A 3 THE RELEVANCE OF TERTIARY EDUCATION AND VOCATIONAL EDUCATION AND TRAINING FOR INNOVATION

Strengthening the innovation system by combining vocational and academic qualifications

The German production and innovation model, particularly in the industrial sector, is based on a specific combination of highly qualified university graduates – mostly from natural sciences and engineering – and highly skilled workers from the dual vocational education system.[39] This structure prevents a narrowing on academic knowledge, a phenomenon that can be observed in many countries.[40] Instead, the German system builds on a combination of different, high-quality sources of knowledge. These sources of knowledge include occupational skills and process-oriented competencies, application-oriented analytical skills as well as abstract theoretical and analytical expertise. The success of the German model largely results from close links between R&D and production accompanied by the spatial proximity of highly skilled workers from diverse backgrounds – ranging from development engineers to skilled workers from various disciplines.[41] High-quality innovations arise from the fact that employees with different qualifications have a common professional language, and that a regular exchange of experience is not only facilitated, but also promoted.[42]

The combination of tertiary education graduates and highly skilled workers proves to be most effective whenever the exchange of knowledge among different skill types is supported by complementary human resource or organisational management practices. These practices include e.g. teamwork, job rotation, broad spans of control, and the delegation of decision-making.[43] In this context, the participation of companies in training apprentices in the dual system shows a positive effect on innovation: training companies are required to keep their training in line with advanced technological standards to meet the requirements of externally developed training curricula which are updated regularly. This ensures a continuous supply of skilled workers with state-of-the-art qualifications.[44] By participating in apprentice training, companies also improve their chances of recruiting highly skilled workers from the external labour market.[45] A solid pool of skilled workers graduating from dual training programmes and thereby having a specific combination of the most recent practical and analytical skills also contributes to a more effective dissemination of process innovations. This has been demonstrated e.g. in a comparative study on the application of CNC (computer numerical control) in German as compared to foreign companies.[46]

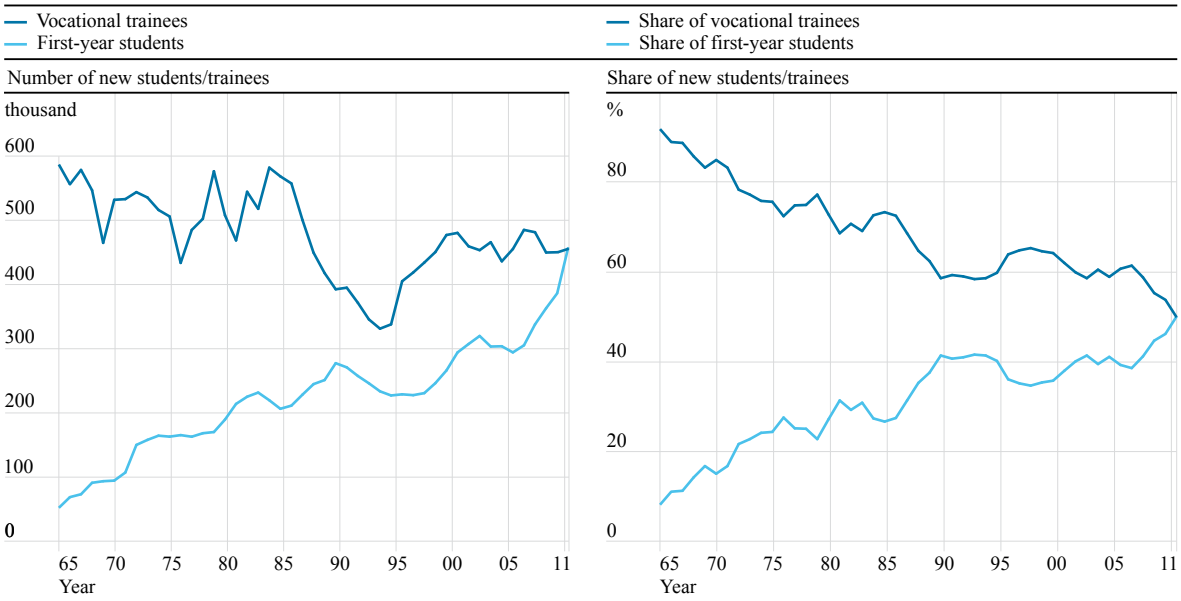
Another important component of the German innovation model is its industrial ecosystem, which is characterised by its variety of relevant resources. The industrial ecosystem in Germany includes suppliers cooperating in development, a wide range of public research and financing institutions, and a functioning dual education system that provides the necessary institutional framework. This system, which cannot be found in Anglo-Saxon countries in particular, provides a basis for German companies to develop their innovation activities.[47] When compared with the United States' system,[48] one of the strengths of Germany's dual system of vocational education and training lies in the fact that a high number of small and medium-sized enterprises are involved in the training of skilled workers within the dual system.[49] In Germany, the interplay of different-sized enterprises on the labour market and the coordinating efforts made by public institutions contribute to the emergence of a comprehensive network that ensures a sufficient supply of skilled workers who meet the most recent qualification requirements.

For example, the early developments in the field of information and communication technologies (ICT) demonstrate that the German vocational education system is able to master the balancing act between standardised training regulations and the need to adapt to changing skills requirements resulting from technological progress. In the late 1990s it was still being discussed if and how the vocational education system would be able to provide skilled workers in future-oriented industries such as ICT.[50] In the meantime, the actual development of apprenticeship training in IT occupations has demonstrated that the dual

First-year tertiary students and first-year vocational trainees of the dual system in the former territory of the Federal Republic of Germany 1965 to 2011

FIG 01

DATA DOWNLOAD



Source: own depiction. Data on vocational schools up to 1990 according to Lundgreen (2008), data from 1991 according to school records *(StBA, Fachserie11 Reihe 2)*; first-year students according to university records *(StBA, Fachserie 11 Reihe 4.1)*, calculations by SOFI. In: Baethge et al. (2014).

vocational education system has done very well even in coping with the dramatic changes in this specific industry: a total of 160,000 individuals successfully completed their apprenticeship training in IT occupations between 1997, when IT occupations were first introduced in the dual system, and 2012. IT occupations may thus serve as a prime example for the vocational education system's ability to adapt to technological progress.[51] Moreover, even start-ups and young enterprises got involved in dual vocational training relatively quickly resulting in the dissemination of the new job profiles in ICT.[52]

Potential threats to the German innovation system posed by trends in the education and employment system

However, Germany's education system is subjected to major changes that jeopardise the advantages of the German innovation system as described above: over the past decades, the ratio between vocational and general tertiary education has shifted dramatically. While in the mid-1960s, 92 percent of school-leavers entered into vocational training and only 8 percent enrolled in university education, in 2011 – for the first time in German history – the share of newly enrolled university students (50.1 percent) and the share of newly enrolled participants in dual training (49.9 percent, cf. Figure 1) were almost equal.[53]

Today, also fewer dual educated workers advance to an engineering level through further education and training, a phenomenon which was still fairly widespread during the 1990s.[54]

Yet, as long as the absolute number of school-leavers was increasing, the growing proportion of first-year students did not lead to serious problems in the vocational education system because the absolute number of vocational graduates remained relatively stable (cf. Figure 1).[55]

However, this situation will change dramatically when taking into account the foreseeable demographic change and the resulting decline in pupil numbers. If the proportion of participants in vocational education remains at this historical low level and the number of pupils continues to decline, the absolute number of new trainees in the vocational education system will also decline rapidly. While more and more pupils aim for a university entrance

qualification *(Abitur),* fewer and fewer pupils consider obtaining a double qualification by entering into vocational training once they have obtained their *Abitur*.[56] It is yet unclear whether the growing number of dual studies *(duale Studiengänge)* simply fills this gap in double qualification by offering university education alongside vocational training, or whether this represents the emergence of a new type of student and academic study.[57]

Yet, it is evident that the classical form of vocational training has been subject to increasing pressure as a result of the aforementioned trends.[58] For almost 20 years now, political stakeholders in national and international educational policy have been focussing on academic pathways.[59] This has led to significant changes in the training preferences of the younger generations and their parents. Here, one of the driving forces has been the OECD's country comparisons "Education at a glance" anchored in an Anglo-Saxon tradition. Over the last decades, these studies set an increase of the student ratio as the major goal for educational policy.[60] This strong focus on academic education is based on the assumption that a university degree would generally offer the best career options, and that academic education could be used on a broader basis in later working life. In contrast, a vocational training course is thought to restrict a candidate's career and labour market options as it supposedly requires candidates to commit to a confined vocational field from the very start. Yet, studies using more advanced methods to examine the labour market outcomes of different types of education demonstrate that such descriptive comparisons clearly fall short and produce incorrect results for returns to education (cf. Box 2). For instance, an advanced study for Switzerland,[61] which takes into account both selection and heterogeneity problems, shows that academic education, when compared to vocational training, leads to significant income gains at the top end of the income distribution, i.e. among the best graduates, these gains disappear in the middle part of the income distribution. They even turn into the negative in the lower part of the distribution. This means that for a large proportion of graduates, dual vocational training generates returns to education that are equally high as, or even higher than, those achieved through academic education.[62]

Recent studies have also shown that occupational mobility, i.e. movements between different businesses

BOX 02

Methodological difficulties in assessing the relative advantages of academic vs. vocational education based on observed differences in income

The widespread assumption that academic education is better than vocational education stems from the observation that many academics generate a good income, tend to have good employment careers and tend to be less affected by unemployment. However, the observed differences in average income between academics and non-academics can by no means be attributed to a causal effect of the type of education alone but may simply reflect differences in the distribution of initial ability. Since academics tend to stem from the upper part of the ability distribution[63] and non-academics, on average, tend to stem from the lower part, this means that their respective incomes will differ considerably for that reason alone. Thus, it is very difficult to assess to what extent current income differences are attributable to said differences in the distribution of ability, and to what extent they are attributable to the causal effect of higher educational levels. It is not possible to observe the income of an academic if he or she had received a non-academic training. Vice versa, it is not possible to observe the income of a non-academic if he or she had chosen an academic career. Yet, this counterfactual observation would be essential for proving the causal effects of academic education.

Besides this selection issue, another problem in measuring educational returns is the fact that the effects of training courses may vary depending on the participant's initial ability. Differences in cognitive skills may serve as an example for illustrating this problem. Thus, it can be assumed that the same academic education will generate stronger effects for individuals with above-average cognitive skills when compared with individuals with below-average cognitive skills. This leads to further distortions in the measured effects. Yet, to date there are virtually no empirical findings available on the causal effects of alternative educational paths for different initial ability levels of candidates.

and occupations, is not confined to individuals with academic education but also applies to those with a background in vocational education.[64] Further studies on Switzerland demonstrate that the highest income levels do not necessarily result from purely academic education. In fact, a combination of educational paths that includes both vocational and academic education can be quite advantageous since combinations of different educational types result in special complementarities of vocational experience and theoretical knowledge.[65] A permeable education system, such as the one that has emerged in recent years in Switzerland, intensifies such complementary effects. In Switzerland, talented graduates from vocational training are provided with good options for advancing their education within the framework of higher vocational education (Tertiary B) or entering into an academic education pathway (Tertiary A).[66] Finally, studies on Germany have shown that, in principle, vocational training is not necessarily a disadvantage when compared to academic education – even during times of structural change. Although skills relating to specific products, processes or technologies tend to be devalued to a higher degree than experience-based or social skills in times of structural change, it seems that neither academic nor vocational education proves to be generally advantageous in this regard.[67]

The main challenges for the coming decades and possible solutions

The decline in pupil numbers due to foreseeable demographic changes, coupled with student-driven financing keys at the general and tertiary education systems plus a general strive for academic education in public opinion and among parents, coupled with low or largely lacking external performance standards in the general education system contribute to an inexorable drift towards general and tertiary education and away from vocational education.

The incentives for all parties involved (parents, children, heads of schools) are pushing in the same direction, towards more and more students entering upper secondary schools and tertiary education institutions. Once started, this process is difficult to bring to a halt, as a continuous decrease in student numbers and reputation reinforces itself and leads ever fewer young people to want to remain in the vocational education system. Over the past decades, a similar process has resulted in a dramatic deline of general secondary schools *(Hauptschulen)* in Germany, which have even been abolished in several of the federal states *(Länder)*.[68]

Given the strengths of the German innovation system described above, Germany's political stakeholders should engage in measures to counteract a similarly strong drift away from dual training. In times of declining pupil numbers, financing keys based on pupil numbers are setting strong incentives for schools to accept greater proportions of students. If a larger share of students enters into upper secondary schools and universities, this can lead to a downward spiral in the performance requirements of these educational institutions, because by lowering their performance standards schools will be able to get a larger share of the shrinking number of pupils (individual schools with high performance standards may instead be exposed to a disproportionate decline in pupil numbers and thus funding).

To ensure that Germany maintains its solid mix of highly skilled workers and graduates from the tertiary education system, a package of different measures and potential solutions are expedient here.

First, it is of central importance to continue investments in maintaining and developing the attractiveness of vocational education. This has to be ensured mainly by a high quality of training and by regularly adapting training regulations to the new challenges of the knowledge society. In addition, the strengths of vocational education need to be communicated more clearly to external target groups – especially to foreign managers and other decision-makers who are not yet familiar with Germany's dual vocational education system. Stakeholders from the relevant bodies involved – i.e. social partners, the Federal Institute for Vocational Education and Training *(Bundesinstitut für Berufsbildung),* businesses, vocational schools, as well as the Federal and *Länder* governments – are called upon to participate in these efforts.

Issues appearing at the bottom of the ability distribution differ significantly from those appearing at the top. It is therefore important to discuss issues independently and to deal with them separately. The most pressing issues at the bottom of the ability

distribution are caused by a lack of educational requirements and initial missed opportunities. Such youths must also be given the chance to prove themselves in real work environments and develop their diverse skills and qualifications from an early stage on. Here, the close relationship between the trainer and the trainee – which in small businesses often comes down to one-to-one coaching – can be a structural advantage. The responsibility that arises from the trainee's integration into the corporate practices of the respective company is a further structural advantage. While these advantages do not apply in the context of schools, they can be decisive especially for youths who have more difficulties with their education. Therefore, all stakeholders from the vocational education system are called upon to create sufficient job opportunities, either by providing traditional training places or, if necessary, by offering supportive measures during the transition from school to training.[69] In addition, the lower part of the ability distribution must be provided with attractive occupational profiles with adequately reduced requirements and shorter durations, complemented by specific measures to support the transition from school to working life. This would increase the chances of obtaining a qualification that can lead to subsequent qualifications. Existing programmes in this area should be evaluated and programmes should be integrated, to enhance transparency, and, as necessary, programmes should also be expanded.

In the upper part of the ability distribution, the future attractiveness of dual training pathways has to be secured in spite of the strong drift towards academic education. First and foremost, this can be achieved by providing clear-cut career options for vocational graduates. As a prerequisite, it is important to create and clearly communicate career advancement prospects through further training courses within the vocational system (Tertiary B) or through the permeability towards the university education system (Tertiary A).[70] In future, all qualifications should be designed in a way that allows for additional successive qualifications and, again, this must be made transparent and communicated more clearly. Businesses and universities need to participate in these efforts, and political decision-makers need to coordinate their educational policies accordingly.

Horizontal and vertical permeability plays a key role in securing the future of Germany's dual education system, as does the recognition of skills acquired in working life[71] and transparent access to higher education for qualified professionals without general university entrance qualification.[72] In this context, recent steps taken in developing recognition procedures should be continued further. The efficient use of existing recognition options should be systematically evaluated. In addition, access to universities for qualified professionals without university entrance qualifications *(Abitur)* should also be evaluated and made more transparent.

In future, Germany's education policy must focus on directing public awareness towards an optimal educational mix and flexible individual educational biographies rather than a mere increase in the proportion of university graduates. A stronger focus on an individually optimised education mix may also help alleviate the problem of high dropout rates in the tertiary education system.[73] During a difficult phase in their life, young people may have little interest in or aptitude for a purely academic pathway and will more likely consider entering into vocational education if they recognise that clear-cut development opportunities are provided. This would mean that they wouldn't have to put all their eggs in one basket and potentially risk failure within the higher education system. This way, false starts with potentially adverse, long-term effects on self-esteem can be prevented, and valuable occupational and non-cognitive skills can be gained instead. At a later stage, these skills can lead to additional successive qualifications based on individual preferences and through a variety of development opportunities.

Conversely, by entering into vocational training at a later stage, many dropouts from tertiary education institutions may also be provided with valuable future prospects during a difficult phase in their life. Even the crafts sector has realised that vocational training may represent an attractive alternative for the current high number of university dropouts, especially in cases where candidates are acutely lacking interest in or aptitude for a purely academic education. Thus, the Chambers of Crafts *(Handwerkskammern)* are increasingly creating programmes that aim to tap this potential. Here, partnership programmes with universities can increase the attractiveness of such alternative options. As part of a further differentiation of the German academic landscape – a measure that has been called for in the 2013 EFI

Report – individual universities could be provided with valuable opportunities to reposition themselves.[74]

Alternative means of financing the general education school system and the tertiary education system should also be considered to stop the strong drift away from the dual vocational education system; a drift that results from a downward spiral in performance standards in upper secondary schools and universities. In future, financing formulas should be based on quality measures and learning progress rather than on quantity measures, i.e. pupil or student numbers. Also, suitable indicator systems that integrate all levels of the German education system have to be developed.

In addition, regular external achievement tests focussing mainly on measuring learning progress, should be considered to be performed at all school levels and not just in the context of the centralised school-leaving examination *(Abitur)*. Such comparative assessments should be based on exogenous criteria – as is the case with e.g. PISA – and results should be made publicly available at school level. When introducing such external achievement tests, schools should also be granted more flexibility regarding the use of resources. Theoretical and empirical studies show that school autonomy combined with external achievement tests are the best means of ensuring that schools reach the intended objectives.

Finally, the above-mentioned developments and challenges must be documented more clearly by introducing advanced education indicator systems. Since its 2012 Report, the Expert Commission has also integrated professionals with non-academic (dual) training into the "qualification level of the European workforce" indicator. In addition, the Expert Commission is planning to record "on-the-job training" more closely, based on the IAB Establishment Panel *(Betriebspanel)* commissioned by the Institute for Employment Research (IAB). However, due to the available data, this indicator will be applied at national level only. Education indicator systems should be expanded further and should also be coordinated at international level. The aim is to record the performance of education systems with a vocational focus to a greater extent in international statistics and educational comparisons.

Recommendations

- Investments in maintaining and developing the attractiveness of vocational education should be continued.
- Young people with low educational qualifications and missed opportunities should be provided with additional entry-level and transitional measures for accessing the vocational education system. For the purpose of transparency, existing measures should be evaluated, more closely integrated and also expanded if necessary. Furthermore, young people should be provided with occupational profiles with reduced requirements and shorter durations which are compatible to subsequent additional qualifications.
- Talented, ambitious graduates from vocational training should be provided with clear-cut career options based on individual development opportunities and an increased permeability between different educational tracks.
- Future goals for the German educational system should focus on an optimal mix of different types of education and flexible individual educational paths, rather than the ratio of university graduates. To achieve these goals, new education indicators will have to be developed.
- Based on the foreseeable decline in the numbers of graduates from compulsory schooling, the financing formulas for upper secondary and tertiary education should in the future focus on schooling quality and learning achievements, rather than focussing on student enrolment numbers.
- Regular external achievement tests should be conducted at all levels of the general school system. These should aim to document the individual learning progress in particular. The results of these assessments should be made publicly available at school level. Such assessment tests should be combined with an increase in autonomy for schools in terms of allocating their resources.