situation in the early 1970s, these simulations imply that the optimal tracking time should have been anticipated further by the end of the century to about 3 years of comprehensive school in order to accommodate the slowdown of productivity growth and the relative demand shift toward more general and versatile jobs. In practice, however, during this period "...reforms have attempted to narrow the gap between the Hauptschule and the other tracks through prolongation of compulsory education from eight to nine years and by introducing additional subjects into the curriculum..." (Müller, Steinmann and Ell 1998, 145). These reforms can be interpreted as a prolongation of the comprehensive period and as a delay of the tracking period.

We see two ways to reconcile our simulations with the observed trends in German school design. The most natural way is to argue that either the size of peer effects has declined or the noise in the selection process has increased, perhaps as a consequence of the substantial inflow of immigrants. As shown in Table 2, the efficient tracking time is very sensitive to changes in these two parameters. The other way is to interpret the current trends as deviations from the efficient policy, driven perhaps by distributional and equity concerns. If the observed equilibrium is a political equilibrium driven by majority voting rather than the efficient outcome which maximizes total net output, tracking can also be delayed if the majority of students are in the vocational track, as in the case of Germany, and face the risk of obsolescence of their vocational skills.

Our simulations show that the relative share of graduates from vocational tracks is marginally affected by changes in productivity growth but varies significantly with changes in the demand for skilled labor. In particular, a 10 percent increase in upskilling is expected to increase by 18.1 percent the share of graduates from the generalist track. We conclude from this that the widespread academic drift, which characterizes both Germany and other developed countries, can be interpreted as the response of school design to the relative demand shift toward more general and versatile skills.

Conclusions

I have argued that optimal tracking is the outcome of the trade-off between the advantages of specialization and the costs of early selection and skill obsolescence. Drawing on the calibrated model by Brunello, Giannini and Ariga (2004), I have simulated how endogenous school design should vary with the significant changes in the rate of technical progress and in the relative demand for skilled and versatile jobs which occurred in Germany during the last twenty years of the century.

The simulations suggest that the relative share of graduates from general schools should have significantly increased, which confirm the existing evidence on academic drift in secondary schools. They also suggest that the efficient tracking time should have been anticipated by close to percentage points, which is not what has happened in Germany since 1970. I speculate that either other key parameters have changed in the required direction – a reduction in the size of peer effects and/or an increase in the noise of the selection test – or that the observed policies have deviated from efficiency considerations, perhaps because of distributional concerns.

A tentative conclusion is that equity considerations play a more important role than efficiency in policy decisions concerning the tracking of secondary schools. After all, the reforms of secondary schools which took place in Italy and the United Kingdom during the 1960s were not driven by efficiency considerations, but by the concern that premature tracking could increase social stratification and exclusion.

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