



the skill matching challenge

**ANALYSING SKILL MISMATCH
& POLICY IMPLICATIONS**





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and policy implications

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We provide information on and analyses of vocational education and training systems, policies, research and practice.

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Foreword

Cedefop analyses of skill needs and supply provide a core input to debates on future developments in European labour markets. Policy-makers increasingly recognise the added value of anticipating skill trends to support evidence-based policy-making.

At the time of writing this report, Europe is battling a major recession. Matching skills and jobs is gaining importance with rising unemployment and increasing difficulties for people entering the labour market to find jobs matching their potential. At the same time, structural trends challenge Europe's ability to provide the skills that its economies need to grow and prosper. The European population is ageing rapidly, leading to a large outflow of experienced workers in the coming decades while those nearing retirement will need to adapt to the new skills that many jobs require. The dynamics of today's labour markets not only create new jobs while others shrink or disappear, but also contribute to changing skill requirements in many existing jobs.

The analysis of skill mismatch is, therefore, a crucial pillar of Cedefop work on skills. Assessing mismatch and its effects involves much more than straightforward comparisons between skill needs and skill supply. Skill mismatch is a complex phenomenon affecting citizens, enterprises, economies and societies. It refers not only to skill gaps and shortages, but also to skills exceeding job requirements.

The prominence of skill mismatch as a core challenge on many policy agendas, such as the new skills of jobs initiative, inspired Cedefop to explore and analyse skill mismatch systematically. After setting the priorities for future work on skill mismatch research in 2008 (Cedefop, 2009), this report is the first in a series bridging the worlds of research and practice, aiming to provide insights that enable evidence-based policy-making. The report gives a broad overview of skill mismatch and the factors that contribute; it analyses economic and social costs and discusses why mismatch should be a concern for national and European policy-makers. As cross-country information on skill mismatch is limited, the report also discusses how skill mismatch can be better approached and measured in surveys to give more detailed and sound analyses in the coming years.

I believe this report serves a clear need by structuring the currently scattered information on skill mismatch. Organising research findings to answer seven important questions, the report is a direct input to evidence-based policy-making. I am convinced this publication will add to the understanding of skill mismatch in Europe and help national and European policy-makers to make choices to aid matching skills and jobs in Europe.

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Director of Cedefop

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Table of contents

Foreword	1
Acknowledgements	3
Executive summary	6
1. Why be concerned about skill mismatch?	9
1.1. Framing the issue and policy background	9
1.2. Glossary of terms	12
1.3. Aim and format of this report	14
2. What do we know about skill mismatch in Europe?	16
2.1. Vertical mismatch and impact on wages	16
2.2. Horizontal mismatch and impact on wages	21
2.3. What is the likely duration of skill mismatches?	22
2.3.1. Individual overeducation and overskilling	22
2.3.2. Overeducation and overskilling at firm level	23
2.3.3. Undereducation and underskilling in individuals/firms	24
2.3.4. Skill shortages	24
2.3.5. Skill gaps	25
2.3.6. Skills obsolescence	25
3. What causes skill mismatch?	27
3.1. Causes of overeducation	27
3.2. Underlying causes of skill shortages	32
3.3. Causes of skills obsolescence	32
3.4. Mismatch and individual characteristics	34
4. What are the links between the different types of skill mismatch?	36
4.1. Skill shortages, skill gaps, undereducation and underskilling	36
4.2. What is the relationship between overeducation, overskilling and skill shortages?	40
4.3. Combinations and durations of mismatch	43

5. Business cycle impact on skill mismatch	46
5.1. Skill mismatch and business cycles	46
5.2. The impact of the economic crisis	47
5.3. Evidence from Australia	50
6. The implications of skill mismatch	51
6.1. Skill mismatch and productivity	51
6.1.1. Overeducation and productivity	52
6.1.2. Skill shortages and productivity	53
6.1.3. Skill gaps and productivity	53
6.2. Skill mismatch and job satisfaction	54
6.3. Possible positive impacts of skill mismatch	55
6.4. Skill mismatch costs for society	56
7. Appropriate skill mismatch measuring	59
7.1. Measuring overeducation and overskilling	59
7.2. Focusing on overskilling	62
7.3. Measuring skills obsolescence	64
8. Skill mismatch data needed in Europe	65
8.1. Improving data on skill mismatch in Europe	65
8.2. What information should be collected and how?	66
8.3. The way forward	68
Annex: comprehensive schemata for skill mismatch questions in surveys	69
References	72
List of tables	
1. Glossary of terms	13
2. Reported incidence of overeducation	18
3. Types and causes of skills obsolescence	33
4. Combination of mismatch for firms	43
5. Data sets containing questions to individual employees on skill mismatch	60
Boxes	
1. Theoretical approaches to overeducation	29
2. The Beveridge curve	39

Executive summary

With global competition increasing, demographic change unfolding and rapid technological change intensifying, skill mismatch has come to the forefront of Europe's policy debate. Skill mismatch refers not only to skill shortages or gaps, but also to qualifications, knowledge and skills exceeding job requirements. Shortages in some sectors may occur simultaneously with overeducation in others. When skill mismatch takes time to resolve it imposes real costs on individuals, enterprises and societies. Given the relevance of matching skills and jobs and how information on mismatch is scattered, this report synthesises evidence and provides new insights to promote comprehensive policies that prevent and address skill mismatch and its consequences. An overview of the meaning and characteristics of different types of skill mismatch, such as overeducation and overqualification, are provided in the glossary of terms in Section 1.2.

Skill mismatch is a widespread phenomenon in Europe, with overeducation incidence averaging around 30 % and a substantial share of the population undereducated. Whether skill mismatch is stable or increasing over time differs between countries. The overeducated suffer a wage penalty, but earn more than their matched colleagues, while the reverse applies to the undereducated. Mismatch between the type of skills someone has and the type of skills required is also prominent and has a negative impact on earnings. There is, however, some disagreement on the extent to which mismatch is a temporary or a long-term phenomenon, but both overeducation and overskilling may persist over long periods. The overeducated may be trapped in low-level jobs while the undereducated or underskilled are paid more than those with the same level of education in matching jobs and, therefore, have no incentive to move. The duration of skill shortages will be a function of their level and complexity, while the duration of skill gaps is linked to retraining. Skills obsolescence can occur over a relatively short number of years compared to a working lifetime, which means that lifelong learning is essential for successful careers.

To understand the causes of mismatch, one needs to look at its various forms. A core reason explaining overeducation is the asymmetry of labour-market information. Better-informed individuals are better prepared to avoid overeducation than less-informed ones. Part of what is described in the

literature as 'overeducation' reflects the differences in individual abilities and of skills within particular education categories. Light can be cast on this issue by considering the job satisfaction of workers in this state or the extent to which their skills are used. Several factors are responsible for skill shortages, such as insufficient training, education and training systems responding slowly to market changes, skill-biased technological progress and business cycles. Skill shortages also emerge when people accept a low-skilled job while continuing to search for a better match, for instance when options are limited for personal or family reasons. Skills obsolescence, which is a process rather than a state, occurs when skills depreciate due to ageing or lack of use at work; or when economic developments change the skills that firms need. Mismatch is more relevant for specific groups, such as young people entering the labour market, older workers, females, ethnic minorities and the disabled. Certain racial minorities suffer from mismatch to a greater degree than the majority population. Whether women suffer more than men is less clear. Older workers are likely to suffer most from skills obsolescence but little evidence links skills obsolescence to long-term problems.

What are the links between the different types of skill mismatch? Overeducation and overskilling are expected to be negatively related to labour shortages. Whenever they coexist it is probably because skills or education are of the wrong type or because the two phenomena refer to different occupations in the same enterprise, industry or economy. It seems there is no strong correlation between the occurrence of skill shortages and skill gaps, but the latter may be closely linked to underskilling. Various types of mismatch can be present at the same time in firms but probably not simultaneously within specific occupations.

Different phases of the business cycle result in different imbalances between labour demand and supply. These imbalances have profound implications on how skill mismatch arises and how it influences the economy. Studying the dynamics of skills creation and destruction is at the heart of understanding mismatch driven by the business cycle. Currently, there is insufficient empirical evidence to address the complex policy issues involved. In the present downturn, the following policy issues need to be addressed urgently: the role of training; the role of obsolescence; and how they may affect different parts of the economy, in particular vulnerable groups of people and vulnerable industries, such as those under intense international competition.

Mismatched individuals may suffer from lower wages and are less satisfied with their jobs than if they were properly matched; employers may suffer from

lower productivity; and the economy may suffer from a loss of output. This is true for overeducation, overskilling and skill shortages. Both skill shortages and skill gaps might lead to a loss of competitiveness; this is supported by empirical evidence. Similar arguments apply to over/undereducation and over/underskilling; this is confirmed by studies of US firms. However, if skilled workers are hired anticipating future manpower requirements this could have a positive effect for firms and be favourable for society through increased innovation.

How to measure skill mismatch is a core concern. Three alternative methods have been used: systematic job evaluation (objective measure), worker self-assessment (subjective measure) and empirical method (where data sets do not contain a direct question on the phenomenon). Each method has weaknesses. The report argues that over and underskilling may be superior measures to over and undereducation, especially if we are concerned with potential welfare losses. Skills obsolescence can be measured in several ways, but little consensus exists on which method is the most appropriate, while few data sets contain questions that can be used to assess skills obsolescence.

Good data are probably the most crucial prerequisite to supporting timely, effective and evidence-based skill mismatch policies. The current shortcomings of data sets may take years to remedy. Ideally, new matched employer-employee panel data, with information on labour demand and supply, should be developed. Collecting these data is very expensive and several years of data are needed for full research potential. Individual or household data can be used instead, but with a comprehensive coverage of the various elements of mismatch, which is not currently the case. Remedying existing data sets is cheaper than developing new ones. An alternative cost-effective method for collecting Europe-wide data on mismatch could be a new module containing questions on mismatch, possibly introduced in several existing European large panel surveys at regular but infrequent intervals (such as once every three years). We support the view that alternative means of data collection should also be considered for issues that may be too detailed to be informed through conventional interviews.

Why be concerned about skill mismatch?

Skill mismatch should be of concern to all citizens, but especially to policy-makers, employers' associations and trade unions. Because of skill-biased technological change, its incidence will increase over time, though overeducation could have some positive effects. As Europe's population is ageing rapidly, skills obsolescence is also likely to grow in importance. Matching skills and jobs is, therefore, crucial for Europe.

It is unrealistic to assume that labour markets can work without temporary imbalances but skill mismatch that takes time to resolve or is even permanent implies real economic and social losses. Aiming to provide insights supporting evidence-based policy-making, this report considers all types of skill mismatch and their interrelationships, recognising that their measurement and interpretation is not always straightforward. The report focuses on seven research questions, on some of which relatively little is known. In this chapter, we examine why policy-makers and other stakeholders should be concerned about skill mismatch. Subsequently, we provide a glossary of terms and elaborate the aim and the set-up of this report.

1.1. Framing the issue and policy background

Skill mismatch has come to the forefront of the policy debate in Europe, with global competition increasing, demographic change progressing and rapid technological change intensifying (European Commission, 2008a). Skill problems might arise, with shortages in some sectors combined with the problem of overeducation in others. Skilled people frequently working in elementary jobs is a pervasive international phenomenon. The challenge facing Europe is to provide businesses with the right skills to encourage innovation and growth, to address unemployment and to ensure that the potential of Europe's citizens is fully utilised.

As the European Commission Communication on new skills for new jobs (European Commission, 2008) observes, skill matching should be improved to confront rising unemployment. It is also suggested that the composition of skills emerging from both European Union universities and training systems needs to be better adapted to innovation-driven economies. Further, skill-

biased technological change results in a need for education upgrading as demand for more highly-educated workers increases at the expense of the less educated (¹). The recent Cedefop report on *Future skill needs in Europe* (Cedefop, 2008) notes that out of a net employment increase of over 13 million jobs between 2006 and 2015 almost 12.5 million will be at the highest qualification level (ISCED 5 and 6).

Skill mismatch is a crucial policy issue, not only for policy-makers but also for social partners including employers associations and trade unions. Reducing skill mismatch is likely to generate social benefits with higher job satisfaction for employees and possibly reduced stress from work, increasing health and wellbeing. At macro level, skill shortages and skill gaps can potentially lead to a loss of competitiveness as wage rates are bid up and productivity lowered within industries where skill problems exist. Productivity may also suffer if firms are forced to place lower-skilled workers in skilled positions and/or if where a skills shortage exists, workers use their position to alter their employment terms and conditions in a way that harms productivity.

As the European Commission Communication on new skills for new jobs (European Commission (2008b) states, skills upgrading is important for Europe's future growth potential and for employment equity, given the vulnerability of those lacking skills. It goes on to state that, due to imperfect information and structural rigidities, the lack of appropriate skills harms competitiveness, particularly for small enterprises. The communication suggests that skills upgrading is the most relevant solution to current and anticipated imbalances in the labour market.

Skill-biased technological and organisational change has not only increased the demand for highly-skilled manpower but has also been encouraged itself by the availability of such manpower. An increasing pace of technological change is likely, however, to result in growing skill shortages and skill gaps if appropriate education and training is not provided. At the same time the routine tasks of the middle-skilled may be eliminated by new technologies (hollowing out).

Mismatches are usually explained by a combination of information asymmetry between employers and employees, incomplete information in the labour market, differences between people, and transactions costs.

(¹) For a recent theory paper on the implications of on-the-job search in a matching model, which traces out the effects on the composition of jobs, unemployment, wages and labour-market reactions to shifts in the supply of and demand for skills, see Dolado et al. (2009).

Therefore, tackling mismatch by providing labour-market information and efficient job placement services should be a priority for policy-makers. This holds for both vertical and horizontal mismatch.

Vertical mismatch, which is commonly referred to as overeducation, occurs when an individual is hired for a job advertised as requiring a lower level of education than the individual possesses, or alternatively, when an individual is employed in a job which requires a lower level of education. When overeducation is partly a consequence of lower ability at a given education level or choice of employment by the individual concerned, this does not, in itself, imply a particular role for policy. If overeducation is merely a temporary phenomenon, policy-makers should not be too concerned but, for many employees, overeducation lasts a long time. Yet, if employers hire the overeducated, anticipating a future need, their action may have positive rather than negative repercussions.

Along these lines, for Schlotter (2008), overeducation can be a desirable feature of education and training systems and, following Sloane (2003), low-skilled workers may compensate for their lack of skill/ability by additional education to gain employment which they might otherwise not obtain. However, overskilling has negative effects on the wages earned by individuals experiencing it and on their job satisfaction. Greater care in job matching may, therefore, not only improve the welfare of overskilled employees, but also have positive effects on productivity and the growth in the economy. Finally, skills obsolescence is likely to grow in significance as the pace of economic and technological change intensifies and the labour force is ageing. Here there is a need for policies which encourage employers to retain older workers, as it is much more difficult to find new employment as workers age.

Graduates sometimes face horizontal skill mismatch, when not the level, but the type of education or skills are inappropriate for the job. Those with specific degrees do better than those with more general degrees (arts and humanities). This suggests that better information should be provided for potential students to address and prevent mismatches of this type.

A particular policy issue is whether genuine mismatch requires action from education providers or employers. For skill mismatch, whether horizontal or vertical, Weststar (2009) suggests that attention should be shifted away from education reform towards considering the impact of workplace and job design. This could be best achieved by giving workers greater task discretion on both social and technical control. The former includes taking part in decision-making, while the latter includes the ability to plan certain

aspects of the work and elements of choice in the way work is performed. Training needs of mismatched workers should also be considered.

Data on skill mismatch in Europe shows that it is pervasive, but evidence is scattered and there is much confusion about what is meant by different aspects of skill mismatch. Poor understanding of skill mismatch implies poor understanding of interactions between types of skill imbalances, thereby preventing coordinated actions. Addressing skill mismatch problems is especially relevant for vulnerable groups on the labour market, such as migrants, older workers and young people transiting from school to work.

1.2. Glossary of terms

Literature is not always clear on what is precisely meant by different types of skill mismatch. For example, it is often not straightforward to assess whether mismatch refers to qualitative or quantitative aspects and what is meant by occupational or education levels in a context where the notion of levels is blurring in many workplaces. Despite this, it is useful to have some initial understanding of various types of mismatch before examining more detailed issues. Therefore, Table 1 presents a glossary of terms. Although the definitions are based on a loose interpretation of literature and sometimes combine qualitative and quantitative dimensions of mismatch, they allow better understanding of different types and dimensions of mismatch. As an example, overeducation is defined in terms of years and overqualification in terms of credentials. While these terms are used interchangeably in literature and not all questions in various surveys allow a clear distinction between the two, they are not equivalent. In fact, Brynin and Longhi (2009), using data from the e-Living project showed that, while a qualification higher than required mostly generates a wage premium, time spent in education does not. The latter may involve repeating a year of study and reflects variations in ability, motivation or institutional arrangements which differ between countries.

Table 1. Glossary of terms

Overeducation	A situation in which an individual has more education than the current job requires (measured in years).
Undereducation	A situation in which an individual has less education than the current job requires (measured in years).
Overqualification	A situation in which an individual has a higher qualification than the current job requires.
Underqualification	A situation in which an individual has a lower qualification than the current job requires.
Overskilling	A situation in which an individual is not able to fully utilise his or her skills and abilities in the current job.
Underskilling	A situation in which an individual lacks the skills and abilities necessary to perform on the current job to acceptable standards.
Credentialism	A situation in which the level of education required to obtain the job exceeds the level of education required to perform the job adequately. It relies upon a belief of the employer that the possession of certificates and diplomas implies higher productivity on the part of the individual.
Real overeducation	A situation in which an individual possesses more education than the current job requires and also in which current skills and abilities are underutilised.
Formal overeducation	A situation in which an individual possesses more education than the current job requires, but in which current skills and abilities are fully utilised.
Genuine overeducation	A situation in which an individual has more education than the current job requires and this state has a negative effect on the level of job satisfaction.
Apparent overeducation	A situation in which an individual has more education than the current job requires, but this does not adversely affect the level of job satisfaction.
Skill shortage	A situation in which the demand for a particular type of skill exceeds the supply of available people with that skill.
Skill surplus	A situation in which the supply of available people with a particular skill exceeds the demand for it.
Skill gap	A situation in which the level of skills of the currently employed is less than that required to perform the job adequately or the type of skill does not match the requirements of the job.
Economic skills obsolescence	A situation in which skills previously utilised in a job are no longer required or have diminished in importance.
Physical (technical) obsolescence	Physical or mental skills and abilities deteriorate due to atrophy or wear and tear.
Vertical mismatch	A situation in which the level of education or skills is less or more than the required level of education or skills.
Horizontal mismatch	A situation in which the level of education or skills matches job requirements, but the type of education or skills is inappropriate for the current job.
Subjective measures of mismatch	The mismatch estimate is obtained by self assessment in employee responses to a questionnaire.
Objective measures of mismatch	The mismatch estimate is obtained by evaluating job requirements.
The empirical mismatch method	The mismatch estimate is derived from differences in the actual education of an individual within an occupation relative to the mean or modal level of education of all people employed in that occupation (where there are no direct data on mismatch obtained from either of the above methods).
Crowding out/ bumping down	When better qualified workers are hired to do jobs that less qualified workers could also do, they are crowding out the less qualified workers from what would be their traditional employment possibilities for that level of skill. Bumping down refers to the fact that this process works from the top to the bottom and pushes the less qualified workers to even lower level jobs. At the extreme some lower level workers may lose employment altogether when crowding out occurs.

1.3. Aim and format of this report

Of all types of skill mismatch, the concept of overeducation has received most attention in literature. This concept was first introduced in 1976 by Richard Freeman in *The overeducated American*, an influential book based on US experience (Freeman, 1976). Since then literature on overeducation has grown substantially and points to the 30-40 % of the working population falling into this category and suffering from a substantial wage penalty compared to properly-matched workers. In most countries a smaller, though often substantial, number of workers are mismatched in the sense of being undereducated for their job. Interpretation of these phenomena is, however, far from straightforward. First, measurement issues arise from the diversity of information sources, such as the subjective responses to questions directed at employees, 'objective' estimates of the education requirements of jobs obtained by job analysis, or estimates derived by the empirical method from the spread of education qualifications within occupations. Second, the relationship between occupations and their education requirements may be imprecise. Thus, some jobs may merely specify a minimal education requirement, while education requirements may be rising over time as jobs become more complex.

In recent years, a more limited strand of literature, encouraged by new data on the issue, has focused on both overskilling and underskilling (e.g. Allen and van der Velden, 2001; Green and McIntosh, 2007). This has raised questions about the relationship between overeducation and overskilling. There is also much older literature on skill shortages, i.e. insufficient numbers of suitably-qualified applicants to fill available posts, and the associated concept of skill gaps, i.e. when management judges that existing employees lack appropriate skills to maximise their contribution to output. Further, there is distinctive, but more limited, literature on the related question of skills obsolescence.

Although there has been a lot of attention on different types of skill mismatch, little attempt has been made to synthesise and integrate these disparate strands in literature. By drawing together consistently the various strands of research literature on skill mismatch and by synthesising empirical evidence, this study provides new insights to promote comprehensive policies to prevent and address skill mismatch and its consequences.

While conducting a literature survey, this study also reviews concepts, theories and empirical evidence on skill mismatch. To analyse and evaluate skill mismatch in a broad and comprehensive way, it focuses on the following research questions:

- (a) what do we know about skill mismatch in Europe?
- (b) what causes skill mismatch?
- (c) what are the links between the different types of skill mismatch?
- (d) what impact do business cycles have on skill mismatch?
- (e) what are the implications of skill mismatch?
- (f) what is the most appropriate method of measuring skill mismatch?
- (g) what types of data are needed to assess and analyse skill mismatch in Europe?

As some of these questions have been relatively neglected in literature, any conclusions drawn must be tentative.

What do we know about skill mismatch in Europe?

This chapter examines the pervasiveness of skill mismatch in Europe. Ideally, we would wish to know the extent of various types of mismatch and trends over time but, as comprehensive data on skill mismatch is limited, we focus instead on discussing the incidence of vertical and horizontal skill mismatch and their impact on wages. Though incidence varies substantially across countries, overeducation is found to be substantial across Europe with significant negative effects on earnings. The incidence of overskilling is lower, but higher for men than for women and increases with the level of education. In several countries, where evidence is available, horizontal mismatch is also substantial and impacts on earnings in a similar way. In Section 2.3, we review evidence on the duration and persistence of mismatch. The available information supports the hypothesis that much of it persists over the medium to the long term and may differ by level of education. Evidence on skills obsolescence suggests that many individuals, particularly the more educated in high-tech industries, may require substantial lifelong learning to remain productive.

2.1. Vertical mismatch and impact on wages

One of the most recent surveys (McGuinness, 2006), summarised in Table 2, in line with Groot and Maassen van den Brink's (2000) meta analysis, found that subjective measures of overeducation yield higher mean figures (29 %) than objective measures (22 %). This suggests that employees do not have, as some have argued, a clear tendency to exaggerate their own qualifications. The lowest incidence is recorded in the Netherlands and the highest in the US. For McGuinness (2006) it is reasonable to conclude that overeducation has remained relatively stable over time, although it is not always the case. Green and Zhu (2008) reported that in the UK overeducation increased for men from 21.7 % in 1992 to 33.2 % in 2006, while for women the comparable figures were 23.8 % and 32.1 %. However, they also split the overeducated into two groups – 'real' and 'formal' according to whether or not it is accompanied by underutilisation of skill. Real overqualification has been steady or rising only slowly.

Gottschalk and Hansen (2003) classified occupations in the US as graduate and non-graduate on a different basis: whether 90 % or more of workers in that occupation were graduates or, failing that, there was a significant graduate pay premium of 10 % or more in that occupation. They found that the probability of a graduate being employed in a non-graduate job actually fell between 1983 and 1996, a result 'which stands in stark contrast to those in previous studies' (Gottschalk and Hansen, p. 450). Similar findings have been obtained by Cardoso (2007) for Portugal and by Grazier et al. (2008) for the UK. It is clear, therefore, that conventional data on the incidence of overeducation should be treated with caution.

Ignoring the above distinctions about the precise nature of overeducation, Sicherman (1991) suggested that there were two stylised facts in relation to the effect of mismatch on pay. First, there is a pay penalty for overeducation, but the overeducated earn more than their matched colleagues. Second, the undereducated suffer a pay penalty relative to their matched colleagues but earn more than if they were properly matched. Later studies tend to confirm these results. Groot and Maassen van der Brink (2000) in their meta analysis summarised 25 studies as producing unweighted average rates of return of 5.6 % for attained years of education, 7.8 % for required years of education, 3 % for years of overeducation and -1.5 % for years of undereducation.

There is, however, little or no information on how employers differentiate the pay of their employees in this way. Is it, for instance, based on some form of assessment of performance? There is evidence that wage benefits of overeducation decline with additional labour-market experience. This is consistent with 'sheepskin effects', whereby initial pay is determined by certification, but eventually workers are sorted into their most appropriate jobs on the basis of performance, so that qualifications become less significant over time.

Chevalier (2003) found a pay penalty of 26 % for genuinely overeducated graduates, but only 7 % for those who were only apparently so. The wage penalties for overeducation appear to be greater than for overskilling, but this may reflect a failure to correct for unobserved differences between individuals in most studies. Wage effects may also vary by level of education or occupation. Mavromaras et al. (2009d) found that there were wage penalties associated with overskilling in both Australia and the UK, but these were larger for men than for women and increased with education level.

Table 2. Reported incidence of overeducation

Name of study	Year	Definition employed	Country	Data collection	Incidence of overeducation (%)
Groot and Maassen van den Brink	2000	Meta-analysis			26.2 (°)
Galasi	2008	Subjective job requirements	25 Countries	2004-06	33.00
Groot	1996	Objective standard deviation-based measure	UK	1991	11.00
Alpin	1998	(1) Objective occupational dictionary-based measure	UK	1995	27.00
		(2) Objective standard deviation modal measure		1995	37.70
Sloane et al.	1999	Subjective – job requirements	UK	1986-87	30.63
Green et al.	1999	(1) Subjective (2) Subjective	UK UK	1995	27.40
				1997	32.00
Dolton and Vignoles	2000	Self assessment – subjective job requirement	UK	1986	30.00
Battu et al.	2000	(1) Subjective – satisfaction	UK	1996	40.40 (°)
				1996	40.70 (°)
		(2) Objective occupational dictionary-based measure	UK	1996	21.75 (°)
				1996	22.15 (°)
		(3) Subjective – degree requirements	UK	1996	33.65
1996	38.00 (°)				
Dolton and Siles	2003	Subjective – not clear which one they used	UK	1998	22.00
Chevalier	2003	(1) Objective occupational dictionary-based measure	UK	1996	17.00 (°)
		(2) Subjective – job requirement	UK	1996	32.40 (°)
		(3) Subjective – satisfaction	UK	1996	16.20 (°)
Green and Zhu	2008	Subjective job requirements	UK	1992	26.40
				1997	26.50
				2001	32.50
				2006	37.30
Grazier et al.	2008	Occupational classification	UK	1994	40.00
				2004	30.00
Hannan et al.	1998	Objective standard deviation	Ireland	1992	20.00
McGuinness	2003a	Subjective – job requirements	Northern Ireland	2000	20.00
McGuinness	2003b	Subjective – job requirements	Northern Ireland	1999	24.00

Name of study	Year	Definition employed	Country	Data collection	Incidence of overeducation (%)
Hartog and Oosterbeek	1988	Subjective – required education objective	Netherlands	1982	16.00
				1960	7.00
				1971	13.60
				1977	25.70
Groot	1993	Objective standard deviation-based measure	Netherlands	1983	16.10
Groot and Maassen van den Brink	2000	(1) Objective standard deviation-based measure	Netherlands	1994	11.85 ^(a)
		(2) Objective occupational dictionary-based measure	Netherlands	1994	15.90 ^(a)
		(3) Subjective	Netherlands	1994	11.15 ^(a)
Allen and van der Velden	2001	Subjective – required education	Netherlands	1998	14.00
Dekker et al.	2002	Objective occupational dictionary-based measure	Netherlands	1992	30.60
Kiker et al.	1997	(1) Objective standard deviation mean measure	Portugal	1991	9.40
		(2) Objective standard deviation modal measure	Portugal	1991	25.50
		(3) Objective occupational dictionary-based measure	Portugal	1991	33.10
Cardoso	2007	Occupational classification	Portugal	1986	5.00
				1999	1.00
Alba-Ramirez	1993	Subjective – job requirements	Spain	1985	17.00
Bauer	2002	Objective standard deviation-based measure	Germany	1984-98	11.50 ^(a)
Büchel and van Ham	2002	Subjective – job requirements	Germany	1998	15.80 ^(a)
Patrinos	1997	Objective standard deviation-based measure	Greece	1977	16.00
Duncan and Hoffman	1981	Subjective – job requirements	US	1976	42.00
Burris	1983	Objective occupational dictionary-based measure	US	1977	21.70
Rumberger	1987	(1) Subjective – job requirements	US	1969	35.00
				1973	27.00
				1977	32.00
		(2) Objective occupational dictionary-based measure	US	1973	57.00
Verdugo and Verdugo	1989	Objective standard deviation-based measure	US	1980	10.90 (b)

Name of study	Year	Definition employed	Country	Data collection	Incidence of overeducation (%)
Sicherman	1991	Subjective – job requirements	US	1976 and 1978	40.80
Tsang et al.	1991	(1) Subjective – required education	US	1969 1973 1977	35.00 27.00 32.00
		(2) Objective occupational dictionary-based measure	US	1973	57.00
Cohn and Khan	1995	(1) Objective standard deviation-based measure	US	1985	13.00
		(2) Subjective measure – Sicherman definition	US	1985	33.00
Robst	1995	Subjective – required education	US	1976, 1978 and 1985	44.68
Hersch	1995	Subjective – job requirements	US	1991	21.00
McGoldrick and Robst	1996	(1) Subjective – job requirements	US	1985	50.00 (°)
		(2) Objective occupational dictionary-based measure	US	1985	30.80 (a)
		(3) Objective standard deviation-based measure	US	1985	12.55 (°)
Daly et al.	2000	Subjective – required education	US	1976	37.75 (°)
			US	1985	32.65 (°)
			Germany	1984	17.50 (°)
Gottschalk and Hansen	2003	Occupational classification	US	1983	9.00
			US	1996	5.00
Vahey	2000	Subjective – required education	Canada	1982	31.00 (°)
Cohn and Ng	2000	Objective modal measure	Hong Kong	1986	35.00 (°)
			Hong Kong	1991	34.00 (°)

(°) Average, (a) Males only

Source: Adapted from McGuinness (2006).

There are also differences between countries. Galasi (2008) used the European Social Survey to analyse the effects of education mismatch across 25 countries. Overall, 33 % of workers were found to be overeducated, but this ranged from 15 % in the Netherlands to 79 % in Estonia; these data suggest a higher proportion of undereducated, with a mean of 59 %. Otherwise most of the empirical regularities found in earlier literature seem to hold.

2.2. Horizontal mismatch and impact on wages

We must also consider horizontal mismatch. Robst (2008) suggested the following four hypotheses in relation to this type of mismatch:

- hypothesis 1: the wage effects of overeducation are larger when workers are also mismatched the basis of type of degree and level of occupational requirements;
- hypothesis 2: among workers mismatched on the basis of level and type of education, the wage effect depends on the transferability of skills between type of degree and occupation;
- hypothesis 3: individuals who face discrimination (such as coloured people, the disabled and single women) or who have lower ability are more likely to be mismatched due to demand-related reasons. Supply-related mismatches are more likely among married men and women than among single men and women;
- hypothesis 4: the wage effects of mismatch are likely to be larger when workers have accepted a job due to demand-side reasons (i.e. genuine mismatch) compared to supply-side reasons (i.e. apparent mismatch).

Robst finds that overeducated men, whose work and field of study are related, earn 2.4 % less than well matched men. However, if the job is only somewhat related the penalty rises to 7.1 % and to 21.6 % if it is completely unrelated. For women the corresponding figures are 3.6 %, 5.3 % and 19.1 %. The income penalty for horizontal mismatches appears to exceed that for vertical mismatches. Further, while most workers report supply-side reasons as the main reason for being in a particular job, it also appears that wage effects are large where workers are mismatched for demand-side reasons. A Swedish study (Nordin et al., 2008) found that being horizontally mismatched was associated with 38 % lower income for men and 26 % for women. An Irish study (Kelly et al., 2008) found, in contrast, a much smaller pay penalty of around 5 % for those who were mismatched by field, though this varied by field of study. In this case the vertical mismatch penalty (14.4 %) exceeded the horizontal.

2.3. What is the likely duration of skill mismatches?

The extent to which a particular form of mismatch persists over time determines the costs to the individual, firm or economy. While evidence on persistence of overeducation is rich, it is limited to insights based on cross-sectional data. Meaningful tests for mismatch persistence require longitudinal data on individuals and jobs over a longer period of time. Evidence on the persistence of other forms of mismatch is scarce, but some conclusions can be drawn.

2.3.1. Individual overeducation and overskilling

There has been considerable debate on whether individual overeducation will persist over time. Sicherman (1991) found a positive and significant relationship between job mobility and overeducation which was taken as evidence of non-persistence. However, later research produced more mixed results.

Some studies have reported evidence of higher rates of job mobility (e.g., Alba-Ramirez, 1993; Sloane et al. 1999; Alba-Ramirez and Blázquez, 2003), higher rates of promotion within firms (Hersch, 1995; Dekker et al. 2002; Alba-Ramirez and Blázquez 2003; Groeneveld and Hartog, 2004), or greater levels of quit intention (Hersch, 1995; Robst, 1995) among the overeducated. Sloane et al. (1999) also reported that, while overeducated workers were more likely to have short job tenure with their current employer, they were also more likely to experience involuntary job separations and to exit from employment into unemployment. Further, for McGuinness and Wooden (2007) increased job mobility cannot be taken as evidence of falling overeducation given that workers are most likely to move from one overeducated job to another. The most convincing evidence to support the view that overeducation can be a long lasting phenomenon comes from studies of graduate labour markets, but these studies are typically based on cross-sectional data or short time-series. Dolton and Vignoles (2000) found that 38 % of a large sample of UK graduates in 1980 was overeducated in their first job; six years later this proportion still stood at 30 %. Similarly, McGuinness (2003c) reported that among a sample of graduates in Northern Ireland, 31 % indicated that a university degree was not a requirement for their first job, and after two to four years this proportion was still at 24 %. Finally, Frenette (2004) reported on longitudinal data for Canadian graduates, which showed little evidence

of any decline in the incidence of overeducation over a three-year window (between two and five years after graduation).

Research on overskilling persistence is much more limited as panel data on overskilling in Europe are lacking. McGuinness and Wooden (2007) examined durations using the first four waves of the household income and labour dynamics for Australia (HILDA) panel. The study concludes that overskilling tends to be a non-transitory phenomenon with less than 25 % of employees who were severely overskilled in wave 1 likely to be matched three years later. The study also found that, as for overeducation, increased job mobility cannot be evidence of reduced overskilling. Mavromaras et al. (2009b) using HILDA found that overskilling varies by education level: it is rare among university graduates, but highly persistent; it is low but significant among school leavers from general education; and none at all is found among vocational education and training graduates.

Graduate studies focusing on overeducation and overskilling are typically based on short time-series. This hampers the ability to examine whether overeducation in the early stages of a career are reversible later on, when people acquire more training or experience. Also, these studies only provide a partial picture of mismatch persistence, as they focus on the transition from school to work. Far less attention is on transition from unemployment to work, mainly because suitable data is lacking, but also due to insufficient analysis of the incentives and preferences, decisive factors in people's education and occupation choices. Many research questions remain open, but we can tentatively conclude that overeducation and overskilling are non-transitory phenomena.

2.3.2. Overeducation and overskilling at firm level

Although overeducation and overskilling can be a long lasting phenomenon for individuals, it does not mean firms retain overeducated or overskilled workers for long periods. High rates of voluntary and involuntary separations among the overeducated and overskilled ⁽²⁾ suggest that their average job tenure is likely to be some fraction of their total mismatch duration. However, the fact that the overeducated earn a premium relative to matched colleagues, coupled with the finding that the probability of involuntary separation tends to be much lower than the probability of voluntary separation ⁽³⁾, suggests that employers hiring overeducated and overskilled workers have some

⁽²⁾ Sloane et al., 1999; McGuinness, 2003; McGuinness and Wooden, 2007.

⁽³⁾ McGuinness and Wooden, 2007.

productivity advantage. This is confirmed by Jones et al. (2009) using British workplace employment relations survey (WERS) data to demonstrate higher productivity in firms employing overeducated workers. However, the consistent finding that the overeducated and overskilled have lower job satisfaction ⁽⁴⁾ also indicates that retaining such workers may not be in the firm's long-term interest. Therefore, the extent to which firms retain overskilled or overeducated workers will depend on the magnitude of any short-term benefit relative to the long-term cost. From an economy point of view, demand for skills and educated labour rising over time should reduce the incidence of overskilling and overeducation, provided that the surplus are in areas of demand within the economy and that workers are mobile.

2.3.3. Undereducation and underskilling in individuals/firms

Generally, the undereducated have no incentive to become matched, as they earn a premium relative to matched colleagues with similar education levels ⁽⁵⁾. Little research exists to date for the underskilled, so for now we will assume that their situation reflects that of the undereducated.

Accepting that earnings reflect workers' marginal products, the finding that the undereducated are paid less than matched individuals in the same job who are matched ⁽⁶⁾ suggests that firms employing undereducated workers may have some productivity penalty. The extent to which a firm will continue to hire undereducated workers will vary according to the underlying causes of the undereducation itself. If undereducation relates to an inability to hire suitably qualified workers, i.e. a skill shortage, then the duration of undereducation within the firm will be highly correlated with the persistence of the skill shortage within the economy generally.

2.3.4. Skill shortages

Duration of skill shortages depends on the level at which the problem is assessed. For firms, the shortage will persist as long as the vacancy remains unfilled or until the firm adopts an alternative strategy for dealing with the problem. Duration will be longer the more complex and skilled the unfilled vacancy so duration should vary across occupations and sectors. For the economy more generally, duration of skill shortages will depend on the time elapsing before it is communicated through the market mechanism and the period required to induce and train individuals in the specific skill area.

⁽⁴⁾ Battu et al., 1999; Fleming and Kler, 2007.

⁽⁵⁾ Kiker et al., 1997; Sloane et al., 1999.

⁽⁶⁾ Kiker et al., 1997.

2.3.5. Skill gaps

Given that skill gaps relate to the firms' current employees and that they are specific to the firm's requirements, dealing with skill gaps largely remains the responsibility of firms. Generally, skill gaps can only be eradicated through firm-sponsored training or by providing individuals with relevant incentives to participate in upskilling. Duration depends on the period necessary to retrain individuals in the relevant skill areas, as for skill shortages, and on costs involved. Given the difficulties and costs associated with equipping workers with basic and advanced skills, durations are likely to be shorter for skill gaps related to intermediate skills. However, when skill gaps arise as a result of firms adopting a second best strategy in the face of skill shortage, duration will again be related to the duration of skill shortage.

2.3.6. Skills obsolescence

Here we are interested in how long on average it takes for a worker's skill to become obsolete. In an early study, Bosworth (1978) noted that little was known about the obsolescence of technical knowledge. However, using a restrictive definition – the time when a particular technology was no longer embodied in goods currently being sold – he was able to use patent renewal data to measure obsolescence. Evidence pointed to annual rates of decay of well over 10 % in the post-war period. Neuman and Weiss (1995) showed that obsolescence was more evident in high-tech than low-tech industries and greater for more educated workers. Allen and van der Velden (2007), using a Dutch survey, reported that 30 % of skills in their sample had become obsolete with a half-life for competences in the range of 10 to 15 years. This implies that many individuals would have to renew their competences regularly over their career, giving justification for lifelong learning.

In the 1970s several studies examined the rate of obsolescence among engineers. Notably, Kaufman (1974; 1975) pointed out that the introduction of computer technology was critical and ironically threatened most those introducing it: engineers, computer scientists and other technical professionals. He defined obsolescence as 'the degree to which organisational professionals lack the up-to-date knowledge of skills necessary to maintain effective performance in either their current or future work roles' (Kaufman, 1974 p. 23). He developed an open systems approach (Kaufman, 1989) to analyse obsolescence, based on extensive questionnaires sent to technical professionals in a single organisation. The approach considered four elements: environmental change (e.g. rapid changes in technology); organisational climate (determined largely by managerial policies and practices); the nature

of work (in terms of job assignments); and individual characteristics such as the cognitive and personality factors related to keeping up-to-date. The last of these is important in determining how individuals cope with rapid technological change (Trimmer et al., 1998; Pazy, 1998; 2006). The US National Academy of Sciences concluded in 1985 that engineers could work productively over a longer period if they had access to effective continuing education regardless of the state of the business cycle. This required interdisciplinary approaches and non-technical skills that are not imparted by the formal training of engineers.

What causes skill mismatch?

This chapter analyses the causes of different types of skill mismatch. Based on evidence, we discuss the causes of overeducation, skill shortages and skills obsolescence, and reflect on the role of individual characteristics. Overeducation can result from the asymmetric nature of the supply of labour-market information. However, literature has devoted little attention to explaining overeducation by considering the decision processes of firms and individuals. A key issue is whether perceived mismatches represent labour market sorting on the basis of the lower ability of the individuals concerned; it is perhaps necessary to disaggregate overeducation according to the level of job satisfaction or use of skills of overeducated workers. Insufficient training, markets reacting slowly to changes, skill-biased technological progress and business cycles are core factors explaining skill shortages. When skills depreciate due to ageing or when economic developments change the skills that firms need, this process is referred to as skills obsolescence. Young people entering the labour market, older workers, females, ethnic minorities and the disabled are disproportionately affected by skill mismatch.

3.1. Causes of overeducation

Education type and level may influence the likelihood of mismatch on entering employment. As Stigler (1961) observed, the higher the level of education the better defined the set of jobs a worker can obtain and the better the information individuals have about the nature of the labour market. Further, individuals in narrower fields of study (such as law or medicine) are likely to have a better defined set of job alternatives than those in more broadly defined ones (such as arts and humanities). Thus, Kucel and Byrne (2008) suggested that those from broader educational backgrounds are likely to be less well informed about labour-market opportunities. Using the 2003-05 British labour force survey, which contains information on type of degree and the nature of the job finding process, they found that graduates in hard disciplines are significantly less likely to apply for a job through a private employment agency, by relying on an advertisement or by a method other

than through personal contacts relative to those from broader educational backgrounds. Thus, overeducation can result from the asymmetric nature of the supply of labour-market information.

Büchel (in Cedefop; Büchel, 2001) advocated regarding overqualification as a result of a decision-making process by both employers and employees. For employees, the choice between unemployment and work, or different types of jobs, precedes overeducation. Employer decisions may involve dealing with problems in recruiting workers with the right skills. Very few studies have focused on the decision-making processes of both firms and individuals to explain the occurrence and persistence of overeducation. Research on the role of employers in hiring mismatched workers is also rare, although this is a possible strategy for fluctuating demand for skilled employees and rising demand for skilled manpower. Sloane et al. (1996) also pointed out that undereducated workers compensated for lack of qualifications by having more experience, tenure and training (the substitutability hypothesis), so one cannot necessarily infer that mismatch is wasteful. In their matching model for UK graduates, Battu et al. (1999) included variables capturing the nature of the job (e.g. occupations, sector of work and size of firm). Unsurprisingly, higher occupations increase the likelihood of matching, with individuals in the education sector and private practice more likely to be matched and size of firm being positively and strongly related to the probability of a match.

A key issue is to what extent perceived mismatches represent labour-market sorting on the basis of varying quality of labour within education levels. This is particularly so as the number of graduates has increased substantially in many countries. If less able individuals have entered the pool of graduates, quality may have fallen over time which may increase the incidence of overeducation. For example, Battu et al. (1999) controlled for the degree class and institution type in the UK, finding that the class of degree has a significant effect on graduate earnings, with a first class degree having a 8-13 % premium over a lower-second class one, and graduates from more established universities earning 8-11 % more than graduates from former polytechnics, holding constant a measure of overeducation. Dolton and Vignoles (2000) and Green and Zhu (2008) also found that those with better degree classifications and those from more established universities are less likely to be overeducated.

There may also be cohort effects if individuals qualify for entry into the labour market in periods when there is an excess supply of qualified applicants. This will happen because it takes some time for workers to accept a lower-skilled job and then continue searching for a more complex one

which pays more (Gautier, 2000). This may be reinforced when the individual faces short-term constraints on the search process through personal, family, location or other reasons. As Dolton and Silles (2003) also suggested, the process of finding a suitable job may take some time, so we would expect in this case, and in contrast to what was stated earlier, that overeducation is a temporary phenomenon. Most studies of skill mismatch, however, focus on the state of mismatch rather than on the process of becoming mismatched; available data does not allow for analyses that follow the same individuals in their employment careers, which makes a valid assessment of persistence difficult.

Most data sets do not contain the data necessary to correct for individual heterogeneity. One exception is the British national child development study. Using this data set, Green et al. (1999) found that individuals who scored higher on a maths test administered at age 16 were significantly less likely to be overeducated later in their working lives, and this effect was substantial. Their analysis of the International adult literacy survey (IALS) also suggested that individuals who lacked good quantitative skills were more likely to be overeducated. Büchel and Pollmann-Schult (2001) found that in Germany a poor grade in the school leaving certificate had a strong effect on the later risk of overeducation for graduates with a vocational degree and after controlling for selectivity effects.

Box 1. Theoretical approaches to overeducation

There is no generally-accepted theory of overeducation (McGuinness, 2006), but it is possible to consider how the phenomenon relates to various models of the labour market as illustrated in the table below. The standard Becker/Mincer human capital model suggests in its simplest form that wages are determined by endowments of human capital and particularly years of education and experience. There is no role for demand side factors, where more years of education imply higher earnings, and no distinction is made between actual and required years of education. Thus, any year of education is just as valuable as another. In contrast, in the Thurow job competition model, marginal productivity resides in the job rather than the worker, and in the extreme, education simply serves to place the individual at the front of the queue for jobs, as it signals that the employer will be required to invest less in training. Hence, the return on overeducation is zero, as all workers in a given job are paid the same. In contrast, the Sattinger job assignment model (Sattinger, 1993) considers both supply and demand to be important determinants of wages, as there is an allocation problem in assigning heterogeneous workers to heterogeneous jobs. At any time it is unlikely that there will be a perfect match and overeducation can be a persistent problem. Earnings will be a function of both worker and job characteristics and this model can encompass the human capital and job competition models in a more general equation which is sometimes referred to as the Duncan and Hoffman model (1981) or in other cases as the ORU model.

$$\log W_i = \beta_0 + \beta_1 q^r + \beta_2 q^s + \beta_3 q^u + \varepsilon$$

In this model, actual educational qualifications (q) of individuals are decomposed into the required or normally accepted level (q^r), surplus or more than required (q^s), and deficit or less than required (q^u), qualifications in relation to those necessary to do the job. The human capital specification implies that $\beta_1 = \beta_2 = \beta_3$ and the job competition model that $\beta_2 = \beta_3 = 0$. Tests of these models, using an F test on the residual sum of squares, tend to suggest that generally the job assignment model outperforms the other two. The theory of career mobility associated with Sicherman and Galor (1990) suggests that individuals may be prepared to accept jobs with low returns on education provided that this is accompanied by a higher probability of promotion. In this context overeducation is a purely temporary phenomenon and additional returns on education will be obtained later. Finally, Frank's theory of differential overqualification (1978) is based on the proposition that, for married couples, the search for a pair of jobs will be constrained geographically and only infrequently will the best job offer for both spouses occur in the same location. If the husband's job choice dominates because of the wife's responsibilities for children, married women will face the greater constraints, whether as tied stayers or tied movers and we expect married women to experience greater overeducation than either married men or single men or women.

Theory	Main proponent(s)	Main determinants of wage	Predictions of overeducation (overskilling)
Human capital model	Becker (1964), Mincer (1974)	Supply (personal characteristics)	Return on years of overeducation = return on years of required education
Job competition model	Thurow (1975)	Demand (job queues)	Return on overeducation is zero
Assignment model	Sattinger (1993)	Supply and demand	Return on years of overeducation < return on required education
Career mobility theory	Sicherman and Galor (1990)	Training costs are general and paid for by the individual	<ul style="list-style-type: none"> • in the short-run return on years of overeducation < return on required education • in the long-run return on years of overeducation < return on years of required education
Theory of differential overqualification	Frank (1978)	Gender and family status	Return on years of overeducation < return on required education

Where data sets lack the appropriate variables, indirect methods are necessary. Thus, Chevalier (2003) distinguished between apparently and genuinely overeducated graduates in the UK based on their answers to questions on job satisfaction. Graduates in graduate jobs are defined as 'matched', whatever their level of satisfaction. Those satisfied but in non-appropriate (or non-traditional graduate) jobs are described as 'apparently overeducated' and those in non-graduate jobs and dissatisfied as 'genuinely overeducated'. A similar approach was adopted by Allen and van der Velden (2001), who used a 1991 Dutch data set which allowed job levels to vary for given education qualifications. They distinguished between a formal education mismatch and a skill mismatch based on two key questions: whether the current job offered sufficient scope to use acquired knowledge and skills (utilisation); and whether they would perform better in their current job if additional knowledge and skills had been acquired (skill deficit). While about 15 % of their sample experienced underutilisation, a much higher proportion experienced skills deficits and the latter was only weakly related to education mismatches.

These results cast doubt on one of the key assumptions of assignment theory, namely that education mismatches imply skill mismatches. One interpretation is that overeducation in part masks unmeasured ability differences and is, therefore, spurious. Taking these results together, it seems clear that a substantial part of what is described in literature as overeducation merely reflects the heterogeneity of individual abilities and of skills within particular education categories. Far from implying inefficient allocation of labour, this suggests that the labour market is functioning effectively in allocating workers to jobs which match their skills and abilities (Sloane, 2003).

Brunello et al. (2007) argued that employment protection legislation might increase the extent of skill mismatch by making it harder for individuals to obtain their first job and more difficult for firms to reduce staff because of restrictions on firing. Using the European Community household panel 1994-2001 they found a positive association between skill mismatch and employment protection legislation. Their regression analysis for the five largest countries suggests that men are more likely to be mismatched than women (⁷), that overqualification increases with years of education (apart from Germany), and declines with increased labour experience, which, in contrast to evidence cited earlier, suggests that overqualification is a temporary

(⁷) This is in contrast to other findings reported elsewhere.

phenomenon. There are also important differences between countries, with the suggestion that for Germany and the UK some workers may choose to become overqualified to avoid unemployment. Adopting a fourfold classification of mismatch in terms of combinations of overeducation, overskilling and matching, it appears that skill mismatch rather than overqualification causes pay penalties.

3.2. Underlying causes of skill shortages

Skill shortages can be caused by underinvestment in training. The idea of market underprovision of skills can be traced back to Pigou in 1912 (cited by Haskel and Holt, 1999) who argued that the additional transferable skills associated with training will raise the probability that a worker will be poached, thus reducing the likelihood that training will take place. Individuals may underinvest due to perceived high training costs, coupled with uncertain returns (Booth and Snower, 1996). Information gaps or inadequately structured education provision may also lead to incorrect investments on the part of students, while insufficient labour-market mobility can also lead to imbalances (Neugart and Schomann, 2002).

Institutional factors may also prevent the labour market from clearing; for instance, centralised wage bargaining systems may be unable to consider sectoral or regionally-based changes in demand. A sluggish supply-side may also contribute to the problem. For instance, Haskel and Martin (2001) argued that skill shortages in the UK have arisen primarily as a consequence of education supply failing to keep pace with skill-biased technical progress. Finally, the incidence of skill shortages will vary according to the economy's position in the business cycle. Specifically, skill shortages tend to have a strong negative correlation with the claimant count (Frogner, 2002). Hogarth and Wilson (2001) go so far as to suggest that skill shortages are actually a significant driver of the business cycle itself, placing a productivity constraint on the economy which in turn leads to a downturn in activity. Further, the factors listed above may also act as drivers for undereducation and underskilling.

3.3. Causes of skills obsolescence

Skills obsolescence, which may lead to skill gaps, is a process rather than a state. De Grip and van Loo (2007) distinguished between physical (technical) and economic skills obsolescence as outlined in Table 3. Technical skills

obsolescence results from depreciation of manual skills or physical strength through ageing, while economic obsolescence occurs as a result of changes in production technology which alter the optimal input mix for firms. If there are new skill requirements as a result of changes in production, this may have a major impact on job specific skills. If employment declines across an industry or occupation, this is referred to as sectoral skills obsolescence. If firm reorganisation or closures occur more job losses may result in firm specific skills obsolescence. Physical (technical) obsolescence and job loss combined may result in organisational knowledge loss. Thijssen (2005) has identified a third type of skills obsolescence: perspectivistic obsolescence. This refers to outdated views and beliefs on work and the work environment. Skills obsolescence can manifest itself through unemployment, crowding out to lower-skilled jobs, lower wages or through problems in performing the job properly. As workers become more educated and skill biased technological change remains important, while at the same time the workforce is ageing, skills obsolescence is likely to become even more significant.

Table 3. Types and causes of skills obsolescence

Types	Forms of human capital depreciation
Physical (technical) obsolescence	
Wear and tear	<ul style="list-style-type: none"> deterioration of mental and physical capacities through ageing, illness or injury decreasing capacity to learn and adapt to new situations
Atrophy	Insufficient use of skills as a result of overeducation, increased specialisation or unemployment
Economic skills obsolescence	
Job specific skills obsolescence	New skill requirements due to changes in production
Sectoral skills obsolescence	Employment declines either by industry or occupation
Firm-specific skills obsolescence	Voluntary or involuntary quits resulting from firm reorganisation or closure
Organisational knowledge loss	
	Combining wear and tear of skills of individual workers or quitting by workers with firm specific skills
Perspectivistic obsolescence	
	Outdated views or beliefs concerning the nature of work and the work environment

Source: Adapted from de Grip et al., 2007.

Weinberg (2007) showed that skills obsolescence arises in two ways. First, the diffusion of new technology may increase the obsolescence of existing skills. Second, experienced workers who have accumulated greater stocks of skills relevant to the old technology lose more human capital when switching to new tasks. Contrary to expectations, skills obsolescence occurs not only in strongly field-specific and technical fields of study, but also in more generic and non-technical fields (Allen and van der Velden, 2007). The traditional vintage human capital model emphasises the imperfect transferability of human capital across technologies, implying that younger workers will be the primary adopters of new technology. New technologies may also complement existing skills and there is some evidence that this applies in particular to more educated men with substantial (30-40 years) experience.

3.4. Mismatch and individual characteristics

Are there particular personal characteristics which make certain individuals more prone to mismatch than others? Particular groups may be more subject to discrimination in the labour market – young workers, older workers, females, ethnic minorities and the disabled – and this feature may also manifest itself in labour-market mismatch.

Young workers are likely to be particularly prone to skill mismatch as new entrants into the labour market, and the finding that overeducation is linked to a lack of work experience supports this hypothesis. One Dutch study by Dekker et al. (2002), for example, found that the proportion of overeducated decreased from 41.7 % for the 15-19 age group, to 27 % for the 30-44 age group and 18 % for the 49-64 age group. Many other studies report similar results. Older workers may suffer from mismatch as a consequence of skills obsolescence, which is more likely in industries subject to rapid technological change or in decline through shifting patterns of demand.

In an early US study, Frank (1978) examined the link between gender and overqualification. He suggested that, in a dual earner household, there would be greater constraints on married women than married men on account of child-rearing causing intermittent labour-force participation on the part of the wife. Married women would tend to be tied stayers or tied movers, thus limiting their ability to obtain optimal matches in the labour market. However,

McGoldrick and Robst (1996), who attempted to test whether married women in small local labour markets were more prone to overqualification than those in larger labour markets, could find no evidence to support this proposition. Büchel and Battu (2003) extended this analysis using German data by making allowance for commuting distances between home and work and found that longer commuting distances tended to reduce the likelihood of overqualification, though not differentially between men and women.

An alternative reason why one might expect gender differences in mismatch is the presence of fixed costs of employment together with higher quit rates for women than men. This may lead employers to require higher ability from women relative to men when hiring for particular jobs. Thus, van Ours and Ridder (1995) found that women in their Dutch data set required almost six months more work experience than men to be hired for the same job, implying that they were overqualified in this sense. Yet, overall there is mixed evidence of skill mismatch being a more serious problem for women than for men across countries, with counter examples. Why there are such differences between countries seems to be an important issue for further research.

Studies of skill mismatch across ethnic minorities are limited in number. Battu and Sloane (2004) used the Fourth national survey of ethnic minorities 1993/94 to investigate whether overeducation was greater for ethnic minorities in Britain than for the white majority using a modal measure of required education across 60 occupations. They found that overeducation was higher for non-whites than for whites, while undereducation was lower for non-whites, but within the non-white population the African Asian group was more likely to be overeducated than Indians. The consequences of labour-market mismatch in terms of the wage penalty were more severe than for the indigenous white population. Lindley (2009) examined the extent of overeducation among UK immigrants using labour force survey data for 1993-2003, again estimating over- and undereducation in terms of deviations from the mode. The results were largely consistent with those of Battu and Sloane (2004), though in this case Indian immigrants were more likely to be overeducated compared to indigenous whites.

Studies of labour-market mismatch among the disabled are notable by their absence, and often a disabled dummy is not even included in the estimating equation. Where it is, there is sometimes a significant effect on the probability of overeducation. This is clearly an area for future research.

What are the links between the different types of skill mismatch?

This chapter analyses to what extent, how and why different types of skill mismatch occur simultaneously. First, we look at skill shortages, skill gaps, undereducation and underskilling. We then examine whether overeducation, overskilling and skill shortages can occur simultaneously. In the third part of the chapter we focus on the duration of particular combinations of mismatch. There does not appear to be a strong correlation between the occurrence of skill shortages and skill gaps, but the latter may be closely linked to underskilling. Both overeducation and overskilling may be a consequence of excess labour supply, which can be illustrated by the Beveridge curve. Skills obsolescence is different from the above as it is a process rather than a state. Levels of skill are important as it is open to a skilled worker to obtain an unskilled job, while it is not normally open to an unskilled worker to obtain a skilled job. This is reflected in the concept of skill bumping (or crowding out). Various types of mismatch can be present at the same time in individual firms but not often in the same occupations. Ideally we require matched employer-employee data sets to cast light on all these phenomena.

4.1. Skill shortages, skill gaps, undereducation and underskilling

Skills related problems can arise because of skill shortages or skill gaps.

Skill shortages refer to a skills related labour-market shortage, i.e. where there are not enough individuals with the required skills within the economy to fill existing vacancies. This is the most simplistic definition to skill shortages. However, measurement issues are clearly important (e.g. Green et al., 1998) and some recent attempts have been made to move towards a more refined system of definition that incorporates training lead times. For example, Richardson (2006) proposed the following system for defining skill shortages:

- (a) level 1 shortage: there is a shortage of individuals with the relevant technical skills who are not already using them and it takes a long training time to develop these skills;

(b) level 2 shortage: there are few people who have sufficient skills and are not already using them, but such skills can be developed relatively quickly.

Skill gaps occur when skill levels in the workforce are below those desired by employers or when job requirements do not match precisely the content of the knowledge and abilities of individuals.

The 2001 UK employer skills survey (UKESS) concluded that skill shortages were more commonly associated with skilled occupations with more substantial education and training requirements. In terms of skill gaps, the UKESS study found that these were more strongly related to poor human resource management practices such as lack of staff training and poor labour retention. Therefore, it is not at all evident that skills gaps and skill shortages are necessarily strongly correlated.

Each of these concepts points to the difficulties employers are faced with in attracting sufficient labour of the right quality. Skill shortages are not easy to measure, but indicate that the demand for labour exceeds the (available) supply at the given market wage. However, if employers are not willing to pay the market wage to attract additional labour, this should not be considered a labour shortage. In a classic paper Arrow and Capron (1959) focused on the possibility that lags in decision-making could result in a dynamic shortage. Such lags may occur through the time taken to recognise that there is a need to raise salaries, in obtaining approval for the increase and in putting the new pay policy into action. The reaction speed of an employer will be influenced by institutional arrangements such as the presence of long-term labour contracts and partly by the speed with which information about salaries, vacancies and the availability of workers becomes generally available throughout the market.

Wage adjustments are, however, only one possible means of adjustment and non-wage adjustments appear to be more common in the short-term. Common examples are reducing output, adjusting inventories, increasing overtime, using more vigorous recruitment methods or reducing hiring standards. It is in the last of these circumstances that skill gaps may arise in the sense that employees hired under such circumstances are less likely to possess the skills necessary to complete tasks with maximum efficiency. Skill gaps seem to equate with underskilling and it is difficult to differentiate between the two, apart from the fact that skill gaps may reflect the views of the employer and underskilling the views of the employee. In both cases the remedy seems to lie with the provision of additional training.

In one study of Northern Ireland, Bennett and McGuinness (2009) found that 58 % of employers in the IT and engineering sectors adjusted to the

problem of skill shortages by training and upskilling their existing staff, and 47 % chose to recruit staff from other backgrounds and train them up. Under such circumstances workers may find themselves undereducated in relation to existing workers in the occupation to which they have been upgraded. Though individuals in this category may lack formal qualifications, they may have previous experience of the type of work, so that they will not necessarily be underskilled.

All the above scenarios imply that demand exceeds supply. Where supply exceeds demand, a reverse scenario will apply. If there has been a rapid increase in the numbers graduating with certain qualifications skill surpluses may arise, resulting in the downgrading of some individuals who find it more difficult to obtain a job matching their qualifications. This crowding out may result in skill bumping in which workers with lower qualifications are also subject to downgrading or lose their jobs altogether. Both overeducation and overskilling may result in these circumstances. If overeducation is caused by too many qualified workers chasing too few jobs we would expect a high rate of unemployment among those workers with lower qualifications who have to compete with more educated workers, as well as a low vacancy rate. Overeducation can also result from institutional regulations, if unemployed persons are required by employment officers to accept lower-skilled jobs than those for which they are qualified to avoid losing unemployment benefits, as occurs under workfare policies.

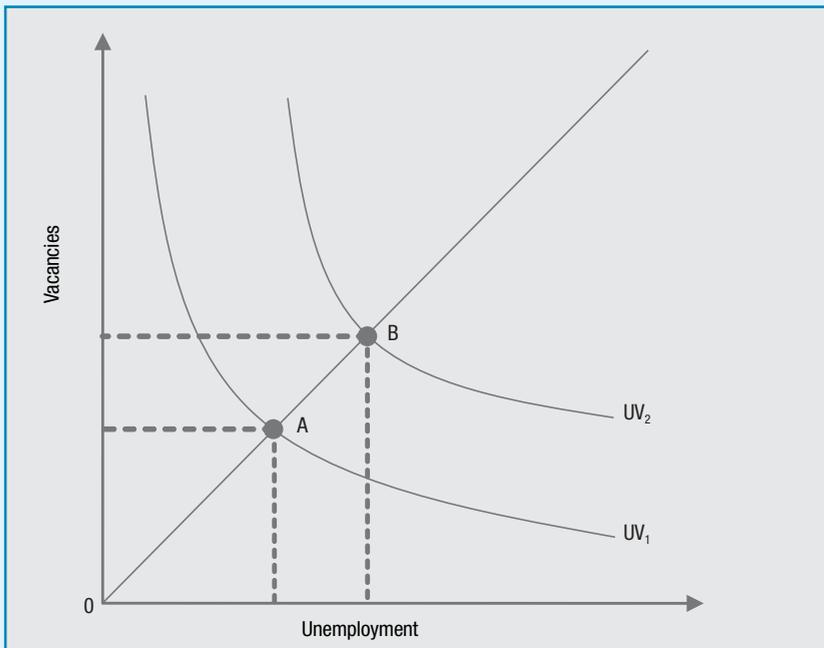
Underskilling may arise as a result of skills obsolescence, which occurs when skills become less valuable in the production process. This particularly applies to older workers. While they may be retrained in new production techniques, such as computer technology, this may be uneconomic because of the shorter pay-back period compared to that of younger workers. A further problem is that a mismatch between the level of education and/or skills and the job lack of use of capabilities may lead to a decline in workers cognitive abilities (the 'use it or lose it' phenomenon as described by de Grip et al., 2008).

Suitable employee-employer linked data are undoubtedly required (see Chapter 8) if we are to understand fully and quantify the relationships that exist between skill mismatches for the firm and skill mismatches for individuals. However, in the absence of such data, it is possible to develop some reasonable and ultimately testable hypotheses based on existing knowledge. First, evidence suggests that little overlap between skill shortages and skill gaps exists. For instance, data from the 2001 UK employer skills survey revealed that less than 1 % of establishments experienced both skill

shortages and skill gaps. Such a weak occurrence supports the view that firms experiencing skill gaps have little difficulty in recruiting staff, suggesting that skill gaps tend to be more heavily associated with skill deficiencies, while skill shortages are more commonly associated with higher level functions ⁽⁸⁾.

Box 2. The Beveridge curve

Both cases of supply exceeding demand and demand exceeding supply can be portrayed on the Beveridge curve (see below) which relates unemployment to unfilled vacancies. This assumes that there is labour-market equilibrium when the number of unemployed (U) equals the number of unfilled vacancies (V). When U does not equal V there is an imbalance at the level of the economy, region, industry, occupation or individual firm. However, this pays no attention to the quality of employed labour relative to the quality of filled jobs. Those in employment may be under- or overutilised as reflected in levels of education qualifications, skills or abilities.



⁽⁸⁾ Haskel and Martin (2001) showed that skill shortages are greater in the high-tech sectors of the economy.

Both A and B represent points of equilibrium but, in the latter case, vacancies equal unemployment with a higher level of both vacancies and unemployment, representing increased structural unemployment. In this sense there is a greater degree of mismatch either because labour is immobile or it is equipped with insufficient or the wrong sort of skills.

When an economy is subjected to shocks, such as rapid technological change, skill mismatch will occur if workers cannot readily learn new skills or are unwilling to accept jobs that do not utilise their existing skills, and employers are unable or unwilling to redesign jobs so that they can be performed by people with a different set of qualifications from those originally intended. Geographic mismatch may arise if neither workers nor jobs are fully mobile because of the costs of mobility. Other considerations are on the employer-side, whether minimum hiring standards can be met by applicants or wage offers are acceptable to them. This suggests that labour market dynamics are likely to play an important role. In a recent study Ochsen (2009) estimated the Beveridge curve for nine countries, eight of them European, over the period 1960-99. He found that mismatch is not generally lower in those countries considered to have more flexible labour markets, though it has decreased in some countries in which the labour market has become more flexible.

Frogner (2002) reported on evidence from an occupational disaggregation of the UK employer skills survey data that tends to verify this view ⁽⁹⁾. However, this is not to say that skill gaps cannot occur among highly qualified staff. For instance, McGuinness and Bonner (2002) and Bennett and McGuinness (2009) uncovered skill gaps in soft skill areas such as business awareness and communication among IT and engineering professionals.

4.2. What is the relationship between overeducation, overskilling and skill shortages?

It is important to determine whether overeducation results from supply-side or demand-side reasons. The former may include accepting jobs for their amenities, location advantages or family reasons. The latter may include a lack of jobs with appropriate education requirements or discrimination on the grounds of gender, race, disability or other group characteristics.

⁽⁹⁾ Professional, associate professional and skilled trades were found to account for 56% of all skill shortage vacancies despite accounting for only 34% of all jobs. With respect to skill gaps, according to the 2001 UK employer skills survey, firms employing sales/service staff, personal service staff or workers in elementary occupations, were most likely to report skill gaps.

If, when advertising a vacancy, an employer requires a higher level of education than is necessary to perform the job, it is referred to as credentialism. This is a term widely used in sociological literature to describe a situation in which employers require diplomas or certificates for jobs to screen and identify personal traits that are desirable in the workplace. It is assumed that people with higher level diplomas or certificates are inherently more productive. This may also be justified on the grounds that more educated individuals learn faster or change the nature of the job in such a way that their productivity eventually becomes higher than that of less educated workers. Credentialism is more likely to occur when there are skill surpluses. Employers hiring workers with lower education than required is likely to be exceptional and reflects skill shortages.

We would expect a negative relationship between overeducation and/or overskilling and labour shortages. Since shortages are an increasing function of excess labour demand over labour supply, it becomes necessary for employers to make maximum use of existing labour and we would expect it to be easier for previously overeducated or overskilled employees to find better matches. Where skill shortages and/or overeducation/overskilling coexist this is symptomatic of individuals possessing the wrong skills or type of education or preferring their current 'mismatch' because of compensating job differences.

Few studies have examined the relationship between these variables over time because most data sets containing appropriate questions tend to be single cross-sections and only panel data extending over reasonably long-time periods can consider changes in employment status. We would expect a continuing shortage of, say, engineers to be reflected in reduced rates of overeducation and overskilling among engineering graduates. In contrast, a surplus of engineers resulting from a sudden increase in the supply of engineering graduates would be expected to lead to a bumping down phenomenon in which non-graduate engineers are crowded out of higher engineering jobs. Skott (2006) has noted an asymmetry between the options facing high- and low-skill workers. It is open to high-skill workers who are unable to obtain high-skill jobs to accept low-skill jobs for which they are overeducated. An equivalent option is not open to low-skill workers since they are not qualified for high-skill jobs. This could give rise to a decline in both the relative employment and the relative wage of low-skilled workers when faced with a transfer of high-skill workers into low-skill jobs. Skott observed that this occurred between the early 1970s and the mid-1990s in the UK and the US. Any tendency of employers to keep skilled labour in

the recession because they fear it will be difficult to recruit skilled labour in the recovery phase will tend to weaken the above tendency.

The idea that, as the proportion of the labour force with qualifications increases, some of the educated may be forced into lower-prestige jobs (generating overeducation) has been examined by Battu and Sloane (2000). If the less educated are bumped down this implies that the mean level of education will rise across all occupations and some of the uneducated may be forced into unemployment. This, in turn, implies that wage differentials overall will widen, thus offsetting any tendency for the wage differential of the educated to fall relative to the wage for uneducated workers with an increase in the supply of qualifications.

Using data from the social change and economic life initiative and the British household panel survey, both of which use the Hope-Goldthorpe scale to measure occupational prestige, Battu and Sloane (2000) found evidence of skill bumping for Britain between 1986, 1991 and 1995, but this declines as one moves down the occupational hierarchy and does not extend to the lowest education qualification categories ⁽¹⁰⁾. In a similar study for Belgium, Nicaise (2000) found evidence of bumping down for men, but not for women ⁽¹¹⁾. However, if crowding out is important we would expect to find that it is concentrated in recessionary periods when skilled workers find it more difficult to obtain jobs at their own level. Further, if it is a temporary phenomenon only new workers are likely to be subject to it, as existing employees may have job protection. Using Dutch data for the period 1992 to 1995, Gautier (2000) found relatively little evidence of crowding out, but where it does happen it seems to be a temporary phenomenon and to be driven either by short-term variations in the supply of high skilled workers or by shocks to the relative productivity of high skill jobs. Asplund and Lilja (2000, for evidence of bumping down in Finland) found that the deep recession in the early 1990s led to a substantial decline in the employment of the least educated and this boosted the upgrading of occupational skills, consistent with bumping down. It remains true, however, that there are relatively few studies which have attempted to assess the extent of crowding out and skill bumping across countries and over time.

⁽¹⁰⁾ The Hope-Goldthorpe scale has 36 categories ranked by 'social desirability' of male occupations. The categories are assumed to provide a high degree of differentiation in terms of both occupational function and employment status. It is important to highlight that this class schema was devised for men, but the scores are commonly used for both men and women (Goldthorpe and Hope, 1974).

⁽¹¹⁾ It is suggested that women may be more driven by family considerations than are men. Thus, non-employment of women is more frequently determined by supply-side constraints than is the case for men and this tends to offset the bumping down effects on wages.

4.3. Combinations and durations of mismatch

Some general predictions can be developed about the likely relationships between worker and firm mismatches. Following Cedefop (Cedefop, Descy and Tessaring, 2001) under and overeducation (or more strictly under and overqualification) occurs when qualifications of workers do not compare with job entry requirements; over and underskilling occur when job content does not compare with workers' skills and competences. We wish to draw out potential interrelationships between measures of skill shortages at individual and firm levels. Table 4 summarises some potential connections for firms.

Table 4. Combination of mismatch for firms

	Skill shortages	Skill gaps
Overeducation	Overeducation and skill shortages are not likely to occur together within occupations within firms. But they can coexist across occupations within firms.	There is a potential correlation as the overeducated may still not possess the correct mix of skills required by the firm. However, overeducation will not be correlated with basic skill gaps.
Overskilling	Overskilling and skill shortages are not likely to occur together within occupations within firms. But they can coexist across occupations within firms.	These can coexist within occupations within firms but only in different dimensions whereby the skills surplus to the individual are not the skills demanded by the employer.
Undereducation	Undereducation and skill shortages will exist within occupations within firms if firms are reacting to skill shortages by upskilling existing staff.	Within firms and occupations, while we do not expect both to coexist in basic occupations with low entry requirements it is possible for them to coexist as the education requirement of the occupation rises.
Underskilling	Underskilling and skill shortages will exist within occupations within firms if firms are reacting to skill shortages by upskilling existing staff and some deficits remain.	We might expect some correlation within occupations and within firms if both the worker and the employer recognise they are deficient in the required skills.

In terms of overeducation and skill shortages, the occupations within which the firm employs overeducated workers will not correspond with the occupations where skill shortages are being experienced. However, this is not to say that the firm cannot simultaneously experience overeducation and skill shortages in different occupations. Nevertheless, there is nothing to suggest a strong correlation is probable at firm level. At macroeconomic level, a high incidence of both overeducation and skill shortage would provide a strong indication that the composition of education supply is poorly aligned with labour demand. Turning to skill gaps, it is possible that overeducated workers within the firm may also be those identified as possessing skill gaps: the overeducation may be indicative of the fact that such workers possess the incorrect mix of skills required by the firm. However, the consistent finding that the overeducated earn more than matched individuals doing the same job would tend to suggest the overeducated do not have skill gaps. Further, the overeducated, by nature of their education attainment, will not tend to be deficient in basic competences, where skill gaps are most likely to occur, leading us to the general conclusion that overeducation and skill gaps are also likely to be poorly correlated at firm level.

Overskilling arguably represents a much more direct measure of individual underutilisation than overeducation. Nevertheless, the relationship between overskilling and skill shortages remains unchanged from that outlined for overeducation. While both phenomena may occur across occupations within firms they will not tend to be highly correlated within occupations. Once again, at economy level, a high incidence of both overskilling and skill shortages suggests that some rebalancing of post-compulsory education and training supply would benefit both workers and firms. Overskilling and skill gaps can, however, occur both within occupations and within firms, but only in different dimensions, whereby the skills that are surplus to the individual are not the skill areas in which the firm is experiencing a shortfall. Unlike overeducation, where the relationship between skill gaps can be discounted, no study has yet demonstrated that the overskilled earn a premium relative to matched workers carrying out the same job, leaving open the possibility that the overskilled may, nonetheless, lack essential skills.

Evidence suggests that many employers attempt to overcome the problem of skill shortages by upskilling their workers to fill vacancies. It may well be that reallocated workers do not possess the credentials required to fill the post; therefore, some correlation between undereducation and skill shortages might be expected. However, evidence from firm-level surveys suggests that skill shortages relate to a lack of individuals with the necessary skills and

experience, as opposed to qualifications, and so the within-firm correlation is likely to be weak. In terms of skill gaps, if the deficiencies relate to basic skills then undereducation is unlikely, given that entry requirements to the occupations in question will be relatively low. However, the likelihood of correlation will be higher the greater the entry requirement of the positions where skill gaps are being reported.

Finally for underskilling, we might expect a relatively strong relationship between this phenomenon and skill shortages in instances where firms seek to relieve the problem of unfilled vacancies by training and reallocating existing staff. Specifically, if upskilling deficiencies remain in terms of the individual worker's ability to carry out the job in question, then upskilling will result in skill gaps. So, there are circumstances where we might expect strong correlation between underskilling, skill shortages and skill gaps at firm level.

Table 4 neglects skills obsolescence, which is different in nature as it is strongly related to technical change, to rapid changes in work organisation and to shortcomings in higher education in particular. It is only weakly related to current skill shortages and not at all to the prospects for future skill acquisition (Allen and van der Velden, 2007). In fact, skills obsolescence should be considered a process rather than a state.

Business cycle impact on skill mismatch

This chapter considers the impact of business cycles on the occurrence of skill mismatch. It is difficult to assess what impacts the economic crisis Europe is facing at the time of writing will have on skill mismatch. Little is known about the relationship between skill mismatch and the business cycle because of the lack of extensive panel data, but there are reasons to believe that such a relationship exists. Some general assessments are possible: there is also evidence that skill mismatch is a persistent phenomenon in difficult times and that overskilled workers who change their jobs do not always improve their position.

5.1. Skill mismatch and business cycles

Few, if any, studies have examined the relationship between various dimensions of skill mismatch and the business cycle because most data sets which contain appropriate questions tend to be single cross-sections. To understand what happens over the business cycle requires panel data extending over a sufficiently long period to pick up the various stages of the cycle.

By their very nature, business cycles result in a continual change in the balance between labour demand and supply. Change happens in relation to the match between the stock of job vacancies and the skills of the unemployed, and to the flow of jobs and skills into and out of the labour market through job destruction, job creation, training and skills obsolescence. The impact of business cycles varies by sector and occupation. Volatility in cyclical excess product demand or supply is likely to influence labour-market outcomes in terms of more or less under- and overeducation and under- and overskilling. In the first instance, business cycles will impact on skill mismatches through changing the level and composition of the demand for skills and the returns on the way in which these skills are matched in the workplace (reduced in a downturn, increased in an upturn). It is also likely that the response of the labour market itself could influence the duration and depth of a business cycle, especially through the ability of the market to preserve existing skills and offer training in new ones.

Training is crucial in this context. The way the costs of training end up being split between the worker, the employer and possibly the State could be influenced by the business cycle. It could also influence the resulting skills composition and ability of the labour market to match jobs and workers during a recession and the recovery that follows. The distinction between (firm or sector) specific and more general training and education matters because of the financial incentives they imply regarding who covers the cost of training. Firm/sector specific skills are not transferable to other firms/sectors. It follows that firms have a stronger incentive to contribute to the cost of generating specific skills rather than general skills, as the former cannot be poached as easily.

Recent research by Mavromaras et al. (2009d; 2009c) using UK and Australian data suggested that skill mismatches are less prevalent and their negative consequences are less severe where education is more specific to the needs of the employer (i.e. a higher proportion of 'specific' versus 'general human capital'). However, this finding was based on data that included only years in which the economy was doing well. The recent downturn indicates that, what can be an advantage during a buoyant economy, can also become a problem during a downturn, because workers with more (sector, occupation) specific skills are less flexible in shifting to new jobs if and when their own sector/occupation is adversely affected by the downturn. In a recession, the best skills for a displaced worker are general ones, as they allow broader search in sectors that may have been less affected by the downturn. For example, highly specialised vehicle industry workers may suffer a larger drop in pay during the current recession than less specialised but equally well qualified service industry workers. There is little research in this area and generating evidence using conventional large survey data sets will not be feasible for some time: the data at hand in 2009 just touches on the starting phase of the current downturn and so all data series refer to very different general economic conditions. Further, the data from previous recessions may not be as useful because considerable institutional changes have taken place in the last two to three decades in most Western economies.

5.2. The impact of the economic crisis

Despite the lack of relevant research and appropriate data, some developments are easy to forecast for the recent downturn. The (re-)training effort will have

to be intensified before the upturn has even started because of its lagged effects. If we wait until an upturn is clearly visible, we will experience a slower recovery handicapped by skill shortages. However, there is a natural reduction in the willingness of employers to pay for training during a recession. A prime reason for this is that employers contribute to the cost of training and recessionary pressures have a negative effect on such investment. There is also a natural increase in the willingness of individuals, especially the unemployed and new labour-market entrants, to purchase more education and training as this may be the only way to obtain a new job.

Further, there is a considerable reduction in the social opportunity cost of the State paying for the worker training during the current recession, which will be the stronger the deeper the recession proves to be. This applies in particular to displaced workers, but also to young labour-market entrants. There may be problems, however, with these hypotheses. First, the displaced workers will probably be the least productive ones and their training may not be the most cost-effective intervention ⁽¹²⁾. Although equity arguments may shift the balance in favour of training the less able displaced workers, as may the presence of a strong unemployment support and welfare net, such considerations may not reduce the level of skill mismatch when the upturn occurs. Second, it is not clear where and how training should be provided. A mix of classroom and workplace training seems appropriate, as is a mix of specific and general training. However, there is little research to guide specific choices and the danger is always present in subsidising skills and sectors that have little economic future but a strong lobbying presence in the current industrial scene.

Skill shortages are also related to both the business cycle and the extent of skill mismatches. In the upturn, skill shortages will lead to increases in undereducation and underskilling as labour with appropriate education and skill is in short supply. Conversely, in the downturn new entrants to the labour market may experience difficulties in locating jobs with the appropriate levels of education and skill.

There is some suggestion from skills shortage literature that some shortages persist over most stages of the business cycle in some skilled occupations: what varies is their extent over different stages of the business cycle. Such shortages are also often evident in industries and occupations with modest employment growth or even employment decline. Shortages

⁽¹²⁾ The same will not apply to young labour-market entrants, where long-term adverse consequences will influence a much wider segment of ability distribution.

can coexist with relatively high overall unemployment or in the occupation under analysis. One reason is that, in cyclical downturns, employers often reduce training places and apprenticeships, which can affect the number or trained workers for many years to come, including the upturn years when demand for skills may have fully recovered. Further, qualified workers who lose their job during downturns often do not return to the same industry or occupation. This can result from demand or supply changes in industry restructuring, making some of the older skills obsolete, or individual workers having experienced long-term unemployment/non-participation during the downturn, with adverse effects on their ability to work when the upturn occurs. In these situations undereducation and underskilling may also exist regardless of the stage of the business cycle, and it can play a role in the intensity of downturns and the speed at which an upturn in product demand can be translated into a wider economic upturn. The role of mature industries and mature workforce (sometimes the two go together) may intensify the effect of mismatches and may indicate the need to train younger workers and retrain older workers.

There may also be cohort effects in how graduates are matched with jobs related to the business cycle. If graduates enter the labour market in a period of recession they may be more likely to experience overeducation; the effect of this may persist over the longer term. Further, taking the employment of an overeducated graduate (presumably to a non-graduate job) as an example, this employment is likely to cause bumping down as a side effect, displacing a non-graduate worker who may be less qualified generally, but perfectly well qualified for the (non-graduate) job the overqualified graduate obtained. It is well established in literature that increasing unemployment in the less qualified part of the labour market may cause severe scarring effects. The longer the lead time needed for training any specific type of graduate, the more likely it is that cyclical volatility may have detrimental scarring effects. Similar phenomena may be observed where there may be sudden sharp increases in the number of graduates even if the economy is not in recession, as absorption is more difficult. This is again accentuated where there are long training lead times.

Some of the more general literature on the nature of dynamic labour-market adjustment is relevant. Although worker quits are often associated with both wage gains and higher job satisfaction, many workers quit again within one or two years. There are two rival explanations. First, Burdett (1978) assumed that job quality in a new job is perfectly observable *ex ante*, so that repeated quit behaviour results from workers using new

jobs as a stepping stone to even better jobs. Second, Jovanovic (1979) assumed the complete absence of such information, so that repeated job moves result from disappointment over job quality. Gielen (2008) observed that an appropriate test is whether any improvement in job satisfaction is permanent. The British household panel survey shows that the stepping stone model can explain up to 80 % of repeated job behaviour and 20 % learning about job quality. Using Finnish data, Bockerman and Ilmakunnas (2009) suggested that heterogeneity of workplaces and wage compression hinder creating sufficiently compensating wage differentials, so that adverse working conditions encourage workers to quit. The implication is that, at any time, labour markets will be in disequilibrium.

5.3. Evidence from Australia

In one of the few attempts to measure the dynamics of overskilling, McGuinness and Wooden (2007) used the first four waves of the household income and labour dynamics for Australia (HILDA) data set. The results suggest that, while the overskilled express a desire to quit in order to obtain a job which offers a better match, they are not confident of their ability to achieve this. Further, though they have a higher propensity to be mobile than matched workers, some of this higher mobility is due to involuntary separations; even where job separations are voluntary, most job moves do not result in improved skill matches. Also, many overskilled workers move into unemployment or inactivity. This adds to evidence that policy should focus on skill mismatch rather than education mismatch. Using the first six waves of HILDA, Mavromaras et al. (2009b) examined the extent of persistence defined as the ability of the state to perpetuate among the overskilled. The strongest persistence was found for those with higher education. Lower persistence, but still strong and statistically significant, was found for those with up to year 12 schooling. There is no trace of overskilling persistence for those with vocational education and training, indicating that mismatches are much easier not only to avoid but also to correct for those with vocational training. A caveat for this, and many other contemporary findings, is that they have been derived from data drawn exclusively from Australia in an economic upturn. It is not clear that these findings can be generalised and extrapolated to study today's recession climate in Europe without careful consideration. Despite this caveat, evidence suggests that, at least for some groups, overskilling is not a purely temporary phenomenon.

The implications of skill mismatch

This chapter discusses the implications of skill mismatch. The next section examines the impact of mismatch in terms of productivity and discusses overeducation, skills shortages and skills gaps. The following section reviews the impact of skill mismatch on job satisfaction. We then turn to possible positive impacts of overeducation or overskilling for employers and end by reflecting on the overall costs of mismatch for society. Skill shortages have a significant impact on productivity, GDP growth and earnings, though less is known about the effects of skill gaps or skills obsolescence. We know that overeducation reduces job satisfaction for individual workers while, for firms, hiring overeducated workers can be a deliberate strategy to benefit from extra skills in the long term, despite negative impacts in the short term.

6.1. Skill mismatch and productivity

We might expect that both skills shortage and skills gap can lead to a loss of competitiveness as wage rates are bid up and productivity lowered within industries where skill problems exist. Productivity may also be harmed as firms may be forced to place lower-skilled workers in skilled positions and/or, if in an area with skills shortage, workers use their position to alter their terms and conditions inefficiently from a productivity perspective.

Finegold and Soskice (1988), and Haskel and Holt (1999), take the analysis a step further by describing a scenario whereby skills shortage can lead to low-skill equilibrium within the economy. They described a situation where firms react to skills shortage by investing in technologies that complement the low-skilled element of the workforce, resulting in an economy characterised by low wages and a low demand for high-skilled labour. As a consequence of the low demand for high wage/high-skilled workers within the labour market, individuals will no longer invest in their own human capital, thus perpetuating the low-skill equilibrium position. Tether et al. (2005) argued that once a low-skill equilibrium has become established, there are no obvious policy levers for correcting the situation. However, despite some extensive discussion of the theoretical concept in literature, there is little actual evidence linking skills shortage with the emergence of a low-skill equilibrium.

6.1.1. Overeducation and productivity

While the wage effects of overeducation, overskilling, undereducation and underskilling are well known (Hartog, 2000; Sloane, 2003; McGuinness, 2006; Mavromaras et al., 2009a; 2009d) their implications for firm productivity are less clear cut. In imperfect labour markets, firms may obtain a rent from the services of their employees, which means that the link between the wage and productivity is imprecise. There may also be differences between short-term and long-term effects, since overeducation is known to reduce job satisfaction, which in turn may negatively influence performance, both directly and indirectly, through its effects on absence and quit rates. Tsang and Levin (1985) suggested that overeducated workers often exhibit counter-productive behaviour in the workplace, but this might also be influenced by their lower ability, health problems or a different attitude towards work.

The effects of overeducation on productivity can be measured in two ways. If wages equal marginal productivity, the finding that overeducated workers receive a wage premium over matched colleagues, though less than matched workers with the same education as themselves, suggests that such workers are somewhat more productive than matched colleagues. An alternative and preferable approach, given the presence of imperfect labour markets, is to measure productivity directly through analysis of output per head in individual companies or industries. The expectation is that, since overeducation reduces job satisfaction, there will also be a negative effect on productivity, through higher shirking, absence and quit rates. As Hartog (2000) observed, this leaves a puzzle since, along this line of reasoning, overeducation should reduce wages rather than increase them as the wage evidence suggests.

If workers are genuinely mismatched, in the sense that they are not fully utilising their education qualifications or skills in their current jobs, reallocating labour appropriately should increase productivity and GDP/GNP at macro level. However, as Borghans and de Grip (2000) pointed out, to assess this properly we require better understanding of the skills that people currently possess and the precise ways in which they utilise these skills.

Unfortunately, much less is known about this than about the allocation of different types of workers in the labour market. Also, what is known is largely confined to single case studies. In one of the few direct attempts to measure the effect of overeducation on productivity, Tsang (1987), applying a Cobb-Douglas production function approach and using data on companies within the US Bell Corporation, found evidence of negative productivity impact. Unfortunately, Tsang's (1987) study is the only attempt to measure productivity effects using company data.

6.1.2. Skill shortages and productivity

Skill shortages are important for their impact on productivity, GDP/GNP growth and earnings. Frogner (2002) cited descriptive evidence from the 2001 European social survey to support this in terms of the productivity impact, although evidence on earnings was more limited. A study by the National Institute of Economic and Social Research (Mason and Wilson, 2003) reported that relative to German plants, output per worker in British firms was over 60 % lower, with the authors arguing that this productivity gap was a consequence of lower-skill levels. Further, Haskel and Martin (1996) suggested that skill shortages reduced annual productivity growth in the UK by 0.4 percentage points over the period 1983-99. On productivity corollaries, Nickell and Nicolitsas (1997) estimated that a permanent 10 % rise in firms reporting skill shortages lowers investment proportionately, and R&D by a temporary 4 %. Evidence from more specific sectoral studies include that of Bennett and McGuinness (2009), who reported that, after controlling for the influence of selection bias, output per worker was lower in high-tech firms experiencing both hard-to-fill and unfilled vacancies. Finally, Forth and Mason (2004) found among UK firms that a quantity shortfall in the number of graduate engineers and scientists led to lower output per worker.

But not all empirical evidence points in the same direction. For instance, McGuinness and Bonner (2002) and McGuinness and Doyle (2003; 2005) found no evidence that unfilled vacancies substantially lowered the productivity of Northern Ireland IT and construction firms. Further, for Forth and Mason (2004) skill shortages arising as a result of the poor quality of applicants had no productivity impact.

6.1.3. Skill gaps and productivity

While the productivity effects of skill shortages in firms have been relatively well researched, much less is known about the productivity effects of skill gaps. Nevertheless, some studies tested the impact of skill gaps on productivity-related variables (McGuinness and Bennett, 2006; McGuinness and Bonner, 2002), but no significant relationships were found. Some descriptive evidence suggests, however, that firm performance across a range of indicators is severely constrained as a consequence of such gaps (e.g. Hogarth and Wilson, 2001). A series of Northern Ireland sectoral studies (NIERC, 2000; 2001; 2002; Erini, 2005) reported descriptive evidence that skill gaps substantially hampered firm performance on several fronts. Further, the UK national employment survey (2003) also found that over a fifth of employers reporting skill gaps delayed introducing new products, while a third stated

that skill gaps represented a barrier to implementing new work practices (Tether et al., 2005).

Further, de Grip et al. (2008) found, using a Dutch data set, that job worker mismatch induces cognitive decline (use it or lose it) with respect to immediate and delayed recall abilities, cognitive flexibility and verbal fluency. This adds to the relevance of preventing overeducation and also provides a reason why overeducation should have a negative effect on earnings.

For skills obsolescence, contrary to expectations, Allen and van der Velden (2001) could find little evidence of long-term problems and no effect at all on current wage levels. This may be a result of informal on-the-job training or the fact that job loss is an important outcome for workers with obsolete skills.

6.2. Skill mismatch and job satisfaction

The overeducated and/or overskilled earn less than if properly matched, but more than properly matched colleagues. There is, therefore, an incentive to move to a job reflecting better their education and skills. In contrast, the undereducated or underskilled earns more than if properly matched, but less than properly matched colleagues. As in this case there is no incentive to move to a job reflecting better education and skills we expect the mismatch to last longer than in the previous case. This should be reflected in lower job satisfaction for the overeducated/overskilled and higher job satisfaction for the undereducated/underskilled.

There is limited, but increasing, literature on the effects of skill mismatch on job satisfaction. For the US, Tsang and Levin (1985) were the first explicitly to model this relationship. They suggested that overeducation may result in reduced work effort, increased production cost and lower productivity. Tsang (1987) found evidence for this in the Bell Telephone company and Tsang et al. (1991) confirmed this, using a broader cross-industry data set. Hersch (1991, 1995) found similar results for Oregon manufacturing and warehouse firms. For Britain, Battu et al. (1999) found that job satisfaction among graduates was significantly adversely affected by mismatch in non-graduate jobs. Yet, though Belfield and Harris (2002) found a similar relationship, using the same data set, this did not appear to be associated with education quality, which might be expected to raise job satisfaction through increasing the job-offer rate. In contrast, Büchel (2002) found no significant difference in job satisfaction between overeducated and adequately educated workers in Germany.

Allen and van der Velden (2001) differentiated between education and skill mismatches and found that there was only a significant negative relationship between mismatch and job satisfaction for skill mismatch. Similarly for Britain, Green and Zhu (2008) found that overqualification is not a problem for job satisfaction in itself if it is not accompanied by skill mismatch. For Spain, Badillo-Amador and Vila (2008) also found that skill mismatches are a better predictor of job satisfaction than education mismatches, which are not only related to differences between individuals but also influenced by workers' previous perceptions, suggesting that a dynamic structure is appropriate for analysing job satisfaction.

The above studies neglect the possibility that an overlap exists between observed and unobserved characteristics which determine both overeducation and job satisfaction. For this reason one Australian study (Fleming and Kler, 2007) used a different statistical technique and considers various facets of job satisfaction rather than just overall satisfaction. It was found that the impact of overeducation on job satisfaction is positively biased for three of the six facets of job satisfaction considered when using a traditional statistical technique. However, even with the improved estimation, the significant negative relationship between overeducation and job satisfaction remains. Similar results for facets of job satisfaction using Australian data were found by Linsley (2005) and Kler (2006) ⁽¹³⁾, the latter finding that overeducated graduates are more satisfied with job security than matched graduates. Finally Mavromaras et al. (2009d) used the panel element of the household income and labour dynamics for Australia and distinguish between overskilling and overeducation, finding that it is only overskilling on its own or jointly with overeducation which has a negative effect on job satisfaction. This parallels the findings in relation to the effect of mismatch on wages.

6.3. Possible positive impacts of skill mismatch

Employers will hire overeducated or overskilled workers if they believe that such workers are more productive and the extra productivity is not outweighed by the higher wages required to attract such workers. They will also use the undereducated and underskilled if the lower wage costs of such workers compensate for lower productivity.

⁽¹³⁾ The facets considered by Linsley are satisfaction with work and with level of responsibility; in the case of Kler they are satisfaction with pay, job security, hours, work and flexibility.

Dupuy and de Grip (2002) suggested that overeducation is related to the hiring policy of large firms. By hiring overeducated workers when the supply of highly educated workers exceeds demand for their services, large firms increase their opportunities to substitute high-skill for low-skill workers in times when high-skill workers are in short supply. High elasticity of substitution between high-skill and low-skill workers in large firms explain their higher rates of labour productivity. Further, this also encourages skill biased technological change (Acemoglu, 2002). However, to determine precisely the relative efficiency of using the overeducated instead of matched workers is difficult. As Jochmann and Pohlmeier (2003) pointed out, the traditional Mincer human capital earnings function approach may reflect decreasing returns on schooling or the non-random selection of individuals into overeducation status. Using the 1998 wave of the German socioeconomic panel they presented Bayesian estimates of treatment effects to overcome these problems and found, contrary to earlier studies which neglect selectivity issues, no evidence of overeducation depressing earnings.

Jones et al. (2009) included an overskilling variable, using the British workplace employment relations survey 2004 (which is a matched employer-employee data set), in equations explaining five measures of performance. He found that the variable is positive and significant in at least some of the equations. This may explain why employers hire overskilled workers and pay them more, but the effect is likely to be short-term as such workers are more likely to quit. For Germany Büchel (2002), using the German socioeconomic panel, found that overeducated workers in low-skill jobs (where most of the overeducated are found) tend to be more productive than their matched colleagues, which he also took to explain employer motivation in hiring the overeducated. Clearly, however, more studies among firms are required to understand better this phenomenon and to examine its short-term versus long-term implications.

6.4. Skill mismatch costs for society

The economy will lose the output that could have been generated by real-locating genuinely mismatched workers to higher productivity jobs. There is no loss of output implied, however, for apparently mismatched workers (as defined in Chevalier, 2003) as their current jobs reflect their actual levels of ability or skills. Further, whether overeducation imposes real costs is challenged by some researchers who view overeducation or overskilling as an inherent

phenomenon of market economies, as education and training systems cannot adapt instantly to labour-market needs. Others have argued that the notion of overeducation is not valid, as people are able to shape their own jobs or employers may tailor jobs to the skills of workers (Halaby, 1994).

It is reasonable to conclude that skill shortages are likely to prove costly to the economy by restricting productivity growth in key sectors. Accepting that, for many reasons, the market will fail to clear and skill shortages persist, another question arises on the extent to which the wage mechanism is sufficient to provide an effective signal of changing labour-market conditions. Evidence is mixed. Finegold and Soskice (1988) found that individuals in Britain are less likely than in other countries to increase training in reaction to a rise in labour price. However, Connolly (1996), using data from the national child development study, suggested that the demand for training is responsive to changes in price. Nevertheless, the principal problem arises from the often substantial training time-lag associated with producing skilled labour, implying that the market signal usually occurs too late to aid a timely market response. Further, the price mechanism itself may be a poor indicator of labour-market shortage, given that increasing wages is one of a range of strategies adopted by firms to tackle the problem of skill shortages (Bennett and McGuinness, 2009). Frogner (2002) confirms this, reporting that less than half of firms, claiming to experience skill shortages in the 2001 European social survey, indicated a willingness to raise the wage.

Thus, job mismatch may be associated with social costs, which can be defined as private costs plus negative externalities. Alternatively, social benefits may be higher than private benefits if it were not for mismatch. For instance, at macroeconomic level national output, and hence welfare, is potentially lower than if workers and firms were fully matched in the economy. The loss will be a function of the number of workers who are mismatched and the difference in productivity if they were reallocated. Such a loss is likely to be greater for skill mismatch than education mismatch, given the fact that the latter is not likely to incorporate lower ability effects. In addition, tax revenues may be wasted on equipping individuals with non-productive education, suggesting less than optimal allocation of resources by governments. However, education may also enable certain individuals to gain employment who otherwise may find it difficult to do so.

Most studies that have examined the relationship between mismatch and job satisfaction have found a significant negative relationship (for British graduates see e.g. Battu et al., 1999). This would represent a social cost. However, recent work using the household income and labour dynamics in

Australia panel suggests that such a negative relationship only applies to overskilling, not to overeducation, and that it is not uniform across all employed individuals. This needs to be examined in relation to other countries.

Finally, there may be a link between labour-market mismatch and discrimination, which makes certain groups more susceptible to mismatch. Battu and Sloane (2004) and Lindley (2009) have, for example, found that relative to whites, individuals from some ethnic groups are significantly more likely to be overeducated, suggesting that they find it harder to locate optimal matches. In addition, migrants may be faced with lower recognition of their qualifications, if obtained in country of origin, than is warranted on economic grounds. For gender, differences in mismatch appear not to be marked in many countries. However, Johansson and Katz (2007) found that, in Sweden, women were more likely to be overeducated and men more likely to be undereducated. It is also possible that gender-based differences in subject choice may further exacerbate the problem through increased horizontal mismatch. Again in Sweden, Nordin et al. (2008) found that there were clear gender gaps in the share of mismatched jobs in certain disciplines. Men were more likely to be mismatched in female-dominated occupations and females more so in male-dominated occupations. The gender gap in income declines from 12 % to 2 % when type of degree is included in their analysis, implying that men are more likely to use education to select into well-paid fields than are women. Last, for older workers we have to consider the problem of skills obsolescence and the possibility of a subsequent mismatch arising from structural factors. A particular problem arises from the fact that there is a relatively short payback period in relation to any investment in retraining and several studies suggest that retraining older workers may be uneconomic for this reason. However, if there is substantial skills obsolescence there may be no alternative to retraining older workers. As employers are less likely to hire older workers than they are to continue to employ them, this emphasises the need for measures to encourage employers to retain older workers rather than to dismiss them.

Rising levels of education may also affect pay dispersion. Increasing dispersion in the returns on graduate education in the UK has been detected by Green and Zhu (2008) over the period 1994 to 2006, when the numbers of graduating increased sharply. While the benefits of graduate education improved at the top end of the distribution for both men and women, at the bottom end they sharply decreased. This means that the financial risks associated with investment in higher education have increased, since individuals cannot be certain where they will end up in terms of the overall earnings distribution. This could result in insufficient supply of individuals coming forward to meet the needs of the economy.

Appropriate skill mismatch measuring

Consistent with the considerable attention to overeducation in literature, we begin by giving an overview of data sets that include items on overeducation or overskilling. Five European and two UK data sets extending beyond 2000 contain relevant questions, but only the household income and labour dynamics for Australia data set is a panel. We discuss three alternative measures: the objective method, the subjective method and the empirical method can be used to measure overeducation and reflect on their weaknesses. Subsequently, we explain why overskilling offers a better picture of skill surpluses. Few data sets, however, contain questions on it. In the final section we argue that skills obsolescence can be measured in different ways, but that there is little consensus on what is the most appropriate way of measuring; few data sets contain questions that can be used to assess skills obsolescence.

7.1. Measuring overeducation and overskilling

In Table 5 we list the main recent cross-country data sets which contain relevant questions on overeducation and overskilling, plus several single-country data sets which contain questions on overskilling and have advantages. We focus on the concept of overeducation and overskilling, where the main measurement issues seem to lie. Three alternative measures have been used to measure overeducation:

- (a) systematic job evaluation, used to determine the precise level of qualifications required to perform a particular job. It is referred to as an 'objective' measure, but fails to allow more than one education level to be appropriate for particular occupations, particularly if they are broadly defined. It also fails to allow for the possibility that the appropriate education level may change over time;
- (b) worker self-assessment, referred to as a 'subjective' measure, depends on the precise question asked, such as 'how much education is required to obtain a job like yours?' or 'what level of education is required to perform this job?'. When firms specify a level of education higher than

necessary to perform a job, it suggests the use of credentialism and may well result in overskilling or skill underutilisation;

- (c) most data sets do not contain a direct question on overeducation, in which case reliance has to be placed on the empirical method. Conventionally, mismatching occurs when the level of education is more than one standard deviation above or below the mean for education within an occupation. This cannot be directly compared with the above two measures as it ignores minor differences between actual and mean education.

Several studies have sought to assess the correlation between different measures of mismatch. McGoldrick and Robst (1996) showed that the incidence of male overeducation varied from 50 % under the objective measure to 30 %

Table 5. Data sets containing questions to individual employees on skill mismatch

Data set	Type	Dates	Questions
European Community household panel	Panel	1994-2001	overskilling (three questions)
European social survey	Cross-section over 30 countries	Biennial 2002/03, 2004/05, 2006/07, 2008/09	over- and undereducation
European working conditions survey	Cross-section	1996, 2000, 2005	over- and underskilling
Flexible professional in the knowledge society (REFLEX)	Mail questionnaire, nine countries (graduates only)	2005	overskilling, underskilling, horizontal mismatch, overeducation and undereducation
EU e-living project	Household survey six countries	2001 and 2002	over- and underqualification
Workplace employment relations survey	Matched employer-employee data	2004	over- and underskilling
UK skills survey	Cross-section	1992, 1997, 2001, 2006	over- and underqualification overskilling
Household income and labour dynamics in Australia (HILDA)	Panel	2001	overskilling

under the subjective measure and 16 % under the empirical method. Battu et al. (2000) found that the various measures tended to identify different people as being overeducated with correlations under two subjective measures being around 0.2 to 0.3. Verhaest and Omey (2006) considered the reliability of five different measures of overeducation on the basis of encompassing tests. They concluded that objective job evaluation and subjective data on the level of education required to do the job should always be preferred over the empirical method or to subjective measures of the education level required to get the job. Allen et al. (2006) suggested that analysis of the wage consequences of education mismatch needed to be complemented by including the effects of job-worker skill mismatches, expecting that the wage effects of education mismatches would be absorbed by the skill mismatch measure. In fact, there is little correlation between the two. Green and McIntosh (2007) found a correlation between overeducation and overskilling of 0.2. Further, when an overskilling variable is included in a wage equation already containing an overeducation variable, the coefficient on overeducation only falls from -0.164 to -0.144, a statistically insignificant difference.

An obvious problem with measures for overeducation is that they treat different degrees of overeducation in the same way. A graduate in a job for which only a higher school leaving certificate is required is treated as a graduate in a menial job, while the policy implications of the two cases might be different. It is less likely this occurs under the empirical method, but using the standard deviation criterion is purely arbitrary. Further, there is another ambiguity according to whether the mean or the mode is used as the standard. In many, though not all countries, the incidence of overeducation is higher than that of undereducation, so the mode, rather than the mean, would appear to be the appropriate yardstick. Where the number of workers in an occupation is limited or the dispersion of actual qualifications wide, any measure of central location is likely to be unreliable. Thus, De Oliveira et al. (2000) suggested generally limiting the analysis to cases where the modal number of years of education is shared by at least 60 % of the workers in that occupation.

The measures discussed above are examples of vertical mismatch but none deal with the case of horizontal mismatch, where the level of education is appropriate but the type is not. For example, some degree fields focus on occupation-specific skills that may not easily transfer to other occupations, while others focus on more general human capital (e.g. arts). But, perhaps, the biggest problem of overeducation as a measure of mismatch is the frequent omission of any measure of ability in empirical work on the phenomenon, so that we simply do not know whether overeducated workers are in this state simply for low ability given the level of education.

7.2. Focusing on overskilling

Such reasoning suggests that overskilling might be regarded as a superior measure of mismatch, particularly where the question makes direct references to ability. The Australian HILDA panel asks respondents whether they use many of their skills and abilities in their current job, with a response of 1 corresponding to strongly disagree and 7 to strongly agree. This, however, requires a cut-off point for being overskilled and does not allow clear delineation of the underskilled⁽¹⁴⁾. In contrast, the question in the British workplace employment relations survey 2004 simply asks individuals how well the skills they personally have match the skills they need to do their present job. Here, however, there is a five point scale with respondents answering that their own skills are much higher, a bit higher, about the same, a bit lower or much lower than needed. This enables a clear distinction to be made between those severely overskilled or underskilled or only moderately so. Neither of these data sets contains a direct question on overeducation, though one can be derived using the empirical method.

The European Community household panel, which ran for eight years between 1994 and 2001, also contains questions on overskilling. In 2001 respondents were asked whether they had formal training or education that had given them the skills needed for the present type of work and how much this training and education had contributed to their present work. A further question asked whether the respondents felt that they had the skills or qualifications to do a more demanding job than they now have. Brunello et al. (2007) have examined these questions for five countries using both probit and multinomial analysis, and Badillo-Amador and Vila (2008) have done so for Spain. The latter use the modal procedure to estimate education mismatch using years of education. They defined the overskilled as those answering positively to the first and third questions and the underskilled as answering negatively. Those who answer yes to first question and no to the third are defined as adequately skilled; those who answer no to the first question and yes to the third are, debatably, defined as wrongly skilled. These questions are also not ideal as they refer to education as well as skills; it is impossible to disentangle the two.

The European working conditions survey conducted in 1996, 2000 and 2005 contains relevant questions on skill mismatch. In 2005 respondents

⁽¹⁴⁾ The same will not apply to young labour-market entrants, where long-term adverse consequences will influence a much wider segment of ability distribution.

were asked which of the following alternative would best describe their skills in their own work:

- (a) I need further training to cope well with my duties (underskilled);
- (b) my duties correspond well with my present skills (matched);
- (c) I have the skills to cope with more demanding duties (possibly overskilled).

The 2005 survey was not analysed in relation to these questions.

The REFLEX graduate survey 2005 contains data on graduates in nine European countries and has the advantage of asking separate questions on skill and education mismatches. Skill mismatches are identified from workers' responses on a scale from 1 (not at all) to 5 (to a very large extent) to the questions: to what extent does your current work demand more knowledge and skills than you can actually offer; and to what extent are your knowledge and skills utilised in your current work? For overeducation the equivalent question is 'what type of education do you feel is most appropriate for the current work?'. This can be compared directly with reported education levels.

The European social survey 2002/03-2008/09 has information on 25 countries and contains two questions relevant to education matching: first 'if someone was applying nowadays for the job you do now, would they need any education or vocational schooling beyond compulsory education?'; and 'about how many years of education and vocational schooling beyond compulsory education would they need?' The 2001/02 e-Living project contains questions on both qualifications and years of education but for a more restricted range of countries.

It is necessary to consider all possible combinations of skill mismatch. Ignoring undereducation and underskilling, which are less common phenomena, there are four possible matching combinations:

- (a) matched education and matched skills;
- (b) overeducation, but skill matching;
- (c) matched education, but overskilling;
- (d) overeducation and overskilling.

The first case is more likely where there are specific qualifications, as in law or medicine or skilled craft apprenticeships. The second is more likely when the individual is at the lower end of the ability distribution for a given qualification, so that he or she is unable to obtain a job which matches that level of qualification. However, the job obtained may make full use of that person's skills or abilities. Alternatively, this combination may result through choice, if the job has non-pecuniary benefits which offset the lower

wage offered. The third case might occur when employers raise the level of education required for the job, as they realise that the supply of individuals with a particular level of education is now higher than it was. If the requirements of the job have not changed this amounts to grade inflation. The final case may be more likely for married women returning to work after childbirth or who are constrained by a job move on the part of the husband (tied movers). The constraints on job search make it more difficult to find jobs commensurate with their qualifications and abilities.

In the context of the above four measures, recent work by Mavromaras et al. (2009d), using the HILDA panel, indicates the need to run separate equations for each of the four groups. Only those subject to overskilling, either on its own or jointly with overeducation, suffer from lower job satisfaction, and for men when controlling for unobserved individual heterogeneity there is no clear wage penalty for overeducation. This is not the case for overskilled men. This emphasises the need for data sets which have separate questions on overeducation and overskilling, which are panel in nature and ideally which enable one to identify horizontal and vertical mismatches.

7.3. Measuring skills obsolescence

Finally, we should consider measuring skills obsolescence, which is far from straightforward. In principle it can be measured:

- (a) objectively, by testing the deterioration of workers' skills over time;
- (b) through subjective methods such as asking workers (or employers) whether they face skills obsolescence;
- (c) by the individual measurement of productivity (e.g. tests of workers' skills deterioration or levels of wages);
- (d) by the rate of innovation which should indicate the speed of obsolescence.

Survey data questions include Blechinger and Pfeiffer (2000) 'how much of the occupational knowledge and skills that you acquired during your apprenticeship can you still apply in your current work?' and Van Loo et al. (2001) 'have your qualifications depreciated due to changes in your current job?' and 'what is the extent to which your qualifications are suited to your current job?'. Relatively few data sets include such questions.

Skill mismatch data needed in Europe

Given the problems that current data sources pose, this final chapter considers data needed to analyse skill mismatch comprehensively in Europe. We would learn most from a new matched employer-employee panel containing appropriate questions but this would be very expensive. We suggest to add to panel data sets several questions in the form of modules, to be asked once every two or three years; to use several European panel surveys to allow comparative analyses; to consider alternative methods for information collection of a more detailed, but also revealing nature.

8.1. Improving data on skill mismatch in Europe

One of the current problems in analysing mismatch in Europe is the absence of appropriate questions in regular series such as labour force surveys and household panels. A panel with enough observations to observe changes in mismatch over the business cycle would be ideal and, if a matched employer/employee panel, this would enable control for unobserved individual heterogeneity both in relation to personal characteristics of individuals and establishments.

While this would provide substantial gains in understanding the mismatch problem, developing a new data set would be very costly. To collect this new information cost-effectively would demand funding and support for adding a set of pertinent labour-market mismatch questions to several existing large data sets. This can be difficult because most data sets are already overburdened and interviewee fatigue is a serious problem but it would be a lot cheaper than starting a new data set. Given the rather long-term nature of training and education, yearly collection of the relevant information may not be essential.

The cost-effectiveness of the data collection could be improved by dispensing with annual information and starting a special module, collected once every two or three years, as part of several existing, long-running data sets across Europe. The questions asked should preferably be the same in all data sets. Where we judge that there may be a requirement for some

additional questions for purposes of equivalisation, these should be asked as necessary. Appropriate momentum could be assured by starting with collection in years 1, 3, 5 and then moving to a longer three-year interval, 8, 11, etc. The information collected in this way can be almost as useful as that collected annually and will be supported by the annual information as well. Where specific detailed information cannot be obtained through conventional survey interview methods, alternative methods, such as qualitative analysis and discrete choice experiments, should be considered as complements that could enhance our understanding obtained from large survey data sets.

8.2. What information should be collected and how?

For new information useful within a wider survey context, separate questions should be asked in relation to skill shortages, skill gaps, over- and undereducation, over- and underskilling, and skills obsolescence. Some of the information could be obtained from employers, some from employees and some from both to check for consistency ⁽¹⁵⁾. This would be much cheaper and would provide real gains in identifying links between these different concepts.

Only the employer has the relevant information on skill shortages and should be asked whether there are any occupations they are unable, or have difficulty, to fill. This could be supplemented by questions on the duration of vacancies and the wage competitiveness of the employer. Further, employers could be asked what they perceive to be the reasons for the skill shortages. For skill gaps, employers should be asked to cite cases where existing employees do not have the required qualifications, experience and/or specialised skills to meet the firm's skill needs for an occupation. This needs to be supplemented by questions on training provision and why this has not solved the problem or has not taken place. In case of a matched data set, employees could be asked the same question on underskilling to check for consistency in responses from the two parties.

Questions on over- and undereducation should ideally focus on both qualifications and time spent on being educated. Further they should focus

⁽¹⁵⁾ A major project including a study and network of European labour-market analysts using firm panel data and linked employer-employee data was launched in 2008 and is due to report this year.

on the education level required to do the job rather than to obtain the job, though the latter could be asked as a supplementary question. Objective and subjective approaches are to be preferred to the empirical method. Information on the objective approach could be obtained from the employer, while the subjective approach requires questions addressed to the employee. If both are asked in a matched panel, the responses could be checked for consistency. In particular, employers need to be asked why they hire overeducated workers and how they differentiate their pay from that of properly matched colleagues. Similarly, employees need to be asked why they accepted a job for which they were overeducated. Any panel element could be used to ascertain time trends. Questions also need to be asked on horizontal and vertical mismatch.

Questions on over- and underskilling seem to be more informative than those on over- and undereducation and seem to be less contaminated by unobserved individual heterogeneity. It is necessary to ensure that any scale used for employees to rank the extent to which they use their skills and abilities allows the underskilled and the overskilled to be classified clearly. It is important to include 'ability' and 'skill' in the question. Questions on the extent and type of training should be included to establish whether or not the provision of training diminishes the extent of overskilling and underskilling.

Skills obsolescence is often hard to measure using currently available data sets. Questions on skills obsolescence should allow differentiation between economic and technological change explanations. The latter will be illustrated by reductions in overall employment and relative employment by occupation, on which the employer is more likely to have information, while the former is more related to the individual. This needs to be linked to age and the provision of retraining. Using a panel, workers can be asked at different times to rate the extent to which their skills are suitable for their current job; the reduction in the score will then indicate the degree of obsolescence. Induction time (the time the respondent expects a new recruit to learn how to do the job) has been found to be a strong determinant of skills obsolescence, and so it is useful to have a question on this in any survey.

An important but overlooked aspect is the role of past training on present overeducation and overskilling levels. It should not be assumed that the provision of education and training always reflects accurately the preferences of the trainees. Little is known, in the economic context of mismatches, of the role that education providers may play in generating mismatches. How provision is funded and organised, as well as how it tries to address

the demand by trainees and their future employers, is as important as it is inadequately researched. For example, the space at the borders between vocational and university level can be riddled with problems related to entrenched education positions. Key aspects are curriculum design and permeability between VET and general education. Such problems appear in different guises in many countries and their presence can distort the efficient provision of education in a fast changing economy. The collection of information on the type of provision and how this meets the needs of trainees and the industry should become standard in related data sets.

8.3. The way forward

What is the way forward? First, comprehensiveness of relevant questions on skill mismatch in surveys (see Annex) should be ensured to understand the relationship between different forms of mismatch. For example, do vertical and horizontal mismatches tend to have a positive, negative or no relationship? Does skills obsolescence tend to intensify the problem of labour shortages? Only if individual data sets contain a comprehensive list of questions are we likely to be in a position to answer such questions. Then it will be necessary to establish which European panel data sets can be used to include these questions alongside their wider survey questions.

Comprehensive schemata for skill mismatch questions in surveys

1. Qualifications (employee questions)

- (a) How long did it take you to obtain the highest qualification you currently hold?
- (b) Was it obtained on a part-time or full-time basis?
- (c) What is the normal time taken to obtain this qualification?
- (d) From which institution did you obtain this qualification?
- (e) Was the qualification classified and if so what classification did you obtain?
- (f) Is a particular qualification required to obtain the job you currently hold?
- (g) If so, what is it?
- (h) Has the level of required qualification changed since you obtained this job?
- (i) What level of qualification do you consider to be necessary to perform the job adequately?
- (j) What field of study do you consider to be most appropriate for this work?
 - exclusively own field;
 - own or related field;
 - a completely different field;
 - no particular field.
- (k) Has your employer offered you training to enable you to perform your current job better or to perform another job?

2. Skills and abilities (employee question)

- (a) How well do the skills and abilities you have match the skills needed to do your current job?

My own skills are:

- much higher;
- a bit higher;
- about the same;
- a bit lower;
- much lower than needed.

3. Skill shortages and skill gaps (employer questions)
- (a) Are there any occupations that you are unable to fill or have difficulty in filling?
 - please name them
 - (b) On average how long does it take before a vacancy is filled?
 - (c) How do your wage rates for these shortage occupations compare with those of your main competitors in the labour market?
 - above average;
 - average;
 - below average.
 - (d) What are the main reasons for these labour shortages?
 - lack of qualified applicants;
 - the job is unattractive;
 - location;
 - other, please specify.
 - (e) Are there any occupations in which existing employees do not have the required qualification, experience and/or specialised skills to perform the job to acceptable or most efficient levels?
 - please name them
 - (f) What are the main reasons for these skill deficiencies?
 - skill shortages;
 - changing job requirements;
 - labour turnover;
 - other, please specify.
 - (g) Which skills are inadequate?
 - technical/ICT;
 - numeracy;
 - literacy/communication skills;
 - problem solving;
 - teamwork;
 - other, please specify.
 - (h) Why does the company not provide off-the-job training to remedy this?
 - costs;
 - time constraints;
 - no suitable training available;
 - other, please specify.

4. Skills obsolescence (employee questions)

- (a) Are there any skills you once possessed no longer required in your current job?
 - if so, please name them
- (b) Are there new skills which have emerged in your current job that you do not possess?
 - if so, please name them
- (c) Do you consider that your ability to perform your current job has diminished over time?
- (d) How long does it take a new employee to become fully proficient in the job?
- (e) Has this duration increased over time?
- (f) Do you think that you will be able to continue in your present job until the normal age of retirement?
- (g) Has training been provided by your employer to update your skills?
- (h) If so, when and how often has this been provided?

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Better understanding of skill mismatch can help policy-makers in their efforts to match skills and jobs in Europe. Skill mismatch is a complex phenomenon affecting individuals, enterprises, economies and societies; it does not only refer to skill gaps and skill shortages, but also to skills exceeding job requirements. This report aims to structure the currently scattered evidence on skill mismatch by analysing seven important questions. It provides a broad overview of skill mismatch and the factors that contribute to it, analyses its economic and social costs, and argues why skill mismatch should be a concern for national and European policy-makers. As information across different countries is currently limited, the report also discusses how skill mismatch can be better approached and measured in surveys, with the aim of enabling more detailed and sound analyses in the coming years.

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