The Link between Job Creation, Innovation, Education and Training: An Assessment of Policies Pursued at EU Level
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Abstract

The study analyses how EU cooperation strategies in the realms of employment, innovation and education and training interact in shaping labour market dynamics and influence the quantity and quality of new jobs. It attempts to give an assessment of whether the current policies pursued at the EU level are appropriate to reach the objectives of generating higher growth and more and better jobs.
This document was requested by the European Parliament’s Committee on Employment and Social Affairs

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<th>Description</th>
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<tbody>
<tr>
<td>CEDEFOP</td>
<td>European Center for the Development of Vocational Training</td>
</tr>
<tr>
<td>CIP</td>
<td>Competitiveness and Innovation Programme</td>
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<tr>
<td>ECHP</td>
<td>European Community Household Panel</td>
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<tr>
<td>EES</td>
<td>European Employment Strategy</td>
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<td>ECVET</td>
<td>European Credit System for Vocational Education and Training</td>
</tr>
<tr>
<td>EGF</td>
<td>European Globalisation Adjustment Fund</td>
</tr>
<tr>
<td>EQF</td>
<td>European Qualifications Framework</td>
</tr>
<tr>
<td>ERDF</td>
<td>European Regional Development Fund</td>
</tr>
<tr>
<td>ERA</td>
<td>European Research Area</td>
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<tr>
<td>ERC</td>
<td>European Research Council</td>
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<tr>
<td>ESF</td>
<td>European Social Fund</td>
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<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EUROFOUND</td>
<td>European Foundation for the Improvement of Living and Working Conditions</td>
</tr>
<tr>
<td>FP7</td>
<td>Seventh Framework Programme</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GERD</td>
<td>Gross domestic expenditure on research and development</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IPTS</td>
<td>Institute for Prospective Technological Studies</td>
</tr>
<tr>
<td>ISCED</td>
<td>International Standard Classification of Education</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RTI</td>
<td>Research, Technology and Innovation</td>
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</table>
**STI**  Science, Technology and Innovation

**SME**  Small and Medium-Sized Enterprises

**VET**  Vocational Education and Training
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EXECUTIVE SUMMARY

Background

Education, innovation and employment are fundamental building blocks within the Lisbon agenda, where the EU set itself the ambitious goal to become the most dynamic knowledge-based economy in the world, in order to maintain economic growth with more and better jobs.

The three variables are highly interrelated from a macroeconomic perspective. Human capital enhances individual employment chances. It also serves as an input to produce innovation and therefore can impact on technological change. Technological change can impact on the development of labour demand both in quantitative and qualitative terms. The employment consequences, in turn, depend on the available quantity and quality of human capital.

Considering these interactions, it is obvious that also the policies in the fields of education and training, innovation and employment pursued at the EU level are highly interrelated; it is therefore important to ensure that they form a coherent whole.

Aim of the study

The study serves to analyse how EU cooperation strategies in the realms of employment, innovation and human capital formation interact in shaping labour market dynamics and influence the quantity and quality of new jobs. The aim is to obtain an assessment on whether the current policies pursued at the EU level are appropriate to reach the targets of generating higher growth and more and better jobs, and furthermore whether they are consistent or could be better aligned to reach the targets. This sets the basis for recommendations as regards further development of EU initiatives within the triangle innovation-human capital-job creation.

Approach

Analysing the issues at stake is a difficult endeavour. The macroeconomic variables in the innovation-human capital-employment triangle are closely interconnected. The scope of the policies within this triangle pursued at the EU level turns out to be very wide, and there is great diversity as regards the concrete policy actions pursued at the decentralized level. Adequate impact assessment of these actions is often missing.

Therefore, the study adopts a simplifying approach. First, it focuses on the instruments implemented at the EU level, rather than on the individual initiatives pursued at the Member States’ level. Second, it does not attempt to perform an impact assessment, but asks whether the assumptions underlying the instruments and priorities of EU policies have a solid conceptual and/or empirical basis. This approach is also used to gauge the consistency of the EU strategies that belong to different policy fields.

The basis of the assessment is a comprehensive review of the relevant EU documents and communications, and of the conceptual and empirical research addressing the dynamic links between innovation, human capital development and employment (policies).
Outline

The study first provides an overview of the main EU policies in the realms of innovation on the one hand, and education and training on the other hand, against the background of the European Employment strategy. The next part reviews the state of knowledge as regards the macroeconomic interactions between innovation, supply of human capital and employment. On this basis, the core part of the study is devoted to an analysis and assessment of the effectiveness and consistency of EU initiatives in the innovation-human capital-employment policy triangle. Policy conclusions drawn from the previous findings bring the report to a close.

Rationale of EU policies

The ultimate rationale behind both EU education and training policies and EU innovation policies within the Lisbon strategy is to generate additional employment and economic growth. The report argues that from the point of view of a social planner with the double aim of generating employment and growth, one may justify public intervention in human capital formation if it triggers innovation processes contributing to higher economic growth. One may also justify public support for innovation, if it triggers inventions creating more employment opportunities than it destroys. Finally, one may argue for coordinated innovation and human capital formation policies, if innovation generates employment growth biased towards better skilled workers. If this is the case, and if the production of innovation in itself makes use of skilled workers, making progress on the supply of skilled labour may even trigger a self-reinforcing dynamic in the sense that availability of high-skilled workers raises the relative demand for high-skilled workers.

To substantiate this rationale for public policies intervening in innovation or education and training, or both, the report gives answers to two different sets of questions:

- What are the consequences of the innovation process on overall job creation or job destruction? How does innovation affect the employment opportunities of workers at different skill levels?
- How do innovation generating activities directly fuel demand for qualified labour? How relevant is the availability of human capital in general for the speed and direction of the innovation process?

Innovation and Employment Change

The study shows that technical, product and organizational change through innovation is one of the main sources of employment dynamics. Theoretical and empirical considerations lead to the conclusion that the supply of qualified labour is likely to make a substantial contribution to income per capita growth through increased employment and total factor productivity.

Although it is clear that there are direct effects of skills upgrading on employment, associated with better employability of more-qualified workers and stronger labour force attachment, the links between the two areas are much more complicated.

Innovation processes play a decisive role for the employability of a better qualified labour force. If one accounts for innovation dynamics, better education can have an external social return that goes beyond the private returns to education. Higher education speeds up innovation directly by providing the personnel for research and development, and indirectly through quicker and better adoption of more productive technologies yielding higher total factor productivity.
Different innovation processes can have different implications for employment. Process innovation tends to reduce employment levels but product innovation tends to increase employment. Overall the empirical evidence suggests that innovation does not generally reduce the number of jobs at the aggregate level. Several mechanisms can be responsible for this:

- New technology can yield lower prices, which creates additional demand.
- Innovating firms can obtain rents from their first mover position.
- Workers sharing part of innovating firms’ profit can consume more.
- Technological unemployment can put downward pressure on wages.

How well these mechanisms work depends crucially on the institutional characteristics of the economy. Definitely, the subsequent reallocation of labour is not neutral with regard to skills.

For instance, new information technologies are complementary to skilled labour, as they save on routine activities. The adoption of information technologies lead to organizational changes, such as flatter hierarchies, that favour skilled labour. Information technologies also foster the growth of international trade and globalization, leading to a specialization on activities that require skilled labour in industrialised countries.

The fundamental message is that the rise of innovation activities and the adoption of information technologies across all sectors of the economy combined create more jobs. The speed at which self-reinforcing innovation processes can generate more and better employment opportunities first of all hinges on the availability of specialized talents with the ability to be inventors. But skills needs are not confined to narrow elites with excellent technical and engineering skills. Modern distributed innovation processes demand soft skills related to management and coordination. General education, and especially general higher education, helps providing these soft skills. The ongoing labour demand shifts also do not make unskilled labour fully obsolete. Innovation and new technologies cannot substitute the non-routine work done by low skilled workers. Still, workers with lower qualification levels are also faced with changing skills requirements.

**Skills Employed in Innovation**

The empirical picture suggests that the growth of innovation-related activities is directly linked with rising employment of researchers. Thus innovation policy, understood in a wider sense, comprises education policies aimed at generating specialists or immigration of talent. Nevertheless the study shows that the skills employed in the innovation process are quite diverse. In general, they depend on:

- the nature of the innovation in question – whether it is product, process or organizational innovation,
- the technology and the industry of the innovating firms,
- the position in the industry life-cycle,
- the available types of skills within the organization and the economy as a whole,
- the capacity of transforming existing skills and growing new skills.

As innovation activities are essentially knowledge activities, they require more and better skilled workers of all kinds. However, it is difficult to pin down the exact skill requirements.

General skills related to project management, communication and coordination are important complements to science, engineering and technology skills in R&D activities. Increasing collaboration between organizations in innovation requires greater managerial skills.
If one considers non-technological innovation and the innovative adoption of existing technology, soft skills related to communication and management and specific skills related to the activities themselves are required for successful innovation projects.

The study documents that skills shortages, from an enterprise perspective, can be a serious obstacle to innovation activities. Yet there is no simple answer to the question what types of skills are required in the innovation process. This implies that European education and training systems must be designed in an extremely flexible manner. However, one cannot constantly redesign education and training schemes. The complexity in anticipating specific skill needs is far too high. This focuses the scope of education and training policies on setting the frame for efficient private human capital investment decisions.

**Skills Upgrading and Market Frictions**

In contrast to the arguments in favour of general skill upgrading, analysts and decision-makers have expressed concerns that the labour market could not absorb a higher supply of well educated workers. This view is supported by the fact that European workers often are employed in jobs inadequate to their skills. The phenomenon of over-education is especially important in Eastern Europe.

Yet this perspective just points at one side of the market. On the other side, employers often claim that they cannot fill their posted vacancies, as the available job applicants do not match the expected qualification standards. Thus there appears to be skill mismatch on the labour market.

A review of the empirical evidence for Europe does not suggest a general oversupply of workers with tertiary education. First, the match between jobs and workers depends on a number of factors of which formal education is only one. As the wage premium of higher formal education has not decreased, the over-education phenomenon seems mostly related to workers with formal qualifications not in line with the requirements of the labour market, but not with inappropriate skills. Furthermore, over-education has not become more prevalent. Thus it appears that EU labour markets generally can accommodate a growing supply of qualified workers.

While skill mismatch phenomena are not strong enough to argue against expansionary education policies, the design of education policies should be in line with ongoing processes on the labour demand side. In some of the Member States over-education is a substantial labour market feature that leads to substantial wage losses for those individuals who cannot find a job that would make efficient use of their skills.

Two additional points are relevant for the design of employment and education policies:

- Labour market policies that impede occupational mobility can be important drivers of mismatch and over-qualification. Higher mobility can be especially beneficial for groups that have a weaker position on the labour market
- The empirical observation that mismatch of formal qualifications has worse effects than over-qualification hints at inefficiencies in education and training systems. There is scope to strengthen the incentives to invest in those types of formal qualification that are in demand on the labour market.

Therefore, a consistent framework for education and training policies needs to comprise a wider perspective on the institutional frame in which investment in human capital and the use of education and skills take place.
Consistency of EU Innovation and Employment Policies

The analysis reveals that there is not much scope for direct coordination of innovation policies and employment policies pursued at the EU level. However, the link with education and training policies is central to both policy fields, thus the consistency between employment policy and education policy on the one hand, and between innovation policy and education policy on the other hand ensures that employment policies and innovation policies are also well aligned with each other.

The uncertainty of innovation projects and the difficulty to assess their consequences makes it impossible to gear innovation policies towards employment goals. Innovation changes growth and growth changes employment.

Innovation, industrial change and the adoption of new technology has important effects on the structure of labour demand. This leads to winners and losers. Employment policies can serve to counter adverse labour market developments stemming from innovation as they arise. However, the nature of the innovation process is that its employment consequences are uncertain ex ante. Innovation policies in many cases do not yield any marketable innovation at all, while in some cases they may yield innovation that generates huge employment impact. Due to the uncertainty about the employment outcomes of innovation, linking support for innovation to desired employment objectives or expected consequences is conducive to waste.

Still employment policies have an important role in helping workers to adapt their skills. Conversion training for the external labour market, temporary wage cost subsidies, mobility aids and enterprise creation are among the preferred means of employment policy in this context. Setting up intermediary organizations that take over the task to place workers displaced by technical change into new jobs appears as particular good policy practice. In this light, the instruments targeted at disadvantaged workers that are provided by the European budget, such as the European Social Fund or the European Globalisation Adjustment Fund, if they are properly managed and controlled, can be important means of active European employment policy.

Consistency of EU Innovation and Education Policies

The study shows that in most European Member States education policies are not well integrated with innovation policy. Effective innovation policies seek fields of high innovation potential as their targets. But adequate supply of well-educated experts providing the basis for successful R&D is not guaranteed. Therefore education development policies can enhance the effectiveness of innovation policy.

A reason for little coordination of innovation and education policies at national level is the allocation of the policy competences to different institutions. This constitutes coordination problems. The study refers to the case of Finland to demonstrate that creating a new body responsible for the development of an integrated education, research and innovation policy may help overcoming coordination problems.

At the EU level, several documents reveal that developing the important role of skills for innovation is understood as a target area in the domain of EU education and training policies, as well as in the domain of innovation policy. A more specific approach integrating education and training and innovation policies is lacking, however, as the EU only has competence to support and coordinate national policies in the important area of tertiary education. Where the EU has direct competencies, like in the area of mobility of academics or in the area of recognition of qualifications, policy initiatives go into the right direction.
EU Education and training policies and employment targets

Referring to the basic human capital investment model, the study shows that the EU education and training framework has a sound theoretical basis. Thus, the framework first of all aims at achieving higher efficiency of education and training systems. But the work programme is also based on the notion of several externalities warranting government subsidies to work against a private under-investment in human capital. Such externalities arise from financial market and labour market imperfections, in particular.

As regards governance, the study highlights conceptual limitations of the quantitative benchmarks approach applied for the coordination of EU education and training policies. It suggests that this approach does not improve decentralized policy setting in the most efficient manner. A key issue is the very disparate education and training landscape in Europe; therefore, a target scheme based on relative achievement would probably yield better outcomes.

Considering the dimensions of education and training that are targeted by the EU education and training policy framework, an in-depth analysis of the related empirical evidence suggests that they are generally well matched with the ambition to obtain opportunities for more and better employment in Europe. The job creation aspect is most directly present in the areas concerning creativity and entrepreneurship, which aim at fostering innovation and turning innovation into products and jobs. But considering the availability of specialized talent as an input factor to innovation, the job creation aspect also appears present in the higher education benchmark. The employment aspect is also present in "raising skills at all levels" as the overall EU education and training strategy target.

The promotion of employment can work via several channels:

- Labour market participation rates are a positive function of the potential wage rate.
- Better qualified workers working on average longer hours.
- Higher education in general has a positive impact on the retirement age.
- Higher education is a lever on closing the male-female participation gap.

In sum, a general qualification upgrading strategy may boost employment through rising labour force participation and employment rates, in accordance with EU employment guidelines. The qualification strategy may furthermore promote social inclusion, by reducing gender-related labour market imbalances and facilitating the integration of older and disadvantaged workers.

An additional objective of EU employment policies is generating higher productivity at work. The study argues that the skills upgrading policy is consistent with this target:

- According to the human capital investment framework, individual skills acquired have a direct positive effect on labour productivity, on the condition that the human capital embedded in workers is employed at its proper productivity level.
- Human capital acquisition furthermore has an indirect effect through the capacity of innovation.

In principle, falling capital intensity could dampen these positive effects. But this factor is probably weak in the European knowledge-based economies where employment of human skilled labour and physical capital tend to move together.

The skills upgrading strategy is only consistent with the Lisbon objectives, however, if the labour market can absorb the additional supply of skills. The study argues that there is scope to improve upon individuals’ incentives to invest in those types of formal qualification that are in strong demand on the labour market. At the tertiary education level, moderate fees would create such incentives.
In addition, public resources devoted to schooling institutions could be allocated according to their capacity to produce graduates that perform well on the labour market. Finally, policies working on the qualitative dimension of education and training (such as EQF and ECVET) could help achieving higher labour market relevance of learning outcomes.

“New Skills for New Jobs”

The study argues that the “New Skills for New Jobs” initiative is important because it shifts the attention of European employment policy to institutions that can facilitate matching processes. This includes better job search provision, counselling and optimal design of passive social protection measures like unemployment benefits. The challenge to design efficient unemployment schemes, for example, is to strike the balance between giving individuals sufficient time for searching an adequate job to avoid skill mismatch, and bringing individuals quickly back to work to avoid skill depreciation.

A further challenge for European employment policy is to prevent over-qualification. The task is to improve upon the capacity of labour markets to smoothly absorb the growing supply of better educated workers without impeding labour market opportunities for less skilled workers. Labour market institutions that enhance the employment opportunities for labour market outsiders, wage flexibility and job-to-job transition rates can help reducing the risk of over education associated with expansionary education policies.

Finally, the quality of matching hinges on the labour market relevance of learning outcomes. Thus the “New Skills for New Jobs” initiative points to the necessity to work against imperfect education choices. Imperfect choices can result from inefficient design of education systems, but also from lack of robust anticipatory information. The initiative emphasises the latter, and has fostered initiatives to forecast long-term future skill needs in Europe.

However, any attempt of anticipating future labour market needs is faced with serious methodological obstacles. The complexity arises from the adaptation processes within the labour market in response to emerging skills imbalances. As a consequence, the results obtained to inform EU employment policies (as well as private decision makers) are generally burdened with large error margins. This bears a risk that active management of anticipated changes might increase rather than decrease skill mismatches.

Employment Policies as Levers on Education

Based on the notion that human capital formation to a large extent is a private investment process, the study argues that labour markets features can be an effective lever on directing education choices and thus promoting the achievement of the desired education and training targets, if they serve to increase the expected private return to investment in human capital. In this regard, three policy strategies are discussed in detail.

The first strategy is to strengthen individuals’ labour market attachment by improving participation opportunities. Participation rates and education levels are generally positively correlated. Individuals who do not participate in the labour market do not make profitable use of their human capital and therefore invest less in education and training. Participation-enhancing employment policies discussed include instruments aimed at i) more gender equality in the labour market, which can reap the benefits of the growing attachment of women to higher education to the full, ii) the design of social welfare benefits as in-work benefits, which promotes the acquisition of more than just basic skills, and iii) lower marginal tax rates, which promotes the acquisition of higher education levels and better qualified employment.
A second strategy is to strengthen wage flexibility. Skill-biased technical change shifts the relative demand for workers of different skill types. Only if wages are sufficiently flexible, these relative demand shifts translate into relative wage changes that send the correct signals to individuals who have to decide about the investment into skills. In particular, institutions that favour wage compression, notably collective wage bargaining institutions, may prevent individuals from engaging in more and better education.

The third strategy is to foster vocational training by securing the stability of employment relationships. In the European economies faced with increasing global competition and innovation, worker turnover rates are on the rise. Shorter duration of employment relationships may generate too little investment in workplace-related human capital enhancement financed by employers. This provides a rationale for policies aimed at more stable employment relationships within firms. International evidence suggests that stable employment relationships can promote workplace practices combining formation of job-specific specialised human capital with high labour productivity.

One instrument to raise average tenure within firms is employment protection legislation, but this measure can have negative side effects. An alternative is temporary wage subsidies to employers hit by an economic shock who keep their workers. This instrument preserves workplace specific human capital by reducing the number of redundancies. It could complement the existing European employment policy tools that serve workers’ adaptation to economic shocks.

**Policy Conclusions**

In brief, the core policy implications of our policy assessment can be summarized as follows:

- The EU strategy of general skill upgrading contributes to economic growth and higher employment rates. The development of skills for innovation is especially important, as these can contribute to self-reinforcing growth cycles.
- Employment policies are important to counter adverse labour market developments stemming from innovation. However, one cannot directly integrate employment objectives within innovation policy.
- The “New Skills for New Jobs” initiative rightly stresses the importance of matching processes on the labour market. However, emphasis put on the anticipation of skill needs is probably too strong.
- An important possible effect of employment policies is to strengthen the incentives for private investment in human capital that support policies aimed at more and better education.
- Flexicurity is important to preserve human capital in dynamic labour markets. In addition, employment policies that stabilize worker-employer-relationships can encourage employers to support vocational training specific to the workplace.
- Education policy can support employment policy targets by paying close attention to potential skill mismatches.
- Integrated education, research and innovation strategies can foster skills for innovation. The main direct responsibility in this field, however, lies with EU Member States.
1. **INTRODUCTION**

The global financial crisis that started in 2008 has worsened the short-term perspectives of the world economy. In the era of globalization, the European economies and labour markets cannot immediately disconnect from the current severe economic downturn. The negative employment consequences of the financial crisis have only strengthened the necessity to improve Europe's adaptability to economic change. In the aftermath of the turmoil, it will be necessary to regain employment opportunities for displaced workers, and possibly retrain them to provide the skills in demand after the structural change that the realignment of the financial system and subsequent restructuring in production and services industries will bring about.

However, the European skills challenge goes beyond such rather short-term considerations. Increased global competition with labour abundant countries, low adaptability and mobility on the European labour markets marked by low employment levels and considerable fiscal burdens are key factors contributing to a dissatisfactory growth performance of the European Union (EU). In the future, demographic ageing will pose another challenge to the European Union and the Member States.

If one leaves the potential intake from net immigration flows aside, the growth rate of the population in Europe will be negative over the next decades. This perspective implies that everything else equal, the European economy in the intermediate future will expand at a slower rate than it did in the past. Though a decline in absolute economic growth does not by necessity reduce well-being of a then smaller population, this development is a matter of concern for decision-makers. Weaker growth dynamics in an ageing Europe may contribute to shift economic and political power toward groups of more dynamic countries with younger populations.

Simple growth accounting suggests that two factors help maintaining economic growth in this environment: rising employment volumes and/or productivity levels.

Against this background, the aim of higher employment rates has become the heart of the European agenda since the launch of the European Employment Strategy (EES) in 1997, which centred on the four pillars of employability, entrepreneurship, adaptability and equal opportunities. The Lisbon agenda agreed upon in 2000 integrated the EES and refocused it towards the strategic objective of higher employment rates. The goal to turn the EU into a knowledge-based economy capable of producing more growth and jobs by 2010 was to be confirmed ever since, even if economic slowdown and, most recently, the economic crisis due to financial market turmoil, have dampened prospects to reach the defined goal.

The Lisbon strategy reflected a consensus reached that Europe's fairly rich endowment with human capital provides an essential comparative advantage in the globalized economy. Thus strengthening this advantage is generally seen as a core factor to increase living standards and preserve the European welfare system. In this spirit, proactive policy actions at the EU level supporting job creation have gained greater momentum. The ultimate goal of these policies is to acquire an industrial structure which fits the productivity level of the most competitive economies in the world.

In order to enhance the capacity of the EU and the Member States to turn knowledge into business opportunities and ultimately new jobs, great emphasis has been put on the so-called “knowledge triangle” of education, research and innovation. Consequently European cooperation on policies since the launch of the knowledge-centred Lisbon agenda has been especially intense in such fields.
A coordinated action in innovation policies directly targets the creators of highly productive employment. The key idea is that the creation of knowledge-intensive employment first requires the capacity to innovate. A broad perspective on innovation capacity goes beyond research and development (R&D). It means the ability to create new knowledge and to transfer new products and processes to the market. This broad approach to innovation policies is reflected in a specific innovation strategy agreed upon the EU level. Among EU initiatives in the innovation area is the Competitiveness and Innovation Programme 2007-2013 complementing the longer established 7th Framework Programme for research, technological development and demonstration with measures promoting entrepreneurship and innovation through financial support.

European cooperation was also enhanced in the education and training policies. The so-called Education and Training 2010 Programme agreed upon at the 2002 European Council meeting at Barcelona, and the follow-up strategic framework for European cooperation in education and training up to the year 2020, launched in May 2009, deliver the strategy for developing the education and training systems of the Member States.

Within this strategy the EU follows the principles of improving the quality and effectiveness of the education and training systems, facilitating access and opening up education and training systems to the wider world. It has also adopted common objectives in a range of benchmark areas which have led to policy initiatives at the level of the Member States implemented through the open method of coordination. Some of the education and training benchmarks are also included within the EES.

From an economic point of view, the main justification of government interventions that foster education and training is that a higher supply of educated and trained people supports growth and the creation of highly productive jobs. In this perspective, skill gaps are a key problem that lowers productivity growth in Europe. This means a latent demand of employers for highly productive jobs is not realized due to lack of people with a developed ability to perform these jobs adequately. It also means that the amount of human capital generated in the market – through individuals investing in and schools and firms providing education and training – is less than what would be socially desirable.

Reinforcement of the knowledge triangle has been identified as a critical need for creating economic growth. Indeed, innovation policies and education and training policies are highly interrelated. On the one hand, innovation itself is a skill-intensive activity. Thus the success of innovation policies may depend on the success of skill building policies providing an adequately qualified labour force. On the other hand, innovation might change the pathways and pace of technological progress, which impacts on a changing pattern of labour demand. To the extent that innovation policies induce skill-biased technical change, they raise the relative demand for higher qualified workers. Therefore, they may generate a need for both specific education and training policies and/or employment policies aimed at improving the adaptability of the labour force.

Recently the EU Council has acknowledged again that, due to such links, the impact of policy initiatives in the realms of innovation, education and training and employment do interact. Also the European Commission has recently started placing stronger emphasis on the links between innovation and education and training as vehicles to job creation. It more than ever stresses the role of adequate supply of skilled labour as determinants of innovation and employment.

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2 Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully-functioning knowledge triangle.
3 See for example the European Commission Communication proposing 2009 as the European Year of Creativity and Innovation (COM (2008) 159).
Against this background, the objective of the present study is to obtain a better understanding of the way EU cooperation strategies in the realms of employment, innovation and human capital development interact in shaping labour market dynamics and influence the quantity and quality of new jobs. The goal is to understand if the policies pursued at the EU level are appropriate to reach the EU targets of generating higher growth and more and better jobs. This is not a straightforward endeavour for several reasons. First, the macroeconomic variables in the innovation-human capital-employment triangle are closely interconnected. As the connections between the variables essentially emerge from the interplay of demand and supply on labour markets in disequilibrium, it is conceptually and empirically difficult to isolate the partial impact of a particular trend, institutional setting or policy action on just one of the variables.

Second, the scope of the policies in the realms of innovation, education and training, and employment pursued at the EU level turns out to be very wide. In addition, while the strategic considerations and priority areas within the current EU programmes are quite easy to grasp, there is great diversity as regards the concrete policy actions pursued at the decentralized level. Adequate impact assessment of these actions is furthermore often missing. In response to these challenges, we adopt the following methodological approach to analyse the issues at stake. First of all, we focus on the instruments implemented at the EU level, rather than on the individual initiatives pursued at the Member State level. Second, rather than attempting at proper impact assessment of a particular instrument on the outcome variables of interest, we ask whether the assumptions underlying the instruments and priorities of EU policies in the innovation-human capital-employment triangle have a solid conceptual and/or empirical basis. Considering the current state of economic knowledge, could one reasonably expect that the instruments support progress towards EU economic growth and employment targets? Third, we use a parallel approach to gauge the consistency or possible inconsistency of the policy strategies that belong to different fields. If one reviews the current state of theoretical and empirical knowledge about the interrelation of economic progress on the innovation, human capital and employment dimensions, how do policy priorities need to be aligned to meet the overall EU targets? In order to simplify the discussion, we focus on the possible pairwise combinations within the three policy areas.

In detail, the report will proceed as follows. In the next chapter, we introduce the instruments of the main EU policies aimed at fostering innovation and modernising European education and training systems. Chapter 3 lays the basis for the assessment of these policies, in terms of their capacity to promote EU employment and growth targets. We provide a detailed review of the state of knowledge as regards the macroeconomic interactions between innovation, the supply of human capital and employment. We cover both the relevant conceptual and empirical literature. In a first step, we focus on the dynamic effects of innovation on the volume and the structure of labour demand, and pay special attention to the reinforcing dynamic process of skill-biased technical change. We also explain how the process of innovation production itself directly hinges on the employment of educated workers. This leads to the prediction that an economy endowed with a highly educated labour force has the potential to generate more innovation and therefore higher economic growth. Yet in order to ripe the full benefits from expansionary education policies, functioning markets are important. Otherwise the additional skills supply may suffer from unemployment, under-employment or wrong employment.

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4 The term "qualification" in general refers to the formal outcome of an education process, like graduating from university or obtaining a vocational degree. The term "skills" in generally refers to the ability to apply cognitive or practical knowledge to complete tasks. It is skills rather than qualifications which normally get rewarded on the labour market. However, as qualifications frequently are a good proxy for skills, we will use the two terms interchangeably in this report. In addition, the report uses the term "human capital" to refer to the complete productive skills embedded in a worker.
On this basis, chapter 4 provides an analysis and assessment of the effectiveness and the consistency of the initiatives in the policy triangle innovation-human capital-employment pursued at the EU level. We start with an evaluation of the consistency of European strategies on innovation with employment policies on the one hand, and with the current EU education and training policies on the other hand. Next, we turn to an assessment of the EU framework for education and training: we first discuss its potential capacity as regards progress on the EU employment targets; in a second step, we study how EU employment policies match and support progress on the EU education and training policy targets.

Policy conclusions drawn from the previous findings bring the report to a close in chapter 5.
2. EU POLICIES FOR INNOVATION AND EDUCATION AND TRAINING

2.1. Introduction

In March 2000 the European Council agreed on a strategic target for the Union to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. On the occasion of the Lisbon strategy review in 2005, the focus of policy efforts was re-oriented on delivering stronger, lasting growth and creating more and better jobs. The Broad Economic Policy Guidelines and the Employment Guidelines which have been adopted since then as an integrated package, were re-designed according to these objectives.

Within the Integrated Guidelines for Growth and Jobs for the period 2008-2010, both innovation and education policies are core elements.

Innovation is addressed as a fundamental part of the microeconomic guidelines to raise Europe’s growth potential. Innovation is seen as a factor contributing to the creation of new markets and modes of production, to the improvement of existing products and modes of production and to a better capacity for absorbing new technologies. These processes can fuel productivity growth as well as job creation, the core driving forces of economic growth. This is why EU programmes have been targeted at investments in innovation in accordance with the Lisbon employment and growth objectives.

The priorities of the European Employment Strategy are achieving full employment, improving quality and productivity of work, and strengthening social cohesion. In addressing these objectives, the provision of better education and skills is a natural priority. Individuals who are endowed with more human capital generally realize higher employment rates, are more productive and work in better jobs. They are also less likely to be socially excluded because of failure to enter or remain in the labour market. This is why EU education policies have been targeted at increasingly effective investments in human capital. The provision of skills in demand on the labour market is a most effective means of raising employment levels and thereby generating higher economic growth.

On the one hand, knowledge as an engine of sustainable growth is regarded as a combination of research and development, innovation, education and lifelong learning. This requires innovation policies that keep a view on the supply of human capital. On the other hand, innovation-based economic growth changes the demand for skills. This requires education policies designed to ensure adaptability to new competence requirements.

In the following, we will describe EU policies in the fields of innovation (section 2.2) and education and training (section 2.3) respectively.

2.2. Innovation Policies

The European growth performance over the last decade has been weak in the international comparison. As a result, unemployment rates and budget deficits in many large EU countries have remained high and progress on productivity has been relatively weak, for example when compared to the US. Data suggest that this development partly stems from the fact that the EU and the Member States have not fully exploited their innovation and research potential.
In fact, the innovation gap between the EU, the US and Japan, the world leaders in technology, seems to be increasing. This trend can be identified by observing the EU performance regarding two core indicators: patents and population with tertiary education. In addition, there is clear evidence that Europe is lagging behind the US in terms of scientific output. A glance at R&D expenditure confirms the leading position of the US. Moreover, US universities appear to be more integrated in the innovation process than European universities.

Innovation policy at the European level and various EU initiatives are an important element in counteracting these tendencies.

The innovation policy agenda of the EU has grown substantially over the last decades. Since the mid-1980s, the science, technology and innovation (STI) policy of the EU has become a multi-level policy area regarding contents, budgets and institutions (Grande 2000, Borras 2003). Thus STI policy is no longer exclusively in the hands of national authorities. National policies are supplemented by regional innovation policies and supranational programmes, in particular the initiatives of the EU. Since the mid-1980s national policies have been complemented by Community action with a transnational dimension.

Since the Single European Act came into force, the science, technology and innovation policy has become a policy priority at the European level. The Single European Act established competencies for a common STI policy at the EU level and provided procedure legal basis for implementing multiannual Framework Programmes. The Maastricht Treaty has given the European policy for research, technology and innovation (RTI) an even stronger base by granting the Commission the authority to ensure coordination between Member States’ and Community activities.

The Lisbon European Council in 2000 strengthened the common innovation and research policy objectives as part of the Lisbon strategy. The goal of boosting innovation was complemented at the Barcelona European Council in 2002, when the Member States agreed that R&D investment in the EU should reach 3 % of gross domestic product (GDP) by 2010, with a substantial increase in business R&D expenditures, which should account for two thirds of total R&D investment. The Lisbon strategy aims at mobilizing knowledge and innovation for growth and emphasizes that innovation is a central driver of economic growth and that the challenges posed by the information society, by biotechnology and eco-innovation require an increase and an improvement of investment in R&D and human capital.

The most ambitious goal, however, is that of establishing a European Research Area (ERA) aimed at realising efficiency gains by utilizing synergies between research infrastructures in different Member States. It is believed that less dispersion and overlap in national research programmes would facilitate the exploiting of Europe’s scientific and technological potential. If successful, the ERA might give the European Commission more autonomy to initiate projects and programmes that affect national STI players – research organisations, industries, national funding agencies or user groups. Nevertheless, the largest part of STI policy is still pursued at the national level. Banchoff (2002) observes that the Member States pay close attention to retaining their individual decision-making powers in STI policy.

In outlining EU innovation policy, we distinguish three different roles of the European institutions in the innovation policy landscape:

- The European Union acts as regulator. This function becomes particularly clear in the policy area of intellectual property rights, where, apart from the European patent, all intellectual property rights are subject to European regulations. This role also extends to standards and other regulations that are relevant to innovation policy, such as state aid guidelines.
The European Commission acts as programme owner by funding or co-funding STI activities in the Member States. The most important instruments in this regard are the 7th Framework Programme for Research and Technological Development (RTD Framework Programme), the Competitiveness and Innovation Programme and the Structural Funds. These three instruments are expected to contribute to competitiveness and to achieving the goals of the renewed Lisbon Strategy for Growth and Jobs.

The third role stems from the need to manage and to coordinate the complex horizontal policy field of science, technology and innovation policy, which is in fact a multi-layer policy field. In policy areas where there is no mandate for the EU to act as policy maker, regulator and/or as programme owner due to missing rationales from a subsidiarity perspective, the European Union takes on the role of communicator, with the “right” to initiate discussions, to propose coordinated solutions and to monitor Member States’ progress on the agreed goals.

A case in point is the “open method of coordination”. In 2000 the Lisbon European Council decided to apply the “open method of coordination” to innovation policy to facilitate the alignment of learning processes and actions among Member states. The benchmarking, monitoring, and evaluation of national policies and frameworks belong to the instruments of the “open method of coordination”. However, this system is not binding in the sense that it is not accompanied by a system of legal sanctions. It is based on peer pressure and aims for a diffusion and transfer of best-practice. Thus it is at best considered to be a tool for policy learning at the national level, coordinated by the EU.

In the following we outline the innovation policies at the EU level with a strong focus on the European Commission as programme owner. First we provide a short description of the rationales of EU STI policy based on the subsidiarity principle and then go on to present the main programmes at the EU level.

Given the budgetary frame for a European STI policy and the conflicts on the budget, it becomes clear that a centralization of STI at the European level is not a feasible option. On comparing the expenditures for RTI at the EU level with those of the individual Member States, it seems as if the European level only existed in the shadow of national technology and innovation policy. Pavitt (1998) went so far as to suggest that the EU budget for STI is too small to have an effect on technological change and economic growth in Europe. However, this view neglects the importance of a European STI policy as a supplement to national efforts and a coordination device (Hölzl 2006).

The subsidiarity principle is one of the central instruments for the preservation of national sovereignty and compels the European Commission to justify its proposals by generating a European “added value”. The subsidiarity principle is closely related to the economic theory of federalism (Breuss and Eller 2003, Alesina et al. 2005, Erderveen et al. 2008). Leo et al. (2008) apply this to STI policy. They find that only if there is a low heterogeneity of preferences and a high potential for cross-border spillovers and scale effect, can there be a clear rationale for a centralization of policy competences. When potential spillovers and scale effects are likely to be low, then the specific field of policy should be allocated to the national or regional level. Conflicts on the assignment arise when there are high-scale and spillover effects but at the same time there is heterogeneity of preferences across countries.

In fact, a glance at the assignment of competencies to STI policy in Europe reveals that for many policy fields, there is no clear rationale assigning them exclusively to the EU. One example would be the IPR policy and the design and enforcement of state aid guidelines. Other policy areas are rightly multi-layered, while others, such as local knowledge transfer, clearly are a mainly national or even a mainly regional policy field.
With regard to innovation policy, the contribution of a better coordination of STI policy across different policy levels might prove to be far more important than the financial contribution of EU STI policy. This may be especially important for the policy field of skills for innovation, as there is a great institutional heterogeneity in the educational and vocational training institutions across the EU. For science policy, a stronger financial engagement of private investors could play an important role for the effectiveness and excellence of European research.

The most visible instrument of EU STI policy is the R&D Framework Programme. However, the EU also uses other policy tools such as regulation, standard setting and cohesion policy. These tools, as well as the focus on policy coordination and learning, suggest that the relevance of a European STI policy must not primarily be measured by comparing budget volumes. In fact, EU STI funding is small when compared to STI expenditures by most Member States. It needs to be understood as an essential supplement to national efforts. The European initiatives are still one of the few innovation programmes today that allow centralized funding of pan-European innovation projects.

The programmes, apart from the structural funds, only comprise a fraction of the total EU 2007–2013 budget. The 7th Framework Programme and the Competitiveness and Innovation Programme represent approximately 8% of the total EU 2007-2013 budget, whereas the Structural Funds represent 35%.

The three programmes are distinct since they focus on different phases and actors of the innovation process. Nevertheless, synergies are expected to emerge and it has been recognised officially that ‘synergy between cohesion policy and these instruments’ (the 7th Framework Programme and the Competitiveness and Innovation Programme) ‘is vital’ so that research and cohesion policies reinforce each other by providing national and regional development strategies.

### 2.2.1. RTD Framework Programmes

RTD Framework Programmes follow the rationales of STI policy at the European level and are oriented towards the provision of EU-wide public goods and policies in the fields of science, technology and research. There is a strong focus on supranational collaboration, i.e. the requirement that participants in research projects come from different countries, except in the funding from the European Research Council, which is oriented on scientific excellence. While the Framework Programmes were initially oriented more towards collaborative applied and business-oriented research than national applied RTI initiatives, the instrument is becoming increasingly also a means of science policy.

The 7th Framework Programme (FP7) will run between 2007 and 2013 and has been allotted a budget of €50.521 billion. It concentrates primarily on research and development and is excellence-driven. The FP7 also contains most of the instruments of the EU that aim at structuring the European Research Area (ERA) to overcome the fragmentation of the European research fabric and create critical mass. This is especially visible in the institution of the European Research Council (ERC), further implementation of coordination programmes of national research programmes and the promotion of the mobility of researchers. The main target groups are industry, universities and research centres and individual researchers.

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5 Council decision of 6 October 2006 on Community Strategic Guidelines on cohesion.
The FP7 is composed of four specific programmes:

- **Cooperation (64.1% of the budget):** The objective of this programme is to support the entire range of research activities carried out in transnational cooperation. The instruments to structure the European Research Area (ERA-NET, ERA-NET+) are considered under this heading. The bulk of this programme is industry-driven and concentrates on collaborative research. The multinational collaborative nature of the research project financing under this heading ensures that the research projects are generally precompetitive, which reduces potential windfall gains. In addition, the focus on thematic priorities ensures that the research outcomes benefit all Member States. Research is thus guided towards research areas with a European added value. Moreover, the multinational collaboration brings together research partners from different EU countries. This may have an important effect on the way in which industrial research is carried out in Europe and thus contribute to the structuring of a European Research Area.

- **Ideas (14.9% - including the ERC):** This programme is targeted at scientific frontier research. Competition at the European level should assure that the best research projects across all scientific fields are selected. This programme is overseen by the European Research Council. In the long term, a viable European Research Area requires a European provider of competitive funding for frontier research. Pan-European competitive funding increases the competition between researchers and guarantees that the best scientific projects are selected at the European level.

- **People (9.4%):** The aim of this programme is to increase the human potential of research and technology in Europe. The set-up of a coherent set of Marie Curie actions focuses on increasing the mobility of researchers and thereby reducing the fragmentation of the European research area.

- **Capacities (8.1%):** The objective of this programme is to support research infrastructures, research for the benefit of small and medium-sized enterprises (SMEs) and the research potential of European regions (Regions of Knowledge), as well as to contribute to the realisation of the full research potential (convergence regions) of the enlarged Union. Thus the initiatives grouped under the Capacities programme have regional policies as primary interest.
Figure 1 illustrates two different aspects of the distribution of funds in the Framework Programme. The left-hand panel relates funding per capita to GDP per capita. As expected from the orientation of the FP, the relationship is positive, with richer countries receiving a larger share of funding from the FP than poorer countries.

When capacities are taken into account, a different picture emerges. In the right-hand panel, where the contribution of the FP to the national gross expenditure on research and development is related to the share of gross expenditure on R&D in GDP, it is seen that the relationship is negative. That is, the FP is more important for R&D expenditures in countries that have a low capacity for R&D as measured by the ratio of gross R&D expenditures to GDP.

In absolute terms the richer countries receive more funding, but when the RTD capacities are taken into account this is not always true. In fact, as right-hand panel in Figure 1 illustrates, the contribution of funding contracted via the FP to national GERD is in general larger for the cohesion countries than for the richer countries.

The focus on thematic priorities and collaboration implies that the Framework Programme is primarily based on a 'technology push' conception of technological change. Thematic priorities are all related to EU-wide or global public goods or directed towards issues with large potential external effects for the EU. Luukkonen (2000) emphasises that the added value of European research funding does not necessarily lie in the funding of research that otherwise would not have been carried out – that is its simple 'additionality'. Instead, added value may arise from the programme’s capacity to change the way in which research is carried out in Europe. In addition, there is evidence that collaborative research projects in the FP have large additionality effects. Coordination projects like ERA-NET are justified by the policy coordination function among Member States, with the aim of fostering learning of best practice in RTI policy-making on the national level.
The newly instituted European Research Council that funds excellent academic research is an important element in setting up a common research area. In the long term, any viable concept of ERA requires a European provider of competitive funding for frontier research that operates in a similar way as the American National Science Foundation. Europe-wide competitive funding increases competition between researchers and guarantees that the best scientific projects are selected at the European level.

Overall, it appears that the Framework Programme is indeed geared towards European public goods, the internalisation of negative externalities through coordination and the creation of positive externalities on a European scale. Thus the Framework Programme largely fulfils the criteria implied by the subsidiarity principle for policy action at the EU level.

The Framework Programme does not address skills for innovation and labour market issues directly. An exception is the programme “People”, which aims at strengthening skills of high level researchers.

2.2.2. Competitiveness and Innovation Programme

The Competitiveness and Innovation Programme (CIP) is a new programme that brings together into a common framework several existing quite specific programmes supporting competitiveness and innovation. It ensures the continuity of EU activities that have a proven and successful track record. The CIP emphasises both technological and non-technological innovation.

The CIP consists of three distinct programmes:

- The Entrepreneurship and Innovation Programme (59.8 % of the budget): A first objective of this programme is to encourage entrepreneurship and to improve conditions for entrepreneurs and SMEs. Actions are geared towards the improvement of access to finance for start-ups and growing SMEs, as well as investment in innovation activities. Further goals include the creation of an environment beneficial to SME cooperation, innovation in enterprises, entrepreneurship and innovation culture, enterprise- and innovation-related economic and administrative reforms including policy analyses (Pro-inno Europe and Europe INNOVA).

- The Information and Communications Technology (ICT) Policy Support Programme (20.1 % of the budget): This programme is aimed at creating a Single European information space by strengthening the internal market for information products and services, and stimulating innovation through a wider adoption of and investment in ICT. It builds on the previous e-TEN, Modinis and e-Content programmes.

- The Intelligent Energy – Europe Programme (20.1 % of the budget): The aim of this programme is to support sustainable development in the field of energy by supporting energy efficiency and the rational use of energy resources, as well as promoting new and renewable energy sources and supporting energy diversification.

The focus of the CIP on ICT and energy means that there is some thematic overlap with the Framework Programme. Yet in comparison to the Framework Programmes, the CIP is oriented more towards the diffusion and adoption of new technologies. Its purpose is to bridge the gap between basic research (covered by the RTD Framework Programme) and measures related to business practices, industry processes and sector strategies. The CIP primarily targets SMEs, business support services and policy learning. It is thereby largely complementary to the RTD Framework Programme.
The CIP, geared towards innovation policy, stretches the subsidiarity principle more than the Framework Programme does, especially when it comes to the promotion of venture capital, SMEs and entrepreneurship. However, these policy fields are not disputed by the Member States, despite a number of fairly similar programmes currently in place. The CIP is generally consistent with the arguments in favour of a European RTI policy and the argument in favour of the CIP is primarily related to the coordination principle.

The aim of the CIP is to promote competitiveness and innovation policy by supporting the coherence of innovation policy across Member States. As with the RTD Framework Programme, skills for innovation do not play a central role in the CIP.

2.2.3. Cohesion Policy and Structural Funds

The central motive for a redistributive policy at the European level is the concern about regional inequalities: disparities in income, unemployment and standard of living among regions even belonging to the same country. The redistribution programmes at the EU level are closely tied to the belief that the geography of economic activity matters. They show awareness that agglomeration externalities benefit economic activity close to the centre.

It is the explicit aim of European cohesion policy to orient structural policies towards the strategic goals of the Lisbon and Göteborg agendas. The aim of the structural funds therefore is not only to redistribute financial resources but also to strengthen the factors determining regional development. The increasing emphasis within the EU on RTI is also present in the structural funds. For quite some time the European Commission has strongly urged beneficiary Member States to pay attention to implementing actions in favour of innovation. The orientation towards RTI capacities and infrastructure in the Structural Funds is justified on the basis of the evidence that in the last 10 to 20 years innovation has become a crucial part of economic catch-up and development strategies.

The resources of the Structural Funds and of the Cohesion Fund are delivered through multi-annual development programmes, managed jointly by the Member States, the regions and the Commission. In contrast to the RTD Framework Programme and the Competitiveness and Innovation Programme, these programmes are based on a partnership principle in which the Commission contributes together with the Member States and the regional authorities. Since 2007, the EU cohesion policy, which has been allocated a budget of € 307.6 billion for the period of 2007-2013, has been revolving around three new priorities or “objectives”, which make research and technological development, as well as the transition to a knowledge economy, a top priority:

- Convergence (81.7% of the budget): Support for growth and job creation in the least developed Member States and regions. The Cohesion Fund is geared towards Member States with a per capita GNI lower than 90 % of the Community average, while resources from the European Regional Development Fund (ERDF) and the European Social Fund (ESF) are allocated to the least developed regions. While the ERDF is intended to fund projects on research, innovation, and infrastructure in the least developed regions, the ESF directly targets projects for employment, human resources and social inclusion.

- Competitiveness and employment (15.8% of the budget): This objective is designed to help European regions deal with economic and social changes. In this case the ERDF is targeted primarily at innovation and the environment, and the ESF is aimed at labour market issues. All employment initiatives have to be based on the European Employment Strategy.

- Territorial cooperation (2.4% of the budget): This objective is designed to stimulate cross-border cooperation on dealing with projects such as urban or rural development, and is financed by the ERDF.
Between 2000 and 2006 RTI expenditures amounted to about 5.2% of the total Structural Funds (European Commission 2007), but there were substantial differences between countries (Hölzl 2006).

The challenge of RTI policy in the structural funds is to assist adapting local policies and institutions in order to aid the enhancement and realignment of workable local and national innovation systems. The reaction of cohesion regions and countries crucially depends on the ability of their innovation systems to develop innovative networks and formal and informal institutions that support growth.

Evaluations of RTI activities in structural funds for the period 1994-1999 suggest a high failure rate (Circa et al. 1999). Failure was primarily related to a strategic incoherence of the RTI investment and regional development strategies. The RTI investment too often was guided by a ‘technology push’ conception of innovation. Beneficiaries were mostly public research capacities while critical capabilities of technology transfer and business research activities were not considered appropriately. It also turned out that orientation towards R&D-intensive industries often had no impact in less favoured region due to lack of focus on activities reflecting and reinforcing local comparative advantages (Midelfart-Knarvik and Overman 2002).

Thus structural funds initiatives have been adapted to put stronger focus on regional comparative advantages. As the local workforce can be a source of comparative advantage, innovation policy within the programme has become oriented more strongly towards skills for innovation. In fact, in contrast to the Framework Programme or the Competitiveness and Innovation Programme, structural funds explicitly put the development of skills on the agenda. They can provide funding for the improvement of skills especially in the catch-up countries.

2.2.4. The European Investment Bank

The European Investment Bank is the largest multilateral lender in the world today and facilitates spending that is approximately equal to the total EU budget (Robinson, 2009). It was created to provide financial support for the objectives of the European Union.

The i2i programme of the EIB is of special interest here as it aims at fostering skills for innovation. The i2i programme was launched by the EIB Group in response to the Lisbon agenda with the objective to mobilize up to €50 billion over the current decade. From 2000-2006, loans advanced under i2i had reached close to €45 billion.

The i2i programme focuses essentially on the following three objectives:

- Improving access to quality education and training
- Supporting excellence in research, development and innovation
- Promoting the diffusion of ICT networks, including audiovisual activities

The objective “improving access to quality education and training” focuses on lifelong learning. The EIB states that the primary goal of its activities is to improve the quality of education in the EU. This goal is to be achieved by supporting investment and education, i.e. financing educational intervention in all educational institutions ranging from pre-schools to universities and including technical and vocational training education. The support is also oriented towards training programmes in enterprises and vocational training.

Following a period of quantitative expansion encompassing new education infrastructure, emphasis for lending to education and training will be given to improving the quality of education on offer, and to developing skills of teachers and trainers. The EIB contributes in the form of loans that have to be repaid. This does not directly increase EU expenditure. Nevertheless the financing of the EIB has significant effects because the loans usually cover a long time period, carry a relatively low interest rate and often target projects that could not easily be funded through other sources.
2.2.5. Possible synergies and overlaps

EU-financed programmes supporting innovation share similar broad objectives, but they differ with regard to the actors and phases of the innovation process targeted. The structural funds are to be used in developing the research and innovation capacity in the Member States and regions, while the CIP focuses on the commercialization of innovation projects with a European basis and the FP7 encourages R&D activities at large.

Overall the “division of labour” between the EU programmes fostering innovation seems fairly consistent. The areas where synergies could be improved, especially research infrastructure and policy-learning initiatives, are relatively minor.

Opportunities for synergies mainly emerge from the thematic complementarities between the programmes with stronger technological or sectoral focus (Reid et al. 2007). The main overlap concerns the support for research infrastructure under both Structural Funds and the FP. Even if FP7 provides funding solely for infrastructure of a pan-European interest, this may be considered as overlap between the two programmes as infrastructure decisions have always a localized effect. In addition the initiatives aimed at policy development both at the cross-country and the inter-regional level considerably overlap.

Arguments in favour of a supranational European RTI policy emphasise the aspects of internationalisation of RTI, higher positive externalities through technological spillovers and the internalisation of negative external effects. RTI policies where heterogeneity of preferences is high or where externalities are low should be allocated to a national or even a sub-national level. The FP fits this description best and is therefore the most important element of the EU RTI policy. The Structural Funds are a means of redistribution policy with the focus of strengthening the factors determining regional development. Thus the specific actions in the structural funds are guided primarily by regional and national actors, whereas the FP and the CIP are largely guided by the European Commission.

As regards skills for innovation, a number of communications from the Commission have emphasized the need to modernize the European tertiary education system in order to close skill gaps and to increase the supply of highly qualified researchers. The Council Resolution on new skills for new jobs explicitly aims at fostering skills in R&D and innovation, through inter alia the development of innovation clusters, involving enterprises as well as institutions for education, training, and research.

Within the EU innovation policy framework, the Structural Funds are the locus for policies aimed at fostering skills for innovation. In addition, the networking activities and the exchange of good practices promoted by the CIP are instruments for fostering policy learning and the coordination of skills for innovation initiatives at the Member State level. The EIB provides additional support for the innovation activities pursued at the EU level by providing long-term funding to national and regional actors that implement “skills for innovation” projects.

2.3. Education and Training Policies

The objective of making progress in the fields of education and training as a strategic option for the EU is based on the notion that human capital is the factor representing Europe’s main comparative advantage. It is furthermore based on the empirical observation that the EU, in some dimensions, lags behind the achievement of some of its main competitors, most notably the US. This concerns both performance in the knowledge-based economy, as indicated by overall labour productivity and educational attainment levels, and the levels of investment in education.

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6 See, for example, “Putting knowledge into practice: A broad-based innovation strategy for the EU” (COM 2006(502)), or “Delivering on the modernization agenda for Universities: Education, Research and Innovation” (COM 2006(208)).
7 Council Resolution of 15 November 2007 on the new skills for new jobs.
Considering the resources allocated to education, total public expenditure in the European Union is broadly comparable to the US levels. However, the EU appears to suffer from under-investment from the private sector. The share of private investment in education is 1.91% of GDP in the US and 0.76% of GDP in Japan, whereas it is only 0.23% of GDP in the EU. But it is not solely the lack of money injected in education that constitutes the most important aspect of the European disadvantage. Rather, it is the quality of human capital created by education and training systems, the key to reaching the employment policy objectives in the knowledge-based economy, that is lacking.

The empirical evidence points to a skills gap between Europe and the US of about one year of education. Europe is lagging behind in terms of lower general and upper-secondary education. Furthermore, the US manages to generate a greater share of higher education graduates. In the field of higher education, the gap can chiefly be attributed to the population with degrees from general and advanced research programmes. This is consistent with the fact that US spending per student is higher than the European average.

Education has a strong impact on the relative performance of individuals in the labour market. We will briefly review some well-known facts. First, individuals with higher levels of education exhibit lower unemployment rates and higher employment rates than individuals with lower education in each country. Within Europe, differences in employment rates are much higher when comparing individuals with lower levels of education with highly educated individuals.

Second, at higher education levels, the employment gap between men and women is smaller than at lower education levels. Thus it is plausible that the employment rate gap between the US and Europe could be radically reduced by making progress on higher education. This would also promote the social inclusion of women. More generally, a reduction in unemployment fuelled by progress on individual human capital endowment is an effective means of generating a socially inclusive environment.

In the light of these facts it is safe to say that improvements on the human capital endowment of the population could have a strong direct positive impact on European employment levels, thus enhancing economic growth. One of the important underlying mechanisms is that an individual’s geographical and occupational flexibility systematically increases with the level of education. For this reason, raising education levels is an important means of promoting Europe’s capacity to adapt to changing labour market conditions in the face of technical progress and innovation.

These generalized notions on the benefits of increasing investment in human capital through better education and skills are clearly present in the EES, with employment priorities and guidelines playing a leading role in the implementation of the education and training policies pursued at the EU level. The following two EES guidelines express the objective of better education and skills:

- the expansion and improvement of investment in human capital (guideline 23), and
- the adjustment of education and training systems to new competency requirements (guideline 24).

Of these two general guidelines, the former stresses the need to design EU education and training policies to ensure general progress on achievement levels as regards the supply of skills. The latter focuses on the capacity of education and training systems to provide the type of skills in demand on the labour market. This focus acknowledges that the demand for skills in knowledge-based economies is subject to constant change. Thus workers, if they are to preserve good employment in continuously changing labour markets, need to be in a position to update their skills throughout the course of their lives.
To make progress on the objective of matching skills, EU education and training policies on the one hand aim at building up adequate key competencies in the initial education stages, in order to facilitate learning in later stages, and on the other hand seek to ensure a higher supply of effective, open and flexible learning pathways, with a special view to enhancing training throughout the life-cycle, i.e. lifelong learning.

2.3.1. The Education and Training 2010 Work Programme

Within the EES, the agreed EU instruments and activities supporting the education and training agenda integrated in the European employment strategy have been launched through the Education and Training 2010 Work Programme. In May 2009, the Council adopted a follow up, namely the “strategic framework for European cooperation in education and training.”

This section gives an overview of the Education and Training 2010 Work Programme, and the progress on education policies achieved until now. The new strategic framework that will guide future EU education and training policies is described in section 2.3.2.

The Education and Training 2010 Work Programme, adopted jointly by the Council and the Commission in 2002, underlined the importance of reforming education and training systems in the Member States with three strategic objectives: facilitating the access of all to education and training systems, opening-up education and training systems to the wider world and improving the quality and effectiveness of education and the measurement of progress through agreed instruments.

According to Articles 165 and 166 of the Treaty on the Functioning of the European Union (formerly 149 and 150 of the EC Treaty), Member States have full responsibility for the content and organisation of their education and training systems. It is therefore primarily the Member States who should take action in this field of policy. Yet the EU’s strategy relies on the benefits of countries working together and learning from each other. Thus the open method of coordination involves exchanges of experience and good practice, joint policy development, benchmarking and measurement of progress.

In the area of education and training, like in other areas of EU policies to which the open method of coordination has been applied, intergovernmental governance works in four stages:

- The EU Council agrees on broad policy goals.
- Member States transpose guidelines into national and regional policies.
- Specific benchmarks and indicators are agreed upon, which serve to develop policies progressively. In this context, the term “benchmark” is used to refer to concrete targets. Indicators are statistical measures that serve to underpin policy messages and analyse progress at national and EU levels. Indicators also allow identification of good practices and setting the European performance into the global context.
- Results are monitored and evaluated against the benchmarks and indicators, the advancement achieved as regards the implementation of the Education and Training 2010 Work Programme thus has been documented and assessed in regular progress reports.

The broad policy goals set for EU education and training policies have been informed by the Lisbon employment and growth objectives, and the targets of the European Employment Strategy in particular. As the Education and Training 2010 Work Programme developed, eight policy domains making up the EU education and strategy have been identified: improving equity in education and training, promoting efficiency in education and training, making lifelong learning a reality, strengthening key competences among young people, modernising school education, vocational education and training (VET) and higher education, and enhancing employability.
In line with these goals, a coherent framework of indicators and benchmarks for monitoring progress towards the objectives in education and training has been identified.

Table 1 provides an overview of the current set of indicators proposed by the Commission to attain a coherent measurement framework for the monitoring of education and training policies. The list of core indicators represented in the table replaces a more extensive list of 29 indicators that was used for monitoring progress in the field of education and training during the period 2003-2006.

Some of the indicators, e.g. the “early school leavers” indicator, function as measures for more than one of the policy domains. It is also worth noting that among the proposed 16 core indicators, only 8 are already broadly established and have been used for monitoring objectives before. The table highlights these indicators in bold font.

Some of the remaining indicators, like those referring to special needs education and ICT skills, need further clarification. The development work necessary to construct some of the indicators is still underway. The European Statistical System or other data providers first need to gather additional information, before it will be possible to have meaningful indicators for language skills, learning to learn skills, adult skills, civic skills and the professional development of teachers. But even when pending issues of coherent measurement of these indicators are solved, gauging Member States’ progress on these important fields of EU education and training policy will be difficult for some years to come, as time series data are lacking.

In addition to the coherent framework of 20 indicators surveyed above, the monitoring process within the open method of coordination in EU education and training employs a core of 5 benchmarks. The benchmarks define the goals Member State should achieve through their education and training policies as concrete quantitative targets.
### Table 1: EU Indicators for Education and Training Policy by Policy Domain

<table>
<thead>
<tr>
<th>Policy Domain</th>
<th>Indicators</th>
<th>Goals</th>
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</thead>
<tbody>
<tr>
<td>Improving equity in education and training</td>
<td>Participation in pre-school education</td>
<td>Full advantage of education and training in terms of opportunities,</td>
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<tr>
<td></td>
<td>Special needs education</td>
<td>access, treatment and outcomes</td>
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<tr>
<td></td>
<td>Early school leavers</td>
<td>Promotion of gender equality, integration of minorities, social</td>
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<tr>
<td></td>
<td></td>
<td>inclusion, lifetime equity</td>
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<tr>
<td>Promoting efficiency in education and training</td>
<td>Investment in education in training</td>
<td>Parallel move of efficiency and equity</td>
</tr>
<tr>
<td>Making lifelong learning a reality</td>
<td>Participation in adult lifelong learning</td>
<td>Employability in a dynamic environment</td>
</tr>
<tr>
<td></td>
<td>Adult skills</td>
<td>Social inclusion</td>
</tr>
<tr>
<td></td>
<td>Upper secondary completion rates for young</td>
<td>Active citizenship</td>
</tr>
<tr>
<td>people</td>
<td>people</td>
<td></td>
</tr>
<tr>
<td>Key competences among young people</td>
<td>Literacy in reading, math and science</td>
<td>Formation of new basic skills</td>
</tr>
<tr>
<td></td>
<td>Language skills</td>
<td>Eight competences for life and work in knowledge-based society</td>
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<tr>
<td></td>
<td>ICT skills</td>
<td></td>
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<tr>
<td></td>
<td>Civics Skills</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Learning to learn skills</td>
<td></td>
</tr>
<tr>
<td>Modernising school education</td>
<td>Early school leavers</td>
<td>Improved curricula and organization</td>
</tr>
<tr>
<td></td>
<td>Professional development of teachers and</td>
<td>Better and continuous training of practising teachers</td>
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<tr>
<td></td>
<td>trainers</td>
<td></td>
</tr>
<tr>
<td>Modernising vocational education and training</td>
<td>Upper secondary completion rates for young</td>
<td>Attractiveness of vocational training for employers</td>
</tr>
<tr>
<td></td>
<td>people</td>
<td>Increasing participation in VET</td>
</tr>
<tr>
<td></td>
<td>Stratification of education and training</td>
<td>Quality and flexibility of VET</td>
</tr>
<tr>
<td>Modernising higher education</td>
<td>Higher education graduates</td>
<td>Better funding of higher education sector</td>
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<tr>
<td></td>
<td>Cross-national mobility of students in higher</td>
<td>Strengthen university-based research</td>
</tr>
<tr>
<td></td>
<td>education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Investment in education and training</td>
<td></td>
</tr>
<tr>
<td>Employability</td>
<td>Educational attainment of the population</td>
<td>Higher employment rates, especially of older workers and women</td>
</tr>
<tr>
<td></td>
<td>Adult skills</td>
<td>Adaptability throughout life</td>
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</tbody>
</table>
The specific benchmarks in the field of education and training are a reflection on core deficiencies of the human capital formation process in Europe.

First, average skill levels appear too low in view of the economic and demographic challenges. The economic challenge is that the knowledge-economy puts rising demands on skills. Up-skilling is required in face of the relatively shrinking employment opportunities for lower education workers that come about with technological change. Otherwise, the risk of lack of employment and social exclusion may increase. The demographic challenge is that higher human capital per worker must compensate for a shrinking number of workers, in order to maintain economic growth in an ageing society. The Education and Training Work Programme responds to these challenges by stipulating benchmarks that target at the insufficient basic skills for all, the high levels of early school leaving and low participation in lifelong learning by older workers and the low-skilled.

Second, in regard of the knowledge triangle of education, research and innovation, which plays a key role in boosting employment and growth, the share of talent among the European workforce appears too low, especially in comparison to the US. One response to this challenge is appropriate management of economic migration, which is mentioned as part of guideline 20 of the EES to “improve matching of labour market needs”. The alternative response, which is considered part of the EU education and training work programme, is to raise the number of higher education graduates. The peculiar focus set by the EU higher education policy benchmark is on graduates in mathematics, science and technology (MST). The reason is that skills in these subjects are regarded as of particular importance as input to technological innovation.

In detail, the benchmarks employed to orientate Member States’ education, training and skills development policies in their national reform programmes, are as follows:

First, decrease the share of low-achieving pupils (aged 15 years) in literacy by at least 20 percent from 2000 levels. Full participation in the knowledge-based society requires the acquisition of essentially basic competences such as reading.

Progress in the literacy benchmark area is measured on the basis of the results of the PISA studies conducted on behalf of the OECD. Pupils with reading literacy proficiency level 1 or lower on the PISA reading literacy scale are considered as low achieving pupils.

A special issue related to this target is that the system of tests to measure reading literacy proficiency levels has only recently been introduced, and is still developing. Therefore comparative data on reading achievement levels in 2000 is missing for several Member States. The quantitative target is based on the available measures for the year 2000.

Second, there should be no more than 10 percent of early school leavers by 2010. A high number of early school leavers are an obstacle to developing a knowledge-based economy and greater social cohesion.

According to the indicators’ system employed within the programme, early school leavers are defined as young adults with at most secondary education who do not go on to acquire more advanced education. The precise definition is the percentage of the population aged 18-24 with at most lower secondary education who is not in further education or training. The measure can be constructed on the basis of data from the EU Labour Force Survey.

A problem of the measurement concept could be that individuals could acquire more advanced education later in life than age 24, i.e. it is not guaranteed that early school leavers will remain low-educated permanently. However, in practice later skills upgrading appears infrequently.

Third, at least 85 percent of young people of age 22 should have completed upper secondary education. In order to participate in a knowledge-based society, an equipment of each individual with at least upper secondary attainment is required.
The youth educational attainment benchmark is defined as the percentage of individuals aged 20-24 years having attained at least ISCED level 3 education, as a share of the total population of the same age group. The indicator is consistently computed on the basis of data coming from the EU Labour Force Survey.

Upper secondary education typically begins at the end of full-time compulsory education for countries that have a system of compulsory education. More specialization may be observed and often teachers need to be more qualified or specialized. The entrance age to this level is typically 15 or 16 years. The educational programmes included at this level typically require the completion of some 9 years of full-time education for admission or a combination of education and vocational or technical experience.

Programs of upper secondary education are oriented towards provision of general education, pre-vocational/pre-technical education or vocational/technical education. The programs can lead either directly to the labour market or higher education programs.

Fourth, an increase of at least 15 percent from the 2000 levels in the number of graduates in mathematics, science and technology (MST), with a simultaneous decrease in gender imbalance. For a successfully competing knowledge-based economy, an adequate supply of high-qualified scientists is crucial. Therefore, the number of graduates in the disciplines elucidated above is considered essential.

The definition of a benchmark target in the field of MST is somewhat different from the other benchmarks. Instead of population shares, the target is based on an absolute number of students: it thus lacks a structural dimension. The number of MST graduates may just increase as the number of students in tertiary education expands. The share of MST graduates in the workforce may actually decrease, even if the number of graduates is growing. This is the case when the growth rate in MST graduates is smaller than the growth rate in all tertiary education graduates. The MST benchmark is furthermore special because of the embedded equity component.

Fifth, 12.5 percent of the working age population (age 24-64) should participate in lifelong learning. Every citizen in the EU must be able to update and complement knowledge, competences and skills throughout life. Lifelong learning is fundamental not only for the competitiveness and economic prosperity of the EU, but also for social inclusion, employability, active citizenship, and the personal fulfilment of people.

Adult lifelong learning rates are computed on the basis of surveyed individuals in the population aged 25 to 64 who report that they participated in education or training measures in the course of a four weeks period prior to the survey. The information collected relates to all education or training measures, whether or not relevant to the respondent's current or possible future job.

The measurement concept implies that some of the variation in adult education rates may not be informative when judging the strength of lifelong learning activities. First, the measure focuses on the incidence rather than the intensity of lifelong learning. Measured rates are higher when there are shorter education and training measures at a higher frequency. More generally, the measure ignores the quality dimension of education and training. One furthermore expects that more intensive learning on the job as opposed to external education and training reduces the measured lifelong learning rates. Finally, the age window of 25 to 64 should yield higher lifelong learning rates where the effective retirement age is higher.

Note that four of the five core benchmark areas refer to measures that are part of the coherent framework of indicators. The benchmark area that is not represented on the current list of indicators within the coherent framework of indicators and benchmarks is the MST benchmark.
The benchmarks set at the start by the Council to serve as guidelines to the progressive development of national education and training policies were very ambitious. It was clear from the outset that the objectives could only be achieved by a sustained, long-term effort, and furthermore, that progress among the individual Member States would be uneven.

Overall the education and training standards in the EU Member States have been improving slowly but steadily since 2000. In comparison to the initial situation, the number of students in higher education has increased by 3 million. The number of graduates has increased by 1 million per year. All in all, the number of higher education graduates in the working age population has increased by 13 million in the period 2000-2007.

Figure 2: Progress in Five Benchmark Areas 2000-2007, EU27

Despite this improvement, about one third of the European labour force has a low level of education. Further inequities in the European education systems remain. One in 7 young adults only achieves compulsory education or less. Participation in lifelong learning is rather low, particularly among adults who have not completed upper secondary education. Pre-school enrolment in the education system, especially among children in high need categories, i.e. children from families with migration background or of low socio-economic status, is low. Women remain underrepresented among MST students.

Reflecting these fundamental observations, Figure 2 summarizes the state of progress with regard to the five benchmark areas for 2010 at the level of EU27. For the sake of comparability, the target value to be reached by the year 2010 is normalized to 100. The red dashed line sets a reference of achievement supposed that progress towards the final 2010 target were steadily linear.

The figure gives insight into the following:

- The EU as a whole has made very good progress in increasing the number of MST graduates.
The 2010 target had already been achieved in 2003. At present the target has already been exceeded by 80 to 100 percent. More specifically, the number of MST graduates has increased by 29 percent since 2000. Annual growth was particularly large in some of the new Member States (Slovakia, Poland). Despite this remarkable progress, however, the EU has failed to create a more balanced gender distribution, which was included in the MST graduates target. The female share in MST graduates at the EU level has only marginally increased, from 30.7 percent to 31.6 percent.

- The EU has made steady progress in reducing the number of early school leavers. However, the annual rate of progress is very probably insufficient to reach the 2010 target of less than 10 percent early school leavers. The share of early school leavers has declined from 17.6 percent in 2000 to 14.8 percent in 2007. However, several Member States, most notably the Nordic Countries and many of the new Member States, already have early school leavers shares below the benchmark level for 2010.

- At the EU level, only little progress as regards upper secondary education completion among young people has been made. Upper secondary attainment increased from 76.6 percent to 78.1 percent. In order to reach the benchmark of 85 percent upper secondary education rates, future progress needs to be much stronger. Some countries, most notably Portugal and Malta, have made considerable progress. However, these countries started from a particularly low level of achievement. On the other hand, many of the new Member States already performed above the upper secondary completion target set for 2010 some years earlier.

- At EU average level, some progress in lifelong learning participation is observable, although the performance in this benchmark area has slightly deteriorated recently. More specifically, the participation rate in adult education and training increased from 7.1 percent in 2000 to 9.7 percent in 2007. At the EU27 level, female participation rates are always higher than male participation rates. However, these figures definitely overstate the actual progress made on lifelong learning participation. This is due to the fact that changes in survey methodology have led to higher nominal participation rates. The Nordic countries and the UK currently show the highest adult learning participation rates and surpassed some years earlier the benchmark target set for 2010.

- The EU has markedly failed to reduce the share of low achievers in reading. In fact, instead of an improvement, the data suggest that the average reading capacity of European teenage pupils has deteriorated. On average, the share of low achievers among 15-year-old EU citizens has grown by more than 10 percent. Using comparable data available for 18 EU Member States, the share of low performers in reading increased from 21.3 percent in 2000 to 24.1 percent in 2006. Only few Member States (most notably Germany, Poland and Latvia) managed to obtain a lower share of poor 15-year-old reading performers. The clear failure on the reading target within a generally progressing European education training system warrants special attention. As the reading achievement of pupils is measured on the basis of test scores, it is possible that the surprisingly steady and strong decline in literacy rates stems from changes in measurement practices. However, accuracy in measurement practice has, if at all, increased in the course of the PISA and the related OECD studies aimed at measuring the skills of pupils. Therefore, it is safe to claim that the EU has clearly underperformed regarding its pupil reading skills target.
Whereas the EU27 as a whole has made considerable, if not sufficient, overall progress in the education and training benchmark areas, the achievement of the individual Member States remains rather diverse. This is true regarding both the rates of progress made toward the targets and the levels achieved relative to the targets.

On comparing the achievement of the Member States on the various benchmarks, some noteworthy patterns emerge.

A first observation is the huge disparity in specific education outcomes across Europe, as captured by the individual indicators. The early school leavers ratio, for example, ranges from 5.5 percent in the best performing Member State (Czech Republic) to around 40 percent in the worst performing Member States (Malta, Portugal). This suggests immensely different national approaches to schooling and vocational training systems. However, the disparity in quantitative education measures does not necessarily translate into a similar disparity in labour market outcomes. Take again the early school leavers example: where early school leaving is the rule, the adverse labour market and social exclusion effects on individuals have a weaker impact than in countries where early school leaving is the exception. Labour market signals sent by early school leavers are certainly not the same in the two types of countries.

A second observation is that only few countries are below the EU average as regards the entire set of performance measures. Furthermore, the top or low achievers are generally not the same country. This shows that the benchmark areas defined through EU education and training policies can develop quite independently. It thus appears that the target benchmarks cover different dimensions of education and training systems, which makes it possible to tackle the benchmarks with different policies.

An exception is the early school leavers and upper secondary attainment targets, where the top and low performing Member States are almost identical. This observation indicates that the developments in these two benchmark areas are interrelated. The two targets should indeed move closer together, as they are linked by definition. Early school leavers comprise those individuals aged 18-24 with at most lower secondary education, who are not in further education or training. This means that individuals who access the upper education system, typically at the age of 15 or 16 after completion of the compulsory level of education, do not count as early school leavers. In other words, education and training policies aimed at reducing the population of early school leavers quite automatically enlarge the population with upper secondary education attainment, albeit with a certain time lag.

By contrast, the achievement of the Member States in terms of reading literacy appears quite independent from their achievement in terms of the other school level benchmarks. This suggests that the quantitative and qualitative dimensions of schooling may develop quite independently. However, this observation may also raise concerns about measurement. Reading proficiency is a basic skill facilitating the acquisition of knowledge. One would therefore expect a negative correlation between reading literacy proficiency and educational attainment. If the data do not support this correlation, this could indicate that the measures of pupil performance developed in recent years (e.g. PISA) may still require refinement.

Yet country-wide systems for the validation of schooling quality are only slowly coming into place. This is partly the result of the European Qualifications Framework, which has triggered a new focus on learning outcomes. The European Qualification Framework was launched in 2007 with the aim to facilitate the mobility of learners and workers between countries and their access to lifelong learning. This is to be achieved through validation of what individuals know or are able to do. Obviously, such learning outcomes are more relevant for the assessment of educational achievement than for the plain formal level of qualification.
Finally, the massive growth in the number of MST graduates in almost all Member States warrants attention. It can hardly be attributed to specific policy measures adopted in response to the EU education and training work programme. Attaining a degree requires several years of education, and a large share of the 2006 MST graduates chose their field of study shortly after the EU policy target was fixed. The progress observed thus appears to be an outcome of existing, rather than changing, institutions. The most plausible explanation for the high growth rates, especially for those in some of the East European Member States, is a general expansion of tertiary education institutions in progress.

Overall, a quantitative assessment on the basis of the EU education and training policy benchmarking exercise reveals that the implementation of the Education and Training 2010 work programme has fostered progress in some areas. So far, however, progress has been far from uniform, and the rates of progress have been too low given the ambitious objectives of EU education and training policies.

Turning to a qualitative assessment, one area where particularly positive developments have been registered is lifelong learning strategies and qualification systems. In response to the agreements made by the EU Council, most Member States have created explicit lifelong learning strategies setting out national policy priorities. A challenge, however, is the implementation of intended lifelong learning strategies. There appears to be a general lack of appropriate dissemination schemes involving all relevant stakeholders and institutions. Participation of older and low-skilled workers remains especially low. This is cause for concern, as these groups have a disadvantageous position on the labour market and are thus in special need of human capital update in order to achieve more employment security.

Although the seemingly impressive progress made on the MST graduate target is not really informative given the under-ambitious target, it is clear that the Education and Training Work Programme has supported reforms in European higher education systems. In particular, modernization initiatives for universities (complementing the Bologna reforms) have been initiated in many Member States. Progress is now in the direction of more flexible governance and more flexible financing of higher education institutions. At least in some Member States, steps have been taken to strengthen the knowledge triangle by better integrating research and innovation in universities or university-business partnerships.

The progress of EU education and training policies made in these important areas contrasts with unsatisfactory developments in other areas. One problem area remains the provision of basic skills for all. A lack of key competences, high rates of early school leavers and low upper secondary attainment are indicators for deficiencies in the national education systems that generate employment problems for a high number of young adults starting their labour market career. It appears that policies to deliver basic skills are not sufficiently targeted at the socially disadvantaged groups, e.g. migrants, which consequently suffer from “disintegration” in education.

Another problem area is the diversity of national approaches to vocational education and training. Only few European countries have established strict quality assurance systems, or adopted measures to ensure that the content of vocational schemes is well aligned with the rest of the education system and labour market needs. As a result, skill shortages concerning skilled and qualified employees emerged before the economic downturn associated with the global financial crisis.

A final problem is the insufficient amount of investment in tertiary education. The paramount issue in this regard remains the low level of private funding. Investment from public sources cannot compensate for this shortage. Yet the fact that the current trend in public tertiary education investment is only mildly positive, if at all, seems to point to a problematic development.
2.3.2. Strategic Updates for 2020

In the light of the progress made through the Education and Training 2010 Work Programme, and of the need for further human capital development to provide new skills for new jobs, the Council concluded on a new strategic framework for EU Member States cooperation on the reform of their education and training systems (ET 2020). The new framework, launched in May 2009, updates the Education and Training 2010 Work Programme. Firstly, it introduces new strategic objectives that should be addressed by coherent European policies. New benchmarks are built on the existing benchmarks in the European and Training 2010 Work Programme while adding new dimensions. The new framework puts emphasis on the following challenges to education and training policies in Europe:

- the realisation of lifelong learning and learners’ mobility,
- the improvement of outcome quality and efficiency,
- the promotion of equity and active citizenship, and
- the enhancement of innovation and creativity, including entrepreneurship.

Taken together, the updated strategic objectives reflect an increased awareness of problems of implementation, including consistency of education and training policies across the system of schools, higher education, vocational training and adult learning. They also point out the quality, equity and efficiency dimensions of skills formation processes more clearly.

With regard to the lifelong learning objectives, the EU aims at making progress on the implementation of existing lifelong learning strategies and at triggering flexible learning pathways. The methods proposed are centred around the elimination of the barriers between different learning schemes. This strategy addresses both barriers within countries, such as insufficient opportunities to make transitions between vocational and higher education learning systems, and between countries, i.e. insufficient mobility of learners in Europe and worldwide. In order to facilitate transitions between learning pathways, the procedures developed in the European Qualifications Framework to obtain outcome-based standards are a priority theme.

The second objective highlights the quality and efficiency aspects of human capital formation. They are addressed both from an input and from an output perspective. As an input, the quality dimension is reflected in the objective to improve upon the professional development of teachers, while the efficiency dimension is reflected in the ambition to improve upon the governance of education and training systems. It is thus proposed to give institutions greater autonomy, and to develop evidence-based policy and practice.

As an output, the quality objectives of the strategic framework address the modernization of curricula (including the promotion of language capacities) and the development of quality assurance frameworks and standards. The efficiency objectives relate to education and training planning processes in accordance with anticipated future skill requirements. This objective reflects the “New Skills for New Jobs” initiative, which focused attention on developing skills that better match predicted future labour market needs. For this reason, one of the objectives of the new education and training strategy is to integrate an assessment of future skill requirements in skills development policies, in order to improve labour market efficiency.

The third strategic objective is based on the notion that targeting disadvantaged groups is an effective means of raising average skill levels in the labour force. New priority is thus given to measures aimed at reducing educational disadvantage, and focusing on learners who have difficulties accessing and succeeding in education because of their socio-economic background. This strategic objective emphasises early school leaving rates, but also includes the development of national policies that strengthen pre-primary education and the education of learners with a migration background or with special needs.
Finally, a new strategic objective within EU education and training policies concerns the interactions between education, research and innovation. In order to raise the employment and growth impact of education and training, the aim is to provide the transversal and soft competencies required to translate knowledge into innovation, as well as to provide the skills supporting adaption to and diffusion of new technologies. As the means of achieving these objectives, the new EU strategic education and training framework proposes an adaptation of curricula and teaching methods, and, most importantly, a stronger partnership between education institutions and businesses.

The working method to progressively develop policies consistent with the EU strategic objectives remains the open method of coordination. This implies that the measurement of progress towards the agreed objectives is the key to creating political commitment and visible impact of the national reforms. As the EU Council considers the indicators and benchmarks developed in the context of the Education and Training 2010 Work Programme useful in identifying challenges, guiding policy decisions and monitoring progress, they have been updated to define reference levels of European average performance to be reached by 2020.

Again, five benchmarks have been set. The following three form part of the integrated guidelines for growth and jobs:

- By 2020, an average of at least 15 % of all adults should participate in lifelong learning. Thus, the earlier target in the context of the Education and Training 2010 Work Programme is raised by 2.5 percentage points.

- By 2020, the share of low-achieving 15-year-olds in reading, mathematics and science should be less than 15 percent. This target is stronger than the earlier target on two dimensions. First, it reduces the threshold for under-achievement in basic reading literacy by another 2 percentage points. Second, it adopts a wider perspective on basic skills by including basic skills in mathematics and science.

- By 2020, the share of early leavers from education and training should be less than 10 %. This means that the target is the same as in the context of the Education and Training 2010 Work Programme. This acknowledges the slow progress made in this benchmark area so far.

With regard to the two remaining benchmarks, the new strategic framework for EU education and training policies clearly deviates from the previous Work Programme:

- By 2020, the share of 30-34 year olds with tertiary educational attainment should be at least 40 %. The new higher education benchmark seeks to bring the current EU performance (roughly 30 %) closer to the levels of the key competitors. As the benchmark is expressed in terms of a population share, progress will be much more difficult to make compared to the previous MST students benchmark, which was expressed in absolute numbers. A more important conceptual difference compared to the previous higher education benchmark, however, is that it eliminates the structural component targeting specific higher education skills.

- By 2020, at least 95 % of the children between the age of four and the starting age for compulsory primary education should participate in early childhood education. At present the European average is approaching 90%, but there is substantial variation in national performance. This benchmark adds a completely new dimension to EU education and training policies. It reflects the equity concerns of the new strategic framework by highlighting early childhood education as a foundation for later educational success, especially for individuals from disadvantaged backgrounds.
Some additional benchmarks may be added within the context of the new strategic education and training framework. Yet these have not been fully clarified. Development work is under way in the areas of language competences, mobility (defined as physical mobility between countries in the field of higher education), and employability. Employability refers to the capacity of education and training to produce skills that are actually in demand on the labour market, i.e. it links educational attainment to employment rates.

The employability dimension of the updated strategic framework for European cooperation in reforming education and training systems once again stresses the ultimate aim of EU education and training policies of contributing to the EU employment objectives.

2.3.3. EU Cooperation on Vocational Education and Training

Within the EU policies aimed at making progress on competitiveness and social cohesion, cooperation in vocational education and training (VET) is a central pillar. According to the broadest possible definition, VET comprises all measures that enable individuals to acquire knowledge, skills or competences needed for a particular occupation, for a range of occupations or for labour market success in general. Given this definition, it is clear that measures to develop and improve VET are right at the intersection of education and employment policies. As progress on occupation and labour market-related human capital enhances individual employability, VET policies also represent social policy. Finally, considering that demographic change will generate a replacement demand for agents with medium-skilled qualifications, they can be seen as a general economic policy promoting growth rates.

For the design of EU initiatives in the realm of VET, the considerable diversity in vocational training institutions across the Member States has been a challenge. In some countries formal and regulated apprenticeship systems have a long history. Nine EU Member States exhibit participation rates in upper secondary vocational programmes in the range of two thirds and above. On the EU average, however, the VET participation rate is only about one half, which indicates the relatively low status of VET programmes in some Member States. Given that the specific socio-economic context and often local labour market characteristics play a central role in the endeavour to promote VET, the strategy pursued at the EU level relies on voluntary measures whereby the Member States may improve upon the quality and efficiency of their vocational training systems. Therefore, one important pillar of EU policies in VET has been to emphasize the importance of VET to decision-makers.

Yet in addition to this involvement at the political level, measures to enhance cooperation between Member States are a second important pillar. These measures seek to foster mutual learning and disseminate good practice on the one hand, and to develop common tools and schemes to enhance the transparency and comparability of European VET programmes on the other hand.

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8 Forecasts by the European Center for the Development of Vocational Training (CEDEFOP), indicate that the majority of job openings in Europe by 2020 (54.7%) will require intermediate skills.
The Link Between Job Creation, Innovation, Education and Training

The goal to enhance European cooperation in VET and the specific priority areas were first set out in the Copenhagen Declaration in 2002, which initiated the Copenhagen process as the European strategy for improving performance, quality and attractiveness of VET. The Copenhagen process is based on a fairly broad perception of VET within the perspective of lifelong learning. It in particular encompasses vocational learning experiences at different stages over the life-cycle, in various environments such as the workplace, public or private schools, and higher education institutions, and in a formal or non-formal context. The Copenhagen process is being reviewed every two years, which has lead to continuous development and adaptation of priorities for enhanced European cooperation in VET. The sequence of Communiqués agreed in Maastricht (2004), Helsinki (2006) and Bordeaux (2008) documents this process.

The most recent conclusions of the Council and of the Representatives of the Governments of the Member States reached in the Bordeaux meeting on 25-26 November 2008 identify four priority areas of European VET policies for the period 2008-2010, whereby the Member States are encouraged to implement the initiatives proposed under these priority areas. Yet in comparison to the overall strategic framework for EU Member States’ cooperation on the reform of their education and training systems, the liability of the Member States within the Copenhagen process appears weaker. The reasons are the voluntary nature of participation in the process, the lack of quantitative common targets and benchmarks, and the methodological ambition, which means that some of the proposed measures are still in the pilot or early implementation phase.

The remainder of this section briefly summarizes the four priority areas at the current stage of the Copenhagen process.

The first priority area is to implement common European tools and schemes to promote cooperation in VET. This priority area is primarily concerned with facilitating the mobility of workers and learners between the Member States, in order to establish a common European VET area in parallel to the common European area for higher education.

The ambition in this priority area is not to change the content or the quality of national VET programmes itself, but to foster the potential individual and social returns from VET. One way to achieve this goal is to increase the number of choices for individuals seeking to engage in VET, by facilitating access to VET programmes abroad. The other way is to improve upon the portability of VET outcomes, by facilitating the recognition of qualifications, skills and knowledge acquired.

Still this priority area is not concerned with mutual recognition of formal vocational qualifications, which is regulated by binding obligations on the Member States through EU directives. The EU strategy to achieve the goals in the priority area rather hinges on the implementation of common principles for classification and quality validation of individual learning experiences.

In this context, the European Qualifications Framework (EQF) constitutes a reference system to make skills, competences and knowledge acquired comparable. The central idea of the EQF is that it is learning outcomes, as opposed to inputs (often measured in terms of duration of studies), that matter on the labour market. At the heart of the EQF is a set of eight reference levels designed to describe what an individual knows, understands and is able to do.

In order to make this system work, an open step is that the Member States develop national qualifications frameworks that are consistent with and can be linked to the European framework. The agreed aim is to establish suitable national qualifications systems already in 2010, and to refer to the EQF qualifications levels for all new post-secondary education from 2012. However, a key additional step in this strategy will be to establish the credibility of the new European qualifications standards among the recipients, notably employers. As the national qualifications systems will remain in place and are not based on a uniform model, the issue of uniform validation standards is a key matter of concern. At present the development of appropriate quality assurance instruments is still in the pilot stage.
The EQF covers higher education as well as VET. A closely related EU initiative is the development of a European Credit System for Vocational Education and Training (ECVET). The proposed ECVET is a point scheme that aims at a description of vocational qualifications in terms of units of learning outcomes. The goal is to complement other European initiatives, such as EUROPASS (basically a portfolio of documents standardizing proof of qualifications), in order to facilitate the mobility of workers by facilitating the transferability of qualifications between Member States’ learning frameworks. However, defining a consistent scale for crediting usually multi-dimensional and often difficult to measure learning outcomes involves major methodological problems. As substantial conceptual development work needs to be done, at this stage, Member States are free to implement measures to adopt and use the ECVET. Considering that participation in the ECVET is voluntary and that the investment required before using it is substantial, it seems likely that the introduction of a European system of vocational learning credits will be rather gradual and still require considerable amount of time.

The second priority area of VET policies coordinated at the EU level is the promotion of the quality and attractiveness of VET systems.

One dimension of this priority area is the promotion of VET among target groups, which includes the provision of improved information, guidance and counselling systems. The other dimension is enhancing the quality of VET: the provision of higher quality VET is also a means to make it more attractive to students and enterprises. In this regard, the key quality dimension is obviously the impact of VET on labour market outcomes. Higher labour market returns of VET schemes on competitive labour markets should attract individuals to participate in these schemes. A second quality dimension present in the EU communications is the improvement of VET inputs, notably the quality of VET trainers.

The proposed main tool to progress on the quality and attractiveness of European VET systems is the European Quality Assurance Reference Framework for Vocational Education and Training (EQARF). The EQARF, which still needs to be developed, is planned to become the core quality assurance mechanism in the realm of VET systems. It refers to a scheme for programme evaluation, which in principle follows up-to-date standards of quantitative and qualitative policy assessment: first, set specific policy goals, second, design and implement policies according to these goals, third, evaluate the implementation of the policy and estimate the quantitative effects of the programme on the defined outcomes, and finally, process feedback to improve upon the initial policy.

An additional feature of the EQARF is the proposed involvement of the national social partners and other relevant stakeholders in the quality circle. The understanding of the Commission is that social partners’ involvement as a factor contributing to developing quality in VET. Whether they are also given a role in monitoring and evaluation, which could be problematic due to potential self-assessment failure driven by self-interest, will depend on the concrete EQARF procedures, which are to be proposed and developed at the Member State level.

In order to support internal and external evaluation mechanisms, the EQARF stresses the need to develop quality criteria and a statistical data base for assessing VET outcomes and progress achieved through the reform programmes.

In addition, gathering of systematic context information is recommended, in order to obtain adequate background information for policy decision-making at the VET-system level. One element of this are information systems set up to identify changing demands at different levels, whereby the Member States could direct priorities of and access into VET programmes in a responsive, anticipatory way.

However, the indicators mentioned before are often not yet available. Part of the second priority area therefore is to improve upon the data base for setting up evidence-based VET programmes and VET policies as encouraged in the current stage of the Copenhagen process.
The third priority area is to develop the links between VET and the labour market. The importance to progress on validation and recognition of VET learning outcomes is stressed, which draws a direct link to the first priority area. The link towards the second priority area is the suggested involvement of stakeholders and the development of forward-looking skill needs measurement mechanisms as means to direct VET programmes towards skills actually employable in the labour market. Besides, the third priority area encompasses a rather heterogeneous set of targets, e.g. the expansion on counselling and placement services, or the promotion of career related adult training.

The fourth priority area is concerned with enhancing European cooperation. One side of this is to strengthen peer learning mechanisms, in order to make more intensive use of the quantitative and qualitative results from monitoring and assessment of national VET programmes in designing policy initiatives in VET on the national level. The other side is integration of EU priorities in VET within the overall strategic framework for EU Member States’ cooperation on the reform of their education and training systems, described in the previous section.

A key problem in this context is the proper integration of VET elements into the coherent framework of indicators for educational levels. Due to the limited scope and quality of the European VET-related statistics, the solution to this problem will first demand to improve on the data base. Yet if it can be achieved, integration of the VET strategy pursued at the EU level would introduce a novel dimension to the overall education and training framework. A peculiarity of the priority areas within the Copenhagen process is focus on learning outcomes and sound quality impact assessment. The quantitative targets that are implicit in the EU strategy in VET are thus qualitatively different from the quantity-oriented participation rate and duration of studies targets that characterize the current set of indicators and benchmarks for monitoring education and training policies in Europe.

EU Funded Schemes for Education and Training

Although the role of the EU in the education and training sector mainly consists in promoting cooperation between the Member States, setting the strategic framework, the priority areas and the targets for diverse initiatives implemented at the national level, it also assigns significant budget resources to this policy area. Two ways of allocating financial means to support the development of European human capital can be distinguished.

The first way is direct funding of EU level programmes.

For the period 2007 to 2013, various EU-funded initiatives are being pursued under the heading of the Lifelong Learning Programme. This programme, which has an annual budget of roughly €1 billion, provides a uniform frame to run four specific sub-programmes targeted at different stages of education and training in the course of the life-cycle, which mostly continue the tradition of earlier EU programmes: are:

- Comenius (schools),
- Erasmus (higher education),
- Leonardo da Vinci (VET),
- Grundtvig (adult education).

While the programmes are relevant for all stakeholders, institutions and organisations involved in the provision of education and training, the focus is mainly on learners. Achievement of programmes is assessed on the basis of the number of participants involved. For each sub-programme the number of learners that should at least be reached over the period of the Lifelong Learning Programme has been set up.9

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9 The targets range from at least 7,000 individuals (Grundtvig) to at least 500,000 individuals (Comenius) per year, indicating the range in scope of the sub-programmes.
Each of the sub-programmes pursues a range of specific objectives and priorities, but some common features appear. One transversal feature is the promotion of exchange between European citizens. The goal is not only to deepen the sense of a European identity, but also to foster geographic mobility to strengthen the capacity of citizens to adapt to change and to benefit from the opportunities created by single European areas for education and work. Another transversal feature is to promote quality of learning institutions and outcomes, especially through enhanced policy co-operation and dissemination of good practice.

The transversal features of co-ordination and multilateral action help explain why the main responsibility for the Lifelong Learning Programme’s overall implementation lies at the European level, although specific actions are managed at the national level.

The second way how the EU contributes funding to support education and training policies is through its redistributive financial instruments. It relies mainly on the European Social Fund (ESF). The responsibility for planning and implementation of specific ESF policies is at the Member State or regional level, while the general ESF strategies are set at the EU level. Most of the funds serve to assist persons, though there are also resources to develop and modernize structures and systems.

The overarching objective of the ESF is to strengthen economic and social cohesion. As higher employment through more and better jobs is fundamental to achieve this target, the ESF strategy is directly linked to the current European Employment Strategy. Yet the ESF strategy is also linked to the European Social Agenda. Its social cohesion priority sets the focus on redistribution. The first redistributive dimension is a geographic one: the ESF concentrates resources on the least-developed EU regions. In order to reach a convergence objective, regions with a GDP per head of less than three quarters of the EU25-average receive 80 percent of total ESF funding; the second redistributive dimension refers to individuals: ESF resources are primarily to be directed towards citizens who are most vulnerable in society.

The ESF is managed through multiannual programming cycles. The current cycle, which runs from 2007 to 2013, has set focus of the ESF on “Investing in people”, in order to develop a better skilled and more adaptable European workforce. In this thematic context, the regional convergence objective of the ESF translates into the target to provide disadvantaged regions with a workforce that is endowed with the skills required by competitive enterprises. The social inclusion objective translates into the target to build up better human capital in individuals who are less-favoured, in particular job seekers or people facing redundancy.

The ESF pursues this general strategy within several fields of activity. According to the budgets that are allocated to provide financial support for the implementation of education and training measures in line with the European Employment Strategy, the following fields of activity appear especially important in the current programming cycle:

- Development of human capital (34% of the ESF budget): In line with the priorities of EU education and training policies according to the new strategic framework for EU Member State cooperation on the reform of their education and training systems the ESF funding policy in this field reflects a life-cycle approach to education and emphasises the provision of the skills demanded on the labour market. However, the funding for initiatives that aim at increased participation in learning activities at all ages and the development of researchers and innovators is concentrated on less-developed EU regions. Under the convergence objective, the scope of the ESF has been broadened in comparison to previous programming periods to include support for primary education and basic competences. In line with the current targets of EU cooperation on VET, this activity area furthermore aims at increasing quality and attractiveness of vocational programmes, strengthening their links to the labour market and developing systems to validate and compare qualifications and skills.
• Improving equal access to employment (30% if the budget): This priority area supports counselling, integration and training measures for disadvantaged groups, which are identified by low employment rates (in the case of discrimination) or low employability. The low-skilled, the long-term-unemployed, the disabled, migrants, minorities and women are the typical target groups. These groups often face employment obstacles besides inadequate skills. They therefore require specific programmes adapted to the group and to the socio-economic environment.

• Increasing the adaptability of workers and firms, enterprises and entrepreneurs (18% of the budget): With this priority area the ESF seeks to support workers and enterprises in coping with restructuring, more specifically the employment consequences associated with structural changes and business reorganisation. This priority area is not merely restricted to support of outplacement systems and other schemes reducing search frictions on the labour market. It also supports actions related to the adaptability of workers. A central pillar is the provision of training and career guidance, which should be designed to deliver qualifications to prevent (future) unemployment. However, in order to make such programmes effective, it is necessary to obtain anticipatory information on future skill needs. Thus, the current programming has been designed to especially promote the development of forecasting methods and systems. This links the ESF activities directly to the “New Skills for New Jobs” initiative, which seeks to improve the quality of the matching processes on the labour market by anticipation of future skill needs. Besides the support to individuals to enhance their adaptability and support to systems that monitor and anticipate change, the ESF provides funds to support company and sector restructuring. This includes projects to develop early monitoring systems within enterprises or business networks for change management.

The European Globalisation Adjustment Fund (EGF), which has an annual budget of roughly €0.5 billion, was established in 2006 to complement the ESF as a means to manage labour market change. The feature that distinguishes the EGF from the structural funds is that it provides one-off support for a limited period of time to clearly defined groups of workers affected by the globalization process. The Member States applying for support must prove a large number of job losses in a firm or a specific labour market segment over a short time horizon, and furthermore substantiate that the redundancies are linked to international trade.10 If these criteria are met, the EGF funds can be used to finance retraining or other measures to promote re-employment chances of the redundant workers.

The EGF does not finance passive social protection measures, but active unemployment policies aimed at employability. It can also be interpreted as a reflection of the flexicurity concept to reconcile the demand of economic adjustment flexibility with the social and employment security of people. In contrast to the ESF, the EGF currently also lacks an anticipatory focus, for it is constructed as a reactive instrument.

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10 The exact rules have been amended since the initial launch of the EGF, in order to adapt the fund to the global financial crisis.
3. LINK BETWEEN INNOVATION, HUMAN CAPITAL AND EMPLOYMENT

3.1. Introduction

The purpose of this chapter is to provide a better understanding of why policy interventions that successfully foster innovation and/or human capital may help achieve the EU objectives of more growth and jobs. We employ both a conceptual and an empirical perspective to explain the key channels through which innovation and the supply of qualified labour may enhance the employment and economic growth perspectives in modern knowledge-based economies.

The focus is on the interactions of education and innovation in the process of creating employment. In particular, we seek to give answers to two different sets of questions:

- What are the employment consequences of the innovation process beyond the direct demand effect on innovators? On the whole, are the growth effects fuelled by innovation generally conducive to job creation, or to job destruction? As innovation leads to new products or to existing products being produced in a different manner, how does it affect the employment opportunities of workers at different skill levels?

- How do innovation-generating activities directly fuel demand for (qualified) labour? How relevant is the availability of innovators for generating more innovation? How relevant is the availability of human capital in general for the speed and direction of the innovation process?

The answers to these questions can deliver a rationale for governmental policies that intervene in innovation, education and training, or both.

From the point of view of a social planner with the double aim of generating employment and growth, one may justify public intervention in human capital formation, if it triggers innovation processes contributing to higher economic growth. One may also justify public support for innovation, if it triggers inventions creating more employment opportunities than it destroys. Finally, one may argue for coordinated innovation and human capital formation policies, if innovation generates employment growth biased towards better skilled workers. If this is the case, and if the production of innovation in itself makes use of skilled workers, making progress on the supply of skilled labour may even trigger a self-reinforcing dynamic in the sense that availability of high-skilled workers raises the relative demand for high-skilled workers.

The purpose of this chapter is to study the nature of the macroeconomic externalities that may warrant public intervention in the fields of innovation and human capital in more detail. It explores arguments in support of education and training policies, which refer to social returns to human capital exceeding the private return. To be more specific, section 3.2 focuses on the dynamic employment growth consequences of innovation. The aim is to show how the creation and diffusion of innovation affects general employment creation, i.e. creates employment opportunities beyond the labour involved in the innovation production process itself.

On the one hand, we seek to assess whether innovation has a positive or negative impact on overall employment growth. Does productivity growth through innovation destroy more jobs than the general expansion of the economy creates? The conceptual background for this discussion is the so-called endogenous growth theories that have also pointed to the indirect impact of human capital acquisition on per capita income growth. These theories suggest that the availability of human capital supports the creation of innovation and facilitates the adaptation to technological change, as well as the implementation of innovations at the workplace.
On the other hand, we discuss how innovation may shift the structure of labour demand. The conceptual benchmark for this discussion is the reinforcing dynamic of so called skill-biased technological progress, as described by Acemoglu (1998, 2002), Acemoglu and Zilibotti (2001) and Caselli (2006), among others. Innovation is said to have a skill bias, if it raises the demand for high-skilled workers and at the same time reduces the demand for low skilled workers. This might happen on condition that the availability of high-skilled workers fosters the invention of technologies and practices whose use again requires high-skilled workers. If there is skill-biased technological change, it might be necessary to complement innovation policies with ad hoc employment policies, in order to counteract unwanted distributional consequences of technological progress. From this demand side perspective, a need of investing into education and training arises from skill-biased job creation associated with non-transitory shifts in sector and occupation structures, and in the tasks performed within occupations.

These considerations link innovation policies and education and training policies indirectly. As soon as the innovations brought about by successful innovation policies spread out, they may induce an additional demand for qualified workers capable of handling the promoted technology. Yet there is also a direct link between the two policy domains: innovation requires personnel active in research and development.

Section 3.3 looks at the interaction between innovation and employment from this angle. It elaborates on the ideas of analysts like Romer (1990), Grossmann and Helpman (1991) and Aghion and Hewitt (1992) who have specifically stressed the role of technological innovators like engineers for technical change and per capita growth. We will show that higher education labour supply is a key input to the production of innovation. Thus, government initiatives to foster specific human capital formation can be a means to foster innovation.

Section 3.4 turns to the question whether a growing supply of higher educated labour could actually find suitable employment. We stress the role of market imperfections (wage rigidities, imperfections in the education system) that might prevent skills being allocated into the most productive use. The section focuses especially on the hypothesis of skills mismatches in Europe, in order to demonstrate that this type of market failure is generally less prevalent than a casual interpretation of some survey-based evidence could suggest.

### 3.2. Innovation and labour market changes

Technical change is considered to be one of the main sources of dynamics on the labour market, particularly in the creation and destruction of jobs with specific skills profiles. In fact, the analysis of labour market trends show that in most industrialized countries the perspectives of unskilled workers have deteriorated across all economic sectors.

While for the US (e.g. Katz and Murphy 1992) there is some clear evidence that average wages for skilled workers (college graduates with some work experience) have increased compared to lower skilled workers (high school degree), for most European countries the evidence suggests that relative decreases of wages were less pronounced but confirm that unemployment is increasing for lower skilled workers (e.g. Machin and van Reenen 1998). The available evidence does not suggest that this trend is levelling off (e.g. Dustman et al. 2009).

Many of the explanations of this pattern of change put forward in the literature are related to the introduction of the information technology. Information technology led to a pervasive restructuring in all sectors of the economy affecting the demand for skilled labour, as information technology facilitates complementary organizational change and process restructuring.
Here it is important to note that the debate on the employment consequences of innovation and technical change are a well known topic. Radical and pervasive innovations affect the choice of production technology, outputs and organizational forms and lead to a restructuring of production processes. Capital and labour are not perfectly generic as particular choices of technology, output mix and organizational modes at least partially embodied in very specific capital and skills. Thus, changes in the production technology entail changes in specific capital and skills.

Table 2 shows how innovation leads to the destruction of jobs with specific skill profiles and creates the demand for new skill profiles. The creation of new products leads to change in required skills. Old jobs give ways to new jobs. Unemployment is thus a common phenomenon of radical innovation. However, this unemployment is typically a temporary result of adjustment and creative destruction. History shows that growth, structural change and demand dynamics taken together, in the long run the jobs lost because of technological change are found elsewhere in the economy.

In this regard it is important to note that even if technical change ceased, economic activities facing competitive pressure would be forced to cut costs, wages and the increased efficiency associated with learning processes would eventually also lead to job losses. The important question is thus not only at which rate technological innovation and diffusion lead to job losses, but also the question at which rate new economic activities lead to job creation; the efficiency of the restructuring process is clearly affected by institutional settings.
Table 2: Creative Destruction over the Past Century

<table>
<thead>
<tr>
<th>New product</th>
<th>Labour needed</th>
<th>Old product</th>
<th>Labour released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>Assemblers, Designers, Road builders, Petrochemists, Mechanics, Truck drivers</td>
<td>Hors/carriage, Train, Boats</td>
<td>Blacksmiths, Wainwrights, Drowers, Teamsters, RR workers, Canalmen</td>
</tr>
<tr>
<td>Airplane</td>
<td>Pilots, Mechanics, Flight attendants, Travel agents</td>
<td>Train, Ocean liner</td>
<td>RR workers, Sawyers, Mechanics, Ship hands, Boilermen</td>
</tr>
<tr>
<td>Plastics</td>
<td>Petrochemists</td>
<td>Steel, Aluminium, Barrels/tubs, Pottery/glass</td>
<td>Miners, Founders, Metalworkers, Coopers, Pallers, Colliers</td>
</tr>
<tr>
<td>Television</td>
<td>Electronic engineers, Actors, Reporters, Electricians</td>
<td>Newspaper, Theatre, Movies, Radio</td>
<td>Reporters, Actors</td>
</tr>
<tr>
<td>Computer</td>
<td>Programmers, Computer engineers, Electrical engineers, Software designers</td>
<td>Adding machine, Slide rule, Filing cabinets, Paper</td>
<td>Assemblers, Millwrights, Clerks, Tinsmiths, Lumberjacks</td>
</tr>
<tr>
<td>Fax machine</td>
<td>Programmers, Electricians, Software designers</td>
<td>Express mail, Teletype</td>
<td>Mail sorters, Truck drivers, Typists</td>
</tr>
<tr>
<td>Telephone</td>
<td>Electronic engineers, Operators, Optical engineers, Cellular technicians</td>
<td>Mail, Telegraph, Overnight coach</td>
<td>Postal workers, Telegraph operators, Coach drivers</td>
</tr>
<tr>
<td>Polio Vaccine</td>
<td>Chemists, Lab technicians, Pharmacists</td>
<td>Iron lung</td>
<td>Manufacturers, Attendants</td>
</tr>
</tbody>
</table>

Source: Cox and Alm (1992).
3.2.1. **Innovation and the Quantity of Labour**

This question is an old and controversial one (Vivarelli 2007), as technical change is usually considered to save labour. In this case, if output is kept constant, the demand for labour decreases. Most studies show that technical change makes production processes more efficient and reduces the required amount of labour.

On the aggregate level, however, it leads to aggregate job generation when compensating mechanisms, such as technical change leading to lower prices, higher output potential and a reallocation of resources to more profitable uses are strong enough. A look at employment statistics over the past century, which was characterized by an increasing pace of technical change, shows that employment – measured in terms of number of employed and labour market participation - did not decrease but increased in all industrialized countries. In addition there were massive structural shifts in employment. The declining share of employment in agriculture – due to the industrialization of agriculture – was compensated by job creation in industry and services.

Table 2 shows not only how innovation leads to the destruction of jobs with specific skill profiles and creates the demand for new skill profiles, but also that some industries declined while new industries were created due to technical change. Patterns of structural change have profound effects on labour demand for specific skills. Massive shifts in labour demand lead to a reallocation of labour.

This reallocation is seldom a smooth process. Skill mismatches and painful regional restructuring processes may arise. Temporary unemployment, regional disparities and excess demand for other skill profiles are characteristic for a structural change.

But providing rigorous evidence that shows in a scientifically undisputed way that the effect of technical change is positive is very difficult due to measurement problems. Three reasons stand out:

- Available innovation indicators such as R&D expenditures (innovation input) or number of patents (innovation output) are often very incomplete measures of technological change. For example, in ICT patents are of minor importance. Moreover, patents and R&D expenditures or even ICT expenditures are not a good measure of radical technological change.

- Institutional mechanisms can vary at the micro, sectoral and macro levels, across and within countries. Radically new technologies that have the largest impact on the structure and composition of employment need to be matched by organisational changes, new institutions, learning processes and the expansion of new demand. This makes the distinction between innovation and other changes that are not related to technical change as such very difficult.

- Labour demand does not depend only on technological change; it is also dependent on other factors, such as macroeconomic and cyclical conditions, labour market dynamics and regulations, etc. (Vivarelli 2007).

- Due to these issues it is not at all surprising that the available empirical literature finds a differentiated impact of technical change in different countries. Institutional mechanisms play here an important role, labour market institutions, regulation and structural policies may hinder the process of reallocation (Caballero 2007). Studies on the relationship between technical change and job creation are conducted on three levels of analysis The literature on the direct impact of innovations on employment at the firm level in general finds that the effect of innovation on firm-level job creation is positive. Innovative firms are more likely to expand their employment than non-innovative firms (e.g. Pianta 2005, Spezia and Vivarelli 2002). A very important message from this literature is that product and process innovations have a different impact on job creation.
Product innovations lead in general to job creation at the firm level, while process innovations are often associated with job destruction (e.g Harrisson et al. 2008). While these results are interesting, it needs to be taken into account that firm-level studies are unable to tell much about the aggregate employment effects. The employment gains in innovative enterprises can be gained at the expenses of competitors or result in a genuine job creation at the aggregate level.

- Industry studies on the effect of technical change on job creation allow taking into account not only the direct effects within firms but also the indirect effects that operate within the industry. These studies confirm the finding that there is an important difference between product and process innovations. Industries focusing on product innovation tend to experience job creation while industries oriented towards process innovation tend to experience job destruction. However, industry studies show clearly that demand effects are relevant. If innovation leads to an increase in demand due to lower prices of the products, demand compensates and even overcompensates for the labour-saving effect of technical change. If demand does not react to the innovative products and/or lower prices, then employment effects are usually negative. Industry studies thus show that the effects of technical change do not only depend on the nature of the innovation but also on the structure of demand.

- The most complete picture can only be provided at the aggregate level as technological change may lead to the creation of whole new sectors (see Saviotti and Pyka 2004). Such effects can only be captured by aggregate analysis. However, the problem of identifying in clear way the effect of technical change on job creation is largest for aggregate studies. It is difficult to find appropriate measures of technical change and it is difficult to differentiate the effect of innovation from other factors fostering economic growth. Cross-country comparisons are also affected by important influences such as institutional factors and asynchronous business cycles. Nevertheless only macroeconomic analyses allow assessing the importance of the different channels by which innovation affects job creation. A first look at the available empirical studies suggests that the results are mixed. Some studies find a positive association between technical change and job creation, other studies find negative effects. However, there is one result that is important from an economic policy perspective. The findings for different countries suggest that institutional factors are important factors affecting innovation and employment gains. Especially institutional factors related to labour regulation, product market regulation and even labour relations affect the efficiency of the restructuring process. The more efficiently the necessary reallocation of labour and resources between firms, sectors and regions can take place, the better this is for job creation. Pianta (2005) notes that the employment impact of innovation tends to be more positive in countries “in which new-product generation and investment in new economic activities are higher, and in which the demand-increasing effects of price reductions are greater” (Pianta, 2004 p. 582).

What are the channels that counterbalance the labour-saving effects of innovation? Economic literature identifies six main mechanisms (Pianta 2004; Vivarelli 2007):

- New technologies lead in general to cost reductions. In a competitive environment this leads to price reductions, international competitiveness and output increase. Lower prices stimulate demand. Depending on the price elasticity of demand, direct effects are stronger or lower. However, the reductions in prices lead also to a reallocation of spending by customers. Therefore the price effect leads to additional production and job creation.
This helps to offset job losses due to the original innovation. However, to have an overall positive effect, the lower prices also need to offset the decrease in aggregate demand due to the lower demand stemming from dismissed workers.

- If new machines are used in production, then those machines replace jobs, yet at the same time create new jobs for people who build and service those same machines. The importance of this mechanism is limited, even if investment good industries are generally more labour intensive than consumer goods industries. New machines were introduced exactly because of their overall labour-saving effect, thus the channel via new machines is of minor importance compared to the mechanism via lower prices. However, when innovation continually leads to a higher economic depreciation and incentives for new investment, then this effect may gain importance.

- The same is true for the investment channel. Innovating firms earn higher profits due to their temporary monopoly position. If expectations are positive, then job-losses might be compensated by new investments, leading to more production and hence employment in the investment goods sector and in the innovating firm.

- There could also be an effect due to falling wages. Technological unemployment puts pressure upon wages. Falling wages in turn may lead to increased labour demand. However, if labour demand is oriented towards skill profiles other than the workers that are laid off, then this effect will work only in a marginal way. Moreover, in order to work, this channel would require flexible wages.

- The fifth channel is related to the distribution of temporary rents associated with innovative activities. If workers profit in terms of their wages from increased productivity (e.g. through collective bargaining or other mechanisms), this leads to higher incomes and higher consumption. The increase in demand can lead to an increased production and job creation, compensating for some of the job losses.

- The sixth mechanism concerns product innovation. Job losses due to efficiency gains especially arise when new products are introduced. New economic activities and new markets lead in general to job creation. The effect on employment depends on the labour intensity of production processes of the new product and of the displaced product.

The available evidence on the working of compensation mechanisms suggests that the relationship between technological change and job creation is in general positive. Evidence shows that the presence of institutions that allow for a fast reallocation of labour and other resources between firms and sectors is very important. Labour market policies and regulations that favour the smooth reallocation of resources are central.

Overall, the available evidence shows clearly that the fear that technological change leads to job destruction at the aggregate level has no scientific basis. This fear is usually associated with the view that there is an exogenous quantity of labour that has to be distributed in the economy. In fact, this quantity depends on institutions and regulations that affect the level of economic activity.

3.2.2. Innovation and the Quality of Labour

Firms do not only choose the quantity of capital and labour when setting up their production processes; they must also decide what kind of labour they use with specific machinery. Such choices depend on the relative cost and the productivity of the different kinds of inputs (specific capital and specific labour). If the technology adopted by firms requires higher proportions of skilled workers than unskilled workers, technological change is said to be skill-biased (see Acemoglu 2002).
Skill-biased technological change is the most prominent economic approach to explain the labour demand shift towards skilled workers. The central idea is that new technologies – in the modern discussion this is related to information and communication technologies – lead to an increased demand for higher educated workers and to a lower demand for less educated workers, as the productivity of the new technologies can only be unlocked with a higher educated workforce.

Thus higher educated workers are more attractive for employers and the increased demand leads to a wage premium compared to low skilled workers. Low skilled workers become less productive and less demanded. This leads to falling wages for low skilled workers. There is considerable evidence that the polarization of wages between low and high skilled workers has increased over the past decades (e.g. Dustman et al. 2009).

This simple framework has been widely used in the empirical research on labour market inequality. Large increases in the demand of skilled labour are the only way to rationalize constant or even increasing wage premiums in the face of the expansion of tertiary and vocational education. Most of the available studies concentrate on the US and the UK. In both countries wage premiums for tertiary educated workers have risen, despite a massive increase in the supply of workers with tertiary education.

This development cannot be explained on the basis of a skill-neutral technical change, where technical change affects skilled and unskilled labour in the same way. While this assumption has been frequently used in economic research, the available historical evidence suggests that technical change is often skill-biased. For example, at the beginning of the industrial revolution, technical change was rather biased towards unskilled labour. The complementarity of machines and unskilled labour led to the replacement of artisans by unskilled labour and capital.

The empirical evidence shows that in the last three decades the wages of skilled and higher educated workers increased relative to the wages of low skilled and low educated workers. Autor et al. (2005) show for the US that the demand for higher educated workers has outstripped the increased supply of higher educated workers, explaining the increased wage premium for skilled workers.

The key question is what exactly has caused the demand shift. Various explanations have been put forward, but the most important explanation is skill-biased technical change (e.g. Machin and van Reenen 2006).

The rise in the skill premium has coincided with the rapid diffusion of information and communication technologies at the workplace. Empirical studies show a link between the use of new technologies and either the employment share of skilled workers or their wage share.

However, it is important to note that shifts in skill demand can take place within industries as well as between industries (see Schlotter 2008). The key assumption behind skill-biased technical change is the complementarity between technology and skills. Here the literature is based on three alternative formulations:

- Krusell et al. (2000) argue that sharp decline of the relative price of the constant-quality price of equipment investment due to information technology and other innovations is the driving force behind skill-biased technical change, as skilled labour is comparatively more complementary to equipment capital than unskilled labour. The cheapening of equipment capital is especially strong for information technologies, as is the complementarity of information technology and skilled labour.
• The second formulation is based on the rise of innovative activities. Nelson and Phelps (1966) put forward the idea that educated people are more prone to innovate or to adopt new technologies than lower educated people. This idea was taken up by Kruger and Kumar (2004), Greenwood and Yorukoglu (1997) who claim that skilled workers are less adversely affected by technological transformations because it is less costly for them to learn the additional knowledge needed to adopt a new technology. In this case it depends on the pace of the arrival of new technologies whether the wage premium is permanent or transitory. If the shock is singular, then with passing of time more workers will learn how to use the new technology and the wage premium will disappear. However, if the pace of technological change is affected by the number of highly educated in the workforce, than the skill premium can be permanent.

• The third formulation emphasizes that the introduction of new technology is usually associated with organizational changes. Milgrom and Roberts (1990) have put forward the idea that the introduction of new information technologies led to a reduction in the costs of data storage, communication, monitoring and supervision activities that affects the organisational design of firms. The organisation of firms becomes flatter and workers no longer perform only routine tasks. Thus the adoption of the technology leads to organisational change that is skill-based, as the transformation benefits workers with higher general education who are more able to perform multi-tasked activities and have some managerial skills. This formulation emphasizes that the wage premium will be permanent, as workers with higher education will be more productive than workers with lower education.

The supply of skilled labour expanded considerably across most countries over the last decade. Figure 3 compares shares of those who obtained at least tertiary education within the cohorts of the 25 to 34 years old and the 55 to 64 years old in 2006 for a number of countries. With the exception of Germany and the United States, all countries experienced a rapid expansion in the number of workers with tertiary education. The most dynamic countries were Korea, Japan, Ireland and Spain.

This pattern of the expansion of supply is complemented by the picture that the share of jobs complementary with higher education has increased in almost all industrialized countries, while the share of low skilled jobs has decreased (e.g. Coleccchia and Papaconstantinou 1996, Autor, Katz and Kearney, 2008, Dustman et al. 2009).
Table 3 shows the changes in the shares of employment and labour compensation for 10 EU countries for low, medium and high skilled labour. The table shows that between 1995 and 2004 the share in labour compensation of high skilled labour increased for all sectors, while the share of labour compensation for low skilled workers decreased in all industries. For medium skilled workers a decline in the share of compensation can be observed for most industries.

This evidence suggests that there is a general up-skilling trend, that is, qualification requirements are increasing in all occupational categories. This is reflected also by the forecast by Cedefop (2008). Figure 4 summarizes this forecast up to the year 2020. Jobs with high qualification are expected to rise from 1996 from 25.3 % of all jobs to 31.5 %, while low qualification jobs will decrease from 26.2 % to 18.5 %. Medium qualification jobs will increase slightly from 48.5 % to 50.0%.
### Table 3: Skills Share in Labour Compensation and Growth by Industry (EU-10)

<table>
<thead>
<tr>
<th>NACE Group</th>
<th>Description</th>
<th>Average % share in labour comp, 1995-2004</th>
<th>Average annual growth in share 1995-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High Skill</td>
<td>Medium Skill</td>
</tr>
<tr>
<td>A + B</td>
<td>Agriculture, hunting, forestry and fishing</td>
<td>6.0</td>
<td>66.0</td>
</tr>
<tr>
<td>C</td>
<td>Mining and quarrying</td>
<td>18.1</td>
<td>65.2</td>
</tr>
<tr>
<td>D</td>
<td>Total manufacturing</td>
<td>13.4</td>
<td>67.8</td>
</tr>
<tr>
<td>E</td>
<td>Electricity, gas and water supply</td>
<td>18.8</td>
<td>69.3</td>
</tr>
<tr>
<td>F</td>
<td>Construction</td>
<td>7.3</td>
<td>68.8</td>
</tr>
<tr>
<td>G</td>
<td>Wholesale and retail trade</td>
<td>10.2</td>
<td>71.5</td>
</tr>
<tr>
<td>H</td>
<td>Hotels and restaurants</td>
<td>8.4</td>
<td>67.5</td>
</tr>
<tr>
<td>I</td>
<td>Transport, storage and communication</td>
<td>11.0</td>
<td>72.4</td>
</tr>
<tr>
<td>J</td>
<td>Financial intermediation</td>
<td>27.4</td>
<td>67.1</td>
</tr>
<tr>
<td>K</td>
<td>Real estate, renting and business activities</td>
<td>38.9</td>
<td>51.0</td>
</tr>
<tr>
<td>L</td>
<td>Public administration and defence; compulsory social security</td>
<td>23.9</td>
<td>65.5</td>
</tr>
<tr>
<td>M</td>
<td>Education</td>
<td>57.8</td>
<td>37.8</td>
</tr>
<tr>
<td>N</td>
<td>Health and social work</td>
<td>27.5</td>
<td>62.7</td>
</tr>
<tr>
<td>O</td>
<td>Other community, social and personal services</td>
<td>24.0</td>
<td>60.2</td>
</tr>
<tr>
<td>P</td>
<td>Private households with employed persons</td>
<td>14.2</td>
<td>62.0</td>
</tr>
<tr>
<td>TOT</td>
<td>TOTAL INDUSTRIES</td>
<td>22.2</td>
<td>63.0</td>
</tr>
</tbody>
</table>

**Source:** EU KLEMS, NIESR calculations.
Figure 4: Forecasted Qualification Structure of Jobs in Europe

![Forecasted Qualification Structure of Jobs in Europe](image)

**Notes:** EU25 plus Norway and Switzerland, Shares in %

**Source:** CEDEFOP (2008)

Figure 5 shows the changes in demand including replacement demand for existing jobs for 2006 to 2020. Overall there will be a requirement of 105.3 million new jobs in the EU25 plus Norway and Switzerland. The largest demand will be for medium qualifications (54.7 Mill.), high qualifications (40.9 Mill.) and only 9.7 Mill. for jobs with low qualification.

These changes are due to the behaviour of employers who will increasingly recruit qualified people, as well as to the increase in supply of qualified workers. It is important to note that in addition to the changes in expansion demand, there will also be changes in replacement demand, that is, in the number of job openings for already existing jobs. Replacement demand accounts for 81% of total demand.

This forecast suggests that the structural change in Europe from the primary sector and traditional manufacturing industries towards services and the knowledge-intensive economy will continue over the next decade. High- and medium-level skilled occupations are expected to continue growing over the 2010-2020 decade, while the expansion demand (the number of job openings for newly created jobs) for low skilled labour is expected to decline.

The forecast of CEDEFOP is confirmed in broad lines by the in-depth foresight studies of EUROFOUND on changes of skill needs in different industries. The most interesting aspect of the EUROFOUND studies is that they reveal that upskilling may be different across different sectors and depend on the economic and technological development of the sectors under consideration. For each of the sectors four different scenarios were developed in order to provide a picture of future skill needs under different circumstances. We concentrate here on the main findings for the different industries.
For the computer, electronics and optical products industries, the findings of the EUROFOUND study suggest that soft skills will be increasingly important and that the trend of up-skilling across job functions will be very important, as will the requirements that workers are flexible and have knowledge in many different skills (van der Zee et al. 2009). In the electro-mechanical engineering industries, the relative importance of high skilled jobs (e.g. engineers and technicians) is expected to increase while the demand for medium skilled workers is bound to decrease or to remain stable. Also in the electricity, gas, water and waste sectors the trend towards upskilling is expected to be significant; as in the other industries, there is an increasing demand for soft skills.

The building and repairing of boats and ships sector has experienced over the last decade significant employment losses. The associated job destruction hit most skilled labour and engineers. For the future it is expected that R&D will become more important for the sector and lead to an upskilling of the workforce. The textiles and wearing apparel and leather industries (Vogler-Ludwig, 2009) will see an up-skilling of the labour force. Low-skills jobs are expected to decline, as are, to a less dramatic extent, medium-skilled ones. The financial services will witness an increasing demand for high-skilled labour, even if the financial crisis may lead to an overall decrease of employment (Kaisergruber et al. 2009). With regard to jobs with medium qualifications, there will be increased demand for service and sales workers, but a substantial reduction of demand for clerks. Jobs with low qualifications will most likely decrease in the financial sector.

A different pattern emerges for service sectors, especially for personal services. For other services (Dijkgraf et al. 2009a) soft skills are expected to become more important over the next decade. This will not lead to a general upgrading of qualifications, as it does not only apply to highly skilled job functions, but also to low skilled job functions. Thus in comparison to the manufacturing industries discussed earlier, there is no tendency to a general up-skilling. A similar pattern is found for the hotels and restaurants sector and the distribution and trade sector. In both sectors there will be a need for increased flexibility and adaptability of the workforce and a higher demand for soft skills.

The forecasts of skill needs across sectors are different in detail but on average they confirm that soft skills will become more important in all industries with negative impacts on the labour demand for low-skilled and low-qualified workers.
The strong demand for soft skills in all qualification levels confirms the importance of general, rather than very specific skills. Employers favour workers that are more flexible and can react to unforeseen changes and shocks in market conditions. Competencies demanded are associated with problem solving, communication skills and adaptability, that are typically provided by general education.

Additional evidence suggests that the shift towards high-skilled workers is associated with a decline of ‘routine’ tasks and an increase of ‘non-routine tasks’. Autor et al. (2003) show for the US that the growth of information and communication technology was associated with a decline in labour demand for workers performing ‘routine tasks’, like repetitive and predictable work. They find that ICT is complementary with ‘non-routine tasks’. Typical analytic work that is associated with ICT is hypothesis testing and formal and legal writing, but also with ‘soft skills’ such as management, marketing and communication skills.

However, it is important to note that ‘non-routine’ tasks are also typical for low skill jobs such as janitorial services, truck driver or comprehensive bibliography searches. Figure 6 provides evidence from Spitz-Oener (2006) for Germany that shows that the occupations which require non-routine activities, being it interactive, manual or cognitive, increased from 1979 to 1999 while the number of occupations requiring routine cognitive and manual skill inputs decreased. Goos and Manning (2003) and Dustman et al. (2009) confirm these findings for the UK and Germany.

**Figure 6: Development of Aggregated Skill Inputs Between 1978 and 1999, Germany**

Overall the evidence is suggestive of skill-biased technical change, but it does not provide direct evidence on the skill-biased technological change thesis. However, it shows that technical change that has occurred in many industries has driven the demand shifts. There is much evidence that the introduction of information and communication technology reduces labour input of routine tasks and increases required input of non-routine tasks that are complementary to higher skills (e.g. Autor et al. 2003).
A number of studies have tried to relate shifts in the skill structure to relevant technology indicators. The results of these studies (e.g. Machin and van Reenen 2007) provide evidence that skill-biased technological change matters. However, the precise measurement of skill-biased technological change is not as straightforward as it seems; this concerns especially the question whether skill-biased technical change is the only driving force behind the observed shifts in labour demand.

Other arguments have been put forward to explain the observed labour demand shifts. One of the most important is globalisation and trade. The recent decades were characterised by an increase in trade between industrialised and developing countries. At the same time the reduction in the relative demand for unskilled labour in the industrialised countries started. While there is no doubt that international trade and specialisation patterns affect the structure of labour demand in countries, there are important caveats that trade could be the primary force behind the demand shifts (Schlotter 2008):

- Trade flows are not substantial enough to explain the demand shifts.
- Skill upgrading can also be observed in the emerging countries.
- Skill upgrading is also present in sectors with low exposition to international trade.

This suggests that international trade can contribute but is not the primary driving force behind the shifts in labour demand.

Similar arguments hold true for labour market institutions and regulations. However, it is difficult to interpret the changes at the upper end of the skill distribution as arising from labour market institutions that usually affect lower skilled workers more (e.g. minimum wages, unionization).

### 3.3. Skills employed in innovation

The importance of R&D and innovation, which includes technological, process and product innovation, derives from the undisputed fact that they are central drivers of economic growth, especially in the industrialized countries. When one looks at the process of economic growth over the last decades, a primary characteristic was the intensity of private sector innovation activities depicted in Figure 7 (Foray 2004). The share of business-financed R&D to GDP has generally increased, while government-financed R&D has declined in almost all major industrialized countries.

The rise of the knowledge-based economy has a profound impact on the economy in general and on labour markets. In particular, the higher rate of R&D and innovation characterizing the knowledge economy has a direct effect on the structure of labour demand. In order to create innovative technology, it is necessary to have a sufficient supply of qualified workers. Research and development creates rising demand of a workforce that is trained in mathematics, science, engineering. The production of innovation in services or within other organizations also requires special, though probably different, kinds of qualifications.
In fact, the empirical picture suggests that the growth of innovation-related activities and the acceleration of change tilt labour demand towards highly skilled labour. The direct link between innovation and higher education shows in rising employment of researchers. Figure 8 shows that in the knowledge-based economies of Europe, the US and Japan the employment shares of researchers grew markedly over the past decade.

This perspective broadens the scope of innovation policies to focus not only on knowledge-generating entities, such as universities and R&D laboratories, but also on the framework conditions. Important framework conditions include the institutional and organizational dimensions affecting learning, knowledge generation and competence building.

Thus innovation policy, understood in a wider sense, comprises education policies aimed at generating higher education graduates or immigration of talent with qualifications suitably adapted to the needs of the research economy. The remainder of this chapter will study the numerous and complex direct links between innovation and skills.
3.3.1. Human Capital as Input to the Innovation Process

Despite the important connections, surprisingly few studies on innovation processes focus explicitly on the specific skills required as input factors. The main difficulty of obtaining clear results is that innovation processes are strongly heterogeneous. For example, they have a strong sector-specific and technology-specific dimension. This makes it practically impossible to pin down a precise one-to-one relationship between innovation and specific skills.

In a general perspective, the specific skills that are employed as inputs in the innovation generating process will depend on:

- the nature of the innovation in question – whether it is product, process or organizational innovation,
- the technology and the industry of the innovating firms,
- the industry life cycle,
- the available types of skills within the organization and the economy as a whole, as well as the capacity of transforming existing skills and growing new skills to suit the demands of innovation production processes.

In order to understand how different innovation modes affect the skills employed, the following pages discuss the interaction of education and innovation on the basis of three relatively simple models of innovation. The first is a static taxonomy of innovation. The second is the industry lifecycle model focusing on how innovation and the required skills change as industries mature. The third is Pavitt’s (1984) taxonomy of sectoral patterns of technological innovation that differ in their skill base.
To start our exploration, we consider a simple taxonomy of innovation classes. This taxonomy distinguishes between product and technological innovation, process innovation, organizational innovation and marketing innovation. Each of these classes of innovation will typically require different types of skills. Table 4 borrowed from Green et al. (2007) provides an indicative overview of the core skills that are frequently associated with different classes of innovation.

### Table 4: Classes of Innovation and Associated Core Skills

<table>
<thead>
<tr>
<th>Class of Innovation</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product and Technological</td>
<td>Scientific and Technological</td>
</tr>
<tr>
<td></td>
<td>Engineering</td>
</tr>
<tr>
<td></td>
<td>Design and Packaging</td>
</tr>
<tr>
<td></td>
<td>Market and User Research</td>
</tr>
<tr>
<td>Process</td>
<td>Technical</td>
</tr>
<tr>
<td></td>
<td>Project Management</td>
</tr>
<tr>
<td></td>
<td>Organisational and Workflow Design</td>
</tr>
<tr>
<td></td>
<td>Interaction and Relationship Management</td>
</tr>
<tr>
<td>Organisational</td>
<td>Opportunity recognition</td>
</tr>
<tr>
<td></td>
<td>Systems Design</td>
</tr>
<tr>
<td></td>
<td>Leadership</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
</tr>
<tr>
<td>Marketing, Delivery and Interface</td>
<td>Systems Development</td>
</tr>
<tr>
<td></td>
<td>Web Design and Content Development</td>
</tr>
<tr>
<td></td>
<td>Data Analysis</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
</tr>
</tbody>
</table>

**Source:** Green et al. (2007)

Product and technological innovation is concerned with the development of new goods, equipments and services. The core skills associated with this class of innovation are scientific, technological, design and engineering skills. However, in addition market research capacity is also necessary to gather information on the problems that are to be solved through innovation. As modern innovation processes have a ‘distributed nature’, also general management and coordination skills are employed in this class of innovation.

Process innovation is concerned with the development of new ways of producing goods or services. As we have seen, this kind of innovation is usually considered to be labour-saving, as the direction of the innovation process is geared towards making the process more efficient in use of costly inputs. Besides technical and project management skills, process innovation employs skills related to organizational and workflow design, including interaction and relationship management.

The third class of innovation that is increasingly important in modern economies is a ‘softer’ form of innovation, i.e. organizational innovation. The way in which the economic system is organizationally structured is also pivotal to its competitiveness. At the level of the firm, this means that the organisation of running a business is a precondition for its success. The capacity to transform its established organisational structure and practice can unleash efficiency gains supporting business growth.
Organisational innovation is related to changes in management practices. This type of innovation is closely related to process innovation, as it involves the reorganization of established routines. Core skills to master organizational innovation are the recognition of opportunities and the ability to assess the value of changing existing organizational systems. It also employs skills related to leadership, communication and relationship management that are necessary in order to implement the organizational innovation.

This discussion already shows that the demand for skilled labour cannot be reduced simply to the need for some higher level of proficiency in the use of specific technologies. Many of the relevant competencies are related to “soft skills” that go beyond the updating of technological competencies as they pertain to the capacity to understand and anticipate change. This is especially important if innovation is defined in a broad way that goes beyond formal R&D activities.

The industry life-cycle model (e.g. Utterback 1996, Klepper 1997) provides a model of the development of an industry. As shown in Figure 9, this model posits the existence of four different stages which structure the development of an industry.

**Figure 9: Industry Life Cycle Model and Innovation over the Industry Life Cycle**

The first stage begins with the commercial introduction of the new product by its first producer. The size of the market is limited, uncertainty about the commercial success of the product is high and the product is a kind of prototype to be further improved. Therefore the emphasis on product innovation is high. Utterback (1996) calls this the ‘fluid phase’ of the innovation life-cycle. At this stage of industry evolution, the skill base will be concentrated on specialized technical and market-making skills, but also general skills are required, for the simple reason that the industry has not yet defined its specific skill needs.

This phase ends when a number of entrants penetrate the new industry and a ‘dominant design’ emerges (Utterback 1996). Growth of output is high and the design of the product becomes more and more narrowly specified. A dominant design is some form of consensus between the producers and consumers that takes the form of a specific configuration of the product that satisfies the majority of consumers. The emergence of the dominant design changes the competitive interaction. The market has been defined and the logic of the industry shifts from exploration towards efficiency. In this ‘transitional phase’ process innovation progressively replaces product innovation. Entry and the number of firms decrease. At this stage economies of scale become significant. The skill base of the industry becomes much narrower and more specific. In addition, there is a development of technical equipment that shifts the knowledge base from skilled workers into machinery.
In the third phase there is a negative net entry, and the number of exiting firms is much superior to the number of new entrants. The product is now very well defined and competition is based on costs. Knowledge becomes increasingly embodied in capital equipment. Due to the competitive struggle, a large number of incumbent firms disappear, exiting the industry. This phenomenon – called the shakeout – corresponds to the maturity of the industry.

The fourth and final phase is the decline of the industry, when new products increasingly make the product of the industry obsolete. This theory has clear implications how the skill requirements vary over the evolution of an industry. Table 5 summarizes the characteristics of innovation, technology and skills over the industry life-cycle. This pattern of industrial evolution has been found to be empirically valid for a large number of industries (e.g. Klepper and Miller 1995, Klepper and Simons 1997).

### Table 5: Character of Innovation and Skills over the Industry Life Cycle

<table>
<thead>
<tr>
<th></th>
<th>Fluid Phase</th>
<th>Transitional Phase</th>
<th>Specific Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation</td>
<td>&quot;Radically&quot; new products</td>
<td>Focus on process to achieve production scale efficiencies</td>
<td>Gradual cumulative improvements in productivity and quality.</td>
</tr>
<tr>
<td>Key Skills</td>
<td>Entrepreneurial skills, coupled with &quot;high level&quot; specialists in technology and/or marketing, plus adaptive workforce, which develops more specific skills over time.</td>
<td>Organised, functional &quot;scientific management&quot;, plus development of specialist workforce skills associated with mechanisation of production.</td>
<td>Small &quot;elite&quot; with managerial command and control skills, seeking to maintain control over a workforce with low or unspecific skills.</td>
</tr>
</tbody>
</table>

**Source:** Theter et al. (2005)

However, Krafft (2004) shows that the notion of an industry life-cycle may not hold for the modern high technology manufacturing industries. Because of the crucial role of networks, clusters, alliances and co-operations in modern knowledge-intensive industries such as IT or biotech, a shakeout does not need necessarily to occur, or if it does, occurs differently than in traditional manufacturing industries.

Likewise, Barras (1986, 1990) claims that innovation patterns in services are special. Compared with innovation in manufacturing, innovation in services tends to be less reliant on R&D and scientific and technical skills. It is primarily associated with the acquisition of machinery and equipment, acquisition of other external technologies (including software), and training directly linked to innovation (Miles 2005). The most important technology to the service sector is information technology, not only in information services, but also in physical services such as transport, retailing and warehousing. Other services such as domestic services and catering are less influenced by IT. IT plays an important role also in human services such as health services.
Still, service firms are themselves carriers of innovation, especially consultancy firms, training organisations and specialized R&D and design service firms. These knowledge-intensive business services play an important role in innovation processes of other firms by providing specialised knowledge. In addition to expertise in specific industrial, technological or functional domains, the skills on demand in these services are related to communication, network management and the like. This shows that the service sector itself is very heterogeneous, ranging from manual services to knowledge-based services, which in turn build on completely different skills.

The previous observations point to an important dimension of heterogeneity in innovation processes that carries implications for the employment of skills for innovation, namely sectoral differentiation. A good starting point to discuss this issue in more detail is the innovation taxonomy developed by Pavitt (1984) and linked to skills demand by Tether et al. (2005). Pavitt's taxonomy distinguishes five sectoral patterns of technological change.

The first pattern is that of science-based firms. This pattern is usually found in pharmaceuticals, biotechnology and electronics, where scientific knowledge is developed and applied to new and technology-based markets. Innovation activities take place primarily in corporate R&D laboratories and are typically dependent on the knowledge and skills of researcher and scientist in academia. Key skills are scientific discovery, management of science and intellectual property as well as the use of complementary assets.

The second pattern is that of specialist supplier firms. This pattern is usually found in instrumentation and specialist computer software. The firms are generally very small, produce specialised equipment, mainly for science-based and scale-intensive firms. The competitive advantage of these firms is their ability to work closely with lead users. The key skills are therefore the ability to engage in interactive learning and to provide specific solutions. Skills required are high practical skills in programming and engineering related to problem solving.
Table 6: Taxonomy of Sectoral Patterns of Technological Change

<table>
<thead>
<tr>
<th>Sector</th>
<th>Science Based</th>
<th>Specialised Suppliers</th>
<th>Scale Intensive</th>
<th>Information Intensive</th>
<th>Supplier Dominated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Core Products</td>
<td>Electronics Chemicals Drugs Biotechnology Nanotechnology</td>
<td>Machinery Instruments Software</td>
<td>Bulk materials Consumer durables Automobiles Civil Engineering</td>
<td>Finance Retailing Publishing Travel (i.e. large scale services)</td>
<td>Agriculture Services Traditional Manufacture</td>
</tr>
<tr>
<td>Main Sources of Technology</td>
<td>R&amp;D Basic Research</td>
<td>Design Advanced users</td>
<td>Production Engineering Production Learning Suppliers Design Office</td>
<td>Software and systems departments Suppliers</td>
<td>Suppliers Production Learning</td>
</tr>
<tr>
<td>Key Skills</td>
<td>Scientific discovery, Management of Science and IP, Forming / accessing complementary assets</td>
<td>Absorptive capacity to identify and respond to user needs. Problem solving</td>
<td>Scientific functional management, with cross functional integration. Workforce able to adopt and use new technologies.</td>
<td>Information management, integrated with other functions (e.g. logistics). Workforce willing and able to adopt and use new technologies.</td>
<td>Entrepreneurial skills for spotting market trends. Workforce ability to implement and use new technologies.</td>
</tr>
</tbody>
</table>

1. Position
- Develop technically related products
- Monitor and respond to user needs
- Cost effective and safe complex products and processes
- New products and services
- Based on non-technological advantages

2. Paths
- Develop and exploit basic science
- Matching changing technologies to user needs
- Incremental integration of new knowledge
- Design and operation of complex information processing systems
- Use of IT in finance and distribution

3. Processes
- Obtain complementary assets (internally and through alliances).
- Strong links with lead users.
- Diffusion of best practice in design, production and distribution
- To match IT-based opportunities with user needs
- Flexible response to user

Source: Tidd, Bessant and Pavitt, 2001, Table 5.1 (with additional considerations by the authors)
The third pattern is that of scale intensive firms. The car industry is a primary example for this pattern. The volume of production is the key to these firms. By spreading the costs of R&D over a large output, the unit costs of R&D may be low even if the aggregate level is high. Innovation typically occurs at different levels. The first level is general product development which requires high engineering skills. The second level is product design, which is about tailoring general products to specific markets: this requires market knowledge and design capabilities. The third level is the organisation of the production process that requires engineering skills but also increasingly managerial skills, as such firms increasingly moved away from in-house production towards 'system integration'.

The fourth pattern is typical of information-intensive firms. This pattern is characteristic for certain service sectors such as finance, retailing, publishing and travel. The main technology used is information technology, where some of the software is developed in-house. The key technology skill is the ability to develop software, to integrate information technologies into systems such as logistics. The main purpose of innovation is to design and operate systems of information processing.

The fifth pattern is to be found in supplier-dominated firms. These are primarily users of technology and operate usually in market with relatively simple products. This is the dominant pattern in the economy: here entrepreneurial skills for spotting market trends and the ability of the workforce to implement and use new technologies are key skills.

Table 6 summarises the major patterns of innovation, their sources of technology, innovation strategies and key skills. The main value of this taxonomy of sectoral patterns of innovation is that it shows that quite different patterns of innovation co-exist in different industry contexts at the same time. This implies that the demands on the availability of human capital for innovation can be quite heterogeneous across economies depending on the specific industry structure.

Moreover, Vandenbusche et al. (2006) put forward the hypothesis that the optimal skill composition of the labour force changes depending on the technological position of the economy. How much human capital can contribute to economic growth will depend on the distance to the technological frontier. The impact of skilled labour on economic growth is the larger the closer the economy to the technological frontier. At the same time, the growth contribution of unskilled labour shrinks in countries closer to the technological frontier.

The empirical tests performed by Vandenbussche et al. (2006) on OECD data confirm these conjectures. They observe that the positive growth affect associated with higher spending on tertiary education is almost three times higher when a country is on the technological frontier, compared to a country still catching up to the frontier.

From this observation, one can derive an important message for effective innovation policies. Policies aimed at supporting the diffusion of new knowledge require a different composition of the workforce than policies aimed at the creation of new knowledge. In other words, if a country is on the technology frontier such that innovation must be geared towards the creation of new knowledge, a necessary precondition is a sufficient supply of higher education graduates. On the other hand, in situations where the diffusion of knowledge is the primary concern, there is also scope to employ less skilled labour.

On this basis, Krueger and Kumar (2004) put forward an alternative theory stressing that different education systems may be responsible for the weaker European growth performance compared to the US. They argue that with the increasing pace of technical change, general education becomes more important. General education enables workers to operate new production technologies. Firms in economies with a high supply of general skills thus have greater flexibility in technology choice, which generates higher rates of economic growth. As a result, an education system focused on general education, like in the US, is more beneficial to economic growth than an education system focused on vocational education, like in Europe.
Krueger and Kumar (2004) calculate that approximately 60% of the growth differential between Europe and the US is due to the strong orientation of European schooling systems towards secondary education and vocational training. This would suggest that the growth in labour demand for highly skilled workers may be related to more general trends than, for example, the diffusion of ICT. If highly skilled labour generates innovation and is at the same time necessary for the diffusion and adoption of new technology, economic growth and higher education are to a certain extent endogenous.

Crespi and Patel (2008b) show that there are two effects at work. The first effect is that a higher skill level leads to a more efficient labour force. The second effect is that a better-educated workforce raises absorptive capacities to integrate new technologies and ideas. However, it is not only the level and composition of skills in an economy that has important impacts on competitiveness. Sectoral specificities in the innovation process also play an important role.

Crespi and Patel (2008b) also show that the effect of educated human capital on innovation and productivity is positive in most manufacturing sectors, but that the magnitude of the effect varies. In particular they find that skills acquired in formal education are more important in industries characterized by a more radical innovation mode and high R&D budgets than for industries characterized by a more incremental mode of innovation and low and medium R&D budgets.

3.3.2. Skills and Innovation in Enterprises

Some innovation surveys gather information on the environment conducive to innovative activities. These surveys provide some data as regards the importance of sufficient supply of higher education labour for innovation.

The Observatory of European SMEs Survey 2007 covers almost 15 thousand interviewed small and medium sized enterprises (SME) in the EU27 and gathers perceptions on business constraints, competition, human resource problems, internationalisation and innovation. This source produces a clear picture of how important the availability of skilled labour is for the production of innovation.

Figure 10 reports the most important obstacles faced by SMEs over the last two years. The most important individual business constraint reported by SMEs was the purchasing power of customers. The second most mentioned problem was stringent administrative regulations. But issues directly related to the labour force already ranked third and fourth. The difficulties faced by European SMEs in the last two years have the same ranking among country groups, although the level is generally higher in the new Member States (NMS). Moreover, the problems associated with implementing new technology, implementing new forms of organisation and the lack of quality management may also refer to the lack of skilled labour.
**Figure 10: Difficulties and Constraints faced by SMEs, 2007**

<table>
<thead>
<tr>
<th>Issue</th>
<th>NMS12</th>
<th>EU15</th>
<th>EU27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems with the purchasing power of customers</td>
<td>52</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>Problems with administrative regulations</td>
<td>34</td>
<td>36</td>
<td>45</td>
</tr>
<tr>
<td>Lack of skilled labour</td>
<td>39</td>
<td>35</td>
<td>39</td>
</tr>
<tr>
<td>Labour force too expensive</td>
<td>32</td>
<td>33</td>
<td>39</td>
</tr>
<tr>
<td>Problems with infrastructure</td>
<td>21</td>
<td>23</td>
<td>34</td>
</tr>
<tr>
<td>Limited access to finance</td>
<td>20</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td>Implementing new technology</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Implementing new forms of organisation</td>
<td>11</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Lack of quality management</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

**Note:** Difficulties or constraints encountered in the last two years as a percentage of total replies, country groups in comparison.

**Source:** Observatory of European SMEs Survey 2007

More directly related to innovation activities are the hampering factors to innovation from the fourth wave of the Community Innovation Survey (CIS 4). The CIS is a firm level survey conducted every 4 years in EU member states as well as several other non-EU countries. The CIS provides a sound source of statistical data on innovation by using a stratified sample of companies. Figure 11 reports highly important hampering factors to innovation for innovative enterprises, showing that the most important difficulties to innovative activity are cost factors. Especially in the NMS, firms mention cost factors much more often than firms in the EU15 countries. Market factors are the second most important aspect hampering innovation in the EU15 and NMS12.

Innovative enterprises felt slightly more affected by markets dominated by established enterprises than by an uncertain demand for innovative goods or services. Finally, knowledge factors were on average not mentioned as often as innovation impediments, although on the individual country level there is a large variation. In the EU15 and NMS12, lack of qualified labour ranked as the most important knowledge factor, with 11 percent and 10 percent of the innovative enterprises mentioning it, respectively.
**Figure 11: Key Hampering Factors to Innovation in Innovative Enterprises, 2004**

![Diagram showing key hampering factors to innovation in innovative enterprises, 2004.](image)

**Note:** Percentage of total replies of innovative enterprises. Due to a lack of data, the United Kingdom is not included in some cases in the EU15 aggregate, in a similar way the NMS12 aggregate sometimes fails to include Poland and Slovenia.

**Source:** EUROSTAT, Community Innovation Survey (CIS4); WIFO calculations.

As seen in the answers to the Observatory of European above, a large percent of European SMEs are non-innovative. Figure 12 presents the factors that these enterprises consider relevant as regards hindering innovation. If we compare the answers to those from innovative firms, we see that the ranking of factors impeding firm innovation is quite similar between innovative and non-innovative enterprises. The most important reason for non-innovative enterprises not to innovate is the lack of demand for innovative products. Cost factors are mentioned by the largest number of firms as hampering innovation activities in non-innovative enterprises. However, lack of qualified personnel is more often relevant for businesses with innovation activities than for non-innovating enterprises. This clearly hints at employment of qualified labour being a relevant factor in the production of innovation.
Figure 12: Key Hampering Factors to Innovation in non-Innovative Enterprises, 2004

<table>
<thead>
<tr>
<th>Reasons not to innovate</th>
<th>EU15</th>
<th>NMS12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Because no demand for innovation</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>Due to prior innovations</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Innovation costs too high</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Lack of funds within your enterprise or enterprise group</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>Lack of finance from sources outside your enterprise</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Markets dominated by established enterprises</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Uncertain demand for innovative goods or services</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Lack of qualified personnel</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Difficulty in finding cooperation partners for innovation</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Lack of information on markets</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Lack of information on technology</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Percentage of total replies by non-innovative enterprises. Due to a lack of data, the United Kingdom is not included in the EU15 aggregate, in a similar way the NMS12 aggregate excludes Poland and Latvia.

Source: EUROSTAT, Community Innovation Survey (CIS4); WIFO calculations.

Green et al. (2007) analyse micro data from the CIS 4 for the UK in more detail. Their descriptive evidence shows strong links between skills and innovation both at the sectoral and at the firm level. In particular, they provide evidence that a higher share of workers with tertiary education is strongly correlated with both organisational and technological innovation. Weaker evidence is obtained for innovation propensity and expenditures devoted to the training of employees.

In addition, Green et al. (2007) note a positive association of the propensity to innovate and reporting “lack of qualified personnel” as barrier to innovation. This suggests that lack of skilled labour is a hampering factor that influences primarily the decision to further innovation and commercialization, but less the decision of a firm to become innovative altogether.

Hölzl and Friesenbichler (2008) analyse high growth manufacturing firms using micro data from the third wave of the CIS for 16 countries. They measure firm growth in terms of employment, that is, job creation at the firm level. They find that firms consider the availability of qualified personnel to be more important as hampering factor to innovation in countries closer to the technological frontier than in catch up countries.
3.4. Skills upgrading and labour market frictions

The discussion so far delivers strong arguments in favour of policy initiatives aimed at the development of special talent on the one hand and general up-skilling of the labour force on the other hand. The former strategy is immediately conducive to employment growth due to innovation stemming from R&D; the latter contributes to the European employment goals through the enhanced adaptability of a qualified labour force, which also contributes to faster dissemination of innovation or technological and organizational change.

In contrast to these arguments, analysts and decision makers have expressed concerns that the higher numbers of well-educated workers may not be absorbed by the market. This view is supported by two empirical observations. The first observation is that in the EU as a whole and the majority of the Member States the transition from school to work is rather difficult and often associated with rather long unemployment spells. Thus European youth unemployment rates remain high (EUROSTAT, 2009).

The second observation is that European workers seem often employed in jobs inadequate to their skills. The phenomenon of so called over-education seems to be especially important in Eastern Europe. However, the empirical evidence suggests that it occurs in the EU15 as well, which shows that over-education is not just a fading problem of economies in transition. The policy question thus is whether the increase in tertiary graduates has resulted in an oversupply of workers with tertiary education and with a decline in the value of a degree. Put differently, an over-supply of skilled labour in the sense that highly qualified individuals enter jobs for which they are too skilled could push less qualified from the market, or into jobs at lower ranks of the job ladder.

Yet this perspective stresses just one side of the coin. The flip side is that employers often claim that they cannot fill their posted vacancies, as the available job applicants do not match the expected qualification standards. Thus there appears to be skill mismatch on the labour market. In the face of Europe lagging behind in terms of innovation – despite concerted efforts to reverse the trend – skill mismatches and skill shortages are an important policy question. Skill shortages are considered to be most important in the field of Science, Engineering and Technology for several EU Member States (Machin and McNally 2007).

These empirical observations point to the important distinction between employability and employment. While it is generally true that higher education levels are associated with higher individual employment propensities, it is nevertheless possible that skills acquired are unemployed, under-employed or wrongly matched. Education and training policies impact on the supply side of the labour market and a crucial point for their employment outcomes is that labour demand is responsive to the induced relative changes in the skill composition of the workforce. The simplest setting to think about the absorption of workers endowed with different skills is a macroeconomic production function stating that economic output is produced with low skilled labour, high skilled labour and physical capital. In a static setting technology comes into play, as it determines the difficulty to technically exchange the different factors of production with each other.

There is substantial empirical evidence that in the macroeconomic production process, high skilled labour and capital inputs are relative good substitutes, i.e. relatively easy to exchange with each other, whereas high skilled and low skilled labour are complements, which means that they are relatively difficult to exchange against each other. These observations imply that at a given level of output the absorption of a higher supply of skilled labour requires reducing the amount of physical capital as a factor of production, whereas it has little effect on the employment of low skilled labour.
Yet the functioning of this mechanism does not only depend on how easy it is to technically substitute the two factors in the production process. The optimum mix of production factors given a certain technology of production also depends on relative factor prices, i.e. wages and interest rates. Thus the relative factor prices affect the optimum input mix from the perspective of the producer.

Assuming for simplicity that interest rates are determined on the global financial market, we just need to study wages.

With fixed labour demand (or a given output level), the expected wage responses will depend on the elasticity of labour supply. Labour supply is said to be more elastic, if a given change in the wage level yields a stronger change in the amount of labour supplied to the market. The extreme case is that labour supply is fully inelastic. In this case the amount of labour available on the market is fully independent of the wage level.

Under the condition of fully inelastic labour supply, producers will absorb any growth in labour supply through creating more jobs. These jobs will pay a lower wage, however. In the other extreme case, labour supply is perfectly elastic. This means that any marginal decline in the market wage rate would lead to an infinite reduction in the amount of labour supplied. In this case any additional amount of labour supplied to the market is not absorbed, because it could be employed only at a lower wage level. The new potential means of production remain unemployed.

The empirical evidence tells that labour supply in general is neither perfectly elastic nor perfectly inelastic. Yet the slope of labour supply curves varies between countries and also between different types of labour. On the country level, institutions influence the responsiveness of wages to labour supply shifts. In this regard, wage setting practice is particularly important. Stronger collective wage bargaining, typically by trade unions, tends to be associated with more downward rigid wages, in other words less elastic labour supply. Likewise, minimum wage legislation may yield downward wage rigidity. Also the income tax system, social welfare institutions and general labour market flexibility shape the elasticity of the labour supply curve.

If one observes different segments of the labour market, the empirical evidence suggests that the aggregate labour supply curve is less elastic for higher education levels. This may be due to a direct effect of education: wage-related unemployment is more costly for the better educated. This group foregoes higher earnings if unemployed and furthermore the threat of de-qualification outside the labour market is more serious. Stronger labour market attachment implies that wage flexibility (both upward and downward) tends to be higher in the labour market for the high-skilled compared to the labour market for the low-skilled. This effect is reinforced by institutional factors, like the lower rate of union coverage among the better qualified, or the non-binding nature of minimum wages at higher education levels.

The observation of systematically different labour supply elasticity by level of education implies that general skills upgrading might be seen as a means to render the labour market as a whole, i.e. the aggregate of skill segmented labour markets, more flexible. This means that the economy gains higher capacity to absorb shocks (both on the demand and supply side) through changes of wages rather than changes of employment (or unemployment).

One may also put this argument the other way around, however: The smooth absorption of supply of more and better skills on the labour market requires sufficiently flexible employment conditions in a number of dimensions. On the demand side of the labour market, employment-friendly wage-setting mechanisms to ensure that outcomes reflect productivity facilitate the translation of employability through skills into employment. On the supply side of the labour market, institutions strengthening individual labour market attachment increase the employment effects of general skills upgrading, as they facilitate the wage adjustments required to absorb the higher number of effective units of labour if workers get endowed with more or better human capital.
On the other side, skills mismatches refer to skill gaps between labour demand and labour supply and can have important implications at different levels.

On the individual level, skill mismatches may affect the productivity of workers due to lower job satisfaction because over-educated workers are paid less than their (potential) marginal productivity and are not satisfied with jobs that do not coincide with their qualifications and competencies. On the firm level, skill mismatches mean lower quality job matches. Imperfect job matches can yield shorter employment durations, hampering the accumulation of job-specific human capital.

Jovanovic (1979) claims that skill mismatch at the individual level is merely a temporary phenomenon. According to this view, the sources of temporary skill mismatch are imperfect information and imperfect mobility. In other words, skill mismatch appears to be associated with labour market imperfections rather than imperfections in the education system.

Another view on temporary skill mismatches at the individual level is that they reflect individuals’ desire to shop jobs at earlier stages of their career in order to acquire a wider portfolio of skills that are complements to formal qualifications (Sicherman and Galor 1990). This argument further supports the view that skills mismatches do not necessarily reflect an imperfection of education systems. In fact, this theory suggests that skill mismatch at the individual level may even have an efficiency enhancing role. The prediction based on this reasoning is that over the life course mobility within or between firms would gradually lead to better job matches for the individual. The opposite theoretical view on skill mismatches is that they represent an enduring phenomenon. This could be the case, provided that employers use the level of formal education as a screening device to overcome the incomplete information about true individual ability, as postulated by Spence (1973). The empirical evidence in support of Spence’s screening device hypothesis is altogether weak, however.

But also state-of-the art matching theory with heterogeneous individuals and jobs is capable of showing that skill mismatches can be a permanent, structural phenomenon (Albrecht and Vroman 2002). The condition is that high skilled workers are allowed to compete with low skilled workers for low skilled jobs. In this framework skills mismatches may stem from two distinct sources: skills upgrading in the labour force, i.e. a supply side shock, and skill-biased technical change, i.e. a labour demand shock. In either case, one side of the labour market only slowly adjusts to a rapid change on the other market side.

In the case of under-qualification, employers are affected by skills shortages. The costs of posting vacancies are higher, which could reduce job creation rates. Skills shortages may reflect imperfections in the public education system that does not provide the kinds of education and training in demand on the labour market. Employer-provided training does not automatically overcome these imperfections, as in general employers are willing to pay only for education and training measures providing firm-specific skills. To the extent that a skills shortage arises in the domain of general human capital, the amount of employer-provided compensatory training is ambiguous. On the one hand, employers are reluctant to provide such training, because it is uncertain that the job match lasts sufficiently long to recoup the costs of general training; on the other hand, keeping a vacancy open induces a cost that can be avoided by accepting the match and training the matched worker up to the productivity level required.

Another explanation for skills mismatches is that individuals have a preference for types of education in low demand on the labour market. Empirical evidence supporting this hypothesis comes from studies estimating the returns of higher education by fields of study (Machin and McNally 2007). These studies show in general that Science and Engineering subjects have highest return on education and arts the lowest return. These differences are persistent over time, which suggests that individual choices only weakly respond to salary differentials.
Additionally, the responsiveness of schooling choices to differential returns to education by field of study appears smaller in countries where fees charged for higher education are lower (Machin and McNally 2007): if one considers education as an investment choice, pure gratuity can be conducive to waste.

Table 7, taken from Wasmer et al (2007), provides a useful classification of skill mismatches in the EU15. It crosses two dimensions of skill mismatches. The first dimension is whether individuals feel that they have skills or qualifications that would allow them to do a more demanding job than the one they are doing at present. In the table, individuals think they could do a more demanding job are considered over-qualified.

The second dimension of skills mismatches is that one may think they do not have the formal training or education providing the skills needed on the current job. To see how this second dimension is different from the first dimension, consider somebody who has a PhD in biology: if they worked as a taxi driver, they would certainly be over-qualified; yet, if they worked as the CEO of a consulting company, it is likely that they would not be over-qualified but mismatched in terms of formal qualification.

On the basis of this taxonomy, data from the European Community Household Panel (ESHP) show that in fact only one in five workers in the EU15 works in a job correctly matching their formal education and skills. The most common category is workers who work in a job matched to their formal education and training, but do not fully exploit their skills. Altogether, as much as 54 percent of the population report that they may perform a more demanding job.

Table 7: Incidence of Skills Mismatches in Europe 1994-2001

<table>
<thead>
<tr>
<th></th>
<th>Formal training or education that has given you skills needed for your present type of work?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Non over-qualified</td>
<td>21.2%</td>
</tr>
<tr>
<td>Over-qualified</td>
<td>33.0%</td>
</tr>
<tr>
<td>Total</td>
<td>57.7%</td>
</tr>
</tbody>
</table>

Notes: Data on full-time employees in the working age 15-64 drawn from the ECHP. Sweden and the Netherlands are excluded since questions on skill mismatch are not included in the country questionnaire. Data on Germany and the United Kingdom are limited to the period 1994-97.

Source: Wasmer et al. (2007)

One interpretation of the large share of apparently over-educated workers in Europe would be that there is huge waste, in the sense that the labour market does not or cannot make effective use of the skills available. Related to this reading of the data is that there is massive inefficiency in education systems generating non-marketable skills. An alternative interpretation, however, would be that apparent skill mismatches are a rather normal feature of advanced labour markets which constantly need to adapt to changing ways of production and organization. In the literature, one finds evidence in support of both views.
A first empirical observation is that mismatch rates measured according to the concept of Table 7 have not changed since the 1990s, at least on the level of EU15. It appears that mismatch has not gone down despite the technological development (the rise of the internet) raising relative demand for high-skilled workers. This observation suggests that on the European average growth in relative supply of skilled workers balanced growth in relative demand for this type of workers relatively well. At the same time, one finds massive variation in skill mismatch rates across the Member States. In particular, the incidence of mismatch in the sense of workers not employed in jobs suited to their education and training is larger in the South of Europe (Italy, Portugal, Greece) than in the rest of EU15.

The differences between countries, which are also rather stable over time, suggest that the efficiency of national labour market institutions and education systems may have an impact on the different types of skill mismatches. One hypothesis is that skill mismatches are more prevalent in countries where reallocation of labour is relatively costly due to labour market institutions. A labour market institution which clearly reduces matching efficiency on the labour market is employment protection legislation. Imposed firing costs unequivocally reduces worker flows between jobs (Bertola 1999), thus one would expect more skill mismatches on labour markets with more stringent employment protection legislation, which is confirmed by the empirical evidence. The appreciation of the mismatch phenomenon is incomplete without studying the consequences of over- or under-education. The empirical literature especially looks at wage effects of over-education.

The typical approach in the empirical literature seeking to reveal the economic consequences of skill mismatch is to estimate (so-called Mincer) equations that explain the wage level of an individual as a function of a set of personal and job characteristics. After controlling for the wage differences attributable to the personal and job characteristics, it is checked whether the wage level of an individual working in a mismatched job is systematically different from the wage level of a comparable individual working in a non-mismatched job.

The usual finding is a wage penalty for individuals who are over-qualified in their job, yet the magnitude of the negative effect of over-education tends to be small and it is often insignificant in a statistical sense. In particular, it turns out that the estimated wage penalties become significantly smaller if unobserved heterogeneity among individuals is properly accounted for (Messina, 2006). This suggests that indeed part of the over-education phenomenon is a measurement issue due to unobserved heterogeneity in individual ability.

Wasmer et al. (2007) shed additional light on the conventionally estimated over-education wage effect by separating skill mismatches and over-education using the taxonomy of Table 7. The disaggregation uncovers a massive negative effect of skill mismatch. Workers employed in a job that does not fit their education and training on average earn above 10 percent less than workers employed in a matched job. However, for workers who are not only mismatched but in addition over-qualified no further wage penalty is found. Similarly, workers who are over-qualified but work in a job fitting their education and training in general do not seem to suffer a drop in wages. Even in countries where the wage penalty on over-education is statistically significant, it is consistently smaller than the wage penalty on skill mismatches.

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11 See Wasmer et al. (2007), figure 5.1. Unfortunately time series data is not available for all Member States.
12 See Groot and van den Brink (2000) for a meta-analysis on the estimated wage effects of over-education.
Nevertheless one should not take the interpretation of these empirical results too far. Observations from some of the Member States indicate that over-education may have substantial adverse effects on individuals in some circumstances. One example is the ongoing rapid growth of tertiary education in Spain. Here it appears that the demand for workers with higher education does not expand at a sufficient rate to absorb the growing supply. This has led to massive difficulties for university graduates entering the labour market and to wage penalties for over-educated workers (Dolado et al. 2004).

Lamo and Messina (2006) present evidence that over-education is especially relevant in the transition economies of the new EU Member States in Eastern Europe. A typical example is Poland, where the share of over-educated workers among full-time employees in the working age exhibits a clear upward trend. In the observation period from 1997-2003, the over-education rate increased from 11.6 to 15.8 percent. Like in the rest of Europe, over-education propensities increase in the level of education and decrease with labour market experience.

3.5. Implications for Policy Design

The review of the state of theoretical and empirical knowledge shows that progress on innovation, education and employment is highly interrelated in the European economies. This implies that also the potential effects of innovation, education and employment policies pursued at the EU level are highly interrelated. However, the interdependencies between the three variables are highly complex. Furthermore the exact qualitative strength, and sometimes even the qualitative direction, of these links are difficult to determine. Therefore, from a political perspective, it is a highly intricate matter to develop sets of policies that are consistent in the sense of supporting growth on all three dimensions at the same time. The multifaceted crossing points of the policy triangle education-innovation-employment become clear considering the spill-over effects of changes in the skill composition reached by education and training policy. The material analysed in this chapter makes clear that a relative increase in the amount of skilled labour in the workforce can affect the long-term economic development via various channels. The impact on economic growth and employment works through the supply side of the labour market as well as through the demand side, and furthermore through the efficiency of the matching process that brings together labour supply and labour demand.

The quality of the matching process not only hinges on the innate quality of labour in supply and demand, but also on general economic policy conditions and institutional settings. In particular, efficient labour market regulation, product market regulation, financial market regulation and fiscal policy are important levers to the income per capita and employment consequences of an expansion of education levels. In this sense, the effective design of employment policy can reinforce the positive effects of skills upgrading policies.

Higher education raises workers’ absorptive capacities – the ability to learn and adapt. This implies that retraining during working life is easier for individuals with good general education. Programmes aimed at providing second chances for unskilled workers therefore are less effective, as regards the creation of an adaptable and flexible workforce, than general education. In sum, these observations provide a strong rationale for an expansionary education and training strategy. Its effects are the larger, the more employment-friendly the general institutional setting.

However, the links of skills upgrading to economic growth and employment are altogether much more complicated. One has to consider the dynamic interactions between labour supply and demand. In particular, innovation and new technologies lead to changes in work practices and require new knowledge. Therefore, the design of efficient education and training policies is not independent of the design of innovation policies.
Generally speaking, innovation processes play a decisive role for the employability of a better qualified labour force. If one accounts for innovation dynamics, higher education can have an external social return that goes beyond the private returns to education. First, higher education speeds up innovation directly by providing the personnel for research and development. Second, there is an indirect externality of education and training policies on innovation policy, through a better educated workforce allowing quicker and better adoption of more productive technologies, which can yield higher total factor productivity. Within this development it is not only the quantity but also the quality of highly educated workers that matters. The speed at which self-reinforcing innovation processes can generate a general expansion of employment opportunities hinges on the availability of specialized talents with the ability to be inventors. This explains why decision makers need to be particularly concerned about skill shortages if the field of Science, Engineering and Technology.

The possibility to generate positive spill-over effects on the effectiveness of innovation policies may also call for complementary education and training policies. Nevertheless it is difficult to generalize how exactly innovation processes (whether induced by public support or not) impact on the demand for skills. The current skills needs of enterprises are not confined to narrow elites with excellent technical and engineering skills. Modern, more and more distributed innovation processes increasingly demand soft skills related to management and coordination. General education, and especially general higher education, helps providing these soft skills constituting an important trend in the demand for skilled and highly skilled labour.

All these observations have implications for the design of adequate education and training policies. First, due to the complex and diverse skills employed in innovation, countries with educational systems that provide people with general skills usually associated with higher education may have advantages in technology adoption compared with countries that have educational systems with a focus on specialized vocational education.

Second, European education and training systems must be designed in an extremely flexible manner, if they are to provide the diverse and constantly changing skills required as inputs in the production and diffusion of innovation. However, it is important to emphasize one element that makes the relationship between skills and innovation special. Innovation creates a systematic problem for education and training policy, as it may require new skills that do not yet exist in the labour market and are not yet on any educational curriculum. If such skills are not general skills that can be used in other occupations, firms and workers may have little incentives to acquire such skills. This would create a skill gap in the short run. This shows that innovation may be a source of skill mismatches and skill gaps.

At the same time, it is practically impossible for decision-makers to constantly redesign education and training schemes such as to produce the skills required for a maximum impact of innovation on employment and growth. The empirical complexity in anticipating associated specific skill needs is far too high.

While from an aggregate perspective there is clear evidence that the share of tertiary educated people is important as determinant of economic growth for technologically and economically advanced countries, the ongoing shifts do not make unskilled labour fully obsolete. Innovation and new technologies often cannot substitute the non-routine work done by low skilled workers. While occupations that require routine manual or clerical skills have largely decreased, the demand for jobs that require non-routine skills has experienced the highest growth rates. This implies that also workers with lower qualification levels are faced with changing skills requirements. Current skill demands may require updating of curricula for the education and training suited to less able workers.
In sum, these observations suggest that the links between education and training policies on the one hand and innovation policies on the other hand run in both directions. Initiatives fostering human capital can reinforce innovation dynamics. In this sense, education and training policies can have an active role as innovation-supporting policies. In addition, policy-induced innovation dynamics can call for responsive education policies, in order to accommodate triggered changes in the relative demand for different skills types.

In a similar way, one may think of a need to coordinate innovation and employment policies. The available empirical evidence suggests that process innovation tends to reduce employment, while technological progress and product innovation tends to increase employment. In sum, it therefore appears that there is no general aggregate labour-saving potential of innovation at the aggregate level, which could provide an employment rationale for innovation policies. But in any case, one should expect that the working of various compensation mechanisms leads to a reallocation of employment. Does this imply that EU innovation policies and EU employment policies should be coordinated, in order to achieve coherent outcomes? An assessment of the need for coordination must take into account the potential synergies between the policies. More precisely, the low need for direct coordination between the policy fields of innovation and employment arises from two issues.

The first issue is that, while employment policy is orientated towards job creation and the improvement of job quality, it is very difficult to put forward such goals in the innovation policy context. Innovation is uncertain and the outcomes are not predictable. From the outset it is almost impossible to assess the global consequences of new technology in general and the potential effect on labour demand in particular. The impact of innovation and technical change on aggregate job creation is mediated by demand and compensating mechanisms. Compensating mechanisms related to changes in relative factor costs and price effects are very difficult to assess, especially as new products and new processes usually require long time spans to develop. High uncertainty about success and labour demand makes it impossible to formulate any specific employment goals for innovation projects.

The second issue is that employment policy reacts to changes in the labour market. The signal does not come from innovation activities but from observed changes in the labour market situation of workers hit by the consequences of technical change or, in an anticipatory way, by foresight studies that take into account skill needs.

It is important to note in this respect that not only the policy goals, but also the time horizon of innovation and employment policies are different. Innovation policy is proactive, oriented at long-term improvement of competitiveness, economic growth and with this its orientation is geared towards the long-term growth and structure of employment. Innovation and R&D have long gestation lags. The labour market consequences are often unknown at the beginning. Most active employment policies, in contrast, are oriented to short-term and medium-term employment performance. Employment policies are usually passive or reactive policies that are oriented at existing or anticipated problems on the labour market.

From an innovation policy view, labour market policies are normally not a tool to affect innovation behaviour. The most important aspects of labour market policies are those regulations and incentives that affect the innovation strategies of enterprises; in particular, labour market flexibility is often considered to be conducive for innovation.
4. AN ASSESSMENT OF EU POLICIES

The complex interactions between innovation, human capital development and employment shown in the previous chapters set a reference for an assessment on the policy initiatives in the realm of innovation, education and training and employment that are implemented and co-ordinated at the EU level.

The first part of our assessment is devoted to the field of innovation and we ask if innovation policies may have adverse labour market consequences that call for a response to obtain a more consistent overall strategy. In a second step, we turn to education and training policies pursued at the EU level.

The second part of our analysis looks at the consistency of the possible combinations in the triangle education-innovation-employment.

The discussion will be structured along a set of three questions.

First, are the measures adapted in the context of the EU education and training framework effective? Here we study the design of such policies, and discuss whether they are in principle suited to create skills for more and better employment.

Second, if education and training policies pursued at the EU level effectively raise the supply of human capital, how does the labour market allocate the additional supply? Could skills upgrading generate frictions on the labour market?

Third, are education policies and employment policies pursued at the EU level consistent? In particular, if there are potential employment frictions associated with the process of up-skilling the labour force, is there any scope for corrective measures?

4.1. EU Innovation Policy

The European Union has invested considerable effort in building the ERA, which is seen as the R&D equivalent to the common market for goods and services. In addition, an array of initiatives exists that aim at modernisation and innovativeness of the EU economy. The R&D Framework Programmes and the new Competitiveness and Innovation Programme are the primary instruments at the EU level. As the innovation policy is an area where multi-level governance applies, Member States have also been encouraged to prioritise innovation in their National Reform Programmes.

This section seeks to assess how EU innovation policies are aligned to EU employment policies on the one hand, and to EU education and training policies on the other hand. Our review of the general interplay between innovation, education and employment in chapter 3 generated two basic conclusions. First, the production of innovation in itself is a process that employs highly educated labour. The innovation production process is more skill intensive when there is more ample supply of talent. If talent is in short supply, the potential outcomes are either less innovation or more capital-intensive production of innovation.

Second, successful innovation generates dynamic repercussions on future employment. This concerns both the level and the structure of employment opportunities. As a whole, although this is difficult to prove and measure, we can say that innovation seems to create more jobs than it destroys. Innovation also has a tendency to shift relative labour demand from lower educated workers to higher educated workers; this skills-biased technological change hypothesis is consistent with the observation that the increasing share of higher education workers in the labour force has been generally absorbed without a wage penalty and wages of lower educated workers have declined.
Nevertheless, the exact employment consequences of innovation processes are very difficult to substantiate empirically. In particular, it is practically impossible to demonstrate the employment impact of a particular innovation, or, to put it the other way around, to assign observed employment changes to a certain innovation. One of the empirical difficulties is that innovation processes are very diverse. This means that at any time numerous innovation processes simultaneously impact on the economic development in general, and on employment in particular. The second empirical challenge is that innovation can require very substantial amounts of time before unfolding a measurable effect on employment.

To give an example, from today’s perspective it seems an undeniable fact that ICT has an impact on the level and structure of employment. However, the technology underlying ICT was invented many decades ago. If an empirical study had tried to estimate the employment impact of this innovation at that time, it would definitely have come to the wrong conclusions.

4.1.1. Consistency with EU Employment Policy

Innovation-based economic growth leads to industrial change. The review of the available evidence shows that technical change is not neutral with respect to labour demand. With innovation-based growth, new products and new industries with new skill requirements emerge, while the demand for ‘old’ products and the specific skills required in their production declines.

In addition to the changes in labour demand due to shifts in the importance of industries, new technologies affect the content of work. The available evidence suggests that information and communication technologies have had a profound effect on the demand of skills. The skill-biased technical change associated primarily with ICT over the past decades led to an increase in the labour demand of highly skilled workers, while the demand for low and medium skilled labour tends to stagnate or even to decline.

Highly educated workers gain from these developments. This is confirmed also by the recent experience in Europe over the last decades. Evidence shows that the employment expansion in Europe over the period 1995-2005 had two dominant patterns (Eurofound 2008). The first pattern is polarisation of jobs, where job creation was concentrated in the upper and the lower end of the job quality distribution. This pattern was found especially in the Netherlands and France. The second pattern is general upgrading, where the growth rate of high quality jobs was higher than the growth rate of medium quality jobs and – in particular – low quality jobs. Finland, Portugal, Denmark and Ireland are characterised by general upgrading. Most other countries had intermediate patterns.

This implies that the gains of innovation-based economic growth and the associated job creation were not distributed equally across high and low skilled works. The evidence on wage developments also shows that wages of high skilled workers grew faster than the wages of low skilled workers. Technical change associated with ICT favours high skilled and highly educated workers. In addition, the evidence on low-paid employment shows that it is becoming more unstable and precarious.

These patterns may lead to difficulties for low skilled workers and for workers displaced from declining industries. The stagnation of job creation in the low skill segment and the gap of new jobs in the middle of the skill distribution make it difficult to move up the employment structure and may create the need for policy support.

Employment policies directed at increasing the employability through training and retraining and increased mobility of workers thus are fundamental in counterbalancing the possible negative effects associated with skill-biased technical change.
In this context employment policies are reactive policies, as the structural labour demand effects of innovation processes are practically impossible to anticipate precisely. Measures therefore can only be implemented once a relative decline for specific workers has emerged from innovation-related restructuring. A number of policy instruments play an important role to support workers affected by restructuring of economic sectors and of workplaces in enterprises directly. The two key measures of direct assistance are active labour market programmes and unemployment benefits. Indirect measures aim at providing an economic environment where displaced workers can make good use of their skills.

The need for general employment policies arises from the fact that they strengthen job creation, upgrade existing workers’ skills and steer workers towards jobs where they are most productive. From a cost-effectiveness point of view, more controversial are targeted programmes that serve only displaced workers in specific industries, even when they are hit more by the consequences of innovation.

However, in the case of mass layoffs in declining sectors that are concentrated regionally such targeted programmes can be useful. Active employment policies to aid workers hit by skill-biased technical change are primarily oriented at providing workers with conversion training for the external labour market. The rationale is to provide new skills for displaced workers in order to enable them to take up jobs elsewhere in the economy. Conversion training can consist in short-term updates or in the long-term provision of new skills.

However, also other policy measures are available in this context:

- Temporary wage-cost subsidies such as those used in France to compensate for the income loss of redundant workers who are willing to take up lower paid jobs. This kind of wage insurance can enhance occupational mobility by reducing the reservation wage (i.e. the minimum wage required to make a worker accept a job.) A temporary subsidy might be sufficient, provided that productivity gains through learning in the new job are sufficiently large, so that the mobile worker can eventually get back to the earlier wage.

- Mobility aids such as those used in Sweden to relocate workers from regions hit by structural change to areas with dynamic growth of labour demand.

- Enterprise creation. The rationale is to stimulate redundant workers to set up a business on their own. This requires providing advice for starting a company (entrepreneurial skills) and to provide loan guarantees for start-up capital.

Special institutional arrangements can further enhance the effectiveness of such adaptability measures. Setting up intermediary organizations that take over the task to place workers displaced by technical change into new jobs seems particularly useful. The task of these intermediary organizations is to bundle the services that exist for dismissed workers and to propose them to the redundant workers under their umbrella. The advantage of this arrangement is that it raises the probability that the displaced workers are provided with the appropriate kind of service.

Different organizational forms exist for such intermediaries. In large companies they may be specific units of the firm, but they may also take the form of private companies or associations. Public employment services and temporary work agencies can also run the intermediary organizations. Good examples of this practice are some of the Beschäftigungsgesellschaften in Germany, the intermediary organizations of the British Steel industries (e.g. Evans-Klock 1999), and the Arbeitsstiftungen in Austria.
Active support programmes serving displaced workers to cope with restructuring need careful design. Available evidence suggests that especially job-search assistance can be a quite effective means to support reintegration into employment. The results from available evaluations of training and other intensive forms of assistance are more mixed. The evidence on retraining is also mixed. Still, training programmes should be available especially for those at high risk of long-term unemployment and for those who have a high propensity to benefit.

It is worth noting that the active measures mentioned before are practically the same as those that can be provided through the European Globalization Adjustment Fund (EGF): job search assistance, tailor-made retraining, entrepreneurship promotion, aid for self-employment and special temporary income supplements that do not have the nature of unemployment benefits, i.e. passive social protection, like job-search and mobility allowances. In this sense, the EGF is designed to provide measures with a proven track record of facilitating the adaptation of the workforce to economic restructuring.

However, although the EGF contributes to the priorities of the EU as regards strengthening employment and job opportunities in order to reach the objective of better social and economic cohesion, and is therefore fully consistent with the overarching objectives of the EES of achieving full employment levels and reducing unemployment, it is clearly not directly located at the crossroads of innovation and employment. The EGF targets redundancies caused by major and abrupt shocks on global markets, in particular changes in world trade. In principle, such shocks might be associated with innovation. For example, product innovation and changes in production technology can affect the relative scarcity of production inputs owned by the different trading partners and thereby shift the direction of flows of products between countries. But even if there is an innovation element in changing trade patterns, its effects will unfold only gradually. Normally it will be impossible to assign a certain case of redundancies from a global market shock to a particular innovation.

This has implications. First, considering the short-term and one-off orientation of the EGF, it is not useful to amend the eligibility criteria to include a global “innovation shock”. For the short term, this concept would be a contradiction in terms, as new products and processes generally require long gestation periods. Second, even if it were possible to anticipate the specific innovations generated by European policies, it is practically impossible to align the design of the EGF with the European innovation policies ex ante. This would contradict the very nature of the EGF, which is designed as responsive policy.

If viewed from the opposite side, it is also clear that the EGF as an instrument within the EES does not enhance the effectiveness of EU innovation policies. While it can help maintaining skilled workers in the labour force, it is not specifically designed to promote skills for innovation. At present, the EGF devotes the majority of spending to training and job search allowances that help smoothing workers’ transition to segments of the labour market unaffected by global market shocks. However, there is no specific focus on promoting training to the specific and advanced skills for innovation. In fact, time-consuming retraining to higher skills for innovation would be in contrast with the nature of the EGF as a short-term programme with a solidarity dimension, i.e. with the principal aim of averting lasting individual impoverishment of displaced workers.
A further reason why one should not seek to adapt the EGF to innovation matters is that with the European Social Fund (ESF) a complementary – and much larger – programme for support of longer term goals already exists. In principle resources from the ESF can also be used to lend support for workers who are displaced as a consequence of changes on global markets. Yet the scope of the ESF programme is much larger. First, it is not confined to workers who are already displaced. It can also target workers who are only put at risk by the increased competition in global markets. Second, it is not restricted to management of restructuring due to globalisation. The ESF can offer support for any restructuring process, including those induced by product innovation and innovative production technology. Third, as it consists of multi-annual programmes, the ESF can accommodate strategic adaptability measures, including more elaborate conversion training and skills upgrading.

The first two elements imply that the ESF, compared with the EGF, provides a good tool for employment policies that respond to innovation-related employment measures. The third aspect implies that the ESF in principle could serve as a means to develop an integrated innovation and employment strategy. However, while the ESF programmes put indeed an emphasis on information and reporting schemes serving better anticipation of skill needs, this is not sufficient to design precautionary employment policies to cushion restructuring that stems from the innovation processes. As was noted in the context of the EGF, it is practically impossible to anticipate with adequate certainty the longer term labour demand shifts caused by innovation.

The anticipatory elements within the ESF programme can mainly serve two other purposes. The first purpose is to improve on skills matches. Everything else equal, retraining of workers to skills and occupations where an excess demand or bottleneck is more likely will increase employment chances and therefore the adaptability of the workforce. The second purpose is to train the researchers and innovators required as direct input factors in expected R&D and innovation activities. As R&D and innovation supporting measures can facilitate structural adjustment in economically less-favoured regions, the ESF can be used as an accompanying measure to develop specific “skills for innovation” at the right time, provided that there is co-ordinated anticipatory planning.

While these objectives in principle clearly underpin the growth and employment targets within the Lisbon strategy, the ESF programme in practice may not contribute to these targets in the most efficient manner for three reasons. The first reason is that despite the requirement of some sort of (qualitative or quantitative) impact assessment normally built into the initiatives under the umbrella of the ESF, methodologically advanced programme evaluation tools that could measure causal effects are often not applied. In particular, the ESF strategy does not advance the possibilities to run social experiments, the “gold standard” to obtain clean measurement of programme effects. Second, it is possible that ESF funded programmes crowd out other initiative at the national level. An example for this is ESF wage-subsidy programs in support for disadvantaged young adults that are in place in some of the German federal states (Bundesländer) and apparently are responsible for extremely low take up rates of parallel programmes funded from national resources. Measurement of the total programme effect obviously needs to account for such crowding out effects.

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13 This does not say that anticipatory labour market monitoring could not capture the impact of innovation processes in general. But as the empirical basis for skills need forecasting to a large extent is past structural change, this will capture only the employment impact of longer-term innovation processes that furthermore have already started.
The third and perhaps most important reason is that the ESF does not only pursue the employment and growth targets, but at the same time social and economic cohesion goals. As a result, the vast majority of the financial resources is granted as support for economically less-favoured regions on the one hand, and for disadvantaged individuals on the other hand. This means that the funds available are not systematically allocated to the initiatives that would provide the highest economic gains, but to initiatives that underpin cohesion while providing some return. In other words, the strategy of the ESF is affected by an efficiency-equity trade off.

This trade off is also relevant for judging the capacity of the ESF to underpin EU innovation policies. As far as individuals are concerned, a focus on the disadvantaged groups implies that relatively few resources are devoted to higher education which could develop R&D personnel and innovators in order to facilitate the success of innovation policy. As regards the focus on the less-favoured regions, the empirical evidence suggests that networking externalities and other spill-overs at the regional level are relevant determinants of local innovation capacity. Reinforcing dynamics may provide an efficiency rationale to direct the resources for innovation policy to innovation cores rather than to the periphery. In other words, employing innovation policy as structural policy to help less developed regions to catch up can elevate the failure rate of public support for innovation in a non-negligible way.

This observation provides another argument why the ESF programmes as part of the European employment policy appear more strongly aligned to European education and training policies than to innovation policy. Nevertheless certain elements within the ESF initiatives can at least indirectly enhance innovation. The evidence concerning the specific skill needs for innovation collected earlier in this report suggests that soft skills are very relevant for employers. The challenge is thus to organize education in a way that these soft skills relevant for the labour market are provided. This implies that more space should be given to basic education at all levels. The priorities of the ESF for the current planning period are consistent with this demand. In particular, the programme

- puts the focuses on learning of skills for the labour market throughout the life cycle,
- promotes the idea that basic education, including learning at primary levels, is important,
- orients VET to the changing skill needs on labour markets, in order to strengthen the links between vocational learning and employment.

However, while these measures also have an indirect capacity to support innovation, one may as well consider them as instruments supporting EU education and training policies, including VET policies, first of all. In fact, the reflections on the place of the ESF within the innovation-human capital-employment triangle demonstrate that, all things considered, the central link between innovation and employment policy consists in education and training. This is especially true in times of skill-based technical change that favours higher education. For displaced workers, in addition vocational training programmes, conversion training and retraining are central. In contrast, innovation policies focus more prominently on higher education.

The design of innovation policies altogether has only a marginal direct effect on the design of appropriate employment policies. This is also true at the European level. None of the EU innovation programmes requires an interaction between employment and innovation policies. Only in the Structural Funds there is the possibility to integrate employment policies with innovation policies to foster the structural adjustment of regions. On the other hand, employment policies do not directly affect innovation policies.
To sum up, innovation policies and employment policies do not need much direct coordination. However, education and training are central to both policy fields. Thus the consistency between employment policy and education policy on the one hand and between innovation policy and education policy on the other hand ensures that employment policies and innovation policies are well aligned with each other.

The uncertainty of innovation projects and the difficulty to assess their consequences makes it impossible to gear innovation policies towards employment goals. The indirect link is that innovation affects growth and growth affects employment. Innovation, industrial change and the adoption of new technology have important effects on the structure of labour demand. This leads to winners and losers.

Specific employment policies are oriented at solving problems associated with these developments on the labour market. However, the scope for coordination between employment policies and innovation policies is low. At the same time the indirect link between innovation policy and employment policy via education and training is central for the performance of both innovation and employment policies. Thus, the consistency of policy goals between EU innovation policy and EU education policy, and between EU employment policy and EU education policy is central.

4.1.2. Consistency with EU Education and training objectives

As should be clear at this stage of the report, skills contribute directly to high productivity and international competitiveness. A better educated workforce augments the efficiency of labour and raises the capacity of firms to more easily integrate new technologies and ideas. Thus the speed of convergence towards the technology frontier hinges on sufficient supply of proper skills.

Skill shortages could slow the shift to a knowledge economy needed to contest pressure to maintain high employment in European economies faced with increasing international competition and population ageing. If one aims at adequate skills for the knowledge-based innovation-oriented economy, the strong links between innovation and human capital formation call for a consistent policy approach.

On the one hand, successful innovation policies require sufficient supply of personnel with the capacity to engage in research and development. On the other hand, the social benefits of innovation policies in terms of higher growth and employment will be the higher the better the working population is equipped with the skills needed to adopt new innovative products or modes of organisation.

This section provides an assessment of whether European initiatives in the realms of innovation and human capital development sufficiently integrate these interactions in order to achieve consistent results. We therefore first look at whether EU education and training policies are designed to specifically address innovation issues and skill shortages for innovation. As it turns out, innovation and education policies at the EU level hardly go hand-in-hand when it comes to fostering skills for innovation. We therefore briefly discuss whether integrated innovation and education policies are more relevant at the Member State level.

The evidence collected in chapter 3 of this report shows that the skills necessary to support innovation are those related to the ability to perform high qualified research and the soft skills conveyed through general higher education. This makes clear that the single most important policy target at the intersection of skills and innovation is fostering tertiary education. The most urgent challenge facing Europe is therefore connected to the low rates of individuals attaining tertiary education levels in general, and the low shares of the population with advanced education in science and engineering in particular.

Thus the higher education benchmark within the updated Education and training strategic framework, which aims at bringing the share of tertiary education graduates to the level of Europe’s main competitors, notably the US, appears as a means to adapt EU education and training policies to the requirements of an innovation-based growth strategy.
However, from the perspective of providing skills for innovation, it appears that the renewed higher education benchmark is not entirely satisfying.

Empirical research analysing the impact of skilled labour supply on labour productivity growth suggests that the supply of talents – highly educated scientists and engineers – plays an especially prominent role in innovation. Branstetter (2002) and Peri (2005), among others, have shown that a higher supply of talents impacts on a higher number of patents, a useful measure for innovative output.

In this perspective, within the EU higher education benchmark, the structural target of increasing the share of MST graduates is wanting. The observation that Member States have surpassed the MST students benchmark that was built into the Education and Training 2010 Work Programme by a wide margin does not mean that the necessary expansion on the talent dimension is already achieved. Rather, we could argue that the previous indicator for progress in this benchmark area was poorly designed.

As a guideline to orient European higher education policies towards the development of specialist talent for – technological – innovation, it seems recommended to complement the general higher education target with the ambition to reach a higher share of MST graduates among the rising number of tertiary education graduates.

One has to note that any education policy aimed at generating more talent for research and development will not achieve quick success. While institutional conditions such as tuition fees may drive students’ choice of subject away from the fields generating the highest (probably even private) returns, the current lack of MST graduates to some extent is a reflection of personal preferences. Therefore an ambition to improve capacities in math and sciences at lower education levels may also be a successful direction for EU education policy, even if such a strategy would unfold its effects only over the longer term.

Still it appears that the policy field to provide skills for innovation is clearly recognized at EU level. A survey of documents on EU research and innovation policies issued by the European Commission suggests that educational policies should play an important role in the conception of innovation policy as a policy field that involves a large number of policy areas.

The Communication “Delivering on the modernisation agenda for universities: education, research and innovation”\(^\text{14}\) translated this agenda to the field of higher education. It provides the most detailed policy document on tertiary education from the European Commission. It emphasizes that the links between education, research and innovation make tertiary education a core condition for growth in a knowledge-based economy.

Yet altogether the role of the EU is restricted to issuing non-binding recommendations and to the role of facilitator of policy learning. Regarding the field of skills for innovation, the Commission has emphasized that reforms of European higher education would be a key tool. The proposed reforms target inefficiencies that prevent universities from supplying qualifications that match current requirements of the labour market. The diagnosis in brief: insufficient accountability, inadequate rewards for excellence, slow knowledge-sharing and underdeveloped partnerships with private businesses.

A final element in the diagnosis is low mobility of students, graduates and researchers—the only area where EU education policy has its own competence and already plays an important role. The expectation is that higher mobility within the EU higher education area would yield positive externalities by improving the long-term career of academics, a hypothesis altogether supported by evidence (Guellec and Cervantes, 2001; Parey and Waldinger 2008).

The Link Between Job Creation, Innovation, Education and Training

One part of EU initiatives in this regard is of regulatory nature and concerns the structuring of qualifications at the level of University education. The perhaps most important element in this realm is the Bologna reforms. These reforms have introduced some convergence in the structure and length of degree programmes towards the Anglo-Saxon system. The main advantage is that the EU university system becomes compatible with systems of higher education in other countries. Transparency is enhanced and mobility costs for students and graduates are reduced.

A second important part of EU mobility policies is coordinated or even centralised support for students’ and researchers’ mobility. Support programs aimed at fostering the diffusion of knowledge within the EU are an integral ingredient of the strategy to create a European Research Area. One of the important Communications in the area of innovation policy is the Communication “Putting knowledge into practice”\(^\text{15}\). Beside traditional innovation policy instruments, it identifies education as core policy area. It recognizes that innovation remains unsupported without appropriate education. Both improving upon general education (entrepreneurial skills, literacy, scientific and mathematical competence, social and cultural competencies) and shifting advanced education towards MST fields are regarded as necessary to maintain the capacity of Europe to innovate.

With regard to higher education, the Communication emphasizes the need for a stronger partnership between business and universities in order to bridge the gap between academic research and business needs. This theme is taken up in the updated strategic framework for European cooperation in education and training. Here the Commission emphasizes the importance of the knowledge triangle of education, research and innovation (business) for the provision of skills for innovation. Beside an integration of transversal key competences related to general education into curricula, the Commission proposes to foster partnerships between businesses and education and research institutions, in order to create innovation clusters. In this context, the foundation of the European Institute of Technology (EIT) is considered as one direct EU contribution to the field of skills for innovation. The EIT is designed as a practical role model for European universities, as it aims at an integrated partnership of science, business and education. However, it is still too early to assess whether the EIT will manage to make the envisaged contribution to foster skills for innovation.

Apart from this recent initiative, the practice of EU innovation policies appears in stark contrast to the skills for innovation targets officially adopted at the European level.

While the Member States are invited to focus on the provision of key skills related to general education and education of talents in order to improve the employability of workers in the knowledge-based economy and to facilitate innovation, a more specific approach integrating education and training and innovation policies is lacking.

Beside mobility programmes and vocational training programmes, there is no policy initiative in the EU innovation policy that is directed towards the provision of skills. This lack of initiative may be related to the subsidiarity principle establishing that education policy from preschool to universities is a policy area with almost exclusive policy authority of the Member States.

Our survey of the multi-faceted activities within the innovation policy agenda of the EU shows that the dominant means of action are subsidies for innovation projects, public procurement and the establishment of innovative clusters. At the implementation level, there are basically no initiatives to incorporate skills development aspects into these instruments of innovation policy. As far as innovation policies involving innovation subsidies or public procurement are concerned, adding educational goals is practically impossible. Therefore, one may at best constitute a second-round effect of EU innovation policies as they affect the environment in which innovation activities take place. These changes in turn may influence perceptions of skill needs and skill development. But such potential endogenous effects on the supply of skills will be minor and only occur with a substantial time lag.

As there are no major practical examples where one could say that EU innovation policy goes hand-in-hand with a skills for innovation policy, a view on the practice of the Member States is advisable. The Member States would have the regulatory power to combine innovation and education policies to foster skills for innovation.

However, it is very difficult to provide a clear assessment of the policy initiatives relating to skills for innovation in the EU Member States. Cunningham (2004) provides the most recent comprehensive review of policies directed towards the issue of skills for innovation. His review of information relating to programmes and initiatives targeted at improving skills for innovation includes 29 European countries and focuses on:

- organisational aspects of policy development and implementation, including the policy relevance of programmes oriented on skills for innovation policies,
- the modes of delivery of programmes, and
- the institutional set up beyond the public sector.

### Table 8: Importance of Skill Promotion and Training within Innovation Policy

<table>
<thead>
<tr>
<th>Level of Importance</th>
<th>Number of Countries</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Medium-Low</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>Average</td>
<td>11</td>
<td>38</td>
</tr>
<tr>
<td>Medium-High</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>High</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>100</td>
</tr>
</tbody>
</table>

**Source:** Cunningham (2004)

Table 8 displays the results. The first finding is that skills for innovation do not represent a high priority for most countries. In the majority of the countries skills for innovation have an average and medium-low importance for innovation policies. Among the 29 European countries in the survey, only the UK and Finland place high emphasis on skill promotion and training as components of innovation policy.

In fact, the current national strategy of Finland outlining education, science, technology and innovation policy appears as the prime example for an integrated approach to skills for innovation among the EU Member States (see below).
The European overview of skills for innovation policies provided by Cunningham (2004) yields a classification of altogether 123 national policies aimed at improving upon the skills available to enterprises according to the policy means used. In the summarizing Table 9 many policies are assigned to more than one category.

### Table 9: Skill Formation Initiatives and Activities of the Member States

<table>
<thead>
<tr>
<th>Policy &amp; Scheme Category</th>
<th>Number of Programmes</th>
<th>Description of Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting industry involved in curriculum development at (technical) schools</td>
<td>16</td>
<td>Involvement ranges from formal cooperation agreements at the highest government-industry levels (e.g., France) to ad hoc arrangements (UK and Austria). Geography is an important factor – some schemes operate at national level, some at regional (Italy), and others at the level of individual organisations.</td>
</tr>
<tr>
<td>Providing subsidies for employee training (including tax benefits)</td>
<td>22</td>
<td>22 countries report provision of subsidies. Support can be direct or indirect and much is organised centrally (some use of ERD Funding is recorded). It is common to see aid granted to SMEs only. Some schemes operate on the basis of a mandatory levy on business that is repaid in the form of a training grant (Hungary).</td>
</tr>
<tr>
<td>Providing subsidies to develop vocational training projects at firm and sector level</td>
<td>16</td>
<td>Vocational training is frequently organised and coordinated by a public or semi-public intermediary. Some national ministries offer grants for &quot;employment and knowledge enhancement&quot; programmes under a broad umbrella of training. Programmes are in place in Netherlands, Portugal, Sweden and UK.</td>
</tr>
</tbody>
</table>
Table 9 (cont.): Skill Formation Initiatives and Activities of the Member States

<table>
<thead>
<tr>
<th>Policy &amp; Scheme Category</th>
<th>Number of Programmes</th>
<th>Description of Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruitment of highly skilled employees for innovation projects in firms</td>
<td>9</td>
<td>Some recruitment is project specific. Schemes operate at either national or regional level. &quot;Mobility schemes&quot; are designed to allow companies to employ highly skilled R&amp;D personnel.</td>
</tr>
<tr>
<td>Recruitment of researchers, technicians, PhDs and Post docs in firms</td>
<td>16</td>
<td>Schemes in this category aim specifically to increase research activities in firms (and are not targeted at general skills development). Programmes support the employment of researchers in start-ups and transfer of research results (via transfer of researchers). Some countries indicate that one aim of recruitment schemes is unemployment reduction.</td>
</tr>
<tr>
<td>Schemes to allow R&amp;D personnel to gain higher degrees while working in firms</td>
<td>11</td>
<td>Such measures are targeted at reducing &quot;blocking&quot; of research careers. Institutional arrangements that hamper the development of research careers (when academics work in industry or their &quot;applied&quot; research leads to patents rather than publications) are identified as a major obstacle to the mobility of researchers and knowledge transfer. (See &quot;Knowledge Transfer&quot; and &quot;Faraday&quot; Partnership schemes in the UK)</td>
</tr>
<tr>
<td>R&amp;D programmes that include a percentage of the budget for vocational training</td>
<td>4</td>
<td>In a small number of countries, a percentage of research programme budgets is reserved for vocational training (Belgium, Italy, Latvia and Turkey)</td>
</tr>
<tr>
<td>Schemes to allow firms to develop human resource skills strategies</td>
<td>12</td>
<td>HR development is rarely perceived as a strategic target for companies. Schemes in this category aim to support a change in corporate culture that will ensure that the development of HR is taken seriously. Programmes involve training entrepreneurs in techniques for long-term HR strategy-building, and support for contracting-in HR consultants</td>
</tr>
<tr>
<td>Schemes to support innovation management, i.e. to improve the skills of managers of firms in the area of innovation</td>
<td>17</td>
<td>Schemes support the cost of management training (sometimes inside an individual company, sometimes involving a specific training provider). Many programmes are one category in a broader innovation training programme</td>
</tr>
</tbody>
</table>

Source: Based on Cunningham (2004) and Green et al. (2007).
Provision of subsidies for employee training seems the most popular means of supporting skill upgrading. But also programmes that have the capacity to facilitate innovation appear quite widespread. In particular, policies to a) support innovation management, b) get industry involved in curriculum development, and c) support recruitment of highly skilled employees, are found in a large number of countries.

Thus, considering the political practice of European skill formation policies, it appears that there is at least some focus on skills for innovation in most of the Member States. This could explain the low priority level attached to skill promotion and training as components of innovation policy (compare Table 8).

One interpretation would be that the weight of education policies specifically designed to promote innovation within the entire national education policies is small in many countries. An alternative interpretation, however, is that decision-makers do not regard skill enhancing policies primarily as innovation policies, but as employment policies.

A probable reason why one sees relatively little coordination of innovation and education policies at the national level is that the policy competences are allocated to different institutions. Whereas innovation policies are typically under the responsibility of Ministers of Economic Affairs, education policies are typically under the responsibility of the Ministers for Education. In some countries like Germany the primary responsibilities are even on different federal levels, with education policy responsibilities typically more decentralized and innovation policy responsibilities more centralized. This constitutes coordination problems. The Finnish case-study below demonstrates that creating a new body responsible for the development of an integrated education, research and innovation policy may help overcoming coordination problems.

Box 1
Best practice: Integrated education and innovation policy in Finland

The current national strategy of Finland outlining education, science, technology and innovation policy is the prime example for an integrated approach to skills for innovation among the EU Member States. Since 2009 a Research and Innovation Council (formerly named “Science and Technology Policy Council”) has been created to develop and supervise progress of the integrated strategy.

At the core of the Finnish development strategy to ensure sustainable and balanced social and economic development is the understanding that positive development is maintained by a high level of education of the population and versatile development and application of knowledge and expertise. This has lead to a systemic perspective treating education, research and innovation (ERI) policy as an entity.

Within the national development programme, continuous investment in knowledge and know-how has been the chosen approach. The co-ordinated ERI policy programme, started in 2007, manages reforms in areas essential for the overall targets of maintaining high growth and employment despite pressures due to globalisation: reform of university institutions, structural development of higher education institutions, a national innovation strategy, reform of sectoral research, implementation of a researcher career system, internationalisation of research, consolidation of research funding. The main goal of these activities is to improve the quality of research and innovation in a way that promotes converting high-level expertise into productive business activities, new enterprises and jobs.

A specialty in Finland is the implementation of a horizontal innovation policy that aims to also create non-technological and social innovation through partnerships, thus putting emphasis on the role of customers and users alongside traditional R&D-driven activities within research and innovation policy.

The integrated ERI strategy in Finland works on contents, structures and funding.
As an example of best practice, the Finnish approach to contents is probably the most important aspect. The vision for content is a strong competence base combined with well-resourced top units. The operational objective to realise this vision is to further consolidate the knowledge base and to invest – in public-private partnership – on the basis of quality and relevance in (potential) top units. This requires successful choice of fields of high innovation potential. Thus Finland has defined focus areas of high-level research, such as environmental and energy research or knowledge-intensive services. The allocation of innovation funding emphasizes demand-oriented innovation activities on the one hand, and the creation of new innovative growth enterprises seen as employment engines, on the other hand.

A core element within the integrated Finnish ERI strategy is that education policies for the enhancement of human capital are developed in parallel to the content management in innovation policies. The ideal is to ensure that all important fields which are detected as targets for innovation policies have sufficient amounts of well-educated experts providing the basis for successful development measures.

Particular emphasis is put on renewing the researcher community– concrete quantitative and qualitative development targets for researcher education (e.g. the number of graduate school places) are formulated. The quantitative targets are based on evaluation of the quantitative and field-specific need for PhDs. There is an explicit content development aimed at more extensive use of PhDs’ expertise in the business community.

In addition, incentives for talents to engage in high-level research are strengthened by investing in research infrastructures (fitting the orientation of Finish research) and fostering international co-operation. The fairly strong orientation of the EFI strategy towards intensifying internationalization is only in part due to the limited resources of a small country. The strategic goals are opening up markets abroad and facilitating immigration of talent from abroad. It is perfectly understood that building up world-class expertise within Finland is a prerequisite to be attractive for world-wide co-operation.

Altogether, the Finish EFI strategy shows how skills for innovation strategies that merge innovation and education development policies can work at the level of the Member States. In a nutshell, it means that innovation policies are designed with not only a view to employment and growth opportunities in strategic fields, but also with a view to the already available research basis. On the other hand, education policies need to anticipate strategic fields for innovation policies, in order to have sufficient research staff to make them successful.

On top, in both the innovation and the education policy dimension, the Finnish EFI strategy highlights the necessity to strive for world-class excellence, in line with the strategic European goal to maintain a position as the most competitive economy in the word.

### 4.2. EU Cooperation in Education and Training and Employment Targets

The EU framework for coordination and orientation of national education and training policies has recognized human capital as a cornerstone to support growth and create more and better employment. Yet the first question to be answered is whether the specific policies and methods implemented at the EU level are suited to achieve the target of skills for employment, and if so, if they are designed to achieve the employment targets in an effective way.
4.2.1. Rationale for public intervention in education and training

The view of human capital as a lever on employment in itself is not sufficient to command implementation of an EU education and training policy. The immediate connection between education and training and employment also arises, if one explains human capital formation as a private investment process.

The human capital investment model is based on the pioneering work of Becker (1964). It can explain why the private education and training investment process stops at one moment or another. As the returns to schooling are generally decreasing, individuals stop full-time schooling after a certain number of years, and reduce adult learning activities over the life course as retirement is getting closer (Ben-Porath 1967).

In this context, human capital refers to a set of knowledge that is characterized by three features: it is embedded in the individual and thus not transferable; thus human capital is different from physical capital, but also from the income generated by human capital; it is costly to acquire due to the direct costs of education, but also foregone earnings while in education. It however increases the potential income over the life cycle.

As private investors in human capital compare the benefits of better education and skills to the costs of their acquisition, there is a rationale for any intervention that aims at making progress on the efficiency of the education and training system. The production of education is more efficient, if agents can acquire the same amount of human capital at a lower cost, or if they obtain more or better human capital for the same amount invested. Everything else equal, targeting sources of waste within the education and training system therefore is an effective means of generating higher human capital levels.

According to the most simple human capital investment model, there is no room for other types of public intervention in education and training, especially direct or indirect co-financing. Rather, the fundamental implication of the model is that the education and training level obtained by individuals is optimal, if they fully pay for the acquisition of their individual human capital. However, this conclusion only arises in a world without market frictions.

The predictions obtained from the human capital investment model are more complex if one distinguishes between two types of human capital – general skills that are productive in any type of employment, and job (or occupation or sector) specific skills that are only productive in the specific job match. With perfect markets, the conclusion that individuals will fully pay for and optimally invest in human capital only holds for general human capital. In contrast, workers have an incentive to under-invest in job specific human capital. This is due to the possibility that their employment relation terminates before they can recoup the costs of the investment via the higher income associated with the job specific productivity gain.

This argument implies that governmental intervention may be necessary to obtain the optimal level of specific skills. This argument can be particularly relevant in the context of highly specialist skills for innovation, which, at least in the early stage of the innovation cycle, are only of use in a very narrow range of the labour market, i.e. non-general skills.

There is also scope for government policies because of several market imperfections, in particular financial market and labour market imperfections leading to private under-investment on human capital. For example, if individuals are borrowing constrained on imperfect capital markets, they cannot lend on future income to finance current education and training activities. As a result, they will under-invest in human capital. The efficient magnitude of the policy intervention of course hinges on the magnitude of these imperfections.
In this context, public interventions in the market for education and training appear as “second best” policies. Their purpose is to remedy an unwanted outcome associated with inefficiency on another market (the financial market in our example). An alternative to this strategy would be to reach at the “first best” by removing the inefficiency on the other market responsible for the insufficient human capital outcome. However, such a “first best” approach is often more difficult to implement than a compensatory policy in the domain of the second market. Another important rationale for government intervention in the human capital investment process is the supposed externalities on employment of other workers or more generally social welfare. In the context of education and training, such externalities can arise through the impact of skills upgrading on labour productivity through higher technological efficiency of production.

The simplest setting views technology as a factor that raises economic output for any given amount of physical and human capital employed in the macroeconomic production process. This means technical progress allows producing the same amount of output with both less capital and human capital inputs, while one could substitute human capital with physical capital in order to maintain a given output level. Hence the immediate effect of higher technical efficiency of production may be labour (and capital) saving. However, changes in technological efficiency come about through complex processes involving capital investment, research and development and organizational change, which are correlated with the supply of skilled labour.

These processes were discussed in detail in chapter 3. At this stage, it suffices to review the key results suggesting that an additional supply of skills could enhance labour productivity on the macroeconomic average, and therefore employment and growth:

- An increase in the amount of highly qualified labour reduces the relative cost of R&D activities. This yields a higher level of these activities, which at a given success rate yields a higher rate of technical innovation through invention.
- The returns to technical innovation for an investor engaging in R&D depend on how quickly the innovation diffuses in the economy. As new technologies tend to raise the complexity of workers’ tasks, a better skilled labour force facilitates the adoption of new technologies. The resulting profits foster investments in R&D.
- Organizational innovation yields more complex tasks to be performed at the workplace. Therefore, it becomes easier to accomplish organizational change with a better skilled workforce. Quicker diffusion and lower costs help improving profitability of organizational change. This creates additional incentives to engage in this specific type of innovation.

As a result the economy may enter into a positive circle of self-enforcing skills upgrading. Ample supply of skilled labour creates incentives to make productive use of skilled labour. It also facilitates the introduction of technical and organizational change at the workplace. In a dynamic perspective, this raises employment opportunities in the economy even further.

As agents deciding on the optimal investment in education and training do not take into account these positive externalities at the societal level, there is scope for governmental intervention in support of skills upgrading.

The EU education and training framework has a clear theoretical basis in the human capital investment model, as seen above. Thus, it first of all aims at achieving higher efficiency of education and training systems. But the work programme is also based on the notion of several externalities warranting government subsidies to work against a private under-investment in human capital.
The education and training policy framework at the EU level identifies the focal areas of human capital development strategies. It thus guides the direction of reforms determined and implemented at the level of the Member States. The EU framework does not impose specific policy measures, although an exchange of experiences and dissemination of good practice are elements in the open method of coordination. Rather, national progress on the general policy guidelines is monitored through regular status reports. In this way, the implementation of the Education and Training 2010 Work Programme has created momentum to establish reforms in line with a set of common strategic objectives for European education and training systems.

In this context, quantitative benchmark targets are an important, although "soft", means of governance, in order to orientate and enforce the implementation of the EU work programmes within national action plans. The EU approach of guiding education and training policies at the national level through quantitative targets has certain advantages: it simplifies monitoring and comparing progress of the Member States. It also facilitates communicating the notions underlying the EU human capital development strategy.

Nevertheless the benchmarking on quantitative targets as a governance strategy has several pitfalls:

- **Heterogeneity at the Outset**: Considering the achievement of education systems, the Member States are extremely diverse at the beginning of the policy implementation process. At the same time, the chosen targets reflect ambitious goals that are nevertheless realistic at the EU average level. This is problematic from a political economy point of view. Top performers are not encouraged to make further progress. More importantly, the incentives for the poor performers to catch up are weak; they cannot surpass the targets, no matter how their policies develop.

- **Incomplete Targets**: A small set of quantitative targets has the advantage that it directs decision-makers to focus on core benchmark areas. At the same time, it bears a risk that other relevant areas requiring action do not attract sufficient attention. One example is that the important dimension of early childhood education was missing in the Education and Training 2010 Work Programme. Another example is the MST students target, that focused attention on certain subjects at the expense of higher education in general.

A solution to this problem is expanding on the number of benchmark targets. The updated framework of the EU education and training strategy goes in this direction, although details on the envisaged targets (mobility, language and employability) are yet to be determined. The expansion of benchmark areas may have the disadvantage, however, that the intended overall direction of policies becomes more difficult to grasp. This could be the case for the education and training updated work programme. The employability and language capacity targets, for example, are definitely not on the same level of importance as regards impact on employment.

- **Quantity versus Quality**: In the realm of education and training, European tools to obtain systematic quantitative information on skills outcomes are still in their infancy. Thus the benchmark targets tend to stress the quantitative dimension of education. Still the quality dimension would be much more important from the perspective of creating employment through education.

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16 An exception is the basic reading, math and science skills benchmark integrated in the updated EU education and training framework. The practical problem with this benchmark that due to the novelty of the underlying measures, i.e. lack of time series, it is difficult to gauge actual policy progress. For example, the within country swings in PISA results used as a benchmark within the Education and Training 2010 Work Programme appear too large to be attributed only to policy changes. In the domain of education and training, progress made is generally slow, as an important input factor in human capital production is time.
The focus on the quantitative dimension furthermore creates a governance problem. For example, it is relatively easy to achieve progress on lifelong learning in adult education measures by investing a given budget in shorter instead of longer training measures. In the light of these arguments, the new strategic objective identified in the updated education and training work programme looking forward to 2020, namely “to improve the quality (...) of outcomes”, is a good step forward to achieve changes in education levels that will be actually relevant for employment.

In this regard, the initiatives aimed at improving mobility can probably contribute to make considerable progress. In particular the development of the European Qualifications Framework (EQF) and of the European Credit System for Vocational Education and Training (ECVET) as reference systems to measure learning outcomes will allow more in-depth comparison of Member States’ achievement and progress in education. The European targets and benchmarks concerning upper-secondary education and beyond should be adapted as soon as the proposed system of outcome indicators and measures has matured.

Taken together the possible conceptual limitations of a quantitative benchmarks approach to the coordination of EU education and training policies suggests that it does not improve decentralized policy setting in the most efficient manner. A key issue is the very disparate education and training landscape in Europe. Therefore, a target scheme based on relative achievement would probably yield better outcomes. Fixing an inverse relation between the initial achievement and rate of progress expected is a useful approach. It acknowledges that the returns to further reforms are diminishing, as the performance of national education and training systems is improving.

It is however practically impossible to obtain robust empirical evidence for the impact of EU cooperation in education and training on job creation.

The first reason is that the EU education and training policy framework, due to the open method of coordination, only works through the implementation of EU strategies at national level. But it is difficult to assess how national education and training systems would have developed in the counterfactual situation without the EU coordination effort.

The second problem is that in general it is rather difficult to substantiate the employment consequences of a certain reform in the education and training system. The issue here is that it can often take several years before any intervention reveals an effect on individual employment propensities. Thus there is still comparatively little program evaluation in this field. Therefore, even if one could say that the EU framework impacted on a certain reform program, it is unlikely that one could find an empirical impact assessment.

Therefore, we are less ambitious in the following and reflect on what is known about the correlation between the main target areas for education and training embedded in the European policy framework on the one hand and individual employment opportunities on the other hand.

**Life Cycle Approach to Learning**

An important feature of the EU education and training work programme, which seems even more clearly visible in the updated strategic framework, is its emphasis on the need for lifelong learning. More specifically, the work programme embeds the notion of a life-cycle model of skill formation whereby skills obtained at a lower education level are beneficial for making educational progress later in life. The inclusion of the early-childhood education benchmark in the updated set of EU policy benchmark targets for the year 2020 strengthens this perspective.
The current approach is in accordance with the evidence that allocation of public investment in education over different phases of the life-cycle is important to maximize employment opportunities, or more generally, social welfare in an economy (Pfeiffer and Reuss, 2008). The evidence is rooted in the empirical and theoretical research on the learning process over the life-cycle, which puts emphasis on the technology of skill formation (Carneiro and Heckman, 2003).

This concept stems from findings in neurobiology and psychology and argues first, that multiple skills are required for the formation of human capital—cognitive skills such as reasoning and intelligence or memory power, and non-cognitive skills such as persistence and social integration. Moreover, skills beget skills. This means that the formation of human capital is a cumulative, synergetic process which is affected by the environment and genetic endowments and both formal and informal investments into education and training.

The cumulative nature of the human capital process yields two basic features of the nature of learning and skill formation. The first feature is that skills of past periods remain productive for the attainment of current skills. This is the so-called self-productivity of education. The second feature is that the higher the skill level, the higher the potential return of subsequent investment in skills.

According to this concept, any educational intervention at an earlier stage of the life-cycle will have a lasting effect on the outcome of educational interventions at later stages. This approach yields two important policy implications. The first implication is that if one seeks to maximize the total returns to education, the society should invest the available resources primarily at earlier stages of education. Education researchers indeed observe that the highest returns to education investments arise if the investment occurs at a very early stage of the life-cycle. Barnett (1992, 1995) reviews some of the early evidence regarding long-term effects of pre-school education. He observes notable impacts on school achievement, grade retention, placement in special education and social adjustment. Currie and Thomas (1995) and Reynolds and Temple (1998) find high learning to learn effects of pre-school programmes targeting disadvantaged groups.

The second policy implication of the lifetime model of skill acquisition is that if one wishes to reduce inequity in the society, one should direct the scarce public resources for education and training primarily to the most disadvantaged. Public investment into early childhood development in order to equalise initial endowments is better than compensating differences in outcomes later in life (Currie, 2001).

Against this conceptual background, policies pursued at the EU level appear quite well founded and consistent. The targets can be ordered in a chain of education stages: early-childhood education, basic skills, completion of basic schooling (promoting secondary education attainment), tertiary education, and adult lifelong learning. The individual targets in this chain are generally reinforcing in a sense that progress on more basic lower education levels promotes progress at more advanced upper education levels. This is consistent with the skills beget skills model of human capital formation over the life cycle.

However, if one seeks to strengthen the long-term efficiency of public intervention in education and training, and therefore the potential employment effects, it may be useful to put even stronger emphasis on early childhood education than the current strategic framework of EU education and training policies does. In particular, the current benchmarks for policies in this field seem insufficient to push education for children younger than age 3 – especially important for children from disadvantaged background. Furthermore, the quality dimension is particularly important in the domain of early childhood education, and therefore would require special emphasis.

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In any case, the positive labour market and other social benefits of more and better early childhood education unfold only very slowly. Therefore, in face of the current needs for skills fuelled by technological and demographic change, the additional benchmark areas focusing on compensatory education interventions later in life are necessary, too. They are directed towards the employment opportunities of the majority of generations who have already past the elementary stages of the education process.

**Basic Skills**

The technology of skills production model stresses the importance of basic skills for learning to learn. Individuals who have a disadvantage in the skills required to learn early in their life have difficulties to overcome this deficiency later on. Linnakylä et al. (2004) argue that basic skills are prerequisite for successful participation in most areas of youth or adult life. Sufficient skills lower the risk of being marginalised in terms of work, transition from education to work, and benefits from further education. Studies for Canada, Denmark and Australia deliver evidence that PISA performance at age 15 – a benchmark target of the EU Education and training policy strategy – is closely related to future educational success. In particular, there is a close empirical association with subsequent completion of upper secondary education and participation in post-secondary education (OECD, 2007).

However, the direct impact of rising basic skills levels on employment is under-studied empirically. The primary reason is lack of data. Comparative measures of pupils’ basic skills have become available only recently and only few data sets track individual pupils such as to observe their employment career. However, cross-country analysis at the macroeconomic level suggests that reading proficiency in the population positively impacts on the development of economic welfare over the longer term (OECD, 2003). This relationship probably reflects the returns to basic reading literacy proficiency at the individual level.

**Early School Leavers**

From an empirical perspective, there is a direct employment rationale for fighting early school leaving: early school leavers face systematically lower employment rates not only at the transition from school to work, but throughout their life course. Two sources feed the lower employment rates of this skill group. The first is the long-term process of skill-biased technical change shifting relative labour demand toward higher skilled workers. Early school leavers only have a minimum endowment of vocational skills, while in knowledge-based economies employment opportunities for agents without adequate vocational training are in decline.

The second is that early school leaving sends a negative signal to employers. Even if individuals become endowed with the vocational skills required to perform a job normally associated with upper secondary education (for example as a result of practical work experience), employers often take the plain fact of a lacking degree as an indication of negative unobserved abilities.\(^{18}\)

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\(^{18}\) The fact that non-early school leaving also works as a screening device comes through, for example, in the regularly estimated wage penalties for high school dropouts in the US, for individuals without A-level qualification in the United Kingdom, or for individuals without apprenticeship training in Germany.
In line with the “skill begets skill” model of individual human capital development, fighting deficiencies that lead to early school leaving improves the prospects for the entire lifetime learning career. A falling share of early school leavers is associated with a rising share of upper secondary education graduates. This is not only true at the macroeconomic level, but also on the individual level. Upper secondary education can either provide vocational education serving to find better and more stable employment, or it can serve as a stepping stone to higher education afterwards or later during the life-course. Thus higher upper secondary graduation rates can yield higher tertiary education rates even without any specific policy fostering academic training.

Likewise, making progress on upper secondary education participation can contribute positively to lifelong learning. The propensity to engage in adult learning activities is several times higher for individuals with upper secondary education than for individuals without. Therefore, participation rates in lifelong learning programmes increase, if upper secondary education attainment rates increase, even without any adjustment of adult learning policies.

Such dynamic, self-reinforcing education processes obviously support individuals’ long-term employment advancement in the labour market.

Higher Education

The arguments why employment objectives are served by giving impetus to the development of a higher share of workers with academic qualifications have been reviewed at length above. The direct link is that the availability of talent with high general and/or specialist human capital affects the level of employment in innovation production activities such as R&D. This is reflected in the enhancement of innovation and creativity skills as part of the updated strategic objectives for the EU education and training policy framework.

But the indirect effect of higher education for the employment level in knowledge-based economies is even the more important. In a dynamic perspective, implementation and diffusion of new technologies created through innovation tend to create more and especially better jobs. According to the acceleration hypothesis, skilled workers can benefit more from new technologies than unskilled workers, i.e. new technologies are more complementary to skilled work. Thus, human capital becomes an endogenous input in the macroeconomic production function. More rapid economic growth results from an acceleration in technical change associated with growth in production factors strongly required for technological innovation. If a successful circle of endogenous technological change is started, new technologies will create more employment for a skilled labour force, and so on.

As individuals in making their private educational choices do not account for the positive externalities of such macroeconomic repercussion, there can be under-investment into higher education from a societal point of view. In other words, agents deciding to invest in higher education do not only improve upon their own employment opportunities, but also contributes to better employment opportunities of others. Thus the EU employment and training strategy of promoting higher education can raise employment in the aggregate.

Training and Adult Lifelong Learning

Adult lifelong learning refers to human capital formation that occurs after completion of formal schooling and entering into work force. Whereas accumulation of human capital in schooling is generally referred to as “education”, the adult lifelong learning target addresses “training” which takes place while individuals pursue their working career.
The updated strategic objectives of the EU education and training framework more than ever stress the need to support adult learning and vocational retraining over the life course. The perceived challenge is that innovation processes yielding structural and organisational change hamper employment chances of less educated and older workers.

These workers in fact participate less in adult education and training. One explanation can be a non-supportive lifelong learning environment or inefficient education institutions. An alternative explanation, however, is specific individual incentives to train. If one ignores retraining measures for the unemployed, most of the training aimed at maintaining and improving upon productivity of workers today takes place at the workplace. Furthermore there is now sufficient empirical evidence to claim that most of the training is actually paid by firms, although orthodox human capital theory (Becker 1964) hypothesizes that they should not pay for general training, i.e. training of skills that are portable across companies.19

In assessing whether the adult lifelong learning target fits with the EU employment targets, this is a most essential fact. If one wishes to find a scope for policy intervention in this area, one needs to demonstrate that firms from a social perspective systematically under-invest in training.

From a theoretical perspective, several arguments suggest that firms may invest less in training and retraining than socially optimal. One possible case is that the productivity returns from general training are larger than the wage returns.20 This can create a so-called hold-up problem. Trained workers could share the benefits of training with future employers (Leuven 2005). An alternative case is that new employers pay trained workers less than their productivity. The resulting externality on profits is not accounted for by the employer providing the training – the so-called poaching problem (Stevens 1996).

Neither the hold-up problem nor the poaching problem by necessity create under-investment on training, however. More complex models integrating network effects or complementarities between training and innovation demonstrate that the under-provision of training is just one of several possible economic equilibria.21

Careful survey of the empirical facts does not produce convincing evidence that firms would actually provide too little training from a societal point of view.22 To judge whether the training investment process is socially optimal, one has to compare the private costs to the private and social returns in form of higher productivity and wages associated with workplace training. Unfortunately, compared to the literature on the social returns to education, the empirical literature on the social returns to training is still in its infancy.

One may borrow further arguments to justify public intervention on the provision of training from the general discussion on positive education externalities. A first argument is complementarity of training and innovation in the spirit of Acemoglu (1997). The second is positive spill-overs from trained workers on the productivity of unskilled workers. The third is liquidity constraints yielding insufficient private investment into general training. But the available empirical evidence for complementarities between human capital and innovation and positive spill-overs on productivity is exclusively based on education, not training. Only the liquidity argument has some weak empirical support. In particular, it appears that financial constraints reduce training activities of low-income workers after job loss.

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20 This implies that workers are not paid according to productivity which can only occur on a non-competitive labour market.
21 Acemoglu (1997), Brunello and Medio (2001), Snower (1996) and Redding (1996) are just some examples of this literature.
22 See Bassanini et al. (2007) for a comprehensive and balanced overview of the conceptual and empirical issues related to workplace training in Europe.
But the overall empirical picture is that it is practically impossible to judge if the private investment process on training leads to inefficient outcomes, and if it did, how much observed training participation rates would differ from the social optimum. Given the scant knowledge on the training investment process in general and the effects of training policies in particular, decision makers should be very careful with policies aimed at fostering training rates. The conclusion follows that the strong emphasis on the adult lifelong learning target may lead EU education and training policies in an unproductive direction.

Entrepreneurship

One of the new strategic objectives formulated in the context of the recent update of EU education and training policies is the enhancement of entrepreneurship. Entrepreneurship is a traditional pillar of the European Employment Strategy. The integration of this factor into the EU education and training framework thus can be seen as a means to work on the consistency of general employment and human capital development policies.

According to the empirical evidence entrepreneurship is clearly associated with employment growth. Job creation dynamics in newly established firms is generally large. Even if one accounts for the high failure risk of new establishments, much of the employment growth in an economy stems from the start-up of new businesses. The dimension of entrepreneurship is connected to education via two channels.

The first channel is a systematic relationship between years of education and rates of entrepreneurship. The typical form of this relationship is a U-shape, which means that entrepreneurs are more frequent among the low-educated and the high-educated individuals. However, the propensity of small businesses growing into medium-sized and large firms is markedly larger for better educated entrepreneurs.

The second channel is indirect and works through innovation. Especially in high tech areas, innovators often become entrepreneurs in order to bring their own invention to the market. This second channel also hints at the direct link between innovation and entrepreneurship. Therefore, entrepreneurship is one of the areas where education, innovation and employment targets of EU policies immediately coincide.

Focus on Equity

A final noteworthy feature of the EU education and training work programme, which has been strengthened by the strategic update of the framework, is the emphasis on equity considerations. These are visible especially in the early-childhood education participation and early school leavers objectives, that directly aim at better access to education and training for the disadvantaged.

These objectives are in line with the goal of ensuring inclusive labour markets. The argument to target policies on disadvantaged groups is that the education (and thereby employment) gaps between subgroups in the population reflect lack of equal opportunities. This means that the observed differences in outcomes do not arise from individual effort, but from circumstances for which the individual cannot be held accountable, notably race, gender and family background (Roemer 1998).

Under certain conditions, the equity target is also relevant for the employment and growth targets. A policy emphasis on equality can be warranted to the extent that a high degree of inequality in a society in itself may hamper its long-term employment and economic growth potential. Yet this effect would usually only arise in economies with a much higher degree of inequality than is common in Europe (Benabou 2000).
Another possible justification of public intervention to support education of the socially disadvantaged is the inability of poorer families to invest in proper education due to liquidity constraints. As human capital is costly to acquire, liquidity constraints on imperfect financial markets can lead to under-investment in human capital even if better skills improve individual employment prospects. Agents from a poor socio-economic background may be faced with stronger liquidity constraints: if this is the case, they would acquire less human capital than optimal from their own perspective.

One must note, however, that the overall empirical evidence for liquidity constraints reducing human capital formation is at best mixed. Kane and Rouse (1999) can confirm that pupils from low income households invest less in education despite higher returns. They also show that their education choices are more negatively affected if tuition costs increase. In contrast, empirical results presented by Carneiro and Heckman (2004) and Cameron and Taber (2000) indicate that the empirical relationship between educational attainment and parents’ income may be spurious and just reflect differences in ability.

As regards training measures, there is some more solid empirical ground for public intervention serving equity purposes. The notion that skills beget skills implies that individual disadvantages due to failures in education are amplified by the resulting learning disadvantages in training. Put differently, unequal opportunities in education may yield disparities in training outcomes, for which the individual cannot be held accountable. Econometric results by Bassanini et al. (2007) on the basis of the ECHP show that in Europe the participation rate in training is lower for young workers coming from a low-education background, even if one controls for their own level of education. Thus training policies for the socially disadvantaged may contribute to social inclusion, as training yields higher wages and employment chances.23

Yet all things considered, it is not generally true that public investment to strengthen the equity of education outcomes is a better lever to employment than rising average skill levels or even widening the skill distribution by focusing on higher education. In this perspective, it appears that the current EU education and training policy framework has to cope with the well-known general trade-off in terms of employment or growth and social equity (Okun 1975).

4.2.2. Consistency with Employment Targets

The analysis in the previous section showed that the dimensions of education and training that are targeted by the EU policy framework are generally well matched with the ambition to obtain opportunities for more and better employment in Europe. The skills enhancement strategy is designed to make progress on employability, i.e. individual employment propensities. The discussion above showed that the distinction between employability and employment is very important. It is possible that skills acquired are unemployed, under-employed or wrongly matched. Put differently, the EU education and training strategy leading to skills upgrading is only consistent with the employment objective, if the labour market can actually absorb the additional supply of skills.

As market imperfections may impede proper matching of human capital supply and demand, the way the potential effects of EU education and training policies on employment unfold hinges on the general framework of institutions and policies impacting on the economy. Considering that human capital through better education and skills is a factor enhancing the innate productivity embedded in workers, labour market institutions and their capacity to facilitate or impede the use or reallocation of labour are especially important in this regard. In summary, EU guidelines for the employment policies of the Member States rest on the following pillars:

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23 Training policies with this goal should be targeted at individuals (not firms since they do not aim at social equity).
• Full employment whilst strengthening productivity of jobs, i.e. creation of more and better jobs, and social and territorial cohesion (guideline 17 of the 2008-2010 Integrated guidelines for growth and jobs).

• Life cycle approach to work paying special attention to the labour market integration of young workers, female workers and older workers (guideline 18).

• Balance of work incentives and social support, in order to ensure work attractiveness whilst guaranteeing sufficient income for disadvantaged individuals and the unemployed (guideline 19).

• Matching and adaptability to promote employment through higher levels of job creation, occupational and geographical mobility, and to facilitate the adaptation to macroeconomic shocks both from internal and global sources (guidelines 20 and 21).

• Employment-friendly wages to assure labour costs following productivity on the one hand (the gross wage perspective) whilst maintaining employment attractive income levels for workers (the net wage perspective) (guideline 22).

Some of these pillars of the European Employment strategy integrate the strategic objectives of the updated strategic framework for EU education and education policies. In particular, the life-cycle approach to work corresponds to the life-cycle approach to education and training, with its focus on both education for easier labour market entry and lifelong adult learning to ensure employability over the life-cycle.

The matching and adaptability pillar seeks to achieve better matching through better anticipation of labour market needs, including skill needs, and positive management of change, including re-training. This objective comprises the goal to focus more attention on developing skills that better match predicted future labour market needs, in accordance with the “New Skills for New Jobs” initiative.

Thus the first impression is that the frameworks used for co-ordination of employment and education and training strategies at the EU level share a similar theoretical basis. As the recent renewal of the strategic framework for the development of EU education and training policies up to the year 2020 strengthened emphasis on the lifelong learning and efficiency objectives, it furthermore appears that the two fields are now closer together than under the previous Education and Training 2010 Work Programme.

Still we provide a more in-depth analysis of the interrelation between employment and education and training policies pursued at the EU level in the following. The aim is not only to evaluate the general consistency of the two fields of action, the more important objective is to analyze whether there is scope for a more integrated approach to obtain better results as regards both human capital development and employment.

In this section, we discuss the consistency of the EU education and training strategy with the targets of “more and better jobs” that are at the core of the EU employment policy framework. At this stage, we suppose that labour markets are sufficiently flexible to absorb an additional supply of skilled labour. In the following section, we look at the consistency of the two policy areas from the opposite angle and discuss how specific employment policies that set the regulatory frame for labour market development could help making progress not only on the EU employment targets, but also on the education and training targets. Here we will stress the role of labour market frictions impeding progress on these dimensions.
Promotion of “More Jobs”

The fundamental EU employment policy guideline – guideline 17 of the Integrated Guidelines for EU economic policies – demands implementation of employment policies that aim at achieving full employment. The particular targets to be achieved are a higher average employment rate for the EU overall, a higher employment rate for women, and a higher employment rate for older workers. The core employment policy guideline also sets the objective of generating better jobs, a core dimension of which is more productive jobs. And finally, a core overall employment goal is strengthening social cohesion.

In the context of this guideline, investment in human capital is identified as one of the key priorities. Indeed, raising human capital through better education and skill levels is generally considered a most effective means of generating high levels of employment.

From the point of view of economic theory, one basis of this statement is the nature of individual human capital development as an investment process, as recalled above. The view that in making their decisions agents balance returns in terms of higher income to the costs of skill acquisition implies that forward-looking agents with perfect foresight do not invest in human capital that is not productive or not employable. Therefore, one fundamental implication of the human capital investment model is that individual labour market activity and education levels are positively correlated. The individual correlation carries over to the aggregate level.

The following presents the key mechanisms through which skills upgrading may help making progress to the EU full employment targets.

A useful starting point is that changes in the employment rate are driven by two factors: participation rates among the population at working age and employment rates among the participants.

Considering the relation between human capital and labour market activity levels, economic theory predicts that the labour market participation rate is a positive function of potential wage. The reason is that the opportunity costs in terms of foregone earnings when not participating increase in the wage rate. Accordingly, empirical labour force participation rates systematically grow with educational levels. They are often close to a 100 percent for male individuals with tertiary education at prime working age.

Some more subtle correlations need to be stressed:

As regards working hours (conditional on the decision to participate), the qualification upgrading effect is in principle ambiguous. If leisure is a normal good, the better qualified with higher income capacity want to consume more of it and thus spend less time working. However, the empirical evidence shows that the price effect – leisure is more expensive for the better qualified – normally is too strong to dominate this income effect. Thus skills upgrading improves economic output further through the channel of better qualified workers working on average longer hours.

Second, advancement in higher education also has a negative side-effect on participation rates. Individuals engaged in full-time education postpone their entry to the labour market. They forego current earnings to obtain higher future earnings through better education and skills. This investment trade off is also present for training on the job or lifelong learning. As time spent on education competes with time spent on working, the process of qualification upgrading goes along with a transitory reduction in working hours. Everything else equal, this puts a strain on growth of economic output during education or training.
If agents make optimal decisions on human capital, such an output loss is transitory. The future output gains from an additional unit of human capital acquired must be at least as large as the output foregone during the additional time spent in education. Still this line of argument implies that efficiency of education must be a matter of concern for policy makers. It is immediately positive for economic output to speed up the education process, i.e. to make it possible for individuals to reach a defined qualification goal in shorter time.

At present, the timing at which individuals enter the labour market varies substantially across the Member States, even if one compares individuals with the same formal level of qualification. While the efficiency aspect is present in the current EU education and training strategy, it does not especially stress the time dimension of education. In view of the EU employment targets, a strategy aiming at anticipating the age of labour market entry for a given qualification level appears as coherent. An example of such a policy is found in Germany. Most Federal States have recently reduced the compulsory time on the higher schooling track that allows entry to the university system (“gymnasium”) by one year. The positive impact on labour market participation rates among young adults is already visible.

Third, higher education in general has a positive impact on the age at which individuals effectively withdraw from the labour market to enter retirement. Several factors are responsible for this association. There is a positive association between education and health status, which reduces the risk to retire early because of disability. The better earnings and employment prospects of the better-educated make staying in the labour force more attractive than retiring. The better educated also tend to retire later to compensate for the shorter lifetime employment history because of longer training periods.

The specific relevance of these factors hinges on the design of insurance system providing income in old-age. Still, as in general better educated workers retire later, the higher education benchmark within the updated EU education and training framework is immediately consistent with the older worker participation rate objective within the employment policy guidelines at the EU level.

Higher education is also a lever on closing the male-female participation gap. The gaps between labour force participation rates for high-skilled versus low-skilled agents tend to be especially pronounced for women. The explanation is that individuals planning over the life-cycle take labour market participation and fertility decisions simultaneously. As career interruption is more costly for higher educated women, they tend to continue working after child-birth, or, if it is difficult to balance family life and work, abstain from giving birth. Thus, everything else equal, progress on the human capital of women should help making automatic progress on the female employment rate target in the EU employment policy framework.

In this context, it appears that the updated EU education and training strategy framework is not yet fully aligned with the European employment targets. The early childhood education benchmark focuses on provision of childcare for children between 4 years old and the age for starting compulsory education, but there is no definite target for early childhood education rates of younger children. In contrast, the EU employment policy guideline promoting a life-cycle approach to employment sees securing coverage of at least one third of children under 3 years old by 2010 as a useful benchmark.

As a means to obtain maximum return to investment in education, placing this early childhood education benchmark within the strategic EU education and training policy framework is clearly advisable. It would emphasise the dynamic gains from learning to learn, and also help effectively work against exclusion by intervention at a very early stage of life.
But there is also a second rationale to further strengthen the importance of securing childcare provision in an early phase after birth, both from an employment and education policy perspective. The career interruptions around birth have very large negative long-term effects on mothers' employment and wage developments after return to the labour market.

Thus lack of childcare security early after birth is detrimental to the EU higher female employment targets. At the same time, the investment perspective on human capital implies that the anticipated slow-down of the career after a birth-related employment interruption encourages women who wish to realize their wish of having a child to invest less in education. This explains the inverse correlation between fertility and education (as well as employment) levels of mothers in countries without extensive systems of day care provision for children younger than 3 years of age.

An alternative strategy to expanding early childhood education also at very young ages would be to focus on compensatory measures. One of the reasons why mothers experience wage losses after the return to the labour market is depreciation of their human capital while staying at home for childcare. Thus one policy option is education strategies that specifically target mothers during their career interruption. However, human capital depreciation is not the only reason for the wage loss (add network and signalling effects, for example). Therefore, minimizing women’s employment interruptions associated with child birth is probably a more coherent strategy serving both education and employment purposes.24

So far, we have focused on participation rates, whereas the ultimate benchmark for EU policy is employment. The gap between employment and participation rates is the unemployment rate. Thus demand factors come into play. An empirical fact in knowledge-based economies is that the unemployment rates for the more qualified are systematically lower than the unemployment rates for the less qualified. In EU27, the employment rate of 15-64-years-old is around 84 percent for individuals with tertiary education, but only around 48 percent for individuals with less than upper secondary education (figures of 2007). It follows that skills upgrading could markedly reduce the average unemployment rate in the European economy.

Skills upgrading also appears consistent with the European employment policy targets when one considers the female and older worker employment rates targets. In each EU Member State higher education is associated with higher employment rates for both female and older workers. The reason is not only the positive association between participation rates and educational attainment discussed above. Also the unemployment rate differential between men and women, or respectively older versus younger workers, usually decreases as educational attainment grows.

In sum, a general qualification upgrading strategy may boost employment through rising labour force participation and employment rates in accordance with the guidelines for EU employment policy. As a side effect, the qualification strategy may contribute to strengthen social inclusion. It can reduce gender-related labour market imbalances, at least under the condition that the employment policy framework is set so as to facilitate family life and work. It may also promote integration of older workers, at least under the condition that retirement schemes are set up so as to discourage early retirement.

The “life-cycle approach to work” guideline within the EU employment policy guidelines clearly recognizes these conditions as a useful framework to enhance employment. In this regard, the EU does promote the implementation of measures that reinforce the possible employment impact of the up-skilling target at all levels.

24 The strategy is also useful to achieve higher long-term economic growth through population growth. Skills upgrading in combination with lack of childcare facilities seems to be a major source of continuous low fertility in several Member States.
The Link Between Job Creation, Innovation, Education and Training

Promotion of “Better Jobs”

Besides rising employment levels, a core benchmark of EU employment policies is generating higher productivity at work, i.e. “better jobs”. The emphasis put on the quality of employment is essentially rooted in the Lisbon growth objective. Labour productivity is the key link between the supply of human capital and economic growth from a macroeconomic perspective.

To understand this link better, it is useful to refer to the most basic macroeconomic production function which supposes that economic output is generated through combination of three factors: (i) units of effective labour input, (ii) units of capital input and (iii) technology. For simplicity, “technology” here refers to a constant factor that raises economic output for any given amount of capital and labour employed in the production process. Put differently, technical progress allows producing the same amount of output with less physical capital and less human capital. We furthermore assume that one can substitute human capital with physical capital and maintain a certain output level.

A key notion here is that the effective labour input is conceptually different from the number of workers. Workers may produce more or less output depending on the amount of human capital embedded in them. Thus effective labour input represents the number of workers weighted by their human capital content.

This simple framework is sufficient to rationalize on the levers of labour productivity, which is the output produced per worker. A decomposition of the macroeconomic production function yields that a change in labour productivity can come about through a change in one of the following components:

- growth in the amount of human capital embedded per worker,
- growth in capital intensity, i.e. the amount of capital employed per worker, and
- growth in the efficiency of production resulting from technical change.

Considering the first component, we already demonstrated that human capital acquisition in general has a direct positive effect on labour productivity and therefore economic output per worker. This directly follows from the understanding of human capital acquisition as an investment process. In the human capital investment model, the only condition necessary to obtain this result is that the human capital embedded in workers is actually employed at its proper productivity level. In the remainder of this section we ignore any demand conditions that could generate unemployment.

Regarding the second component of labour productivity growth, the relation between the supply of skilled labour and the development of capital intensity is ambiguous. The relation depends first of all on the practical degree of technical substitutability between the effective labour and capital in production.

If it is possible to replace units of physical capital with units of effective labour in the production process, average labour productivity may decline in response to a more abundant supply of effective labour. Employers can maintain a given level of output by employing more workers and fewer machines, which reduces output per worker. On the other hand, the production process may be organized so that additional units of effective labour can only be productive when they are also equipped with machines. In this case a more abundant supply of labour also makes capital inputs more profitable. This mechanism would raise capital intensity.

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25 In technical terms, physical and human capital are said to be complements in this case. In the case explained before, the two factors of production are said to be substitutes.
If seen from a purely technological perspective, one would generally argue that unskilled labour is easier to substitute with physical capital than skilled labour. Therefore, one could say that general skills upgrading can boost capital intensity. It follows that relative growth in the supply of skilled labour tends to reduce the price of this production factor, relative to the price of capital. All other things equal, the ensuing relative price shift would increase the demand for skilled workers relative to the demand for capital. As a result, capital intensity (the ratio of capital per unit of labour) would decline. This would be detrimental to the development of the total labour productivity growth rate and thus to economic growth.

However, this reasoning is based on the assumption of constant labour demand. Yet in a dynamic setting, one should expect an expansion of demand for qualified labour when the supply of qualified labour increases. As soon as a positive shift in the labour demand curve follows a positive shift in the labour supply curve, employment of skilled labour in equilibrium will increase further and at a growing wage. Provided that the demand shift effect is strong enough, the wage level could grow above the starting level. Thus it is possible that the initial negative effect on capital intensity is reversed.

A first channel why a dynamically growing demand for qualified labour should be expected in response to increased employment of qualified labour is the direct demand effect generated on the goods market. Empirical evidence on consumption patterns by level of education shows that the consumption bundles of higher skilled individuals contain a higher share of qualified-labour intensive goods. A second channel is the endogenous technical and organization innovation diffusion processes associated with growing employment of qualified labour.

In summary, it appears that upgrading skills in the workforce is likely to improve labour productivity. There is a direct positive human capital effect and an indirect effect through the capacity of innovation. In principle, falling capital intensity could dampen these positive effects. But the possible capital intensity effect is probably not strong in the knowledge-based European economies where employment of human skilled labour and physical capital tend to move together. Thus it is fairly safe to say that the general EU skills upgrading strategy is consistent with the quality of jobs dimension of EU employment policy.

**Employment Policies complementary to “More and Better Education”**

The assessment of the overall EU education and training strategy and its individual components so far has shown that the benchmark areas and target measures agreed upon are generally appropriate to push human capital development policies of the Member States in a direction that promotes higher employment and economic growth rates.

However, the discussion also showed that the size of the expected positive effects of EU education and training policies hinges on general economic policy conditions and institutional settings. While more and better skills will be generally employable in the European knowledge economy, labour market conditions must be such as to actually employ them in the most productive manner. In other words, any employment strategy built upon a qualification strategy will be more effective, if appropriate labour market policies accompany education policies.

In this perspective, labour market or employment policies primarily appear as reactive policies. Given that the skill composition of the workforce changes, they should set the conditions for the labour market to adapt so as to ensure full and adequate employment of the new skills. The core handle to improve upon then is efficiency of the matching process that brings together supply and demand.
Yet the role of employment policies appears even more important, if one understands that they have an active part in human capital acquisition as an investment process. Agents choose the amount of education and training investments depending on the expected employment of the acquired human capital, and the price obtained for delivering it to the market – the (net) wage. In this perspective, an effect of employment policies that aim at a better functioning of the labour market can be to provide individuals making education choices with the right signals. Therefore, employment policies are also an important lever on human capital formation. This means that it may be possible to generate “more and better education” with less public intervention in the education process.

In this context, it is worth noting that the benchmark proposed by the European Commission to raise investment into modernised higher education to a quota of two percent of GDP does not appear particularly useful. Low private investment rates in Europe, especially compared to the key competitor US and Japan, may just be a reflection of a disadvantage in the private returns to education stemming from the various market and policy imperfections discussed just before.

However, the target seems ill-defined at least as far as the goal of higher public spending on education is concerned. A pure public spending target ignores the social returns of the investment and therefore does not send signals to allocate the additional resources into the most efficient use. Alternatives to a public spending benchmark would be more specific input targets with an empirically grounded benefit-cost relation.

The empirical education literature has extensively studied the impact of public resources raising the performance of students. From this literature it appears that class sizes or student-teacher ratios are relevant inputs in skill production. Yet the strength of the relationship is controversial. A review by Hanushek (1997) concludes that there are no class size effects on student performance, whereas the reading of the literature by Hedges et al. (1994) and Krueger (2003) is that smaller class sizes do have a beneficial effect. Also quasi-experimental evidence by Angrist and Lavy (1999) and Krueger (1999) shows a positive effect of reducing teacher-student ratios, especially on disadvantaged pupils.

Nevertheless, the empirical basis on the efficient allocation of public resources in learning institutions is probably still too controversial to turn it into a benchmark for EU education and training policies. Thus one may prefer a benefits benchmark focusing on the outputs of education (i.e. wage returns) over a cost benchmark focusing on more specific inputs.

The renewed EU education and training policy framework, compared with the 2010 Work Programme, strengthened the aspect of employability. Although the Commission still has to work on a concrete benchmark, the envisaged general direction is to measure labour market success depending on a person’s level of educational attainment. Such a measure works in the direction of investigating the returns to education. Focus on the employment dimension misses, however, the important wage dimension. For example, over-education can be a source of wage compression, see the discussion of mismatch phenomena above, that does not show in employment rates but could send an important signal to individuals making education choices.

“New Skills for New Jobs”

Within the context of the EU employment guidelines, strengthening the private education investment process does not turn up as a prime measure to ensure a better matching of skills supplied with labour market needs. The guidelines rather seem to take more of a planner’s perspective. They suggest that better anticipation of skill needs, labour market shortages and bottlenecks would help directing education and training choices to match demand.
The clearest expression of this demand side orientation within the EES is the European Commission’s “New skills for new jobs” initiative. The initiative encompasses the major European employment support initiative as part of the European Economic Recovery Plan proposed in response to the global financial crisis, as well as the central idea within EU education and training policies to upgrade skills at all levels to increase employability and reduce inequalities. However, the specific feature of this initiative is to adapt education and training systems to generate “new skills” responding to “new jobs” that are expected to be created in the future.

The initiative thus addresses the long-term challenges for EU labour markets in terms of skills requirements. One dimension of this is ageing of the population that will affect both the supply and the demand side of the labour markets. On the supply side, demographic trends change the skill composition of the workforce, as the qualification structure of older workers exiting the labour market is generally different from the qualification structure of the generations entering it. As European education and training have been expanding in the past, this process generates a quasi-automatic increase in average skills levels. Yet it is still possible that the so-called replacement demand due to retirement creates bottlenecks in certain labour market segments.26

On the demand side, the aging process is expected to create additional employment opportunities in human services, notably health and social care jobs. Yet this is only one strand of demand side challenges identified by the “New skills for new jobs” initiative. One other strand is the long-term restructuring of labour demand associated with technological change. The EU Communications on the initiative mention the diffusion of ICT, the development of nano-technology and the shift to a low-carbon economy as mega trends impacting on long-term relative shifts in labour demand.

Against this background the initiative stresses the importance to overcome structural rigidities to prevent skills shortages – mobility, administrative and gender barriers are highlighted. However, altogether the initiative appears to put stronger emphasis on the provision of more transparent information to orientate people, enterprises and skill development, with the ultimate goal to improve matching of vacancies and job-seekers. Therefore the “New skills for new jobs” agenda proposes to systematically improve the capacity of the EU and the Member States in order to monitor and anticipate skill requirements on the labour market on a regular basis.

Several institutions (CEDEFOP, EUROFOUND and the Institute for Prospective Technological Studies) have begun developing models to analyse the impact of technological change on skills demand and to forecast medium to long-term employment prospects by skills. Such initiatives pursued at the EU level are complemented by support for national monitoring and anticipatory systems also financed by the ESF. The ambition is to publish every two years, starting in 2010, systematic assessments of the long-term supply and demand developments on European labour markets, broken down by sectors, occupations, levels of qualification and Member States, with a forecasting horizon of ten years.

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26 A typical example is massive retirement of teachers. The age structure in this occupation is often not smooth which reflects past “stop-and-go” hiring processes associated with changing education policies.
A rationale for the preparation of long-term forecasts is that the education process involves long delays. Therefore, labour market conditions may change between the time when the education decision is made and the time when the skills acquired through this decision are brought to the market. If individuals are forward-looking, they will seek to incorporate their expectations about the future changes in labour market conditions in their education choices. The notion behind anticipatory public information schemes is individuals making systematic forecasting errors. One explanation of such errors would be that people do not look into the future as supposed by the economic choice model. The alternative explanation is that they do not use perfect information, as obtaining information is costly. Public forecasting schemes can address both sources of potential mismatch, first by orienting individuals to the future, and second by reducing information costs.

Nevertheless the anticipatory strategy launched with the “New skills for new jobs” initiative has limitations. From a methodological point of view, although forecasting skills needs has a rather long tradition in Europe, obtaining reliable skill needs forecasts it is still practically impossible. This is true even if one adopts, such as envisaged by the current EU initiative, a multi-method approach (including formal quantitative models, surveys of employers or employees, and Delphi or other stakeholder-involving methods).

The typical – formal quantitative – approach to skill needs forecasting is to start from a forecast of the long-term expansion in different sectors of the economy. The second step is to break the aggregate employment forecast at the sector level down to the skills level. This step integrates information on changing occupation and education structures at the sector level. However, while it is already difficult to obtain reliable short-term forecasts on economic growth, this is even more so as regards forecasts on the long-term economic expansion path. In particular, the very nature of technological progress impacting on both overall growth and the structure of skills demands is basically unpredictable and has indeterminate consequences.

Anticipation of skill needs has to take into account the supply side of the labour market. Concerning labour supply, the development of the labour force with certain skills is rather easy to predict. A forecast involves accounting for participation behaviour of individuals with different educational attainment and a prediction of supply added by education system graduates. As the graduates for several years to come are already enrolled in the education system, this figure is well predictable at least over the medium term. However, the issue is to balance the predicted changes in labour supply by educational attainment with the predicted changes in labour demand. This is an extremely complex problem, which so far has not been technically solved in a satisfactory manner. The complexity arises from the adaptation processes within the labour market in response to skills imbalances. Employers can respond to initial skill shortages by adapting wages or changing their production methods, and individuals can realize promotion opportunities by changing jobs.

As a consequence, the forecasts that could help EU employment policies anticipating skill needs are generally either too rough, or, if they provide greater detail, are burdened with very large error margins, which furthermore widen over the projection horizon. This means that they are generally not useful as a basis for specific policy measures that aim at positively managing anticipated change.

One may even say that implementation of anticipatory strategies has a potential to increase rather than decrease skill mismatch. Simplistic skill needs forecasts have indeed taken education choices (and perhaps education systems) in the wrong direction. A notorious example is changing periods of over-supply and under-supply of engineers, which can be related to imprecise predictions on future skill shortages that do not take into sufficient account the adaptation processes that arise on education and labour markets. Similar phenomena have been observed for other occupations, e.g. teachers.
In view of these limitations, it seems that the capacity of anticipatory reporting schemes in averting mismatches on labour markets is probably much smaller than their current prominent role within the “New skills for new jobs” initiative may suggest. This should at least be considered in the way the results of skill needs forecasts are communicated.

One possibility is to use shorter forecast periods in order to reduce the error margins. The “European Labour Market Monitor” established as of 2009, which provides short-term but up-to-date information, as soon as it develops over time, will probably reveal similar shifts in labour demand patterns as elaborate anticipatory systems. The second possibility is to publish only qualitative results. Any figure on long-term skill needs cannot be taken at face value considering the large error margins, while qualitative information is sufficient to send the intended information signals to decision-makers. The goal of the forecasting exercise after all is to issue early warnings, and not to provide a basis of exact planning of human resources policies or training programmes.

Still altogether there is little reason to believe that an anticipatory approach to employment and education policy would produce better results than an approach first of all oriented towards human capital as private investment. Ample empirical evidence shows that, when making their education choices, individuals on the average respond to the employment and wage signals coming from the labour market. Therefore a plausible strategy for employment policy aimed at enhanced coherence with education and training policy is to strengthen these labour market signals.

From this perspective, the value of the “New skills for new jobs” initiative may consist in shifting the attention to institutions that can interfere with the matching processes (including job search provision, counselling and passive social protection measures like unemployment benefits), and to the importance of imperfect private education choices for the European growth and employment challenges.

Drawing clearer links between employment policies and their implications for the efficiency of individual education choices may help strengthening the overall coherence of employment policies and education and training policies pursued at the EU level. In the following we review the employment policy areas most relevant for making faster progress on the EU education and training policy objectives.

**Participation Incentives**

The most direct and therefore possibly rather effective employment policy strategy to make the most of general up-skilling education and training policies is to work on the disincentives to participate on the labour market.

Everything else equal, a longer expected amount of time spent on the labour market following the completion of education or training unambiguously increases the expected returns to education and thus the amount of individual resources spent on education or training. This rationale works at all levels of education, and for all groups within the population. Three types of employment policies might be considered as especially successful levers on education levels.

The first type is tax reforms reducing the wedge between gross and net wages. From the viewpoint of individuals deciding on educational attainment, the expected wage returns net of taxes matter. From the viewpoint of firms (and the social planner caring about economic growth), the return measured by gross wages (reflecting productivity in supposed competitive labour markets) matters. Too little private investment into education may be a reflection of low net returns associated with fiscal policy rather than inefficiencies in the education system itself.

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27 Anticipatory methods in general assume that past and current trends will continue in some way, i.e. they are essentially driven by historical evidence anyway.
In this context, how progressivity of the tax system is designed is an especially important concern. A tax system is defined as more progressive, if the average tax burden (including other wage related payments, such as social insurance contributions) increases as earnings increase. This places a special disincentive on progressing on education levels. As earnings increase in educational attainment, so does the wedge between gross and net earnings. In other words, the relative reduction in the return to education associated with income taxation is higher at higher education levels.

Policy-makers seeking to reinforce education policies therefore have two options: either reducing the general tax burden at all earnings levels, or, if they aim at fostering higher education levels in particular, reducing the progressivity of the income tax rate. The current employment guidelines do not seem fully consistent with the latter alternative, as they only stress the importance of reducing the tax burden of the low-paid.

The second type is labour market inclusion at low pay levels. The focus of EU employment policy on the tax burden of the low paid is rooted in the notion that participation incentives are especially weak at lower skill levels. The reason is that individuals with low educational attainment often can resort to social transfers if they abstain from work. At a given level of out-of-work benefits, any reduction in in-work tax burdens makes work relatively more attractive. As employment creates a return to the skills used on the job, there is a higher incentive to invest in such skills. This investment does not exist, if individuals expect not to make any productive use of their skills when staying out of work is relatively more attractive.

From an empirical perspective, if out-of-work benefits are relatively high, reducing the wedge between gross and net income is usually not a very effective means to set sufficient incentives for lower skilled individuals to engage in work (e.g. Clauss and Schnabel 2008). The reason is that the utility loss associated with a loss in leisure time is hard to overcome. Therefore, a more effective means to promote work (and thereby education) incentives for the low-skilled is workfare concepts. This means that for employable individuals social transfers are designed as in-work benefits complementing in-work income.

To strengthen education and employment incentives, it is useful to connect the generosity of the benefits positively to educational attainment. In this way, investment in education serves as insurance in case the individual would become long-term unemployed. The rationale of this design is that it allows better educated workers to search longer for a proper job match, as the losses from unexploited human capital in case of mismatch would be larger.

The third type is gender neutrality. Women are generally less attached to the labour force than men. To some extent, this may reflect preferences (which may include gender stereotypes) or specialization advantages – women usually spending more time in child rearing than man. However, governmental policies may reinforce the resulting gender segregation. A typical example is non-neutral taxation schemes that promote unequal distribution of market work within the household. Another common example is childcare provision arrangements in combination with parental leave policies promoting career interruptions around birth.

Against this background, it is interesting to note that the disadvantage of women regarding employment rates is less a problem of non-equal opportunities in education. Women have caught up to outperform men both in terms of graduation rates at higher education levels and in terms of test scores. This is true on the EU average level and many individual Member States, though substantial cross-country variation remains. In any case, male-female education equality is higher than employment equality or wage equality.

Still, there is scope for ad hoc policies. Not only women face lower returns to their human capital if they have difficulties to combine work and child rearing activities and therefore need to work fewer hours or even stay absent from the labour market; they also realize lower return, if they are exposed to high marginal tax rates as second earners.
To the extent that labour market imperfections give rise to the male-female wage gap, they create incentives to under-invest in education.

**Wage Developments and Wage Setting Institutions**

The EU employment policy guidelines highlight the role of labour cost development and wage setting institutions for employment, but they do not in particular stress the role of wages as a factor directly changing the incentives to undertake education. More precisely, it is the relative wages associated with different levels of education, but also the wage dispersion within categories of educational attainment, that have an influence on individual human capital investment choices.

First of all, skill specific wage developments reflect the interplay between the supply and demand on labour markets segmented by qualification. Supposing a flexible market, a higher supply of labour with a given qualification that meets a fixed demand would generate a (relative) wage decline that guarantees absorption of the labour supply shock. As a result, the returns to education fall, which reduces incentives to invest further in this particular qualification. On the other hand, a higher demand for labour with a given qualification that meets a fixed supply would generate a (relative) wage increase. As a result, the returns to education increase, which set incentives to invest more in this particular qualification. This eventually leads to a higher supply, so that the temporary skill shortage vanishes.

This perspective shows the crucial role of wage flexibility, both in the upward and downward direction, to ensure that imbalances arising on the labour market through unmatched supply and demand can send proper signals to individuals to engage in education and training that is actually rewarded on the labour market.

Labour market institutions tend to interfere with the wage adjustment mechanisms, however. Therefore, employment policies allowing wage dispersion according to relative supply and demand developments have an important role in ensuring private education investment choices suited to labour market needs.

In this regard, bargaining coordination or centralization of bargaining and employment protection policies are generally considered the two most important employment policy handles on education.

Several arguments are put forward to explain why bargaining institutions could reduce wage dispersion. A first route is standard rate wage policies that fix the number of job categories in which workers can be placed, as unions seek to limit the ability of employers to remunerate workers differently. Also, supposed that union’s consensus is based on the median member’s preferences, the majority will favour a wage policy favouring the lower paid, as the median wage is generally less than the average wage (Hirsch and Addison 1986). Unionization tends to compress the wage distribution from the top end, which implies that signals to advance in higher education are especially cut.

Also employment protection legislation is often associated with a more compressed wage structure. It is frequently combined with wage regulations such as minimum wages. Limiting the possibilities to set wages is important as otherwise employers could circumvent employment regulation legislation by cutting wages (Bertola and Rogerson 1997). Higher generosity of unemployment and social welfare benefits also tend to have a compressing effect on the wage distribution. As the impact of these measures is regressive, they tend to compress the wage distribution from the bottom end. As a result, returns to education are comparatively high at the bottom end of the skill distribution, which sends signals to under-invest in education.

Turning to the empirical evidence, studying the changes in wage dispersion in several European countries since the 1980s suggests that institutions indeed play a role in compressing wages and therefore shaping incentives to invest in education. Barth and Lucifora (2006) provide two important observations.
The first observation is related to the overall matching of labour supply and demand, i.e. the potential of over-education. Their estimates show that while Europe has experienced a significant expansion in educational attainment and especially tertiary education, it appears that the increase in relative supply of higher skills did not lead to marked lower wage premiums attached to higher education. This suggests that the expansion of European education systems was closely matched to the increased demand for higher skilled labour, induced by skill-biased technological change. This observation is valid throughout the entire wage distribution.

The second observation is related to the role of institutions. Barth and Lucifora (2006) cannot establish a link between neither unionization nor the level of protection and wage developments. However, they show that bargaining coordination tends to compress the wage distribution and furthermore that the compression occurs in the upper part of the wage distribution rather than in the lower part. This means that wage premiums are lower for individuals with tertiary education than for individuals with secondary education where the extent of bargaining coordination is higher. This observation is consistent with the difficulties of many European countries to attract specialist talent from the international labour market who have the choice to enter labour markets with less compressed wage distributions elsewhere – notably the US labour market.

These results may have implications for the design of coherent employment and education policies. On the one hand, labour market institutions seem to have a role to mitigate the inequality enhancing impact of technological change on earnings inequality. Put differently, wage compression at the top end induced by wage bargaining systems makes the use of high-skilled workers relative to low-skilled workers even more attractive. This facilitates reaching the employment targets associated with skills upgrading, as the relatively low wage facilitates absorption of the additional supply of qualified workers. At the same time, however, wage compression induced by wage bargaining systems reduces the incentives for students to engage in more and better education.

This may call for coordination of measures from different policy domains; a combination of institutions in the labour market that promote wage compression, at least at the top end, and student subsidies that compensate the adverse returns to education effect would be a coherent tool.

While this is an example of how employment and education policies may work together to obtain coherent employment and education outcomes, it is necessary to stress that the empirical basis supporting such proposals remains weak. Overall the empirical literature investigating the role played by market and institutional factors in determining the development of wage dispersion in Europe (e.g., Bertola et al 2000, Haffner et al. 2001 and Acemoglu 2002) does not come to sufficiently robust results to warrant any concrete policy recommendation.

**Employment Protection Legislation**

One of the general differences between the US education system and European education systems appears to be that the former provides a rather general curriculum, whereas the latter is designed to provide rather specialist skills. This may account for part of the US-EU growth differential, as more specialization is associated with less adaptability to innovation. But skill specialisation is not only a matter of curricula, but also of employment policy. It appears that the generally higher level of employment protection legislation in Europe tends to raise the demand for specialist education (Wasmer 2002, 2006).
As employment protection legislation imposes layoff costs, it means that employees are well protected in their current job. Firms will not fire them unless they experience a rather large shock. As a consequence, the average duration of typical employment is long. Therefore, workers have an incentive to invest a lot in the specific knowledge required for their job or within their firm. The specificity of their investment gives workers a relatively high wage on their job, but at the same time it reduces their outside options.

In other words, employment protection legislation raises the relative returns to specific skills, and therefore workers over-invest in such skills. However, if general skills are required to benefit from the diffusion of technical and organizational change, the European model can ultimately be detrimental to employment and growth in the long term.

Yet the institution of employment protection has even more intricate implications. It is conducive to low turnover (reducing employment opportunities for outsiders) as workers with specific skills do not have incentives to quit and lose their job-specific skills. Furthermore, in case of a layoff that results from a large shock, the specificity of the skill investment implies that workers insured by employment protection legislation face significant wage discounts and possibly longer spells of unemployment, even if unemployment benefits exist that allow generous search. The specialised workers are also more likely to require more retraining after layoff.

In short, employment protection strengthening skill specialisation makes the reallocation of labour more costly, both from an individual and from a societal perspective. This observation is consistent with the perspective that the interaction of economic turbulence and institutions is at the heart of the European unemployment problem (Blanchard and Wolfers 2000).

Does that mean that in order to make progress on the European employment and education targets it would be necessary to adapt employment policy to introduce less generous employment protection legislation? The answer is no, not necessarily.

As long as the worker remains productive, the mix of highly specific skills and long-duration jobs has the advantage of strengthening identification with the firm, facilitating team production structures. Everything else equal, employers therefore have a preference for this option, as it makes the firm more profitable. From a macroeconomic perspective, at least in a stable environment, the European model compared with the US has the capacity of generating "better", i.e. more productive, jobs.

Considering this possible positive effect, one has to be very careful when advocating policy reforms to promote less stringent employment protection legislation based on the fact that this would facilitate the acquisition of more general skills. A preferred policy option it to design employment policies that are aware of the human capital repercussions of the existing labour market frame and seek to maintain the productivity advantage. The case of the German Kurzarbeitergeld (short-time allowance) presents an example of such good employment policy practice (see below).

Nevertheless the field of employment protection legislation has to be a concern for policy-makers. It introduces an implicit tax on hiring and explicit costs on firing and therefore may reduce the matching efficiency on labour markets. The resulting low rates of job mobility (as indicated by the low European geographic and occupational mobility) can be a source of skill mismatch.

28 This assumes that workers do not fully appropriate the higher firm output associated with productivity gains. However, the workers with specialist skills have relatively low bargaining power, as they can rely less on outside options. One result may be higher unionization, but under normal economic conditions employers would still share part of the surplus associated with the lock-in of specialist human capital.
Box 2

Best practice: Short-term allowance in Germany

Germany is a country with high dismissal protection legislation. As predicted by Wasmer (2006), occupational mobility is low, whereas workers often acquire specialist job-related human capital. This contributes to the high productivity of German workers.

In this setting, Kurzarbeitergeld is an instrument that allows establishments in a critical economic situation to temporarily reduce their labour costs. To avoid firing, they can cut the regular working hours of their employees, or even command them not to work at all, and adjust the wage paid in accordance with the reduction in working hours. Workers receive a transfer payment from the Federal Employment Agency that serves to partly compensate the wage loss. The Federal Employment Agency also compensates social insurance contributions normally paid by the employer, which lead to an additional labour costs reduction.

The instrument plays a very important role as human-capital maintaining employment policy in response to the current global economic crisis.

In Germany, the severe recession dominantly hit the economy through a decline in exports. As export goods are skill intensive, the macroeconomic shock especially affected medium-sized businesses with a highly qualified, often specialist labour force. These businesses provide highly productive workplaces and often organize work in teams. Given these structures, it is relatively costly to fire specialist workers in the face of an economic shock. At the same time, workers would face a relatively high income loss, if they had to rely on outside options. In this institutional context, the possibility to rely on Kurzarbeitergeld to sustain a – temporary – negative demand shock is profitable for both employers and workers.

The incidence of Kurzarbeitergeld therefore has greatly increased in the course of the export crisis. In this situation, the federal government recognized the firm productivity and human capital preserving role of the short-time allowance and responded by making the Kurzarbeiterbeit more generous. In particular, the maximum duration of financial support was extended from six months to two years, and the transfer provided to establishments increased.

These measures have been criticized, however. It is argued that the new regulations could generate too much retention and prevent necessary structural adjustments in those sectors that require structural adjustment.

Another noteworthy feature of the Kurzarbeitergeld reform in response to the macroeconomic crisis is that it introduced an explicit training component.

Establishments that reduce regular working hours to zero and make use of the spare time to offer training to their workers can obtain a higher payment from the Federal Labour Agency than establishments that do not offer training.

However, it turns out that this training subsidy is rarely taken up by employers. This surprising behaviour suggests two conclusions. First, as the under-employment (which would mean unemployment in a fully flexible labour market setting) is not associated with workers having the wrong skills, it is not useful to retrain workers. Establishments (and workers) expect that the temporary economic shock does depreciate the productivity of current human capital. Second, if even subsidization of training does not increase training activities, it appears that – at least in the labour market segment hit by the recession – there is no general under-investment in workplace training.
The two observations may be relevant well beyond the specific German context. The first observation shows that retraining is not always an efficient response to unemployment, as job losses may not be related to inadequate qualification. The second observation gives additional empirical support to the view that public promotion of training activities, the most important form of adult learning, is not required as a remedy to market failure.

In sum, the German case is a good example that employment protection legislation may have productivity enhancing effects and promote the acquisition of specialist human capital.

The case finally makes clear that maintenance of an existing stock of human capital is an important policy dimension in the face of macroeconomic fluctuations. One should consider skill preserving policies as complements to skill increasing education policies. The Kurzarbeitegeld provides workers with an insurance against negative shocks that sets incentives to invest in more job-related human capital.

In sum, considering the potential impact of EU cooperation in education and training on employment and job creation, it appears that the renewed strategic framework on the whole is well aligned with EU employment targets. Both the strategic objectives and the specific benchmark areas are generally suited to provide the skills required to cope with the changing needs of European labour markets, which are affected by technological change and increased international competition.

In particular, the updated strategic framework for EU education and training has the capacity to promote more and more productive employment. In a nutshell, the reason is that the strategy of skills upgrading at all levels is consistent with the ongoing trends of labour demand. Therefore, there is little evidence for over-education at the European level. Rather, the expansion of educational attainment on the supply side over the last decades has been very well absorbed by concomitant labour demand, which shows in stable returns to higher education.
5. POLICY CONCLUSIONS AND RECOMMENDATIONS

Education, innovation and employment are important building blocks within the EU strategic agenda. The three variables are highly interrelated from a macroeconomic perspective. Human capital enhances individual employment chances; it also serves as an input to produce innovation and therefore can impact on technological change. Technological change can impact on the development of labour demand, both in quantitative and qualitative terms. The employment consequences, in turn, depend on the available quantity and quality of human capital.

Because of these strong interrelations, the policies pursued at the EU level designed to achieve progress on these variables are also highly interrelated.

The following summarizes the core implications of our policy assessment.

The EU strategy of general skill upgrading contributes to economic growth and higher employment rates. The development of skills for innovation is especially important, as these can contribute to self-reinforcing growth cycles.

Conceptual considerations and the available empirical evidence altogether support the basic premises of the EU education and training policy strategy for enhanced growth and employment.

Skills upgrading has direct positive growth effects associated with the stronger labour force attachment and the better employability of more-qualified workers. Yet in knowledge-based economies dynamic growth effects are even more important. If one accounts for innovation dynamics, better education can have a substantial social return beyond the private returns to education.

More and better education can boost innovation via two channels. The first channel is a direct one. The innovation capacity of an economy hinges on the availability of specialized talents with the ability to engage in research and development and to be inventors. The second channel is indirect. The availability of a well-trained labour force allows faster adoption and diffusion of productivity-enhancing technologies, which makes research and development for innovation more profitable.

Innovation processes can be quite diverse and encompass technical, product and organisational change. Therefore, the skills involved in innovation are also quite diverse. The challenge is to adapt European education systems to generate more general education and especially more general higher education. Clearly the policy challenge goes beyond generating specialist talent.

Employment policies are important to counter adverse labour market developments stemming from innovation. However, one cannot directly integrate employment objectives within innovation policy.

While innovation generally raises the quantity of employment in an economy, it is also generally associated with a reallocation of employment both within and between sectors. In addition, innovation processes are often biased with regard to skills. The demand for more skilled labour increases compared to the demand for less skilled labour. The position of less skilled workers in the European labour markets has generally worsened over the past decades.
One basis of EU education and training policies, therefore, is the expected labour market consequences of skill-biased technical change. As labour demand is shifting towards higher skilled labour, general up-skilling of the labour force can serve as precautionary measure to avoid labour market polarization disadvantageous for the less skilled workers.

In addition, employment policies can serve to counter adverse labour market developments stemming from innovation as they arise. However, it is in the nature of the innovation process that its employment consequences are uncertain ex ante. As the rate of successful innovations is low, the exact outcomes in terms of labour demand are unpredictable. Innovation policies, for example, in many cases do not yield any marketable innovation at all, while in some cases they may yield innovation that generates huge employment impact. Due to the uncertainty about employment outcomes, anticipatory employment policies are conducive to waste.

This means that one cannot directly integrate employment objectives into innovation policy. Still employment policies have an important role in helping workers to adapt their skills. Conversion training for the external labour market, temporary wage cost subsidies, mobility aids and enterprise creation are among the preferred means of employment support in this context. Setting up intermediary organizations that take over the task to place workers displaced by technical change into new jobs appears as particular good policy practice. In this light, the instruments targeted at disadvantaged workers that are provided by the ESF, if they are properly managed and controlled, can be important means of active European employment policy.

The “New Skills for New Jobs” initiative rightly stresses the importance of matching processes on the labour market. However, the emphasis put on the anticipation of skill needs is probably too strong.

Skills mismatches (rather than over-qualification) are a robust and non-transitory feature of European labour markets. Therefore, the value of the “New Skills for New Jobs” initiative first of all lies in shifting the attention of European employment policy to institutions that can facilitate matching processes. This includes better job search provision, counselling and optimal design of passive social protection measures like unemployment benefits. Also the development of the EQF and ECVET can promote mobility and adaptability, and thereby the quality of matching on European labour markets.

A further challenge is to prevent over-qualification. The role of European employment policy is to improve the capacity of labour markets to smoothly absorb the growing supply of better educated workers without impeding labour market opportunities for less skilled workers. Labour market institutions that enhance the employment opportunities for outsiders, wage flexibility and job-to-job transition rates can help reduce the risk of over-education associated with expansionary education policies.

Finally, the quality of matching hinges on the labour market relevance of learning outcomes. Thus the “New Skills for New Jobs” initiative also stresses the necessity to overcome imperfect education choices, in order to cope with the European labour market challenges. Imperfect choices can result from inefficient design of education systems, but also from lack of robust anticipatory information. The “New Skills for New Jobs” in particular emphasises the latter, and has fostered initiatives to forecast long-term future skill needs in Europe.
However, any attempt of anticipating future labour market needs is faced with serious methodological obstacles. The complexity arises from the adaptation processes that take place within the labour market in response to emerging skills imbalances. As a consequence, the results obtained, that are supposed to inform EU policies (as well as private decision-makers), are generally burdened with large error margins. This bears a risk that active management of anticipated changes might increase, rather than decrease, skill mismatches.

An important possible effect of employment policies is to strengthen the incentives for private investment in human capital that support education policies aimed at more and better education.

The acquisition of human capital to a large part is a private investment process which involves comparison between the individual benefits and costs of education. Employment policies can be an effective lever on the achievement of higher education targets, if they increase the expected return to human capital. In this regard, two employment policy strategies are especially commendable.

The first strategy is to strengthen individuals’ labour market attachment. Participation rates and education levels are generally positively correlated. Individuals who do not participate in the labour market do not make profitable use of their human capital and therefore invest less in education and training. Participation enhancing employment policies include instruments aimed at i) more gender equality in the labour market, which can reap the benefits of the rising educational attainment of women to the full, ii) the design of social welfare benefits as in-work benefits, which promotes the acquisition of more than just basic skills, and iii) lower marginal tax rates, which promotes the acquisition of higher education levels.

The second strategy is to strengthen wage flexibility. Skill-biased technical change shifts the relative demand for workers of different skill types. Only if wages are sufficiently flexible, these relative demand shifts translate into relative wage changes that send the correct signals to individuals who have to decide about the investment into skills. In particular, institutions that favour wage compression, notably collective wage bargaining institutions, may prevent individuals from engaging in more and better education.

Within the updated strategic framework for EU education and training policies, a benchmark indicator for progress on employability is still to be defined. A return to education measure could put emphasis on the links between employment policies and education and training policies.

The size and structure of private wage returns to education produce very useful information for decision-makers. They constitute a summary indicator for various factors that influence education choices. On the one hand, low returns to education can point to inefficiencies in the education system. Individuals may not allocate their resources to those forms of education that yield the highest return on the market, if cost mechanisms do not function properly. On the other hand, low returns can point to imperfections on the labour market. The necessary condition for a wage return is that the skills obtained are actually employed. A focus on wage returns therefore would direct the attention from employability to the actual employment of human capital.
Flexicurity is important to preserve human capital in dynamic labour markets. In addition, employment policies that stabilize worker-employer-relationships can encourage employers to support vocational training specific to the workplace.

In the European economies faced with increasing global competition and innovation, worker turnover rates are on the rise. Two threats to human capital emerge from the trend towards more employment reallocation.

The first threat is that workers forced out of employment do not take new jobs that are a proper match to their human capital. The propensity of this happening depends on several factors. One obvious factor is current labour demand, which is not under governments’ direct control. However, other important factors, notably job search intensity and reservation wages, i.e. the wage offer job seekers are ready to accept to take a new job, are in the realm of employment policies. The challenge here is to design unemployment schemes that strike the balance between giving individuals sufficient time for searching an adequate job to avoid skill mismatch and bringing individuals quickly back to work to avoid skill depreciation. The flexicurity model of providing a high level of income security in unemployment while enforcing job search is a model that strikes this balance.

The second threat is that shorter duration of employment relationships generates too little investment in workplace-related human capital financed by employers. This provides a rationale for European employment policies aimed at more stable employment relationships within firms. International evidence suggests that stable employment relationships can promote workplace practices combining formation of job-specific specialist human capital with high labour productivity.

One instrument to raise average tenure within firms is employment protection legislation, but this measure can have negative side effects. In particular, if different types of workers face different levels of protection, it creates a dual labour market, where human capital investment in the less-protected part can be especially low. An alternative is temporary wage subsidies to employers hit by an economic shock who keep their workers. This instrument preserves workplace specific human capital by reducing the number of redundancies. It could complement the existing employment policy tools that serve workers’ adaptation to economic shocks.

Still changing modes of production may change the relative weight of general versus employer-specific vocational training. As employers do not have incentives to provide for general training, there is scope for compensating vocational education and training policies aimed at the provision of skills that can be carried from one employer to another.

Education policy can support employment policy targets by paying close attention to potential skill mismatches

The available empirical evidence for Europe indicates that over-education is in general a rather small economic problem. The more important issue is that individuals are mismatched because they are not educated or trained in the skills required for their jobs. According to this diagnosis, the fact that individuals choose to get educated and trained in fields and subjects that are not in sufficient demand is a pressing question for education policy.
Unless fields of study are a pure consumption good, there is scope to raise individual incentives to invest in those types of formal qualification that are in demand and get a reward on the labour market. At the tertiary education level, moderate fees would create such incentives. In addition, public resources devoted to schooling institutions could be allocated according to their capacity to produce graduates that perform well on the labour market.

Policies working on the qualitative dimension of education and training rather than on the quantitative dimension (e.g. duration of studies or graduation rates) can foster progress on education and training systems and curricula to achieve higher labour market relevance of the learning outcomes.

**Integrated education, research and innovation strategies can foster skills for innovation. The main direct responsibility in this field, however, lies with EU Member States.**

The role of innovation policy is to directly contribute to the employment and growth targets by creating an environment that is conducive to innovation. The role for education and training policies is to ensure that the skills emerging from universities and vocational training systems support a truly innovation-driven economy. Yet the design of EU innovation policies leaves little room for integrating skills for innovation. Most of the policies involve innovation subsidies or public procurement, where adding educational goals is difficult. Therefore, the practical responsibility in this field is at national level.

There is a clear rationale for promoting skills for innovation. Innovation policies target specific fields with high innovation potential, but effective public promotion of the fields requires an adequate number of researchers and developers specialized in them. Education policies have a role in enhancing innovation policy. Developing an integrated national approach to education, research and innovation can avoid inconsistencies in the skill demands required for national innovation strategies, and the skill supply generated through national education strategies.

Despite the possible co-ordination gains, education policies are not well integrated with innovation policies in most of the Member States. One reason is that the responsibilities for the two areas are often allocated to different institutions. National education, innovation and research bodies which develop and monitor integrated national programmes could help overcome these co-ordination problems. The role of the EU in this strategy to obtain skills for innovation is that of issuing recommendations and facilitating policy learning.
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