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**Skill mismatch  
Identifying priorities for future  
research**

**Cedefop research arena (Cedra)**

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# Foreword

Cedefop's ongoing work on future skill needs and skill supply and the early identification of skill needs in Europe is increasingly recognised as a source of valuable information for policy-makers at national and European levels. The first pan-European forecast of skill needs until 2020 was very well received and fuels European debates on the situation on future labour markets and the upgrading of skill requirements in jobs due to technological innovation and the dynamics of change in work organisations and economies. Cedefop's upcoming skill supply forecasts will complete the picture by analysing how demographic change, patterns of educational choice and other factors and conditions will impact on the supply of people by qualification.

Although it is not straightforward to compare future demand to future supply of skills, efforts will be undertaken to develop methods and indicators to provide insights into future mismatch in European labour markets. The nature of Cedefop's skill needs and supply forecasts imply that these mismatches reflect macro-level shortages and surpluses of people with specific qualifications. The resulting information will assist policy-makers and social partners in designing and implementing labour-market and training policies that Europe needs to face its future challenges.

Mismatch is a complex and dynamic phenomenon, occurring at different levels and related to the overall economic situation of the economy. Next to quantitative mismatch at macroeconomic level, there are other types of mismatch which impact on employing organisations and individuals. Analyses of mismatch, however, often focus on a single level, without considering links and interdependencies between different types of mismatch and without sufficiently discussing underlying causes and dynamic impacts. This makes a comprehensive understanding of mismatch and the policy implications difficult.

Cedefop has recently started new research and analysis to provide more insights on skill mismatch issues and problems in Europe. Several new studies are planned to provide policy-makers with new information needed to anticipate and address mismatch. To establish policy-relevant themes for Cedefop's skill mismatch research in the coming years, experts have been invited to the Centre to share their experience on the most promising research opportunities. Combining the views of experts with careful analysis of relevant academic research has led to five overall research priorities. This working paper gives an overview of these priorities. We are confident these priorities will provide the necessary direction to sound research that is primarily relevant from a policy perspective and hope its outcomes will support the European Commission and Member States in their policy-making processes.

Aviana Bulgarelli  
Cedefop Director

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This report is a team effort and reflects contributions from those involved in Cedefop activities on skill mismatch, in particular, Jasper Van Loo who supervised the publication, Manfred Tessaring and Pascaline Descy.

The priorities for future research on skill mismatch have been compiled by careful analysis of relevant research literature and a brainstorming workshop with international experts held at Cedefop on 30 May 2008. At this workshop, researchers from academic institutions across Europe were asked to provide their perspective on priorities that carry particular policy relevance for research on skill mismatch. Reviewing current research and policy needs, Peter Sloane (University of Swansea), Mark Keese (OECD), Ulrich Walwei (IAB), Walter van Trier (University of Gent), Katarina Katz (University of Karlstad) and Christoph Meng (Maastricht University) identified several issues that need to be addressed in future research. We would like to thank them for their interesting input and stimulating discussions.

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# Introduction

Up-to-date skills addressing the needs of the labour market are crucial for European economies. Skill mismatch refers to various types of skill gaps or imbalances that may be quantitative or qualitative in nature. Skill mismatch has important implications at various levels. In addition to possible adverse impacts on individuals and organisations, skill mismatch may hamper economic growth, competitiveness and innovative capacity at macroeconomic level. For societies, skill surpluses; overeducation or overqualification; and unemployment or involuntary part-time work represent a waste of valuable human resources.

Skill mismatch has become a growing concern for policy-makers at national and European Union (EU) levels. A core element in the current European debate is that to adapt to rapid change, matching skills to jobs is crucial in sustaining productivity and competitiveness. In response to EU Member States' needs, the European Commission launched the 'new skills for new jobs' initiative, which supports the capacities for proactive action and anticipation to be better prepared for future challenges. The initiative should help to improve the capacity to anticipate and match labour-market and skills needs in the EU; to reach the objectives set out in the EU's growth and jobs strategy; to make best use of existing initiatives and instruments; to gather results comparable at EU level and to promote a truly European labour market for jobs and training that corresponds to citizens' mobility needs and aspirations.

In 2007, the Council resolution on new skills for new jobs highlighted the need to anticipate the skill needs and gaps emerging in European labour markets (Council of the EU, 2007). It also stressed the need to improve the matching of knowledge, skills and competences with the needs of society and the economy as a means to increased competitiveness and growth and greater social cohesion. It sees the identification of new types of jobs and skill needs at European level as a core mechanism to develop regular foresight of medium-term skills needs and short-term skill gaps. The 2008 communication from the European Commission (European Commission, 2008) links the new skills for new jobs initiative to the global economic crisis and positions mismatches in the labour market as a growing concern in times of rising unemployment. To improve anticipating and matching, the communication calls for action in addressing mismatches, strengthening the EU's capacity for forecasting and anticipation, deepening international cooperation and mobilising community instruments.

The Council conclusions on new skills for new jobs, published early 2009, support the proposed priorities (Council of EU, 2009). From a research perspective, especially the call to increase the EU's methodological, analytical and common learning capacities for skills and jobs anticipation is a crucial condition to promote a better understanding needed for effective action. Cedefop is contributing to this objective in two ways: by the early identification of skill needs and by anticipating skill needs and supply at EU level. These activities provide new insights mainly at mesoeconomic and macroeconomic levels. Cedefop's new work on skill mismatch

aims to strengthen the comprehensive approach to future skill needs by examining skill mismatch at different levels and pointing out the organisation level and economy wide implications of individual skill imbalances.

The field covered by skill mismatch is vast. It is a multidimensional issue, which can be approached from various angles. As it is generally understood to be a discrepancy between skill demand and supply, theory and research on skill demand and skill supply is relevant to its analysis as well. Skill mismatch does not only refer to imbalances between formal qualifications and required qualifications in work settings, but also to discrepancies between skill demand and supply in a more holistic sense, when it concerns, for example, differences between competences workers possess and competence requirements.

Typically, research on over- and undereducation found that about half of the working population is matched and that the proportion of overeducated workers exceeds the share of undereducated workers. Recent analyses, which consider both over- and undereducation and under- and overskilling, show that skill mismatch, broadly defined, is a pervasive phenomenon in Europe. According to data from the European Community household panel, which are based on self-assessment, only 21% of employees in Europe hold jobs fitting their education, training and skills (Wasmer et al., 2007). Thus, for most workers in Europe, imbalances exist between the skills they possess and the skills demanded in the workplace. Skill mismatch has an important impact on wages: workers reporting that their education and training are not suited for their jobs face a wage penalty of around 11%. Several factors appear to be instrumental in explaining skill mismatch. In particular, in countries with more stringent employment protection legislation and regulations or institutions that increase hiring and firing costs, a larger share of the working population faces skill mismatch.

Strietska-Illina (in Cedefop, Strietska-Illina, 2008) finds that skill mismatch, and in particular skill shortages, have adverse consequences at meso and macroeconomic levels. At firm level, skill shortages can result in higher wages, may increase recruitment costs, can lower productivity or quality, may require more investment in current personnel, can result in market losses, and could imply a greater workload and pressure on current personnel. Skill shortages may result in lower company competitiveness and, with a higher concentration at regional level and greater spread at national level, could eventually deteriorate the overall competitiveness and prevent growth of the regional and/or national economy.

Descy and Tessaring (in Cedefop, Descy and Tessaring, 2001) provide a typology of skill gaps by structuring skill imbalances according to whether they occur:

- (a) when qualifications are inadequate compared to job requirements (overqualification/ underqualification and overeducation/undereducation);
- (b) when jobs are inadequate compared to qualifications (underutilisation and overutilisation);

- (c) when there is unemployment (registered, hidden, or unemployment in terms of working time that is less than desired);
- (d) when shortages or surpluses of workers with particular skills or occupations occur (quantitative/qualitative shortages or surpluses of specific skills).

Strietska-Illina (in Cedefop, Strietska-Illina, 2008) refers to skills gaps to describe the qualitative mismatch between the supply or availability of human resources and the requirements of the labour market. Skills gaps exist when workers have inadequate skill types/levels to meet their employers' objectives or when new entrants to the labour market are apparently trained and qualified for occupations but still lack some of the skills required (NSTF, 1998).

While there is substantial research on the determinants of skill demand, skill supply and skill mismatch in terms of situations or states of mismatch, the processes and dynamics that underlie the development of skill mismatch have not been sufficiently addressed. Recent research has mainly focused on examining:

- (a) changes in skill demand, for example in the economic literature on skill-biased technological change (Machin, 2004);
- (b) changes in skill supply, in the literature on the impact of investing in human capital;
- (c) static analyses of discrepancies between skill demand and supply (Leuven et al., 2000; Kranz, 2006).

In addition to theories and models that focus on the drivers of skill demand, supply and mismatch, some research addresses the implications of skill mismatch. Important topics here are for instance the impact of overeducation, the consequences on the labour market of skill surpluses or shortages, the interdependence between skill obsolescence and long-term unemployment and the impact of the acquisition of general, specific or transferable skills on labour-market outcomes such as wages or career progression.

A careful review of relevant literature reveals that research on skill mismatch lacks sound theoretical frameworks that address skill mismatch issues comprehensively. While different strands of literature on, for example, overeducation (Büchel et al., 2002), skill shortages (Green et al., 1998) and skill obsolescence (De Grip et al., 2002) have emerged, these phenomena have mostly been analysed in an isolated manner. However, skill shortages and skill surpluses can occur at the same time, for example when unemployment and vacancies occur simultaneously (structural unemployment). A more integrated approach to skill mismatch is needed to address labour-market problems by evidenced based policies.

Even if research on skill mismatch is scattered, some classifications are possible. First, it can be classified on the basis of the type of skill mismatch: for instance overeducation, underqualification, underutilisation, skill shortages and surpluses, skill gaps, and skill obsolescence. Second, skill mismatch research can be analysed at different levels. It can be approached from an individual, organisational or economy or

society-wide perspective. Third, there can be a classification on the basis of the impact of skill mismatch. These can for instance cover earnings and career patterns, but also the risk of becoming unemployed.

Although research on some aspects of skill mismatch and its implications has increased substantially during the last decades, there is not yet a common understanding and agreement on what should be priorities for future research, particularly in Europe. In this working paper, we outline five policy-relevant research priorities for future research on skill mismatch. Cedefop's research on skill mismatch is part of the Cedefop research arena (Cedra). Its main aim is to develop and share new thinking about the links between the labour market and skills, which is relevant for academic researchers as well as policy-makers at European and national levels. Cedra explores how labour-market developments shape skill requirements, how participation in education and training impact the supply of skills, and to what extent European labour markets suffer from skill mismatch problems. This focus is complementary to two other Cedefop activities:

- (a) Cedefop's analysis and projection of skill needs and supply, which periodically reviews future trends in labour demand and supply in the EU and identifies macro-level skill mismatches;
- (b) research activities on the economic and social benefits of vocational education and training, in which reduction of skill mismatch is one important potential benefit.

# Research priority 1: improve measurement of skills and skill mismatch

The first research priority concerns the measurement of skills and skill mismatch. In a narrow sense, skill mismatch refers to the concept of 'skill'. In early classical research on skills, skill definitions are closely linked to manual and motor skills or to a combination of mental and physical qualities (Cedefop, Winterton, 2006). Traditionally, the term skill is used to refer to a level of performance, in the sense of accuracy and speed in performing particular tasks (skilled performance). Consistent with more contemporary and comprehensive understandings of the term 'skill' that go beyond merely instrumental interpretations (Proctor and Dutta, 1995), skill mismatch is generally understood as various types of gaps or imbalances referring to skills, knowledge or competences that may be of a quantitative or qualitative nature. Some terms have been introduced to indicate specific types of skill mismatch. An example of this is skill shortages, which typically refer to a situation where firms cannot obtain in the labour market sufficient supply of the required competences (McIntosh, 2005; Haskel and Martin, 2001).

Skills have been analysed in various disciplines. From an economic perspective, the distinction between general and specific skills has been particularly important (Becker, 1962). This distinction is based on the value of skills in the labour market. Classical human capital theory proposes that completely firm-specific investments in skills will not be visible in compensation as workers are not able to use this type of human capital outside their employing organisation. General human capital, on the other hand, is applicable in many different contexts and will be reflected in wages, as firms not rewarding these skills would risk that other firms poach these workers by offering them a higher wage. Current economic research has relaxed the strict distinction between firm-specific and general skills (Cedefop, Barrett, 2001; Nordhaug, 1993; Stevens, 1994). Next to completely firm-specific and general skills, 'transferable' skills specific to an industry or profession are distinguished. Typically, the measurement of general and specific human capital has relied on proxies. In earnings equations, years of education has often been regarded as an adequate indicator for the level of general human capital, while experience or job tenure has been used to account for specific human capital. Borghans et al. (2001) noted that the relationship between skills as proxied by educational attainment is far from automatic for four reasons:

- (a) equal investments in education can lead to different quantities of skills or to skills that differ in market value;
- (b) mismatch may cause not all skills to be used;
- (c) education might be used as a signal for ability rather than a source of skill supply;

(d) the acquisition and depreciation of skills continues after school (Borghans et al., 2001, p. 375).

Measuring skill mismatch requires a good understanding of skills, knowledge and competences and the ways these concepts should be measured. Three conceptual problems inherent in competence measurement are equally important and relevant for measuring skills for establishing skill mismatch (Van Loo, 2008): a definition problem, a classification dilemma and a perspective puzzle.

The definition problem stems from the confusion and discussion around the meaning of competence, which is at least partly due to the fact that competence is relevant in several distinct research fields with different disciplinary roots. The classification dilemma refers to whether competences should be measured as separate skills, knowledge and attitudes, or in a more holistic manner combining skills, knowledge and attitudes. Should generic or specific competence be measured? Specifically referring to the dilemma, should one consider broad aspects of competence or detailed aspects? Broad competence has the obvious advantage of being applicable to many occupational settings, while classifying competence into detailed parts has the advantage of being meaningful for a specific type of job. There are also different interpretations of measuring broad or detailed competences. Specific skills might be meaningful where the focus is on productivity and transitions to new tasks or jobs in the short run, while broad competence clearly has advantages in a long-term perspective, as it measures capacities such as adaptation to changing needs and employability. Finally, the perspective puzzle refers to the specific perspective on the meaning and operationalisation of competence. Three perspectives can be distinguished (Van Loo and Semeijn, 2004): the educational perspective, the labour market perspective and the human resources perspective. In the educational perspective, competence is strongly linked to educational goals, and the learning process. The labour market perspective on competence stresses productivity, outcomes and job requirements. The human resources perspective, finally, approaches competence as the fit between people and jobs and links it to organisational performance.

Next to conceptual problems in measuring skills, there are practical problems in obtaining reliable and valid skill assessments. First, by whom and how should skills be assessed? In principle, there are five main ways to assess skill levels (Allen and van der Velden, 2005). Assessment and testing are two objective measures to assess skills. Supervisor rating, individual self-assessment of skills level and using a job's skill requirements as a proxy for possessed skills are subjective measures. Second, what should actually be measured? Should it be skill requirements, possessed skills or actual skill use? When skill use is measured, should it refer to frequency or importance (criticality) of use? (Murray, 2003). Further complicating the issue are the questions of who defines skill requirements and to what extent skill requirements can be defined in a dynamic manner consistent with change processes in current work settings.

The measurement of skill mismatch is not straightforward either. Skill mismatch is a broad phenomenon which has different interpretations in research literature. An important topic in skill mismatch research is whether it refers to vertical or horizontal skill mismatch. Vertical skill mismatch refers to a situation where the level of skills a worker possesses is higher or lower than is required in the job. In this context, Allen and van der Velden (2001, p. 436) refer to 'formal' education-job mismatch and mismatch between acquired and required skills (skill mismatch). In a study using survey data from four EU Member States and Japan, Allen and de Weert (2007) investigated the relationship between educational mismatches and skill mismatches. They dealt with the question whether (vertical) educational mismatches necessarily imply mismatches between acquired and required skills. Based on graduate survey data, their study does reveal a clear relation between education and skill mismatch, but shows at the same time that these concepts are not interchangeable. They also show that the wage effects of educational mismatches, particularly the effect of working below one's level are much stronger than those of skill mismatches. Horizontal skill mismatch refers to a situation where workers have the appropriate qualification level but different skills than required for the job they occupy. Garcia-Espejo and Ibáñez (2006) see horizontal skill mismatch as an important complement to vertical skill mismatch as overskilling or underskilling does not consider the heterogeneity of skills among individuals who have the same educational level (p. 146). From a policy viewpoint, however, assessing both horizontal and vertical skill mismatch is important to design and implement appropriate responses to skill mismatch problems.

Research on over- and undereducation (and over- and underqualification), in particular, has focused on the vertical dimension of skill mismatch (Halaby, 1994; Hartog, 2000). In research literature, overeducation (as well as undereducation) has been measured using three different methods. In job analysis, job analysts specify the required level and type of education for different occupations and compare this to the actual level of education a worker has (Rumberger, 1987; Oosterbeek and Webbink, 1996). Worker self-assessment relies on the worker's subjective evaluation of the education required in a job (Duncan and Hoffman, 1981) or how much education is required to get a specific type of job (Sicherman, 1991). The third method refers to realised matches, where required education is derived from the level of education workers in jobs usually have attained, by using the mean or mode of the distribution (Verdugo and Verdugo, 1989; Groot and Maassen van der Brink, 1995). A main problem with these methods is that they ignore the diversity of qualitatively distinct types of skills generated by differences in schooling and thus treat the skill endowment of workers as a homogeneous stock of human capital (Halaby, 1994, p. 49).

A general problem with skill mismatch measurement is that when mismatch is strictly measured on the basis of qualification (vertical mismatch), more mismatch may be measured than actually taking place, such as formally undereducated workers who have made up their skill deficits by further training and/or experience.

Skill mismatch measurement based on skills would be a viable alternative. In a more general sense, different skill mismatch measurement methods lead to different answers, implying that the robustness of measurement needs to be improved. Another issue is that identifying skill mismatch does not always imply it truly occurs. Workers who indicate they need more skills to perform their work might not be facing any skill mismatch problems, but rather be referring to a situation of being employed in challenging jobs (De Grip et al., 2008), a situation that might arise in the course of a career. De Grip et al. (2008) also found support for the use-it-or-lose-it hypothesis: overeducated workers face higher rates of decline in their cognitive abilities, while undereducated workers seem to be shielded to some extent from cognitive decline (the intellectual challenge hypothesis). Allen and De Weert (2007) also concluded that identifying a skill shortage does not necessarily imply a below-par worker, but could also indicate a high-powered job. Skill shortages exerting positive effects on wages in Germany and the UK provide support for this argument.

Different understandings of what skills are and what skill mismatch constitutes, what dimensions it may encompass and how different conceptualisations of skill mismatch impact on how much mismatch is identified ask for more research to improve concepts and measurement. This research should focus on establishing clear definitions and on developing valid and reliable measurement methods .

## Research priority 2: examine the persistence of skill mismatch and its impacts

The second priority for research on skill mismatch concerns the permanency of the impacts of skill mismatch: Is skill mismatch a temporary or transitory phenomenon or a more permanent one? At individual level, an example of persistence is overeducation that lasts beyond the initial transition phase between education and work. Examples of persistence at labour-market level is ongoing structural unemployment, which occurs when the labour market does not react to a situation of simultaneous unemployment and unfilled vacancies, and long-term unemployment arising from reduced reemployment chances of those facing longer spells of unemployment. The degree of persistence and the underlying factors causing it determine which labour-market policy measures should be taken. If skill mismatch problems are of transitory nature, as suggested by human capital theory (Green et al., 1999), they should be regarded as temporary frictions affecting individuals or the labour market as a whole that will disappear without specific actions or policies. If, on the other hand, skill mismatch is persistent, this justifies responses from policy-makers.

Persistence can be defined as a characteristic of a continuing, recurring, or prolonged phenomenon. In the context of skill mismatch at individual level, two types of persistence can be distinguished. When the process of skill mismatch itself is persistent, we could speak of phenomenon persistence, such as overeducation not resolved by career mobility. However, if the impact of skill mismatch persists, this could be denoted by effect persistence which, for example, occurs when after an initial overeducation wages remain significantly low even after career mobility has improved the initial match. In the literature on skill mismatch persistence has received limited attention, and when it has been studied, it has mostly focused on the duration of overeducation among graduates in the first part of their career.

Although overeducated workers have less job tenure and are more upwardly mobile than matched workers (Sicherman, 1991), Sloane et al. (1995) found that changing jobs often does not necessarily improve the quality of the match. According to Plicht et al. (1994) graduate overeducation is a transitory and natural phenomenon occurring at the first stage of graduate careers. More recent studies on graduate overeducation found that skill mismatch may be a quite lengthy phenomenon. According to Dolton and Vignoles (2000) the majority of male graduates, overeducated in their first job after graduating in 1980, were still overeducated six years later. Schatterman and Verhaest (2007) looked at overeducated graduates in the Flanders region of Belgium. They showed that more than 40% of graduates remain overeducated seven years after leaving school. In Brunello's (2008) view, the probability of having adequate education increases with age, but the effect is very small. Moreover, ageing reduces mismatch for people below 50 years of age, but

above this age, the negative impact of skill obsolescence dominates positive reallocation effects induced by job mobility.

Various issues relating to persistence have not received a lot of attention in the literature. First, the extent to which other types of skill mismatch are persistent has been underresearched. Second, the literature on the persistence of overeducation has focused on people in the first part of their career without paying much attention to the persistence of overeducation for people later in their careers or those reentering after being out of the labour market for some time.

The question of persistence is inextricably linked to adjustment mechanisms. Skill mismatch may be resolved or reduced by internal or external mobility, by investment in education and training and by adapting jobs. Analyses focusing on the persistence of skill mismatch often do not consider adjustment mechanisms. In the case of undereducation, investments in general or vocational training or gaining experience could eventually make up for vertical skill mismatch. Overeducation might be resolved by internal or external mobility to more demanding jobs.

Many questions on the persistence of skill mismatch remain open and these call for new and groundbreaking research. Questions that need to be addressed are: to what extent is skill mismatch really persistent? What is the nature of persistence and what are the consequences? Is it the phenomenon itself or its impact that is persistent? Not only the extent to which skill mismatch is a temporary and transitory phenomenon, but also how persistence can be tackled by effective policy measures should be addressed.

## Research priority 3: improve understanding of skill mismatch processes, its dynamics and the consequences of skill mismatch

The third priority for future research on skill mismatch is to deepen the understanding of skill mismatch processes, the dynamic nature of skill mismatch and the consequences of skill mismatch. From a policy viewpoint, especially the question of how and how fast skills become obsolete is crucial. It is interesting to note that attention for skill obsolescence as an explanation for mismatch has increased significantly as a result of increasing changes in work and organisations. However, this preoccupation has not been endorsed by research.

Classic studies on engineers (which due to fast changing technologies constitute a good example to study obsolescence) discuss organisational and personal factors contributing to skills obsolescence (Dubin, 1973; Kaufman, 1975) or those influencing the decay and retention of skills in the context of atrophy (loss of skills due to non-use) (Arthur et al., 1998). Summarising the most important contributions in skill obsolescence research, De Grip and Van Loo (2002) distinguished between technical and economic obsolescence (see also Neumann and Weiss, 1995). Technical skill obsolescence affects the stock of human capital a worker possesses. A classical example is the declining physical capacity of a bricklayer, whose skills wear out in the course of the career. Economic obsolescence, on the other hand, affects, due to external developments, the value of the human capital a worker possesses. A prime example is the decline of the value of traditional typewriting skills when word processing is introduced. Thijssen (2005) has identified a third type of skill obsolescence: perspectivistic obsolescence, which refers to outdated views and beliefs on work and work environment. Two empirical studies, Van Loo et al. (2001) and Pazy (1996), examine skills obsolescence and the factors which cause and counteract it. These studies shed some light on the relevance of these factors, but address the issue in a static way, providing little insight on the processes and the dynamics involved. Moreover, little is known about the contextual conditions, such as human resources management practices in firms. Better insights on how and when skills become obsolete and how core factors and contextual conditions impact this process are highly relevant for labour-market policy. This information could be valuable input not only for employment and training policies, but also policies aimed at stimulating lifelong learning in work and lasting employability.

Important elements in new research focusing on skill mismatch processes and dynamics are how the shape of the skill loss function differs between various occupations and how the half-time of skills varies between qualifications. The half-time of a professional is the time after completion of professional training when, because of new developments, practising professionals have become roughly half as competent as they were upon graduation to meet the demands of their profession. Classic studies have estimated the half-time of medical knowledge to be five years

(Rosenow, 1971) and show a decrease of the half-life of engineering graduates from 12 years for a 1940 graduate to five years for graduates at the end of the 1960s (Lukasiewicz, 1971), indicating increasing obsolescence over time. Promising research opportunities exist in adapting and extending the approaches of these classical studies to examine obsolescence patterns for specific types of skills, such as information and communication technology (ICT) skills. This will enable training policies tailored to prevent and address emerging skill mismatch.

In the literature on overeducation, the consequences of mismatch have mostly been addressed in terms of wages (Alba-Ramirez, 1993; Galasi, 2008). Some results have been validated in different studies. Overeducated workers earn less than matched workers with equal education, but more than matched workers in the same job (Brynin and Longhi, 2009). Undereducated workers earn more than matched workers with equal education, but less than matched workers in equivalent jobs (Galasi, 2008; Di Pietro and Urwin, 2006). Di Pietro and Urwin (2006) listed four main theories that could explain the observed wage effects of overschooling. Variations on human capital theory relax the assumptions of perfect abilities of firms to adjust instantaneously their production technologies to changes in the relative supply of labour. This hampers firms' abilities to use fully their workers' education, restricting productivity and lowering earnings. According to assignment theory and heterogeneous skill theory, workers' earnings are determined by both required levels of education and actual skills possessed. In the assignment theory, a close link between educational and skill mismatch is assumed. This theory proposes that overeducated workers are unable to use all their skills and therefore are less productive than similar individuals with jobs for which their educational attainment is appropriate. Heterogeneous skill theory suggests a much weaker link between educational and skill mismatch. The main assumption is that there is significant variability in terms of skills and (sometimes unobservable) abilities among individuals with the same level of schooling. According to this theory those appearing to be overeducated are in fact less able individuals who actually match to their jobs in terms of skills and abilities. Finally, institutional theory suggests that only job characteristics determine earnings.

Few studies focused on other possible consequences of overeducation. Pollmann-Schult and Büchel (2004) found that workers with vocational training of intermediate or high level have significantly better career prospects than unskilled workers but this does not hold for overeducated workers with low-level vocational training employed in jobs for which little or no education at all is required. Also, skill underutilisation (Allen and van der Velden, 2001) or overeducation (Verhaest and Omey, 2008) have a negative impact on job satisfaction. According to Van Loo et al., (2001) skill obsolescence leads to higher risks of unemployment or non-participation. However, the analysis is mainly static and does not allow insight into the underlying processes and issues involved. Allen and van der Velden (2001) found that underutilisation of skills induces on-the-job search. In a general sense dynamic impacts of different types of skill mismatch have not been sufficiently addressed in the

literature, mainly due to lack of panel data. Current studies on skill mismatch either tend to focus on formal education or approach skills as an aggregate of underlying factors, without specifying the actual competences that give rise to skill mismatch.

The consequences of skill mismatch are not confined to the individual level. At meso level, employing organisations suffer from skill mismatch in various ways. Overeducation and the resulting low job satisfaction may lead to low morale and commitment and harm productivity. Skills shortages, which imply that the supply of workers with some skills is insufficient to satisfy the need, will compromise firms' productivity and competitiveness. Skill obsolescence has a direct negative impact on productivity depending on to what extent skills that became obsolete are important in the production process.

At macro level, skill mismatch reflects itself in imbalances on the labour market. An oversupply of individuals with specific sets of skills leads to unemployment or overeducation in the economy. Excess demand at macro level for some types of human capital can lead to undereducation or underskilling. This hampers the ability of economies to innovate, grow and compete. Different types of skill mismatch can occur simultaneously. While unemployment may be a problem in some segments of the labour market, over- and undereducation (or over- and underqualification) occurs in others.

Increased understanding on how skill mismatch processes develop, how fast skills become obsolete, and what personal, organisational and contextual factors contribute to skill mismatch or counteract it, would be valuable input for policies meant to address proactively skill mismatch problems. Better insights into the dynamics of skill mismatch and its consequences requires new groundbreaking research that goes beyond established theoretical models and empirical methods.

## Research priority 4: focus on skill mismatch for vulnerable groups on the labour market

The fourth research priority focuses on skill mismatch problems for vulnerable groups on the labour market. Although processes of skill mismatch are dynamic and impact on the whole working population, from the perspective of policy, it is important to have a clear focus on groups most affected by skill mismatch.

Several vulnerable groups might benefit from policies anticipating, addressing and counteracting skill mismatch. First, young people entering the labour market could benefit when actions are taken to improve the matching process by preventing overeducation or making the incidence of overeducation less prolonged. Research has shown that for graduates moving on to a job in which they are overeducated, spells of overeducation tend to be lengthy and persistent (Dolton and Vignoles, 2000; Schatteman and Verhaest, 2007).

Another important vulnerable group are ageing workers. The vulnerability of this group has several backgrounds. Compared to younger workers, many ageing workers are low-skilled and employed in physically demanding jobs, making them vulnerable to technical skill obsolescence. Although there is no convincing evidence that performance as a whole decreases as workers age, some skills and knowledge are impacted by skills obsolescence (Warr, 1994). In fact, age plays a role in both technical and economic skills obsolescence (Bohlinger and Van Loo, 2008). While technical obsolescence (or depreciation) is linked to age as 'the ability of individuals to apply acquired skills and knowledge to income producing opportunities systematically changes with age' (Rosen, 1975), economic skill obsolescence for ageing workers is often approached as a human capital vintage phenomenon. In the course of time, knowledge, skills and working methods become less relevant or even useless, for example resulting from technological innovations or new ways of working, and those with earlier vintages of human capital (ageing workers) face capital losses. In terms of addressing aging workers' skill mismatch by means of policies, another important issue is that ageing workers often undergo concentration of experience (Rybash et al., 1986; Thijssen, 1992), which implies that over the career, individual skills become more attached to certain work domains and become increasingly less transferable. On the positive side, research indicates that, contrary to widespread stereotypes, the actual learning process of ageing workers is not directly dependent on age. While the speed of learning may decline with age, strong learning motivation, associative skills and experience-related problem solving skills may compensate for this (Ilmarinen, 2001). Experience of concentration may, however, manifest itself in perspectivistic obsolescence, which refers to outdated views and beliefs on work and the work environment (Thijssen, 2005).

Migrants and non-native populations constitute a vulnerable group in various respects. Skill mismatch may occur when high-skilled migrants find themselves trapped in low-skilled jobs or unemployment. For example, Lindley (2009) found that

non-white natives in the UK are more likely to be overeducated than white natives. Lacking transparency and recognition of qualifications, language difficulties and lack of work experience in the new home country may be responsible for this. Low-skilled migrants may face skill mismatch due to obsolescence of their skills. In addition, discrimination may prevent migrants from gaining access to the labour market and further training and hamper career progression.

From the perspective of policy, research that focuses on skill mismatch and its consequences for vulnerable groups constitutes a core priority. Examples of such groups are young people entering the labour market and facing overeducation, ageing workers confronted with skills obsolescence and migrants and ethnic minorities that may, depending on their skill level, suffer from various types of skill mismatch.

## Research priority 5: improve data availability and use

The final priority for research is to improve data availability and use in skill mismatch research. This priority will enable progress on the other four research priorities. It will be a necessary condition to capitalise on the improvement of skill and skill measurement approaches. Although some skill mismatch issues can be addressed using cross-section datasets, a dynamic analysis of skill mismatch requires panel or longitudinal data based on surveying individuals and organisations at multiple points in time. Time-series data would also enable progress on establishing evidence on the extent to which different skill mismatch problems are persistent or temporary in nature. To make progress in the short term, an option might be to have forward and backward looking elements in current surveys, which would capture some of the dynamics of skill mismatch, underlying factors and counteracting conditions.

Skill mismatch tends to be analysed at a single level, while there is little attention for interactions between the individual, the organisational and macroeconomic levels. Analysing how individual skill mismatch and skill mismatch problems at the level of organisations interact requires data that link employee variables with organisation-level variables.

The complexity of skill mismatch problems and the interaction of a multitude of factors at different levels impacting mismatch requires data that capture various dimensions of personal and organisational characteristics simultaneously. Although there is some understanding of how work related-factors impact on skill obsolescence, organisational policies and other factors that cause or counteract skill obsolescence have not sufficiently been researched. Collecting new data or combining existing data sources in innovative ways is an important prerequisite for increasing understanding on skill mismatch.

Finally, data availability for some vulnerable groups is currently limited, as these groups are small, underrepresented or hard to identify in mainstream data sources. This is a problem especially for migrants and ethnic minorities. For some vulnerable groups, rather than isolating them from a data source covering an entire population, specific data collection might be a better strategy to obtain samples sufficiently large for empirical analyses.

Obtaining new data and using available data sources, possibly by linking them, constitutes an important prerequisite to enabling new empirical work to make progress on the other four research priorities identified above. Ideally, new surveys should be tailored to analysis at multiple levels and collect data at multiple points in time to allow more dynamic approaches to skill mismatch. Specific data collection, focused on vulnerable groups, has the potential to yield new insights that can be applied in labour market and educational policy-making.

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