

analysis is novel in three respects. For the first time, a German application directly accounts for family background and cognitive ability at the same time. Moreover, the paper uses very novel cognitive ability measures which have been introduced to the SOEP only recently and have not been used in an analysis of the returns to qualifications before. Finally, the analysis accounts for observable heterogeneity in the return estimates.

A positive and non-negligible family background and ability bias can be detected with respect to all types of post-school qualifications. However, once school qualifications are controlled for, this bias is considerably reduced. Moreover, there is an unexpected negative bias associated with the variable high school.

Overall, the post-school qualification estimates react more strongly to the inclusion of school qualifications than to the inclusion of the sets of cognitive ability and family background measures. However, academic qualifications react much more strongly to their inclusion than initial and further vocational qualifications, which is not too surprising given the strong interdependence between the two. School qualifications are themselves significant and important in size. Also, they by far exceed the return associated with apprenticeship training. However, the differences in the returns to school qualifications show that higher level school qualifications are the most important drivers of the returns to complete educational paths.

As regards the cognitive ability measures, only two of them have a statistically significant impact. Their direct impact is very moderate in size. The learning capacity and stock of knowledge measure (WFT) positively affects wages, while the school grade item non-response indicator is negative. Contrary to what was suggested in the discussion, the cognitive ability measure which indicates learning efficiency and information processing capabilities (SCT) has no significant impact.

Finally, the second paper analyzes linear and non-linear aspects of heterogeneity in the returns to qualifications with respect to cognitive ability. Interaction effects between the type of school qualification and the average grade are significant for high school graduates only. However, the estimate associated with being in the top 25 per cent of the high school grade distribution is double the estimate associated with being in the bottom 25 per cent. The findings with respect to the cognitive ability tests are somewhat unexpected. The main effect of the learning capacity indicator (WFT) rises if the linear interaction terms are included. These suggest however that learning capacity does not have a positive impact across all types of qualifications. Moreover, accounting for non-linearities turns the learning efficiency indicator (SCT) positive and significant. However, being in the top 25 per cent of either test distribution is associated with a negative wage premium for higher level school leavers. In contrast, being in the bottom 25 per

cent of either test distribution is associated with a positive premium for some post-school qualifications.

The **third paper** focuses on sequences of post-school qualifications and specifically looks at post-apprenticeship investments in education both at the vocational and academic levels. Again, the starting point is the apprenticeship system. However, in contrast to the first paper, the analysis goes further and analyzes in how far the structural change in the economy and changing individual preferences may have resulted in the diverging patterns of apprenticeships and related further educational options. The returns to these further educational options are then evaluated. The main contribution of the paper is that it uses longitudinal data and provides fixed-effects estimates of post-apprenticeship formal qualifications at the vocational and academic levels. Thus the analysis accounts for unobservable time-constant individual heterogeneity.

A first descriptive analysis of the role of sequences of post-school qualifications shows that post-apprenticeship investments in further vocational and academic education are important. Already, academic education has a slightly higher weight than further vocational education and it can be expected that post-apprenticeship academic education is going to gain further weight relative to further vocational education in the future. This expectation is based on observations regarding the structural change the apprenticeship system has undergone during the last decades and how further educational options have evolved accordingly. Further evidence suggested that traditional craft and industry apprenticeships and corresponding further vocational qualifications are on a decline. In contrast, commercial and service-related apprenticeships gain importance and corresponding further education options often are pursued at the academic level. Overall, the empirical analysis supports these observations. The return to post-apprenticeship further vocational education is not statistically significant in most specifications. Thus the additional investment did not pay off. In contrast, the positive return to academic education is highly statistically significant and sizeable, except for the sample which restricts the analysis to the self-employed. Entrepreneurial success is thus not a linear function of the level of education. Combining further vocational and academic education is associated with a strong wage penalty.

The job classification analysis of the SOEP sample with regard to the current job individuals had at the time they completed their post-apprenticeship further education provides some further insights. In fact, craft and industry specific occupations at the basic and intermediate level dominate among those with further vocational education, while these occupations play only a minor role for individuals with mixed vocational and academic paths. Here, managing, commercial and service-related occupations dominate. However, high-skill technical occupations

are important as well. Therefore, while purely vocational paths in technical occupations may no longer be economically profitable, mixed vocational plus academic paths are.

Discussion and implications

This dissertation set out to further the academic and political discussions on the effective provision of education in an increasingly older and unequal society whose future economic competitiveness is mainly driven by the quality of its human capital. Moreover, based on the conviction that the German economy can no longer afford to let education potentials go unexploited or to spend resources on human capital investments which are not economically and/or socially beneficial, the papers focused on two specific aspects of the education system which are on the current political agenda: the perceived unequal access to education and resulting path dependencies in terms of the heterogeneity of post-school qualifications, in particular vocational vs. academic. Before these issues are discussed against the background of this work's findings as well as in the light of recent educational policy and reform initiatives, some general remarks on the importance of the concept of the return to education are in order, in particular with regard to its potential for policy recommendations.

In academia the dispute over whether education is a private or a public good, a mixed or a merit good remains unsolved. Moreover, according to Timmermann (2005, pp. 82)⁹⁸ there is disagreement over whether education is associated with positive externalities. However, in Germany education is state-provided and treated as a non-private good. Thus, politically, state intervention in educational matters is justified. Apart from some minor privatization tendencies, the German states are the sole providers of school education in Germany. In contrast, the apprenticeship system is a three-tiered system with responsibilities taken on by the public sector, the chamber organizations and private firms.

Clearly, since education involves the allocation and the use of resources, education necessarily is an economic good (Timmermann, 2005, p. 82). It is also generally acknowledged that education exhibits characteristics of an investment good, with resources spent today and the expectation of benefits tomorrow. Therefore, the educational system is responsible for supplying the economy with skilled labor. The skills and competencies demanded in many occupations have been upgraded due to technological change and the introduction of IT and the educational institutions are under constant pressure to adjust accordingly. Moreover, based on equity considerations and

⁹⁸ Timmermann, D. (2005), Bildungsökonomie, in: Tippelt, R. (ed.), *Handbuch Bildungsforschung*, Wiesbaden, pp. 81-122.

the principle of equality of opportunity, education is a direct means to facilitate social and income mobility.

As a consequence, education should be subject to evaluation based not only on criteria such as efficiency, effectiveness and profitability, but also distributional justice. The return to education is an important economic and direct indicator of the profitability of educational investments in terms of their labor market potential, i.e. the impact of such investment on labor income. Also, if the labor market returns of educational programs indicate the productivity increase in individuals' current job due to the investment, it sheds light on the effectiveness of the investment. Moreover, given certain path dependencies and the determinants of educational outcomes, the heterogeneity in the returns to specific qualifications may serve as an indirect measure of distributional justice.

In fact, there has been a surge in educational evaluation studies, international and national, during the last decade. Politically, the German government has come under considerable pressure after the publication of the first Program for Student Assessment (PISA) results in 2001. The Program evaluates literacy competencies of 15 year old students in reading, mathematics and science. Apart from the fact that the German students performed comparatively weak in the tests, researchers found that the correlation between family background and students' performance is strongest in Germany. In part, these observations were ascribed to the track nature of the German educational system, in particular the three-tiered school system. The latest PISA results suggest, that the association between family background and educational outcomes has declined, but nonetheless remains comparatively strong.

This thesis took up this critique and discussed the influence of family background as well as the impact of the track nature of the school system on school and post-school educational outcomes as well as labor market outcomes. Against this background, it was suggested to estimate the returns to vocational qualifications conditional on secondary school type (paper 1) and to completely separate school and post-school qualifications in order to estimate their return rates separately (paper 2). Moreover, the direct inclusion of family background indicators in the estimations (paper 2) showed how the returns to qualifications were affected by them.

It is a good sign that the returns to all school and post-school qualifications are positive and significant, even if account is taken of differences in cognitive ability and family background. Thus, education generally does make a difference. However, the returns to school qualifications are quite heterogeneous. Moreover, the returns to complete educational paths, i.e. school and post-school qualification, are largely determined by the return to secondary school type. Given

that the choice of post-school qualifications is determined by the type of secondary school and the resulting existence of path dependencies in the educational system, it seems that the German educational system manifests the existing social differences rather than contributes to balancing them and to raising social mobility.

A recent school reform initiative in the state of Hamburg, which particularly aimed at delaying the early streaming into secondary school tracks, was largely rejected in a referendum. The referendum was enforced by a parent initiative, mainly supported by people with privileged background. In contrast, the Federal Ministry of Labor and Social Affairs recently has initiated “the educational package” targeting young and school children in low income families. The package entails a variety of measures to increase equality of opportunity mainly with respect to the access to education such as learning support, learning materials or cultural activities. The benefits have to be applied for and it may be for this reason that the general reception is very low. Overall, better knowledge about the association between individuals’ education and their labor market potential and, more importantly, direct evidence of the heterogeneity in the returns to both school and post-school qualifications, may help to raise people’s and, most importantly, parents’ awareness of the flaws of the established structure of the educational system. This seems even more pressing given the tendencies toward paid (extracurricular) educational courses in child daycare centers.

Furthermore, the thesis suggested that the streaming into secondary school tracks determines the choice of post-school qualifications. It was shown that this choice is highest for high school graduates, since they have access to all types of post-school qualifications. Lower secondary and intermediate secondary school leavers do not have direct access to higher education. They are forced to enter the system of initial vocational education, i.e. apprenticeship training or full-time vocational schooling. Further vocational tracks may be entered conditional on the successful completion of initial training. Recently though, access to higher education institutions has been facilitated for those with further vocational education.

The cross-sectional analyses in papers 1 and 2 suggested a significantly positive and sizeable return to further vocational education relative to having no post-school qualification, even conditional on secondary school type. However, based on the above considerations and the fact that post-apprenticeship investments in further vocational education have declined (in the craft sector), while post-apprenticeship investments in higher education have increased (in banking) over time, it was suggested to estimate the incremental return to further vocational and academic education among those with initial vocational education in a longitudinal setting (paper 3). The

fixed-effects estimates of the returns to post-initial further vocational education were insignificant in most specifications, while the returns to academic education were significant and substantial. Moreover, investments in both further vocational and academic education are associated with a significant wage penalty. In principle, only the fixed-effects estimates allow a causal interpretation of the return estimates. However, the panel analysis may be less representative of the total population.

The findings suggest further systematic research with respect to the direct returns to post-initial investments in further vocational vs. academic education. In fact, if purely vocational paths, in particular the second higher level investment, deliver no positive return, the consequences are large – economically, socially and politically. Recent educational policy has extended financial support for individuals who opt for further vocational tracks. Moreover, the craft sector is legally built on and largely dependent upon purely vocational paths. In addition, further vocational education is the path to further attainment and expected advancement for lower and middle level school leavers. Evidence showed that the attractiveness of this path has already declined. If further vocational education is not economically reasonable, this will have repercussions on the corresponding initial training options. Only imagine a savings account which gives you no return whatsoever. Socially and politically, this finding seriously questions the heading of the federal government’s qualification initiative “advancement through education” for individuals with intermediate school and post-school qualifications, i.e. the majority of the German population.

Overall, I very much agree with economist Alfred Marshall⁹⁹ who once said that “[t]he most valuable of all capital is that invested in human beings”. Yet, the findings of this thesis suggest that these investments have to be very wisely considered and that their value very much depends on the type of investment. Moreover, given that the investments themselves require the spending of valuable resources, public and private, financial and other, and given that the returns to these investments are so heterogeneous in terms of their labor market value, they require constant and very careful evaluation. This thesis makes a small though very committed contribution in this respect.

⁹⁹ Cited in: Wößmann, L. (2003), Specifying human capital, *Journal of Economic Surveys*, 17(3), pp. 239-270.