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An Analysis of Skill Mismatch Using Direct Measures of Skills

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DIRECTORATE FOR EDUCATION

AN ANALYSIS OF SKILL MISMATCH USING DIRECT MEASURES OF SKILLS

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ABSTRACT

The focus of this study is on the potential causes of skill mismatch, the extent of skill mismatch, the socio-demographic make-up of skill mismatch, and the consequences of skill mismatch in terms of earnings as well as employer sponsored adult education/training. A distinction is made between *skill mismatch* and *education mismatch*. The analysis is based on the 2003-2007 Adult Literacy and Lifeskills Survey (ALLS) – a dataset similar to the one that is forthcoming from the Programme for International Assessment of Adult Competencies (PIAAC) in 2013. These studies contain direct measures of key foundation skills as well as measures of the use of certain generic skills at work which allow for a direct measure of *skill mismatch*. The analysis points to the complex ways in which mismatch is generated and the need for an accurate and up to date measure of mismatch, one that reflects the possibilities for skill gain and skill loss over the lifespan, and reflects differences in the quality of qualifications. Two key findings stand out. First, including supply and demand characteristics in an earnings function reveals that labour demand characteristics are more important than labour supply characteristics in explaining earnings differentials. In other words, skills matter for earnings but only if they are required by the job. This has direct implications for understanding better the causes of mismatch on earnings. Second, the skill content of jobs seems to be an even stronger determinant of participation in employer supported adult education/training than educational attainment or literacy proficiency. The influence of demand characteristics thus tends to outweigh the influence of supply characteristics when employers make the decision to support adult education/training. Addressing mismatch thus requires a careful consideration of both the demand and supply sides of the labour market, so as to understand better the variety of factors which may have a negative impact on the effectiveness of skill formation, skill maintenance, and also skill use.

RÉSUMÉ

Le présent document a pour thème l'inadéquation des compétences. Il évoque tour à tour ses causes potentielles, son ampleur et de sa répartition socio-démographique, ainsi que ses répercussions sur le niveau des revenus et sur la participation à la formation pour adultes financée par l'employeur. On notera la distinction établie entre *inadéquation des compétences* et *inadéquation de l'éducation*. L'analyse repose sur les résultats de l'Enquête sur l'alphabétisation des adultes (ALLS), menée en 2003-2007 qui rassemble un ensemble de données similaire à celui que le Programme pour l'évaluation internationale des compétences des adultes (PIAAC) rendra public en 2013. Ces deux enquêtes proposent des mesures directes des compétences élémentaires et de l'utilisation au travail de certaines compétences génériques, permettant ainsi une évaluation directe de l'*inadéquation des compétences*. Ce document décrit les situations complexes qui sont à la source d'une inadéquation des compétences et démontre la nécessité d'une mesure précise et actualisée de cette inadéquation, qui prenne en considération les occasions d'acquérir ou de perdre des compétences au cours de la vie, ainsi que les différences dans la qualité des compétences. Deux conclusions principales ressortent de ces analyses. Premièrement, la prise en compte des caractéristiques de l'offre et de la demande de travail dans une logique de rémunération permet de constater que lorsqu'il s'agit d'expliquer les écarts de rémunération, les caractéristiques de la demande de travail sont plus importantes que ne le sont celles de l'offre. En d'autres termes, les compétences ont un impact sur la rémunération uniquement dans la mesure où elles sont requises pour occuper l'emploi. Cette constatation permet de mieux comprendre les causes des écarts de rémunération. Deuxièmement, la nature des compétences requises par les emplois semble être un facteur encore plus déterminant de la participation des adultes à la formation financée par l'employeur que ne le sont le niveau d'instruction ou les compétences en littératie. L'influence des caractéristiques de la demande a donc tendance à l'emporter sur l'influence des caractéristiques de l'offre lorsque les employeurs prennent la décision de financer la formation des adultes. Aborder la question de l'inadéquation nécessite donc un examen attentif à la fois de la demande et de l'offre du marché du travail, afin de mieux comprendre la diversité des facteurs qui peuvent exercer un impact négatif sur l'efficacité de la formation, le maintien et aussi l'utilisation des compétences.

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EXECUTIVE SUMMARY

1. In view of the forthcoming data from the Programme for International Assessment of Adult Competencies (PIAAC) this study undertakes a stock take of what is known about skill mismatch and investigates the influence of skill mismatch on earnings as well as on participation in adult education/training, using a prior survey of adult skills (i.e., the 2003-2007 Adult Literacy and Lifeskills Survey – ALLS). Similar to ALLS, PIAAC will contain direct measures of key foundation skills as well as measures of the use of certain generic skills at work, enabling a similar but more detailed and up to date analysis for a wide range of countries.

Background and rationale

2. The focus of this paper is on *skill mismatch* rather than *education mismatch*. Much of the research literature on mismatch has focused on the concept of *education mismatch* because relevant data have been relatively easy and cheap to collect. More recently, direct measures of foundation skills together with information on the use of skills at work have been made available in surveys like ALLS. PIAAC will contain similar measures but contain more information on the use of these skills at work, enabling a more detailed analysis. These type of data allow for a direct measure of *skill mismatch*. Advantages of this latter type of measure include a more enriched and nuanced analysis of mismatch issues. In particular, they compensate for the fact that qualifications are not necessarily good indicators of ‘skills’, which is certainly the case for workers who left the education system many years ago. While education mismatch has the advantage of being easier to measure and broader in its coverage of ‘skills’ – albeit indirectly – it has the disadvantage of being much less precise because it does not factor in differences in the quality of similar qualifications and it does not take account of the possibility for skill gain or loss following the attainment of qualifications. For example, employees engage in adult education/training, and firms support adult education/training at various life cycle points of the worker which may or may not be related to qualifications. Skill mismatch is thus more amenable to analysis that considers important dynamic elements which surround the phenomena of mismatch, such as the possibility for skill gain or loss on the supply side, in addition to the changing content of jobs on the demand side.

3. An important disadvantage however, is that the skill mismatch measures used in this study are narrow in scope by focusing on only literacy mismatch and numeracy mismatch. Nevertheless, literacy and numeracy skills are cognitive foundation skills that are important both in their own right and also because the development of other high level cognitive skills is dependent on their mastery. Literacy skills for example, are taking on a more significant role in today’s modern society and global knowledge economy as a consequence of disruptive technologies like Information and Communications Technologies.

4. The analysis contained in this study is motivated by a recent shift in academic and policy debates from a focus on overeducation or skill shortages to a more nuanced overview of imbalances that incorporates skill gaps and skill underutilization. Even if some projections suggest that the supply of skills may outpace demand over the next decade leading to higher rates of overskilling, policy concerns now include an emphasis on the need for tackling the negative consequences of skill underutilization rather than just advocating for a need to scale back the supply of educated adults. Concerns about overeducation remain but are balanced by views that high levels of education are needed to meet the long run needs of the labour market and safeguard against rapid technical biased change and competition in the 21st century. A

key concern is to ensure that work and organisational practices change in ways that make effective use of higher educated workers' skills so as to limit skill atrophy and wasted opportunities to increase productivity.

Understanding the potential causes of mismatch

5. Current understandings of mismatch rest on a relatively weak knowledge base. Much of the analysis of mismatch issues has had a tendency to neglect the type of education undertaken, actual skills held, work experience and the fact that people engage in formal and non-formal learning both inside and outside of work over the lifespan, all of which contributes to a limited understanding of mismatch. This is partly a consequence of a reliance on what is easiest to measure and what we can measure, rather than what we should measure and would be feasible to do so. A key drawback to education mismatch studies is the near exclusive reliance on quantity and qualification based measures of education such as years of schooling or educational attainment credentials.

6. A separate and perhaps more substantive reason for limited understandings of mismatch is the failure to consider more carefully both the role of the supply and the demand sides of the labour market in generating mismatch. Theory suggests that there are a variety of pervasive and complex mechanisms that generate mismatch which require careful consideration.

7. Approaches that emphasise the supply side of the labour market in modelling labour market functioning as it pertains to skills, skill use and skill development, tend to portray skill mismatch as a phenomenon driven by supply side conditions. From this perspective, mismatch tends to be attributed to the inadequacies of the education and training system. In a situation of overeducation, for example, the response is that education and training systems should aim to reduce the number of qualifications they produce. Overall, education and training systems should ensure quality and be made to be more responsive to the needs of the labour market, and to offer more guidance at critical transition points to minimize mismatch.

8. In contrast, approaches that emphasise the demand side of the labour market tend to portray skill mismatch as a phenomenon driven by demand side conditions. From this perspective, mismatch tends to be attributed to the inadequacies of labour market practices and of employers to identify and correct for mismatch, either via the provision of additional education, or in terms of adjusting work and organisational practices in ways that optimize skill use and skill gain, and avoids skill loss over time.

9. These two approaches lead to very different views of skill mismatch, although they are not mutually exclusive. By extension the two approaches can lead to the formulation of very different types of policy responses to skill mismatch. Evidence suggests that there is a need for a more comprehensive and balanced view involving both the demand and supply sides when attempting to address mismatch issues.

10. In summary, doing justice to the complex ways in which mismatch is generated requires a more accurate and up to date measure of mismatch, one that reflects the possibilities for skill gain and skill loss over the lifespan, and reflects differences in the quality of qualifications. Addressing mismatch also requires a careful consideration of both the demand and supply sides of the labour market, so as to understand better the variety of factors which may have a negative impact on the effectiveness of skill formation, skill maintenance, and also skill use.

Investigating the impact of mismatch on earnings

11. Evidence presented in this study suggests that skill supply characteristics are important determinants of earnings, but not independent of skill demand characteristics. In other words, skills matter for earnings but only if they are required by the job. While this makes sense intuitively, a lot of the

research on earnings functions has nevertheless been dominated by a supply side view of the labour market, namely the human capital approach, which has tended to underplay the role of the demand side of the labour market. By extension, this is also true of the discussion on education and training policy.

12. Including supply and demand characteristics in an earnings function helps to reveal that labour demand characteristics are more important than labour supply characteristics in explaining earnings differentials. On average, the characteristics of the job are found to be more important than the characteristics of the individual in determining earnings.

13. For example, workers who are in a situation of skill deficit are found to receive on average about 21% more in monthly earnings than those who have a low level of literacy proficiency but who engage very little in literacy related activities at work. This finding is counterintuitive from the human capital perspective. It confirms the idea that the type of job and job tasks one performs is an important determinant of earnings regardless of one's human capital. It also points to substantive interaction between the worker and the job that they are performing in determining marginal productivity and hence pay.

Investigating the impact of mismatch on adult education/training

14. Skill formation is not just a supply side issue; it is just as much a function of work tasks and work organisation on the demand side. Policies on skill formation thus need to take into account both the supply and the demand side. Particular attention should be paid to identifying the mechanisms that help to foster the optimal utilisation of the existing skill base. Otherwise, many workers even with high qualifications risk losing their foundation skills due to a lack of use, leading to an erosion of value of educational investments.

15. A key finding is that the skill content of jobs seems to be an even stronger determinant of participation in employer supported adult education/training than educational attainment or literacy proficiency. The influence of demand characteristics thus tends to outweigh the influence of supply characteristics. This raises questions about the focus of recent thinking around skills for economic prosperity. Several policy documents have stressed that the answer to the present economic and social challenges is to improve the supply of skilled labour. This view tends to ignore the demand side and takes upskilling for granted or as inevitable. It also ignores the observation that the actual utilization of foundation skills is itself a major factor implicated in skill formation as found in this study, and that large segments of the workforce are still not required to use their foundation skills at work. Evidence thus suggests that there is a need for a more comprehensive view involving both the demand and supply sides. Otherwise, a view based on the supply side only ignores the possibility that there may be structural conditions in the economy, as well as labour market, work and organisational practices that lower the demand for and utilization of skills, which in turn can affect not only investments in skill formation, but may lead to a lack of use of existing skills, and ultimately skill loss.

16. From the perspective of sustaining a good skill base for rapidly growing knowledge economies and addressing inefficiencies in the labour market that are due to skill deficits, it can be argued that public policy has an important role to play beyond relying almost exclusively on initial formal education to increase the supply of skills. For adults beyond initial education, governments have a role to play in fostering the adult education/training necessary to redress their low levels of foundation skills.

17. Employers are found to direct support for adult education/training to many workers who could benefit from developing their foundation skills and be more productive at work (i.e., workers in situations of skill deficit). Nevertheless, many workers in a skill deficit situation do not receive support. The role of public policy is thus particularly important because many other employers may lack the necessary incentives to invest in the foundation skills of their employees even if there may be a need as in situations

of skill deficit. Unless employees' needs are clearly aligned with firms' needs and the risks to investment are minimal, employers' incentives are not necessarily aligned to support the development of 'general' or 'foundation' skills.

18. Understanding better the investment behaviour of employers with respect to skill development is not only important within the context of skill mismatch, but also more generally. This is because employers are the single most important source of financing of adult education/training, and therefore, have a major impact in determining who receives adult education/training and who does not. If as found in this study the tendency is for adult education/training opportunities to be allocated primarily to those who use the skills in question, the risk is that the skill base of the workforce will become increasingly bifurcated, with some workers attracting more investment for continued skill development and others left without any support. This is further exacerbated by the fact that high-skilled individuals already have the motivation to continue to learn, and that individual and job characteristics are found to be mutually reinforcing in promoting skill development (i.e., workers in high-skill match situations participate the most in ongoing education and training and also receive the most employer support to do so).

Summary and conclusion

19. Three major points can be highlighted from this study, which should be taken into account when considering the phenomena of skill mismatch:

- Firstly, it is important to equally consider how both the demand and supply side of the labour market are implicated in generating mismatch.
- Secondly, it is important to consider the dynamics of skill gain and skill loss over the lifespan of workers and how this interacts with changing job content.
- Thirdly, it is important to recognize the dynamics of the interaction between the supply of, and demand for, skills at the macro level.

20. The analysis also suggests that a certain degree of mismatch may be inevitable and normal. It may even be an important catalyst for stakeholders to respond to, setting off the adjustment processes necessary for long run productivity growth. What the natural or normal rate of mismatch is, cannot be answered with certainty, but high rates are likely to suggest a need for active policies that foster adjustments.

AN ANALYSIS OF SKILL MISMATCH USING DIRECT MEASURES OF SKILLS

1. Introduction

1. Recent years have witnessed a growing interest in the phenomena of skill mismatch. This is an important issue for several reasons. In the past, policy concerns tended to focus on a perceived risk of increased *skill shortages* and *skill deficits* as a result of continued skill biased technical change in the economy. For example, much of the policy focus in the 1990s was on the need for skills upgrading and remedial training to respond to the twin challenges of deep structural change in the economy and an ageing workforce (OECD, 1996). While this continues to be a major concern, there is a realization that the issue is much broader than this.

2. *Skill underutilization* is now argued to be an equally important issue (CEDEFOP, 2010a). Recent evidence suggests it is a widespread phenomenon which has several implications including negative consequences for individual workers and the economy as a whole (see Krahn & Lowe, 1998; Boothby, 1999; OECD/Statistics Canada, 2005; OECD/Statistics Canada, in press). Many highly qualified workers are found to underutilize their skills. This is referred to as a *skill surplus*, or alternatively as *overskilling* or *skill underutilization*. In addition, workers with low levels of skills are found to be employed in jobs which appear to have relatively high skills demands. This is referred to as a *skill deficit*, or alternatively as *underskilling*. Skill surpluses and deficits, or alternatively, overskilling and underskilling are also referred to as *skill gaps*.

3. Much of the growing literature on mismatch deals with *education* or *qualification mismatch* rather than *skill mismatch*. This is because of a lack of data to address the latter. Although related, the two concepts should be clearly distinguished because they lead to different types of analyses and implications. In view of the forthcoming Programme for International Assessment of Adult Competencies (PIAAC) study which will contain direct measures of key foundation skills as well as indirect measures of the use of certain generic skills at work, this study aims to do a stock take of what is known about skill mismatch using prior surveys of adult skills as well as to investigate the consequences of skill mismatch on labour market outcomes (e.g., earnings and training).

4. The focus of this study is on the potential causes of skill mismatch (Chapter 3), the extent of skill mismatch (Chapter 5), the socio-demographic make-up of skill mismatch (Chapter 5), and the consequences of skill mismatch in terms of earnings (Chapter 6) as well as employer sponsored adult education/training (Chapter 7). The measure used distinguishes between whether there is a match or mismatch between the everyday literacy/numeracy related practices of workers and their actual literacy/numeracy skills as measured in the 2003-2007 Adult Literacy and Lifeskills Survey (ALLS). Specifically, the following questions are addressed:

- What are the potential causes of skill mismatch?
- What is the degree of match- mismatch between workers' literacy/numeracy skills and their literacy/numeracy use in the workplace?
- What is the socio-demographic profile of skill match-mismatch?

- How do skill match-mismatch categories relate to labour market earnings?
- How do skill match-mismatch categories relate to employer sponsored adult education/training?

5. Brief discussions are included to help the reader distinguish between mismatch related concepts and to situate the related debates (Chapter 2), and on the definition and measurement of mismatch (Chapter 4) in order to locate the concept and measure of mismatch that is operationalized for this study.

2. Distinguishing mismatch related concepts and situating the debates

Rising policy interest in skill mismatch

6. Policy interest in skill mismatch has surged in recent years with a number of national and international bodies giving it a high priority. In Europe for example, the identification and avoidance of mismatch including shortages and gaps, as well as the need to respond to future skill and competence requirements have been defined as a priority in the Bordeaux communiqué (European Commission, 2008). Accordingly, CEDEFOP has embarked on an ambitious programme of work to identify and monitor skill imbalances (CEDEFOP, 2010a; 2010b). Among various other countries recently producing skills strategies (e.g. Australia, the Czech Republic, Denmark, Estonia, Germany, Ireland, Japan, New Zealand, Norway, Poland), the UK Commission for Employment and Skills (2010) provides an exemplar of increased policy attention being focused on imbalances between skills demand and supply in the labour market.

7. Recent years have seen a shift in academic and policy debates from a focus on overeducation or skill shortages to a more nuanced overview of imbalances that incorporates skill gaps and skill underutilization. In some cases, skill gaps are perceived as being more important than skill shortages. In fact, some projections tend to suggest that the supply of skills may outpace demand over the next decade leading to higher rates of overskilling (CEDEFOP, 2010b). Even so, policy concerns now include an emphasis on the need for tackling the negative consequences of skill underutilization rather than the need to scale back the supply of educated adults. Concerns about overeducation remain but are balanced by views that high levels of education are needed to meet the long run needs of the labour market and safeguard against rapid technical biased change and competition in the 21st century. A key concern is to ensure that work practices change in a way that makes effective use of higher educated workers' skills so as to limit skill atrophy and wasted opportunities to increase productivity. Increased numbers of highly educated workers may eventually *crowd out* lower educated workers and thereby exacerbate the problem of skill underutilization unless work practices change to foster a more effective utilisation of skills¹.

8. These perceptions are accompanied by a shift in the conceptualisation and measurement of mismatch from a focus on education mismatch to skill mismatch. The UK Skills Survey is an exemplar of this shift in approach by researchers engaged in informing the mismatch debate. Having focused nearly exclusively on education mismatch issues, particularly the overeducation debate (e.g., Oosterbeek, 2000), academic research interest has over the last decade slowly moved toward the notion of skill mismatch (e.g. Mavromaras, McGuinness, O'Leary, Sloane & Wei, 2010) including the use of indirect and direct measures of skills rather than qualifications in analyzing mismatch. In doing so, the focus is increasingly on issues that arise as a consequence of approaching the issue from this perspective, namely skill gaps, skill underutilisation, skill growth and skill loss.

¹ ***Crowding out*** refers to the process where individuals with higher levels of education secure employment in lower skill jobs at the expense of employment opportunities for those with lower levels of education (Hansson, 2007).

A brief overview of the over- and under- education debate (vertical mismatch)

9. *Education mismatch* (or *qualification mismatch*) has been the most studied concept of mismatch (e.g., Oosterbeek, 2000; Hartog, 2000; Dolton & Vignoles, 2000; Groot & Maassen van den Brink, 2000; Mendes de Oliveira, Santos & Kiker, 2000; Vahey, 2000; Daly, Buchel & Duncan, 2000; Sloane, 2007; Verhaest & Omey, 2006; Galasi, 2008; van der Meer, 2009; Korpi & Tählin, 2009). It refers to a situation in which the educational qualifications held by a worker differ from those perceived to be required either by the employer or the worker to carry out adequately the tasks associated with his/her job – either in terms of the requirement at the time the worker took up the job, or in terms of the current requirements of the job. Typically, measures of education mismatch are limited to three alternative categories, namely *overeducation* (or *over-qualification*), *undereducation* (or *under-qualification*) and *required education* (or *required-qualification*). This approach pertains to the notion of *vertical mismatch*.

10. Overeducation has received more attention than undereducation and has been a major concern for several years. In particular, the vast expansion of tertiary systems over the past few decades in several OECD countries has led to growing fears of overeducation. As early as the 1970s, falling rates of return to college graduates in the United States were linked to the larger supply of graduates (Freeman, 1976). Freeman projected further declines but several studies eventually found the opposite (Bound & Johnson, 1992; Levy & Murnane, 1992; Katz & Murphy, 1992; Mincer, 1997; Goldin & Katz, 1999), namely a rising wage premium among US college graduates even as the number of graduates continued to increase. Several researchers have suggested that skill biased technical change helped sustain the demand for skilled labour even as supply kept increasing (Krueger, 1993; Acemoglu, 1999; Autor, Levy & Murnane, 2003).

11. Several studies have nevertheless found fairly large rates of overeducation over time. Duncan and Hoffman (1981) found an overeducation rate of 42% in the US in 1976, sparking an interest that would lead to numerous similar studies in several countries. There are several extensive reviews of these studies (see Hartog, 2000; Groot & Maassen van den Brink, 2000a; Sloane, 2003; McGuinness, 2006). A meta analysis of 25 studies done by Groot and Maassen van den Brink (2000) found overeducation rates ranging from 13 to 29% and undereducation rates ranging from 10 to 30 %, depending on the method of measurement (see section on measurement of mismatch). Although most studies generally find the incidence of undereducation to be 5 to 10 % lower than overeducation, undereducation appears to be a significant phenomena as well suggesting that fears of overeducation do not do justice to a more complex set of issues surrounding education mismatch.

12. Groot and Maassen van den Brink (2000) also found that overeducation fell from an average of 29% in 1970s down to an average of 21% in 1990s which supports the notion that technical change helped sustain the demand for skilled labour in the face of the ever rising supply. Undereducation however also fell on average from 16% to 13% during the same period. Most recently, Galasi (2008) using the European Social Survey found an average rate of overeducation of about 33 % in Europe. An increase in overeducation rates in the last decade would indicate that the supply of highly educated workers is now outstripping the pace of skill-biased technical change. But trends are difficult to decipher from existing studies with McGuinness (2006) concluding that overeducation rates seem fairly stable over time, and Groot and Maassen van den Brink (2000) reporting that there is no indication that mismatches between education supplied and education required for the job have increased significantly in the 20 year period between the 1970s and 1990s. Mismatch rates are not only potentially linked to the economic cycle but also the context of both the educational system and the labour market. Galasi (2008) for example reported large differences by country in overeducation rates with estimates as low as 15% in the Netherlands to 79% in Estonia, suggesting that the problem is driven not only by the educational attainment profile of a country but also how the structure of demand for skills plays out in the context of the occupational and production profile of a particular country.

13. It is important to consider the over- and under- education debate within a framework which accounts for productivity growth and technical change over the long term and the impact of education, trade and industrial policy, and to acknowledge that there is presumably a natural rate of education mismatch. A key question is whether it is the demand for skills that is driving the supply or vice-versa? *Endogenous technical theory* suggests it is the latter, where increases in the supply of skilled workers induce skill-biased technical change, which in turn stimulates the labour demand for skills (see Acemoglu 1998 and 2002a). But while human capital theory, especially viewed within an endogenous growth framework provides a very powerful and appealing rationale for the economic value of education, as Alison Wolf (2003) has pointed out, unquestioned faith in education and human capital theory by policy makers should be avoided.

14. Partly as a consequence of ease of availability, a key drawback to education mismatch studies is the near exclusive reliance on quantity and qualification based measures of education such as years of schooling or educational attainment credentials. A tendency to neglect the type of education undertaken, actual skills held, work experience and the fact that people engage in formal and non-formal learning both at and outside of work over the lifespan often lead to a limited understanding of mismatch.

A brief overview of the ‘right education’ or ‘right skills’ debate (horizontal mismatch)

15. Rather than focus on the level of education and whether workers have ‘too little’ or ‘too much’ education, a more appropriate question might be to ask whether workers have the ‘right’ type of education to carry out their job successfully. Although this is arguably a more important issue, there are very few empirical mismatch studies focusing on the horizontal dimension (Robst, 2007), namely the mismatch between an individual’s field of education and his/her occupation.

16. The *horizontal mismatch* approach moves away from an exclusive reliance on the level of education by taking into account the type of education. While touching on an important policy debate about whether different types of education are preparing individuals for jobs that are available, it is a difficult question to address empirically. Gauging mismatch based on the correspondence between field of study and occupation is possible. However few datasets contain both these variables, and when they do, sample sizes are typically too small. Moreover, operationalizing the concept is complicated. Firstly, many jobs cannot be matched with a specific field of education (e.g., manager, politician). Secondly, some types of education are designed to foster generic skills while others are much more specific in nature. For example, some fields of study focus on occupation-specific skills that may not easily transfer to other occupations, while others focus on more general skills (e.g. arts and humanities) that are applicable across a wide range of jobs. In countries where educational systems focus more on general skills and leave vocation specific skills to be learned on the job or through employer training, the issue of horizontal mismatch becomes rather ambiguous. This is further complicated by the fact that employers train and retrain their employees at different career points for various reasons (e.g., new job or work organization, new market or context, new knowledge or technology, new products or services etc...). Thus the relevance of the specific type of education is not always easy to establish even if it can be argued that qualifications are needed to obtain a job in the first place.

17. Taking into account the limitations, Robst (2007) used the 1993 US National Survey of College Graduates to find that about 55% of respondents are in a job that closely relates to their degree field, while 25% are in jobs that are somewhat related to their area of study and 20% are in jobs that are not related to their studies. Indeed, many individuals are found to obtain a qualification in a specific field only to work in a different field but the extent of mismatch varies sharply by field of study. A Swedish study by Nordin, Persson and Rooth (2010) using register data which helps to circumvent sample size problems found horizontal mismatch rates as high as 80% for biology graduates and rates as low as 4% for graduates who studied medicine. Their study focused on only Swedish born adults aged 28-39 who completed a

college/university degree. Reflecting the difficulty of studying horizontal mismatch in practice, they also chose to exclude from the analysis less well defined occupations (e.g., managers, politicians, sportsmen and models) and fields of education (e.g., humanities, languages, general services and transports) that are either too vague and/or too difficult to match. Most of the fields of education left in their analysis were precise and matched one distinct occupation perfectly, but some fields of education were broader and matched two occupations (e.g. social sciences).

A brief overview on skill shortages

18. *Skill shortages* are distinct from the phenomenon of skill mismatch but the two concepts are closely related. Skill shortages refer to a situation where employers in specific sectors cannot find suitably qualified workers. This is in contrast to education or skill mismatch since the job is often left vacant and there is no match or mismatch between a worker and a job. However, it may nevertheless lead to a situation where vacant posts are eventually manned by workers who are under-qualified or under-skilled.

19. The main interest in skill shortages by policy makers are the potential negative consequences to economic growth, and particularly the negative effects of shortages on labour productivity. Substitutions to less productive unskilled workers are also suggested to negatively affect labour productivity (Haskel & Martin, 1993), and some have suggested that shortages slow the rate at which more efficient technologies and approaches to work organization are adopted (e.g., Foley & Watts, 1994; Forth & Mason, 2006).

20. Skill shortages can be cyclical, structural and/or geographical in nature. The latter is sometimes referred to as geographical mismatch where there are sufficiently skilled people in the labour market but they are not in locations easily accessible to those jobs. A link to business cycle is rather straightforward where cyclical periods of rapid economic growth can lead to increased skill shortages whereas economic slowdowns are likely to reduce shortages. Finally, shortage can be linked to structural changes for example brought on by the adoption of new technologies which require specific skills that are not readily available on the labour market (e.g. ICT skills).

21. Empirically, there are three widely used approaches to construct measures of skill shortage: employers 'own assessments, indices based on job vacancies and wage growth models. These are discussed in more detail in Quintini (2010). On the basis of employers 'own assessments, Quintini (2010) used the 2009 Talent Shortage Survey conducted by Manpower Inc. to reveal that the share of employers reporting recruitment difficulties in select OECD and non-OECD countries dropped in most countries between the 2007 and 2009 period. Given the onset of recession in most countries following the 2008 banking crisis, this data supports the strong cyclical nature of skill shortages. Nevertheless, many employers in several countries, about 30% on average, continue to report recruiting difficulties in the aftermath of the recent recession.

Distinguishing between education and skill mismatch

22. In contrast to education mismatch, *skill mismatch* is a more direct concept based on whether workers have the actual skills needed to carry out successfully required job tasks. Typically, measures of skill mismatch are limited to three alternative categories, namely *under-skilled* (or *skill deficit*), *over-skilled* (or *skill surplus*) or *required skill*. In this study, the category 'require skill' is split between those who are low-skilled and high-skilled. The conceptualisation and measurement of education and skill mismatch is elaborated in Chapter 4, but a few points are worth noting already at this stage.

23. First, the orientation, purpose and substance of education and skill mismatch concepts and their related debates which are discussed above are closely related and even intertwined, but the distinctions are important because how mismatch is conceptualized and measured can itself lead to major differences in

exactly how the concerns are framed and investigated, including not least under which conditions and assumptions. For example skill gain and skill loss are more relevant in the framing of skill mismatch compared to education mismatch.

24. Second, the two concepts may be perceived as complementary, one allowing for breadth and the other allowing for depth. Qualification mismatch has the advantage of being easier to measure and broader in its coverage of ‘skills’ – albeit indirectly – but has the disadvantage of being much less precise and it does not take account of the possibility for skill gain or loss beyond the attainment of qualifications. For example, employees engage in adult education/training, and firms support adult education/training at various life cycle points of the worker which may or may not be related to qualifications. Skill mismatch on the other hand, is much more precise and it takes account of skill gain or loss, but it is often very narrow in scope (e.g., literacy mismatch or numeracy mismatch). Still, it compensates for the fact that qualifications are not necessarily good indicators of ‘skills’. This is certainly the case for workers who left the education system many years ago.

Situating the over- and under- skilling debate

25. This study investigates literacy and numeracy mismatch in detail in Chapters 5, 6 and 7. Literacy and numeracy skills are cognitive foundation skills that are important both in their own right and because the development of other high level cognitive skills is dependent on their mastery. Literacy skills for example are taking on a more significant role in today’s modern society and global knowledge economy as a consequence of skill biased technical change. Disruptive technologies like ICTs and the accompanying increasing mass of coded knowledge that appears in the form of written information are contributing to an ongoing change in the structure of demand for literacy skills both at work and in daily life. Their increasing relevance to productivity as economies shift to knowledge based production explains their relevance for policymakers.

26. Literacy and numeracy *skill surpluses* are good for growing knowledge economies in the long run, but a lack of use of these skills or *skill underutilization* in the workplace may constitute a problem in the short run. This follows from the “use it or lose it” hypothesis (Krahn and Lowe, 1998; OECD/Statistics Canada, 1995) and practice engagement theory (Reder, 1994; 1998). Literacy and numeracy skills are like muscles that develop if you use them, otherwise they can be lost. Literacy and numeracy skills are not only a function of formal education but also a wide range of other practices that occur over the lifespan including social and cultural practices, and not least, work practices such as engagement in literacy and numeracy related tasks at work (Desjardins, 2004). Practice engagement is thus important to nurture and develop skills (Reder, 2009a; 2009b). By extension workers who are deprived of the opportunity to perform complex literacy tasks may lose some of their skills proficiency.

27. The structural shift of OECD economies toward information and knowledge based economies in the early 1990s brought much attention to literacy and numeracy skills. In the 1990s and early 2000s, the policy focus tended to be on the supply of basic skills needed in an information economy, and on the consequences of skill deficit for individual workers and the economy as a whole. Consequently the discussion was focused on individuals’ literacy and numeracy deficits and the need for training and upgrading. Much less thought was given to how a lack of use and low levels of demand for these skills is linked to skill loss (Krahn & Lowe, 1998) and by extension restricts large groups from receiving adult education and training. Evidence suggests that adults with higher levels of literacy and numeracy skills are much more likely to take up training and receive employer sponsored training (OECD/Statistics Canada, 2005). Accordingly there has been a shift toward an increased concern about the demand for skills and employer practices which can either perpetuate or eliminate skill mismatch (e.g., Bevan & Cowling, 2007).

3. The causes of mismatch

Labour market theories that are helpful for understanding the potential causes of mismatch

28. As pointed out by Quintini (2010), there has been no attempt so far to develop a unified theory of education or skill mismatch, but a number of theories are useful for helping to understand a range of labour market imperfections which could be behind several of these types of skill imbalances. These include: human capital theory, technological change theory, career mobility theory, job search theory, signalling theory, job competition theory, labour market segmentation theory and assignment theory. Each theory is briefly discussed in turn below in the context of how mismatch may arise or persist.

Human capital theory

29. Human capital theory (Schultz, 1961, 1975; Becker, 1962, 1964; Mincer, 1958, 1962, 1974) focuses on the *productivity-enhancing* effects of education. The main premise follows a causal line of reasoning as follows: education develops skills which lead to higher productivity and hence higher pay. Under neoclassical assumptions the theory predicts that in the long run, market forces lead to an equilibrium where there is no mismatch and skills are utilized to maximum potential.

30. The theory of human capital assumes the existence of a single, efficient and fair labour market that distributes jobs and pay on the basis of workers' qualifications, and that knowledge and skills are of pre-eminent importance in the labour market. The theory focuses on the long run supply side of the labour market and pays no attention to variables structuring the demand side such as the individual's occupation, job or job tasks (Hartog, 1985). Jobs and job tasks are effectively treated as homogeneous in the sense that they do not factor into the earnings or matching function. It may be said that job differences are implicitly accounted for, but this is only to the extent that jobs differ in the amount of human capital, and possibly other characteristics, that individuals bring to each job.

31. Thus the assumption is that individuals are always allocated to their optimal position and there is no mismatch. Although mismatch may arise, it is external to the model and is seen as a temporary phenomenon that will resolve itself in the long run. The prediction is that mismatch will set off an adjustment to the production process by the employer in order to make full use of skills available and thus allow for an increase in productivity that is commensurate with available supply of skills; or alternatively, the employee will seek a more appropriate match to fulfil his/her production potential and hence maximize earnings. Quintini (2010) astutely points out complementary theories to the human capital framework which help to explain why mismatch may be observed in the short run and may even remain in the long run. These include *Technological Change theory*, *Career Mobility theory*, and *Search theory* which are discussed in turn below.

Technological change theory

32. Technological change is now widely recognized as a driving force behind productivity and economic growth, but as a phenomenon it has often been treated as external to the functioning of the economy. *Technological change theory* (Romer, 1990; Aghion & Howitt, 1997) attempts to integrate this phenomenon and draw out how technological change comes about and can be harnessed. The primary interest is to understand better the course and rate of the change so it can be influenced through policy. It is, therefore, important to enhance our understanding of the effect of skills including mismatch on technical change.

33. Human capital theory implicitly assumes that employers will adjust their technologies to optimize the use of skills which are available but this is not accounted for explicitly. Acemoglu (1998, 2002a; 2002b) suggests that the skill level of the labour supply may affect the demand for skills leading to skill-

biased technical change and finds some evidence to support this claim. In reality, there are a range of structural barriers to technological change and there may be a lack of incentives for firms to adopt new technologies. Skill shortages is one example but the simple fact that costs are involved may delay adjustments to production processes or lead to the avoidance of change altogether especially if the incentives for long run maximization of productivity are not properly aligned.

34. Mismatch can be affected in several ways by technological change. First, it may lead to skill underutilization because of the cost and other barriers associated with adopting new technologies or in changing the ways in which work is organized. This may lead to a loss of the skills that were gained as a result of increased educational investments and may result in lost opportunities to enhance productivity. To avoid wastage, policy must ensure that firms have appropriate incentives to make full use of available skills, including the incentives to invest in technical change and making the necessary adjustments to the production process to increase productivity.

35. Secondly, firms in sectors that are subject to change may have an incentive to hire workers with more qualifications than are actually needed in order to ease labour adaptations in the future. This leads to overeducation. It may also lead to overskilling but only to the extent that education adds to the supply of skills. Hiring more employees with more skills than necessary might serve as an insurance policy for firms that operate in rapidly changing and uncertain markets. The problem with this line of reasoning is that the prospect of skill loss associated with the lack of skill use is ignored. Still, the costs of compensating for skills loss may be less than the costs of hiring someone new.

36. Thirdly, as technical progress occurs and the qualification requirements for new entrants are upgraded, many individuals who already employed will appear to be ‘undereducated’. But this does not take account of the non-formal education and skill development activities undertaken by the individuals after being hired. Thus while workers may be observed as undereducated they may not be underskilled. Hartog (2000) suggested that undereducated workers are usually expected to have above-average abilities but he does not distinguish whether the person may have been hired ‘undereducated’ or the person became ‘undereducated’ as a result of technical progress. Many workers may be truly underskilled due to the rapid change in technologies for which they have little prior exposure or competencies to deal with.

Career mobility theory

37. Occupational mobility or the changing of job tasks performed over one’s career is now common place in most OECD countries. But the rate of career mobility tends to be highest among younger and more highly educated labour market participants. In other words, the upward trajectory is much higher for well educated youth. Sicherman and Galor (1990) who originate the theory suggest that wage penalties for overeducated workers are compensated by better promotion prospects. This theory is helpful for explaining the high incidence of youths in the overeducation and overskilled categories, but is less helpful in explaining the career mobility of undereducated workers as pointed out by Büchel and Mertens (2004). It is plausible to postulate that as youths gain more experience and more information, they are more likely to move into higher level occupations. To the extent that the theory operates, overeducation is a temporary phenomenon over the life cycle and should correct itself as youths find their way into jobs that match better their skills, and overeducation should decline with age.

38. Even so, there are various barriers to career mobility which must be understood, monitored and alleviated where possible so as to avoid skill loss among youths as well as the loss of opportunities to increase productivity. Barriers may include a lack of information, a lack of opportunities due to poor market conditions, or they may include structural deficiencies in certain occupational areas where mobility is restricted for a wide variety of reasons.

Search theory

39. *Search theory* can help to explain mismatch because of imperfect information available to employees about the nature of production processes, and to employers regarding employees' actual skills. When workers are looking for a job, they do not necessarily have good or accurate information about jobs and may accept a job offer in which the job tasks are not commensurate with their qualifications or skills. Some workers may not obtain a job that suits their potential, especially youths whose levels of education are increasing. For example, younger workers may be in transition seeking to find good jobs but lack opportunity or networks to help them find the right jobs. Others may lack competences to find a job; and/or may need reschooling or retraining to suit available opportunities. Still others may have given up and accepted limited or narrow career paths that are substandard to their potential because of a lack of alternative or forthcoming opportunities and too many education and training barriers or other labour market barriers.

Signalling theory

40. Signalling theory (see Arrow, 1973; Spence, 1973; Riley, 1976; Weiss, 1995) emphasizes the *productivity-identifying, allocative, sorting, screening, positional*, or matching effects of educational credentials. There are several variants to this type of theory (e.g., credentialism, sheepskin model). A common feature among them is that there is asymmetric information in the market place between individuals and employers; the latter do not have perfect information concerning the skills of potential employees (e.g. Stigler, 1961; Spence, 1973; Arrow, 1973). These theories also share the main premise that qualifications carry probabilistic information regarding difficult to observe characteristics which are relevant to job performance including cognitive and non-cognitive skills. Qualifications are thus viewed as merely signals which suggest that the holder is more likely to be: more productive, a more efficient trainee and thus less costly to train, and more likely to adjust efficiently to unforeseen change. Although some extreme versions of this theory rule out the productivity-enhancing effects of education such as the *sheepskin model*, most do not preclude the possibility that education also enhances skills. Moreover, signalling theories do not necessarily reject the basic assumptions of human capital theory, namely that productivity and earning are primarily a function of a worker's skills (i.e., earnings remain a function of individual characteristics). The primary difference is to emphasize the role of education in the matching function which is overlooked by human capital theory, and to suggest that education may not necessarily add to skills and that it is not the only source of skills or skill development.

41. While critics have pointed out that education may just be an expensive way of sorting or allocating workers to jobs and may add little to the skills supply, especially at the margin, a matching process is nevertheless necessary. Employers have imperfect information regarding the likely performance of potential employees. Thus they face a dilemma when they are hiring and have little choice but to infer applicants' abilities to perform by relying for example on their qualifications which are validated and widely recognised. Indeed, there are findings (e.g., Black & Lynch, 1996: 266) which suggest that educational credentials are important to employers when hiring, and thus play an important role in providing access to occupations.

42. Signalling theories are important when interpreting the findings of this study because literacy and numeracy skills are difficult to observe in the day to day functioning of the labour market. Direct measures of skills are made available from large scale studies like IALS, ALL and PIAAC but employers do not generally use the tools needed to directly assess the actual literacy and numeracy proficiency of potential employees. Thus it is interesting to observe whether they are rewarded above and beyond officially recognized credentials. While difficult to observe initially, these skills may be more discernible to employers following a certain period of tenure, and may be rewarded above and beyond officially recognized credentials accordingly. This helps to answer the question of whether actual skills lead to

higher pay beyond the signalling effects of education (see Chapter 6 on earnings differentials and literacy mismatch).

43. The allocative nature of qualifications via signalling effects may induce overeducation via the *inflation* and *crowding out* mechanisms. These have different implications for education and skill mismatch depending on a variety of alternative scenarios.

44. Before describing these scenarios, it is useful to highlight the incentives for individuals to obtain higher levels of education. It can be argued that individuals and many employers, perhaps a growing number, have incentives which are aligned to induce overeducation. Employers with attractive opportunities have the incentive to hire individuals with higher levels of education for a variety of reasons – the most obvious is to select the most able workers. In itself, this does not lead to overeducation, but it provides individuals with the incentive to secure attractive opportunities and higher paying jobs. Alternatively, some employers have the incentive to hire individuals with higher levels of education than may be required. For example, to maintain a more flexible and adaptable workforce as an insurance policy against unforeseen changes in the future. This adds further to the demand for qualifications and the incentives to obtain them.

45. Qualification inflation may arise for at least two reasons, both leading to actual or perceived overeducation. First, as more and more people obtain higher levels of education, the information or discriminatory content and hence signalling value of higher qualifications may be diminished. Second, there may be deterioration in the quality of qualifications as more and more people seek to obtain them. For example, standards may fall, effectively increasing the unobserved heterogeneity of individuals for a given level of education. Workers may thus have attained qualifications that are not commensurate with their actual level of skills. In either case, employers may as a response upgrade the educational requirements needed for certain jobs but not the actual job content. As inflation ensues, the productivity-identifying effects of education are distorted, feeding further inflation. This mechanism leads to a number of alternative implications that are worth noting in order to highlight the potentially pervasive and complex ways in which signalling may generate mismatch.

46. First, if qualifications attained and required have both increased, but there are no real changes to actual skills and required skills, then the additional education induced by inflation effects does not have any enhancing effects on productivity. Nevertheless, it helps to preserve its productivity-identifying effects. However, this is at an inflated cost to those who pay for education.

47. Second, workers who are already employed in jobs that are subject to qualification inflation may appear as undereducated, even if the job content of their job does not change.

48. Third, if qualifications overstate actual skills, for example, because of deterioration in the quality of education, then perceived overeducation may actually be accompanied by underskilling.

49. Fourth, if qualifications accurately reflect actual skills (i.e., educational investments are adding to the actual skill supply), then the overeducation will be accompanied by overskilling. In this scenario, higher educated and thus higher skilled individuals may have an advantage in securing employment in lower skill jobs, *crowding out* the employment opportunities for those with lower levels of education. Unless employers change work practices and adopt complementary technologies to make use of the accompanying skill surpluses, *skill underutilization* will arise, contributing to wasted opportunities to increase productivity, a loss of income, and the loss of the potential value that was created through educational investments because of the risk of skill loss associated with lack of use.

Job competition theory

50. Job competition theory (see Thurow, 1975) is very similar to signalling theories but with an important deviation from the standard neoclassical framework, namely that earnings do not necessarily reflect individual performance. That is, earnings and other rewards are no longer primarily a function of a worker's skills or productivity. Instead, the theory emphasizes the characteristics of the job in determining earnings (e.g., pay determined by wage setting institutions).

51. Signalling however still operates at full strength in the matching of workers to jobs and individuals are seen to compete for top jobs on the basis of their level of education. The incentive for individuals is to invest in additional education to preserve their place in the hiring queue even if they do not need it to perform their eventual job tasks. People are competing for good jobs that pay well. Moreover, individuals may signal their capabilities other than by their credentials. For example, some workers may be able to signal that they have some of the important skills needed for the job simply by being better at communicating and demonstrating results or attitudes necessary for the job. Nevertheless, they may have low levels of other skills such as literacy or problem solving skills. Others may have access to networks which are an important source of labour market entry.

52. According to this theory, employers are interested in better educated workers because they are seen as being less costly in terms of training and adjusting to change. In terms of mismatch, the implications of this theory are very similar to signalling. One exception is that underskilled or undereducated workers may be successful in competing for higher skilled jobs and thus earn more than would otherwise be predicted by their level of qualifications or skills.

Labour market segmentation theory

53. Labour market segmentation theory (see Doeringer & Piore, 1971; Cain, 1976; Duncan & Hoffman, 1979) offers a useful framework for exploring mismatch. The main premise is similar to job competition theory in the sense that it is the job characteristics, not individual ones which are relevant in the earnings function. This theory emphasizes the characteristics of jobs and job markets, rather than the characteristics of individuals in explaining labour market outcomes (Duncan & Hoffman, 1979). Many proponents of the theory have suggested that worker productivity and pay are determined more by the job and its technology than by the human capital of the worker (see Velloso, 1995).

54. Unlike the neoclassical view that there is a single homogenous labour market, segmentation theory views the labour market as being composed of two or more segments. The different labour markets operate under different circumstances such as regulations, technology, demand and supply conditions, which lead to varying salaries and other benefits as well as other outcomes (e.g., promotion, job security, access to training and human capital development, etc.). Originally, segmentation theory distinguished between two segments: a secondary and a primary sector, known as dual labour market theory or "dualism". Typically, the primary sector is viewed as consisting of 'good' jobs with security and high pay and the secondary sector by low-wage jobs, poor returns to human capital, and a high degree of job insecurity.

55. The theory implies that there are various barriers which constrain mobility between segments. Thus while there may be a surplus or deficit of skills in one sector of the economy, these skills are not easily deployed to other areas of the economy. Examples of barriers may include social and cultural norms, but also simply the level and type of qualifications and cumulative work experience. The theory helps to account for the possibility of horizontal mismatch.

Assignment theory

56. Assignment theory (see Sattinger, 1980; 1993; Hartog, 1981; 1985; 1986a; 1986b; Tinbergen, 1956) emphasizes both individual and job characteristics, making it an ideal candidate for exploring the match-mismatch between a worker's skill profile and the skill content of their job. The theory accepts the productivity-enhancing effect of education but acknowledges that the nature of the job is equally important in determining the amount a worker can contribute to production as well as in determining pay and other rewards. Pay is thus driven by both the characteristics of the individual and of the job. A high-skill match pays best, but depending on whether it is the job or individual characteristics that matter most, it is not clear whether overskilled workers earn more than underskilled workers. If rewards are more closely tied to the job, for example, then the underskilled could earn more than overskilled workers, and vice versa, if rewards are more closely tied to individual characteristics.

57. The theory offers a framework in which both the supply and demand for labour are relevant. Like segmentation theory, sectoral differences in pay structures, for example, as a result of different technologies, can be accounted for. In this sense, the model relaxes the assumption of a single labour market. This is in contrast to human capital theory which is built on the logic that productivity and earnings are driven only by the long run supply behaviour of individuals.

58. Otherwise, assignment theory directly builds into the model a function to match supply and demand. The model acknowledges the heterogeneity of both workers and jobs, and it effectively compensates for the lack of explanation the human capital theory model offers in terms of matching the workers to jobs. Human capital theory would essentially arrive at a similar solution through a dynamic adjustment process driven by market forces in the long run. The assignment model however, recognizes that employers do not necessarily adjust their technologies, for example, because workers have higher levels skills. Thus it introduces the possibility for persistent skill mismatch.

59. The matching function in this model may depend on signalling but according to the theory, the most efficient solution, even if it is hardly feasible, is to assign workers in a top-down fashion according to their skill level. The highest skilled individuals are assigned to the highest skilled jobs applying the same assignment method down to the lowest skilled individual and lowest skilled job.

60. Not surprisingly, several studies have found *Assignment* theory to be the most consistent with findings on mismatch and its effect on wages (Duncan & Hoffman, 1981; Hartog & Oosterbeek, 1988; Sloane, Battu & Seaman, 1999; McGuinness, 2006). Few studies however have tested the theory using direct measures of skills. This is taken up further in Chapter 6.

Discrimination theory

61. Discrimination theory suggests that personal characteristics of workers which are unrelated to productivity are also valued on the labour market (Arrow, 1971). For example, women and immigrants may be subject to skill mismatch more than otherwise because discriminatory mechanisms may be operating on educational markets, on the one hand, to constrain skill development, and on the other hand, on labour markets to constrain them from making full use of their skills. Chapter 5 takes a closer look at the distribution of mismatch by age, gender and immigrant status.

Further reflections on potential reasons for observed skill imbalances

62. In addition to the above theories, there is other less formalized but related explanations for why skill mismatch is observed. Technological change theory is discussed further by focusing on the implications of changes in the mix of jobs and job tasks. This is important for understanding skill mismatch because neither employees, nor employers have full information regarding how the nature of job

tasks is likely to evolve over time. Other reasons that are taken up include political economic objectives such as pursuing, perhaps unwittingly, a low, high or mixed skills strategy; and the unobserved heterogeneity of workers.

The changing mix of jobs and job tasks

63. The *hollowing out hypothesis* claims that the demand for medium skilled workers is declining on the basis of a rise in high-wage and low-wage jobs, and a decline in medium-wage jobs, i.e., wage polarization (Kolev & Saget, 2010). In their analysis of labour market trends in the US and European Union economies, Acemoglu and Autor (2010) provided evidence of broad-based increases in employment in high-skill and low-skill occupations relative to medium skilled occupations (i.e., job or skill polarization). They also provide evidence of a broad diffusion of new technologies which they suggest may have served to directly substitute capital for labour in tasks that were previously performed by moderately skilled workers.

64. Computers tend to be singled out as the culprit for *hollowing out*. Computerization may reduce the demand for medium skilled workers, namely by serving as a substitute for medium level job tasks, for example, routine cognitive tasks (Autor, Levy & Murnane, 2003). Others have earlier maintained that the introduction of new technologies requires more skilled workers and that the two are complements (Katz, 2000; Bartel & Lichtenberg, 1987). Evidence on the net effect of the complementary and substitution effects of technological change appear to support the hollowing out hypothesis, but more research is necessary to understand the patterns and their implications.

65. *Hollowing out* is closely related to the *deskilling* of jobs but the two are not identical. The former refers more directly to the change in the mix of jobs, whereas *deskilling* as well as *upskilling* refer more directly to changes in the mix of tasks within jobs.

66. Braverman (1974) questioned the notion that *upskilling* goes hand in hand with technological progress. Instead, he suggested that it will lead to *deskilling*. He noted the division of work tasks, stronger control by the employers through scientific management resulting in de-qualification, and the use of computer technologies to routinize and mechanise non-manual work.

67. Despite intense debates among scholars, evidence regarding tendencies for deskilling or upskilling remains ambiguous (Spenner, 1983; Gallie, 1991; Valla, 1990; Åberg, 2002). This is partly due to varying understandings of skills and considerable variation in the way the demand for skill has been assessed (Moore, 1982; Valla, 1990). There is however, little evidence of widespread deskilling as postulated by Braverman (Gallie, 1991; Spenner, 1983, Åberg, 2002). Deskilling cannot be ruled out, however. It is likely that some deskilling is occurring as technological change affects production and work processes.

68. There is also some evidence suggesting that changes to the occupational structure over time are skill-biased, but this is primarily with regard to a change in the mix of jobs (Osterman, 1995; Åberg, 2002). For example, using the educational requirements of jobs as criteria, evidence supports the view that the labour market increasingly is requiring a better qualified labour force. But this ignores the possibility for qualification inflation and overeducation.

69. Providing a more nuanced analysis of how the structure of labour demand has been evolving, Autor et al. (2003) examined changes in the task composition of work. Using representative US data on job task requirements from 1960 to 1998, they found that routine cognitive (e.g., search, operators) and manual work (e.g., assembly line) have been steadily declining since 1980 which they attribute to the impact of computers. Non-manual work which is difficult to reduce to routines (e.g., nurses, truck drivers) is also

observed to be in decline since 1970. In contrast, they find that cognitive tasks that are non-routine such as those that involve interaction or are analytic in nature have continued to increase sharply since 1970. Their findings confirm that jobs which are based on routine tasks are disappearing because computers are able to perform such tasks more cheaply. But their findings also confirm that changes to the structural composition of occupations is skill-biased since job growth is found to be concentrated in high-skill jobs which are based on complex and non routine tasks.

70. In summary, there is evidence that the skill content of jobs is changing over time. This is reflected in increases of requirements within some jobs as well as increases in the number of high-skill jobs. There is however, also evidence of a reduction in the number of medium-skill jobs.

71. To the extent that upskilling and deskilling processes are operating, either directly via changes in the mix of job tasks, or indirectly via changes in the mix of jobs, skill mismatch is likely to arise. To be sure, the dynamics around technical change may have important and unpredictable impacts on skill mismatch. The net effect of skill demand changes on mismatch is not clear. Some jobs may be subject to deskilling leading to overeducation and overskilling, whereas some jobs may be subject to upskilling leading to undereducation and underskilling.

Market vs coordinated strategies

72. It is possible that the skills of some workers are underutilised because employers pursue low-skills strategies and/or simply mismanage the potential of their employees. For example, the structure and distribution of work tasks may not be well suited to the actual skills base of the workforce. This might be due to lack of incentives to pursue high-skills strategies. Structural conditions which surround the labour market and depend on coordinated governance, for example, may play an important role in influencing the demand for, and use of, skills. These conditions may include institutional structures which underpin relations between employers, workers and the state; legal structures; and, incentive structures which are designed to encourage the adaptation of technical change and the training of the workforce, not just skilled workers but also low and medium skilled workers.

73. While policy makers have argued that mismatch problems can be solved by improving the supply of skills, some scholars point to structural conditions in the economy which lower the demand for and utilization of skills (see e.g. Brown, Green and Lauder, 2001). Some have pointed to evidence suggesting that: "...many employers are competing on the basis of relatively low-skill, standardized production strategies and price-based competition that require only a limited range of low-level skill from the bulk of the workforce" (Lloyd and Payne, 2006, p. 151).

Unobserved heterogeneity

74. Finally, mismatch may simply reflect unobserved heterogeneity among workers including their skills, attitudes and preferences. For example, some workers may just not care whether they use their skills or they may have other preferences. They have graduated and obtained credentials but do not have a preference to pursue opportunities that are commensurate with their skill set. Others may have good levels of specific skills such as literacy but otherwise have low capabilities. Chevalier (2003) for example, suggested that increased access to education in the UK has met more low ability students entering the tertiary sector.

4. The conceptualisation and measurement of mismatch

75. The following considers some of the issues around the conceptualization and measurement of mismatch in order to situate the measure of skill match-mismatch used in this study.

The conceptualisation of mismatch

76. Recent years have witnessed a growing literature based on the concept of ‘education mismatch’, ‘qualification mismatch’ or otherwise referred to as ‘undereducation’ and ‘overeducation’ (see e.g., Oosterbeek, 2000; Miller, 2007; Sloane, 2007; Dolton & Silles, 2008; Korpi & Tåhlin, 2009; van der Meer, 2009; Chevalier & Lindley, 2009). A closely related and often overlapping strand of studies focuses on alternative measures that are more closely tied to the concept of ‘skill mismatch’, namely ‘underskilling’ and ‘overskilling’, or alternatively ‘skill deficit’ and ‘skill surplus/skill underutilization’ (see e.g., Krahn & Lowe, 1998; OECD/Statistics Canada, 2005; Mavromaras, McGuinness & Wooden, 2007; Mavromaras, McGuinness & Fok, 2009a; 2009b; Mavromaras, McGuinness, O’Leary, Sloane & Wei, 2010; Ryan & Sinning, 2009; OECD/Statistics Canada, 2011). There are fewer studies using the latter concepts partly due to the lack of data and the difficulty in measuring skill mismatch, but the advantages are apparent and interest appears to be on the rise (e.g., CEDEFOP, 2010a).

77. Given that *education mismatch* and *skill mismatch* are closely related, the discussion draws from both strands of literature. As mentioned the two concepts are not identical, but the orientation, purpose and substance of the underlying debates are closely related. Nevertheless, the distinctions are important because how mismatch is conceptualized and measured can itself lead to major differences in exactly how the concerns are framed and investigated, including not least under which conditions and assumptions.

78. As an example, findings on *education mismatch* have in many studies been interpreted as evidence that there is over-investment in formal education/qualifications, and/or that the educational system is ineffective in providing the skills needed for the labour market. Such interpretations are debatable for many reasons:

- Firstly, they ignore the fact that education serves a broader purpose than just providing the skills needed on the labour market.
- Secondly, they assume that qualifications truly reflect the supply of skills as well as the demand for skills, ignoring the heterogeneity inherent in standardized classifications.
- Thirdly, they assume that a person’s skills are defined by his/her qualifications once and for all, ignoring the possibility for skill gain and skill loss over the lifespan, including the role of adult education/training and learning in the workplace.
- Fourthly, they presume that the structure of demand for skills is fixed or changes only very slowly.
- Lastly, they ignore the role of technological and organizational innovation, the structure of work settings, and workplace/organizational practices in helping to shape the skills needed and to make use of existing skills.

79. Recognizing these complexities requires a more accurate and up to date measure of mismatch, one that reflects the possibilities for skill gain and skill loss over the lifespan, and reflects differences in the quality of qualifications. Addressing mismatch also requires a careful consideration of the demand side, so as to understand better the variety of factors which may have a negative impact on the effectiveness of skill formation, and also skill use.

80. When examining mismatch the following considerations are important to note. The first is conceptual. Skills and qualifications are not the same thing, even if qualifications are supposed to signify skills. This is not only because of the variety and complexity of the processes involved in defining qualifications, but also because the process of skill formation and skill loss extend over the entire lifespan. Qualifications reflect only the situation at a given point in time, and other than for recent graduates, this is often in the very distant past. These distinctions are particularly important when considering appropriate strategies for dealing with skill shortages and/or skill mismatches.

81. The second regards measurement. How should actual and required qualifications or skills be measured when empirically assessing mismatch between workers and jobs? To what extent do typical indicators such as years of schooling, level of education, credentials or other measures actually reflect qualifications or skills, and what are appropriate measures of the use of those qualifications or skills? The extent to which the measures can be operationalized to do justice to the underlying concepts being measured is a major challenge and has been approached in a variety of ways.

The measurement of mismatch

Education mismatch

82. The definition and measurement of education and skill mismatch varies widely. As outlined by Verhaest and Omeij (2006 see also Groot & Maasen van den Brink, 2000), there are at least four major ways to approach the measurement of 'over- and under- education' or 'educational mismatch'. Quintini (2010) has further specified these approaches as either self reported, normative, or statistical approaches:

Self-reported

- Direct Self-Assessment (DSA): Respondents are asked to subjectively assess whether they feel over- or under- educated for their position or if it just right (e.g., Groeneveld, 1997).
- Indirect Self-Assessment (ISA): Respondents are asked to subjectively assess what they feel is the required educational level to do their job (e.g., Hartog & Oosterbeek, 1988; Frei & Sousa-Poza, 2011) or alternatively what they feel is the required educational level to obtain their job (e.g., Duncan & Hoffman, 1981; Sicherman, 1991; Sloane, Battu & Seaman, 1999), and then over- and under- education is assessed by the analyst by comparing this level with the actual educational level of the respondent.

Normative

- Job Analysis (JA): Analysts subjectively determine the required level of education on the basis of occupational descriptions such as those in the US Dictionary of Occupational Titles (DOT) (e.g., Rumberger, 1987; McGoldrick & Robst, 1996).

Statistical

- Realised Matches (RM): Analysts objectively determine the required level of education on the estimated distribution of educational attainment within each occupational group (e.g., Verdugo & Verdugo, 1989; Mendes de Oliveira, Santos & Kiker, 2000; Bauer, 2002).

83. Verhaest and Omeij (2006) provided an extended discussion of the pros and cons of each method. In brief, subjective reports by respondents are always vulnerable to measurement error which can vary from respondent to respondent. While RM is based on a statistical approach and is the most objective method it is also the most problematic as the required level of education is determined solely by the

characteristics of the employees in those jobs while the actual requirements of the job are ignored (i.e., there is an endogeneity problem).

84. Although Hartog (2000) concluded that JA is the preferred method, it is likely that a combination of the methods, depending on available data, is the best solution. While the JA method is normative and based on a qualitatively oriented subjective approach, it can be argued that the analyst has the advantage of devising a scheme based on all available information and thus to control for the subjectivity that is present in self reported measures. However, the ability of analysts to control subjectivity is arguable. Combining the JA approach with further information such as actual distributions of educational attainment (i.e., RM method) and subjective measures (i.e., DSA or ISA), if available should help to minimize measurement error. For example, Chevalier (2003) mixes the normative or JA approach with the self reported approach to obtain a more refined measure of overeducation.

85. Whatever the method, education mismatch is based on the use of qualification or attainment based measures in order to decipher and summarize both the skills individuals actually have and the skills required in jobs. But to what extent do qualifications do justice to actual skills held and required? As mentioned above, qualifications are not the same thing as actual skills.

Skill mismatch

86. To avoid the shortcomings of translating job requirements into qualifications, some researchers have devised a more direct approach by asking respondents directly about the extent of the use of their skills in their job. For example, in the Household Income and Labour Dynamics in Australia (HILDA) survey, there are self reported responses on a seven point scale to the statement “I use many of my skills and abilities in my current job”. Those who disagree are treated as overskilled and vice versa those who agree are treated as underskilled (see e.g., Halaby, 1994; Mavromaras, McGuinness & Wooden, 2007).

87. Alternatively, respondents can be asked about the extent of use of a series of specific skills (e.g., literacy, numeracy, problem solving, teamwork, etc...) in their job (see e.g., UK Skills Survey). This has the advantage of helping to assess the required level of the specific skills needed to carry out job tasks and bypasses the shortcomings of translating job requirements into qualifications. However, it may be narrower in the sense that not all specific skills are feasible to assess via survey instruments.

88. The method used for deriving mismatch in this study relies on this latter approach. The focus is on the usage of specific skills at work. The ALLS survey gathered information on select reading, writing and numeracy related activities at work. Based on these items, indices of reading, writing and numeracy engagement at work were created.

89. A unique advantage of the ALLS data is that they allow for detailed information on the skills required in jobs to be combined with directly observed measures of skills. Direct measures of skills also help to avoid the drawbacks of translating actual skills into qualifications. The disadvantage is that only two direct measures of skills are available from ALLS, namely literacy and numeracy.

90. Literacy and numeracy skills, as they are defined and measured in ALLS however (see OECD/Statistics Canada, 2005), make up an important part of foundation skills, which are becoming increasingly important in today’s knowledge based economy. Only literacy match-mismatch is considered in Chapters 6 and 7 since an analysis of numeracy mismatch leads to very similar results.

91. Literacy match and mismatch is determined on the basis of reported engagement in literacy related tasks at work and direct measures of the literacy skills of workers. The approach is adapted from a methodology devised by Krahn and Lowe (1998). Persons with reading engagement scores below the median were assigned to the “low to medium-low engagement” category (low-skill job), and those scoring

above were assigned to the “medium-high to high-engagement” category (high-skill job). Similarly, persons scoring at skills Levels 1 and 2 on the prose literacy scale were assigned to the “low-skills” category, and those scoring at Levels 3 and 4/5 were assigned to the “high-skills” category. The approach combines the observed skills and skill use variables to arrive at four match and mismatch categories as follows (the derivation of numeracy mismatch is analogous):

- Low-skill, low- to medium-low engagement → LOW-SKILL MATCH
- Medium to high-skill, medium-high to high- engagement → HIGH-SKILL MATCH
- Low-skill, medium-high to high- engagement → DEFICIT MISMATCH
- Medium to high-skill, low- to medium-low engagement → SURPLUS MISMATCH

92. Despite the strength of these data there are at least two caveats that are important to keep in mind which may contribute to an under or over estimate of the level of skill match-mismatch:

- First, it is not clear to what extent the literacy and numeracy behaviours that respondents were asked about in the Adult Literacy and Lifeskills Survey (ALLS) reflect the range of text-based tasks that are important for labour market success. However, evidence from the Essential Skills Research Project run by Human Resource Development Canada, which examined the reading requirements in a sample of entry-level jobs, suggests that the ALLS questions do capture some of the major dimensions of on-the-job reading.
- Second, the ALLS measures cover only the incidence and frequency of literacy and numeracy behaviours, and ignore the dimensions of criticality and complexity. The Human Resource Development Canada’s Essential Skills Research Project as well as some other research literature, suggests that frequent behaviours, such as reading reports, may have relatively little impact on job performance. Thus incidence and frequency alone may misrepresent the true importance of these behaviours.

93. It should be noted however, that analysis of these measures show systematic variation across industry, occupation, and education categories as one would expect from reasonably valid measures of literacy and numeracy behaviours.

5. An empirical overview of mismatch using ALLS data

The extent of literacy and numeracy mismatch

94. The extent of literacy and numeracy mismatch which is based on the described methodology is displayed in Tables 5.1 and 5.2 for countries that participated in the Adult Literacy and Lifeskills Survey (ALLS). Two sets of estimates for both literacy and numeracy mismatch are provided. One set is based on the assumption that the cut off between high and low skill use is at median. The other set is based on the assumption that the cut off is whether workers engaged on average in any literacy or numeracy activities at least once a week. Results based on these different assumptions are similar in the case of literacy mismatch because the median corresponds to engagement of about one activity at least once a week. Differences are larger in the case of numeracy mismatch because median engagement in numeracy related practices corresponds to engagement in about one activity at least once a month. Only the results based on the median are reported and used throughout the study. A number of important results are worth noting.

95. First, the proportion of literacy and numeracy matches is about 59-69% and 48-65%, respectively, depending on the country. This is not surprising, since one would expect that over time

workers with higher skills would find their way into jobs requiring more skills, whereas those with few skills would not move up the career ladder.

96. Second, literacy and numeracy mismatch is a widespread phenomenon with 31-41% and 35-52%, respectively, of workers having skills that do not match the requirements of their job, depending on the country. A certain level of mismatch is to be expected. However, what this level is (10%, for example) cannot be answered with certainty. High rates are likely to suggest a need for active policies that foster adjustments.

97. Third, literacy and numeracy skill deficits are apparent in every country, but the magnitude varies. Approximately 9-29% and 6-20%, respectively, of the workforce can fall into this category, depending on the country. High rates of skills deficits signal a need for an increased effort to train persons in those jobs.

98. Fourth, the reserve of skills, skill surplus or alternatively skill underutilization pertaining to literacy and numeracy skills also varies substantially by country, ranging from 12-32% and 17-46%, respectively. While a skills surplus is good for growing knowledge economies in the long run, a lack of skill use in the workplace may be problematic in the short run because it exposes workers to the risk of skill loss. High rates of skills surplus signal a need to encourage employers to adapt organizational and work practices which ensure that existing skills are used and not lost over time as a consequence of a lack of use.

Table 5.1. The distribution of observed literacy skills, literacy skill use and literacy mismatch, by country**A. Low and high literacy skill use cut-off based on median engagement (approximately at least once a week)**

	SUPPLY		DEMAND		MARKET OUTCOME					
	Characteristics of workers		Characteristics of jobs		LITERACY MATCH			LITERACY MISMATCH		
	Observed SKILLS (literacy)		SKILL USE (reading engagement)							
	Low- skill workers ¹	High-skill workers ²	Low-skill jobs ³	High-skill jobs ⁴	Total	Low-skill match	High-skill match	Total	DEFICIT mismatch	SURPLUS mismatch
	Per cent									
Bermuda	37	63	39	61	69	23	46	31	15	17
Canada	39	61	39	61	64	22	43	36	18	18
Hungary	49	51	73	27	59	41	19	41	9	32
Italy	76	24	67	33	68	55	12	32	20	12
Netherlands	39	61	39	61	67	23	44	33	17	17
New Zealand	41	59	35	65	64	20	43	36	21	15
Norway	29	71	36	64	63	14	49	37	15	22
Switzerland	49	51	32	68	59	20	39	41	29	13
United States	48	52	39	61	60	24	36	40	24	15
International	45	55	51	49	63	29	33	37	16	21

B. Low and high literacy skill use cut-off based on engagement at least once a week

	SUPPLY		DEMAND		MARKET OUTCOME					
	Characteristics of workers		Characteristics of jobs		LITERACY MATCH			LITERACY MISMATCH		
	Observed SKILLS (literacy)		SKILL USE (reading engagement)							
	Low- skill workers ¹	High-skill workers ²	Low-skill jobs ³	High-skill jobs ⁴	Total	Low-skill match	High-skill match	Total	DEFICIT mismatch	SURPLUS mismatch
	Per cent									
Bermuda	37	63	46	54	65	25	41	35	13	22
Canada	39	61	46	54	63	24	39	37	15	22
Hungary	49	51	77	23	58	42	16	42	7	35
Italy	76	24	73	27	70	60	11	30	16	14
Netherlands	39	61	45	55	66	25	41	34	14	20
New Zealand	41	59	41	59	62	22	40	38	19	19
Norway	29	71	43	57	60	16	44	40	13	27
Switzerland	49	51	40	60	59	24	35	41	25	16
United States	48	52	45	55	61	27	34	39	21	18
International	45	55	45	55	64	27	37	36	19	18

Notes: 1. Low-skill workers defined as workers who perform below Level 3 in the literacy skill domain.

2. Medium- to high- skill workers defined as workers who perform at Level 3 or higher in the literacy skill domain.

3. Low-skill job defined as jobs where reading engagement at work index is below the median (less than index value 13 out of 18) in A and less than once a week in B (less than index value 12 out of 18). The median corresponds roughly to engagement in some literacy practices at least once week.

4. High-skill job defined as jobs where reading engagement at work is above the median (greater than index value 12 out of 18) in A and at least once a week in B (greater than index value 11 out of 18).

Source: Adult Literacy and Lifeskills Survey, 2003-2007.

Table 5.2. The distribution of observed numeracy skills, numeracy skill use and numeracy mismatch, by country**A. Low and high numeracy skill use cut-off based on median engagement (approximately at least once a month)**

Country	SUPPLY		DEMAND		MARKET OUTCOME					
	Characteristics of workers		Characteristics of jobs		NUMERACY MATCH			NUMERACY MISMATCH		
	Observed SKILLS (literacy)		SKILL USE (reading engagement)							
	Low- skill workers ¹	High-skill workers ²	Low-skill jobs ³	High-skill jobs ⁴	Total	Low-skill match	High-skill match	Total	DEFICIT mismatch	SURPLUS mismatch
	Per cent									
Bermuda	53	47	61	39	57	35	21	43	18	25
Canada	47	53	61	39	55	31	23	45	15	30
Hungary	43	57	73	27	52	34	18	48	9	39
Italy	75	25	73	27	65	56	9	35	18	17
Netherlands	32	68	72	28	48	26	23	52	6	46
New Zealand	47	53	56	44	56	30	26	44	17	26
Norway	36	64	56	44	54	23	31	46	13	33
Switzerland	35	65	66	34	48	24	23	52	11	41
United States	54	46	59	41	55	34	22	45	20	25
International	47	53	39	61	56	20	35	44	26	18

B. Low and high literacy skill use cut-off based on engagement at least once a week

	SUPPLY		DEMAND		MARKET OUTCOME					
	Characteristics of workers		Characteristics of jobs		NUMERACY MATCH			NUMERACY MISMATCH		
	Observed SKILLS (literacy)		SKILL USE (reading engagement)							
	Low- skill workers ¹	High-skill workers ²	Low-skill jobs ³	High-skill jobs ⁴	Total	Low-skill match	High-skill match	Total	DEFICIT mismatch	SURPLUS mismatch
	Per cent									
Bermuda	53	47	36	64	57	23	34	43	30	13
Canada	46	54	33	67	55	17	38	45	29	16
Hungary	43	57	49	51	53	23	30	47	20	27
Italy	75	25	48	52	54	38	16	46	37	10
Netherlands	32	68	46	54	59	18	41	41	13	28
New Zealand	47	53	31	69	56	17	39	44	30	14
Norway	36	64	33	67	59	14	45	41	22	19
Switzerland	35	65	41	59	55	16	40	45	20	25
United States	54	46	31	69	51	18	33	49	35	13
International	47	53	64	36	54	33	22	46	14	31

Notes: 1. Low-skill workers defined as workers who perform below Level 3 in the numeracy skill domain.

2. Medium- to high- skill workers defined as workers who perform at Level 3 or higher in the numeracy skill domain.

3. Low-skill job defined as jobs where numeracy engagement at work index is below the median (less than index value 9 out of 18) in A and less than once a week in B (less than index value 12 out of 18). The median corresponds roughly to engagement in some numeracy practices at least once a month.

4. High-skill job defined as jobs where numeracy engagement at work is above the median (greater than index value 8 out of 18) in A and at least once a week in B (greater than index value 11 out of 18).

Source: Adult Literacy and Lifeskills Survey, 2003-2007.

A socio-demographic profile of literacy and numeracy mismatch

99. This section looks at the socio-demographic make-up of literacy and numeracy skill mismatch by considering the distributions by age, gender and immigration status.

Skill mismatch by age

100. Tables 5.3A and B present results showing the incidence of literacy and numeracy mismatches for three age cohorts ranging from 16-35, 36-50 and 51-65. In all countries literacy surpluses are highest among younger adults aged 16-35. In Hungary and Norway, the incidence of literacy surpluses is high with around 37-39% of younger adults with this profile. The estimate is also comparatively high in Bermuda, Canada, and the Netherlands, where there are about 26-30% of younger adults in this situation. With some exceptions, the pattern is similar for numeracy surpluses, although the incidence is lower.

101. Conversely, literacy skills deficits are found to be more common among older workers and less prevalent among younger adults. In Italy, the incidence of literacy deficits does not vary markedly by age. Switzerland features a relatively high incidence of literacy skills deficit among older age cohorts (33%). The overall pattern is similar for numeracy deficits, except in the United States, where younger adults are more likely than older adults to be in numeracy deficit situations.

102. The relatively higher overall incidence of literacy skills surplus among younger adults is perhaps not surprising since they are more likely to be employed in temporary or entry level jobs, in which skill demands are not necessarily commensurate with their area of study or level of literacy skills, consistent with career mobility and search theory. As younger adults gain experience, many are likely to move into jobs requiring higher levels of literacy skills. In other words, the degree of match should naturally increase with age as workers find their way into jobs that have a better fit with their level of skills.

103. It is not possible to discern whether mismatch persists as people gain labour market experience from the ALLS data. Still, notable levels of literacy skill surpluses are found among older age cohorts. This suggests there may be some persistence of mismatch over time. Only in Italy, the Netherlands and Switzerland is the incidence of literacy surplus among older cohorts less than 15%, but nevertheless it remains at least 12% in all countries.

Skill mismatch by gender

104. Gender differences in skill mismatch as revealed in Tables 5.4A and B are noteworthy. Literacy and numeracy skills surpluses tend to be biased in favour of women, in some cases by a wide margin, while literacy and numeracy skills deficits tend to be biased in favour of men. This means that there are generally more women than men in jobs that do not make full use of their literacy and numeracy skills. Conversely, there are more men than women in jobs that require a high level of engagement in literacy or numeracy relative practices, even if they have low levels of literacy and numeracy skills.

105. Women are traditionally disadvantaged, not least on labour markets, which may point to more systematic underutilization of their skills based on discrimination and other allocation mechanisms that are operating on the labour market.

Skill mismatch by immigration status

106. The difference between the proportion of immigrants and non-immigrants who are found to be in a literacy surplus situation on the labour market can be substantial. Tables 5.5A and B reveal that this is especially the case in Canada and the United States where there are, respectively, about 11% and 14%

more non-immigrants than immigrants in a literacy surplus situation. Other countries with less pronounced differences include Bermuda, Norway, the Netherlands, New Zealand and Switzerland. This is not surprising since many immigrants must adapt to and develop the local language which can be crucial for demonstrating literacy skills in the host country's language. Indeed, in countries with high immigration rates, like Canada, New Zealand, Switzerland and the United States, immigrants are found to be more likely to be in a literacy deficit situation than in a literacy surplus situation.

107. Differences in the incidence of numeracy surplus between immigrants and non-immigrants tend to be smaller. However, in Canada, the Netherlands, Norway, Switzerland and the United States, immigrants are more likely to be in numeracy deficit situations than non-immigrants. In Bermuda, Hungary and Italy the pattern is reversed. Overall, the differences are marginal and appear to be highly context specific, for example, with regard to national differences in the extent and source of immigration.

Table 5.3. The distribution of mismatch, by age groups, by country**A. Literacy mismatch by age**

		Low-skill match	High-skill match	Deficit mismatch	Surplus mismatch
Bermuda	16-35	19	41	12	28
	36-50	25	45	12	18
	51-65	36	32	15	17
Canada	16-35	22	36	12	30
	36-50	23	44	17	16
	51-65	30	37	17	17
Hungary	16-35	38	16	6	39
	36-50	45	15	7	33
	51-65	46	16	7	30
Italy	16-35	55	12	16	16
	36-50	61	11	15	12
	51-65	65	6	17	12
Netherlands	16-35	23	41	10	26
	36-50	22	44	16	18
	51-65	34	34	19	14
New Zealand	16-35	27	32	17	24
	36-50	17	47	20	16
	51-65	22	42	21	15
Norway	16-35	12	42	9	37
	36-50	14	49	15	22
	51-65	26	38	19	17
Switzerland	16-35	23	35	21	20
	36-50	21	41	23	15
	51-65	30	24	33	13
United States	16-35	31	28	18	22
	36-50	24	38	24	14
	51-65	24	37	23	15
International	16-35	28	32	13	27
	36-50	28	37	17	18
	51-65	35	30	19	17

B. Numeracy mismatch by age

		Low-skill match	High-skill match	Deficit mismatch	Surplus mismatch
Bermuda	16-35	17	38	29	16
	36-50	24	35	29	12
	51-65	35	21	33	11
Canada	16-35	14	41	26	18
	36-50	17	38	31	14
	51-65	23	31	33	14
Hungary	16-35	20	32	18	29
	36-50	24	29	21	26
	51-65	25	29	23	23
Italy	16-35	34	19	37	10
	36-50	40	14	35	11
	51-65	43	12	38	7
Netherlands	16-35	15	43	13	29
	36-50	18	42	12	28
	51-65	24	35	17	24
New Zealand	16-35	17	39	31	13
	36-50	16	40	29	15
	51-65	22	36	29	14
Norway	16-35	11	49	20	20
	36-50	13	47	22	18
	51-65	21	35	26	18
Switzerland	16-35	11	43	19	27
	36-50	15	42	18	26
	51-65	24	30	24	22
United States	16-35	18	31	37	14
	36-50	18	36	35	12
	51-65	20	33	33	13
International	16-35	17	37	26	20
	36-50	20	36	26	18
	51-65	26	29	28	16

Source: Adult Literacy and Lifeskills Survey, 2003-2008.

Table 5.4. The distribution of mismatch, by gender, by country**A. Literacy mismatch by age**

		Low-skill match	High-skill match	Deficit mismatch	Surplus mismatch
Bermuda	Men	26	41	15	18
	Women	24	40	10	26
Canada	Men	25	39	18	18
	Women	23	39	12	27
Hungary	Men	47	14	7	31
	Women	37	18	6	39
Italy	Men	60	11	17	12
	Women	58	11	15	16
Netherlands	Men	25	44	17	15
	Women	26	37	11	26
New Zealand	Men	23	40	21	16
	Women	22	39	17	22
Norway	Men	17	46	15	22
	Women	14	41	12	33
Switzerland	Men	20	42	29	10
	Women	29	27	20	24
United States	Men	27	35	24	14
	Women	27	32	19	22
International	Men	30	35	18	17
	Women	29	32	13	26

B. Numeracy mismatch

		Low-skill match	High-skill match	Deficit mismatch	Surplus mismatch
Bermuda	Men	17	39	33	11
	Women	30	28	27	15
Canada	Men	14	44	29	14
	Women	21	31	29	18
Hungary	Men	21	33	24	22
	Women	25	28	16	32
Italy	Men	36	18	38	9
	Women	42	12	35	11
Netherlands	Men	11	53	14	22
	Women	26	27	13	34
New Zealand	Men	12	46	31	11
	Women	23	31	29	17
Norway	Men	7	55	22	15
	Women	21	34	22	23
Switzerland	Men	9	49	22	20
	Women	24	28	17	31
United States	Men	12	39	36	12
	Women	24	27	35	14
International	Men	15	42	28	15
	Women	26	27	25	22

Source: Adult Literacy and Lifeskills Survey, 2003-2008.

Table 5.5. The distribution of mismatch, by immigration status, by country**A. Literacy mismatch**

		Low-skill match	High-skill match	Deficit mismatch	Surplus mismatch
Bermuda	Immigrant	18	55	10	18
	Non-immigrant	27	35	14	24
Canada	Immigrant	39	30	18	13
	Non-immigrant	20	41	14	24
Hungary	Immigrant	29	27	2	41
	Non-immigrant	43	16	7	35
Italy	Immigrant	51	13	17	19
	Non-immigrant	60	10	16	14
Netherlands	Immigrant	58	18	12	13
	Non-immigrant	23	42	14	21
New Zealand	Immigrant	24	37	23	16
	Non-immigrant	22	41	18	20
Norway	Immigrant	32	32	12	25
	Non-immigrant	15	45	13	27
Switzerland	Immigrant	35	23	29	12
	Non-immigrant	21	38	23	17
United States	Immigrant	49	21	23	6
	Non-immigrant	23	36	21	20
International	Immigrant	37	28	16	18
	Non-immigrant	28	34	16	22

B. Numeracy mismatch

		Low-skill match	High-skill match	Deficit mismatch	Surplus mismatch
Bermuda	Immigrant	18	44	23	15
	Non-immigrant	25	29	33	13
Canada	Immigrant	25	27	35	13
	Non-immigrant	15	41	27	17
Hungary	Immigrant	21	28	12	38
	Non-immigrant	23	31	20	26
Italy	Immigrant	35	36	21	9
	Non-immigrant	38	15	37	10
Netherlands	Immigrant	40	18	28	14
	Non-immigrant	17	42	12	28
New Zealand	Immigrant	19	35	30	15
	Non-immigrant	17	40	30	13
Norway	Immigrant	19	32	30	19
	Non-immigrant	13	46	22	19
Switzerland	Immigrant	25	27	26	21
	Non-immigrant	13	43	18	26
United States	Immigrant	25	19	42	13
	Non-immigrant	17	36	34	13
International	Immigrant	25	30	28	18
	Non-immigrant	20	36	26	18

Source: Adult Literacy and Lifeskills Survey, 2003-2008.

6. Earnings differentials and literacy mismatch

108. This chapter aims to estimate alternative earnings functions in order to compare the relative influence of labour supply and labour demand characteristics on labour market earnings. The focus is on labour supply and labour demand characteristics that relate to skills, in particular, direct measures of skills and skill use, as well as situations of skill match or mismatch between the observed skills of workers and the extent to which they report using those skills at work. In addressing these aims, data from the 2003 Adult Literacy and Life Skills Survey (ALLS) is used. The purpose is to understand better the earnings differentials of workers vis-a-vis their skill profiles, the extent to which they use their skills in their jobs, as well as in situations of skill match or mismatch.

109. The analysis seeks to extend standard applications of returns to schooling as reflected by the Mincerian approach with three specific additional features:

- a. Direct measures of foundations skills
- b. Direct measures of the requirements of those foundation skills
- c. A measure of skill mismatch based on these two direct measures.

110. The chapter is organized as follows. First, various theoretical perspectives on the earnings function are discussed. Second, a brief review of previous research on earnings differentials that make use of direct measures of skills is provided. Third, a set of empirical models based on alternate specifications of the earning function are presented. Fourth, empirical estimates are provided. Finally, there is a concluding discussion of the results, including in situations of deficit or surplus mismatch.

Discussion of theoretical perspectives on the earnings function

111. There are a range of theoretical approaches which provide an explanation of observed earnings differentials. Some of these closely relate to each other and can be used in combination to add explanatory value. The discussion in this section centres on three distinct approaches. The first emphasizes the supply side of the labour market in determining earnings, which is well grounded in the human capital approach. The second emphasizes the demand side of the labour market in determining earnings, which is grounded in a collection of theories pertaining to some form of labour market segmentation. These two distinct approaches are not necessarily mutually exclusive. Both mechanisms are likely to coexist and jointly operate to determine earnings. Further, one mechanism may dominate over the other in certain contexts, and vice-versa in other contexts. The third approach to earnings differentials emphasizes the interaction between the supply and demand side of the labour market, which is grounded in assignment theory and relates to skill mismatch.

The role of the supply side in determining earnings

112. Specifications of earnings functions have been dominated by a supply side view of the labour market, and particularly by the human capital approach. While this has been a very productive area of research, there are a number of limitations that are worth pointing out.

The neoclassical approach and human capital theory

113. The dominance of the supply side view of the labour market has its roots in the neoclassical economic framework. Namely, individuals who contribute more to the final value of production are assumed to earn more. Complementing this is the theory of human capital – also discussed more directly in relation mismatch in Chapter 3 – whose core premise suggests that the relative contribution of individuals

depends on the knowledge, skills and other attributes embodied within them (Blaug, 1976). On this basis, those with more human capital, holding all other variables constant, should be more productive, and hence earn more.

114. This approach however, makes a number of assumptions. Chief among them, it tends to assume that rates of return to human capital hold whatever an individual's job. The type of job is seen to have little relevance and is more or less ignored.

115. Empirical applications in line with this approach have flourished since the early 1960s, despite evidence that contradicts such assumptions. We know for example, that jobs and pay are not distributed strictly on the basis of worker qualifications and that there are numerous other factors at play. Rewards to individual characteristics, for example, are not observed to be equivalent in all jobs. Nevertheless, there is much evidence to suggest that the more skilled an individual, the more likely he/she is to be rewarded.

116. Key questions remain however, such as which skills and for what jobs do the returns accrue to. Skills are not homogeneous, nor are jobs. For example, some jobs require manual skills while others require cognitive skills. Most applications of human capital tend to ignore that there are different types of qualifications and skills that are needed to complete different tasks in different occupations. Skills tend to be conceptualized as a one big bundle that is linear in growth, and assumed to be a function of schooling. Most importantly, empirical applications tend to rely almost exclusively on years of schooling as an indicator of human capital because this is the data that is most widely available and cheapest to collect.

117. Without direct and more complex measures of human capital, empirical studies are constrained by the assumption that those with a specified level of schooling have similar knowledge, skills and other attributes. Evidence suggests otherwise. Qualifications do not accurately reflect foundation skills such as literacy and numeracy skills (OECD/Statistics Canada, 2005). People receive education of varying quality and they gain or even lose skills as they move beyond the age of having completed their schooling or qualifications.

118. In recent years, intense efforts have been made to provide direct measures of skills for both research and policy, precisely to address the shortcomings of qualification based proxies of skills. One such example includes the direct measures of foundation skills made available through the International Adult Literacy Survey (IALS) and its successor, the Adult Literacy and Lifeskills (ALL) survey, which is used in this study. Accounting for foundation skills offers a unique opportunity to enrich analyses and explore hypotheses concerning the relationship between skills and earnings in greater detail. Foundation skills are merely one aspect of human capital, but the manner in which they are defined makes them a good proxy of cognitive foundation skills.

119. The analysis in this study thus seeks to extend standard applications of returns to schooling as reflected by the Mincerian approach with direct measures of foundation skills. Using direct measures allows for specific skills to be separately valued from the many characteristics that education is supposed to indirectly measure. It also allows for an improved understanding of the correspondence between the inputs and outputs of the human capital formation process. If a particular skill is valued independently from schooling, then schooling may continue to proxy for other characteristics. Singling out specific skills and valuing them is a potentially useful exercise since it can help identify policies, which target certain skills for development and maintenance throughout working life.

The role of the demand side in determining earnings

120. Variables that account for the demand side of the labour market such as job, occupational or work characteristics have been almost entirely neglected in human capital specifications. An alternative

approach to specifying the earnings function is to place more emphasis on the demand side of the labour market. The main premise of this approach is that earnings are primarily driven by the type of job that individuals manage to obtain, and that individual characteristics play a lesser role than purported by human capital theory. At the extreme, this specification contends that earnings and marginal productivity reside in the job, not the individual (see Jaoul-Grammare, 2007; Sattinger, 1993; Cain, 1976; Thurow, 1975).

Labour market segmentation theories

121. The theory of labour market segmentation has traditionally differed from human capital theory in terms of its focus. As discussed in Chapter 3, but more directly as a potential cause of mismatch, this theory emphasizes the characteristics of jobs and job markets, rather than the characteristics of individuals. Conceived broadly, there is a collection of labour market segmentation theories (Cain, 1976). For example, job competition theory can be considered within this family as it also emphasises job characteristics. The latter suggests that marginal productivity and pay is attached to the job, and individuals compete to obtain the best jobs (Thurow, 1975). In this theory, individual characteristics are relevant to the extent that they help individuals compete for good jobs, but they do not necessarily affect productivity and hence pay, at least directly. Individual characteristics might affect productivity indirectly however, by helping individuals to learn how to do the job tasks more efficiently.

122. A common feature of all labour market segmentation theories is that rewards to individual characteristics are not equalized throughout the labour market. Namely, rewards depend on the segment of the labour market where one manages to obtain a job. Job, occupational or work characteristics thus become potentially important determinants of earnings.

The role of both the supply and demand sides in determining earnings

123. The third approach considered in this study considers the role of both the supply and demand sides of the labour market. A useful framework for considering this further is assignment theory.

Assignment theory

124. Assignment theory suggests that both individual and job characteristics are relevant for predicting earnings. As discussed in Chapter 3, but more directly as a potential cause of mismatch, this theory emphasizes that neither the individual's education or skill profile nor the requirements of the job alone are sufficient to determine earnings. Both should be considered jointly. The model acknowledges the difference between individual levels of characteristics and the levels of such characteristics required in the job.

125. This approach is advantageous for at least two reasons. First, it allows for the possibility to recognize that human capital is multi-faceted and that certain types of skills may be more relevant in some occupations than others. Many studies ignore this and by extension the different types of qualifications and skills that are needed to complete the tasks of those occupations. For example, years of schooling regardless of whether there are vocationally oriented or comprehensive, are often treated as equivalent in studies estimating the impact of schooling and/or skills on earnings. Second, it allows for the possibility to recognize that individual characteristics are rewarded differently in different jobs by relaxing the assumption of a single labour market. Whether an individual is employed on a factory-line or in a position with a lot of decision making responsibility makes a difference on how their skills are valued.

Skill match-mismatch

126. Considering both the supply and demand sides of the labour market allows for the possibility to acknowledge that not everyone are in jobs that suit their skills profile, and that this may have an impact on their earnings. Taking into account whether individuals are matched or mismatched with the requirements

of their job allows for the possibility to test whether it is the supply side or the demand side of the labour market that matters most in predicting earnings, and under what kinds of circumstances (e.g., low- vs high-skill jobs).

Previous research on earnings differentials that make use of direct measures of skills

127. Previous research suggests that foundation skills, as measured by the IALS and ALL, have an impact on labour market outcomes, including less unemployment, higher earnings and a greater probability of being in a high-skilled occupation, independent of educational attainment.

128. At least three major findings stand out from these and other empirical studies that have made use of direct measures of skill.

129. First, the importance of foundation skills such as literacy proficiency is substantive and may have increased over time. For example, Green and Riddell (2001), adjust for literacy proficiency and educational attainment simultaneously using a Mincerian type approach. They use the Canadian IALS data and find significant returns to literacy proficiency on the order of 3.0 to 3.5% for every 10-point increase in literacy on a scale of 0 to 500. In Murnane, Willet, Braatz and Duhaldeborde (2001), three types of skills were examined, namely academic skills, skills at completing elementary tasks quickly, and self-esteem, confirming the importance of basic skills in the US labour market. Riviera-Batiz (1992), using the Young Adult Literacy Survey (YALS) data, showed that quantitative literacy has an independent effect on earnings over and above the effect of initial education. Murnane, Willet and Levy (1995) found that the importance of basic skills increased between the 1970s and mid 1980s.

130. Second, controlling for literacy proficiency reduces the return to education (OECD and HRDC, 1997). Osberg (2000: 8) for example, reported results which indicated that 40-45% of the economic return to education is attributable to literacy proficiency. The measure of literacy proficiency in IALS and ALL has been closely linked to cognitive skills, which implies that the residual return attributed to education is predominantly due to the non-cognitive skills which education can be thought to be implicated in helping to form.

131. Third, returns to direct measures of skills can vary significantly between countries. For example, Devroye and Freeman (2001) concluded that in the United States people are sorted on the labour market by literacy proficiency more than any other country. Blau and Kahn (2001) confirmed this by suggesting that knowledge and skills play a significant role in explaining relatively high US wage inequalities. Leuven (2001) also found that the relation between schooling and cognitive scores is steeper in the United States than in other countries. In contrast, Tuijnman (2000) found that the Polish labour market pays for educational qualifications and for work experience but does not independently reward foundation skills like literacy proficiency.

Models to estimate differences in earnings associated with skill supply and skill demand characteristics

132. A series of five models are proposed for estimation in order to observe changes in the parameters of the characteristics associated with skill supply and skill demand.

Labour supply characteristics

133. The first two models to be estimated are limited to individual characteristics, or alternatively supply characteristics. In particular, the emphasis is on skill supply characteristics. The point of departure for these two models is grounded in an adaptation of the most widely used specification of an earnings function, namely, the Mincer equation:

$$\ln[Y_i] = \beta_0 + \beta_S S_i + \beta_X X_i + \varepsilon_i \quad (1)$$

134. Where,

Y_i earnings of individual i

S_i vector of skills of individual i

X_i vector of other individual characteristics of individual i

β_s vector of average growth rate of earnings for each skill in vector S

β_x vector of coefficients for each individual characteristic in vector X

ε_i residual, assumed distribution $\varepsilon_i \sim N(0, \sigma^2)$

135. Earnings, denoted by Y , are a function of skills, S , and other observable characteristics of the individual, X (e.g., gender, immigration status). The error term, ε , is assumed to be normally distributed with a mean of zero as follows: $E(\varepsilon|S,E,X)=0$.

136. A major implication of this model is that people with higher levels of skills earn more, independent of other individual characteristics which are observable. The vector of coefficients, β_s , consists of the ex post average growth rates of earnings associated with each additional skill. In this particular formulation, the growth rates are assumed to be constant for all levels of skills. A non-linear relationship between skills and earnings however, can easily be substituted into this formulation to allow for rates of growth to differ by level of skills.

137. Although the regression model in (1) is more general in its specification of the human capital that may affect earnings, it is based on two different frameworks developed by Mincer (1958, 1974). See Heckman, Lochner and Todd (2005) for an extended discussion of the underlying assumptions of these two approaches.

Model 0: labour supply characteristics

138. Most research based on the Mincer equation, including Mincer's own work, however, has focused on the average rate of return to additional schooling, rather than skills, and has incorporated another proxy for skills into the model, namely work experience. Schooling and work experience are meant to reflect the skills that individuals have accumulated over their lifespan, and in turn capture the extent to which accumulated skills may affect their earnings. While there are other factors implicated in the formation of skills, such as training, and there are different types of skills, such as cognitive and non-cognitive skills, using years of schooling and work experience as proxies for human capital is practical since these measures are readily available. Psacharopoulos (1981) and Psacharopoulos and Patrinos (2004) provided extensive surveys of research based on this original formulation.

139. Equation (2) helps to bridge the general formulation in (1) with widely available measures that proxy human capital. It models skills, S , using a measure of educational attainment (EDLEV) and a proxy for work experience (AGE – typically modelled in either quadratic or log form). Both of these are used to proxy unobservable skills.

$$S_i = \gamma_{ED} EDLEV_i + \gamma_{AGE} \ln(AGE_i) + v_i \quad (2)$$

140. The error term, v_i , represents the measurement error associated with unobserved skills, which may be correlated with earnings in (1), and may lead to bias in the parameters associated with schooling and experience. This is not considered further and represents a limitation to the current study. See Card

(1999) for a discussion of the potential effect of unobserved variables, self-selection, misspecification and the measurement error of observed variables on bias.

141. Limiting other individual characteristics to gender (MEN) and immigration status (NIMM), and substituting (2) into (1) yields the typical Mincer equation as follows, which is estimated as the base model.

$$\ln[Y_i] = \beta_0 + \beta_{S1}' EDLEV_i + \beta_{S2}' \ln(AGE_i) + \beta_{MEN} MEN_i + \beta_{NIMM} NIMM_i + \varepsilon_i' \quad (3)$$

Model 1: labour supply characteristics augmented with a direct measure of skills

142. If all the skills in vector S were observable and measurable, the corresponding regression coefficients could be interpreted as a vector of implicit prices, which estimates the approximate economic value associated with each skill. Not all skills are observed, however. To deal with this, Green and Riddell (2001) introduced two separate vectors, one for observed skills (S^o), and one for unobserved skills (S^u), as shown in equation (4).

$$S_i = (S_i^o S_i^u) = S_i^o + S_i^u \quad (4)$$

143. Further, Green and Riddell (2001) suggested that unobservable skills, S^u , can be proxied by a set of inputs, namely education attainment or years of schooling, experience and possibly others, as these are assumed to produce unobservable skills. Substituting (4) into (1) introduces equation (5), where $\varepsilon_i' = \beta_s v_i + \varepsilon_i$. The error term, v_i , is the measurement error associated with unobservable skills.

$$\ln[Y_i] = \beta_0 + \beta_s^o S_i^o + \beta_s^u S_i^u + \beta_X X_i + \varepsilon_i' \quad (5)$$

144. The Adult Literacy and Lifeskills survey data that are used in this study contain a direct measure of literacy skills (SKILL), which is taken as a measure of observable skills (S^o) as shown in (6). Separately, education level (EDLEV) and a proxy for work experience (AGE) are taken as a set of inputs that are assumed to produce other unobservable skills, S^u , as shown in (7). Finally, in (8), gender (MEN), and immigration status (NIMM), which are known to be significant predictors of individual earnings, are adjusted for in all models. By substituting (6-8) in (5), empirical model 1 is summarized in equation (9).

$$S_i^o = SKILL_i \quad (6)$$

$$S_i^u = EDLEV_i + \ln(AGE_i) + v_i \quad (7)$$

$$X_i = MEN_i + NIMM_i \quad (8)$$

145. Where,

SKILL	Literacy skills level: Level 4/5, Level 3, Level 2 and Level 1(reference)
EDLEV	Education level: More than upper secondary, upper secondary and less than upper secondary (reference)
AGE	Age: 16-35, 36-50 and 51-65 (reference)
MEN	Gender: Men and women (reference)
NIMM	Immigration status: Non-immigrant and immigrant (reference)

$$\ln[Y_i] = \beta_0 + \beta_1 SKILL_i + \beta_2 EDLEV_i + \beta_3 \ln(AGE_i) + \beta_4 MEN_i + \beta_5 NIMM_i + \varepsilon_i' \quad (9)$$

Labour demand characteristics

146. The next model to be estimated focuses on the demand side of the labour market. In particular, the emphasis is on skill demand characteristics. Whereas human capital theory predicts earnings only as a function of worker quality, the emphasis in this model is on skill requirements, R , and other job characteristics, J .

$$\ln[Y_i] = \beta_0 + \beta_R R_i + \beta_J J_i + \varepsilon_i \quad (10)$$

147. Where,

R_i vector of skills requirements at work for individual i

J_i vector of other job characteristics for individual i

β_R vector of average growth rate of earnings for each skill in vector R

B_J vector of coefficients for each individual characteristic in vector J

148. An implication of this model is that people who are in jobs that require higher levels of skills use earn more, independent of other job characteristics which are observable. The vector of coefficients, β_R , consists of the ex post average growth rates of earnings associated with higher levels of skills requirements.

Model 2: labour demand characteristics

149. By substituting (11-12) in (10), empirical model 2 is summarized in equation (13).

$$R_i = READ_i + WRITE_i + NUM_i \text{ (modelled as dummies)} \quad (11)$$

$$J_i = OCC_i + IND_i + FIRM_i \text{ (modelled as dummies)} \quad (12)$$

150. Where,

READ	Reading engagement at work: High intensity, medium high intensity, medium low intensity and low intensity (reference)
WRITE	Writing engagement at work: High intensity, medium intensity, low intensity (reference)
NUM	Numeracy engagement at work: High intensity, low intensity (reference)
OCC	Occupation type: Skilled, semi-skilled, unskilled (reference)
IND	Industry type: High-technology manufacturing; low-technology manufacturing; knowledge-intensive market services; public administration, defence, education & health; other community, social & personal services; utilities & construction; wholesale, retail, hotels & restaurants; transport and storage; primary industries (reference)
FIRM	Firm size: 500 or more employees, 200-499, 20-199, less than 20 (reference)

$$\ln(Y_i) = \beta_0 + [\beta_1 OCC_i + \beta_2 IND_i + \beta_3 FIRM_i] + [\beta_4 READ_i + \beta_5 WRITE_i + \beta_6 NUM_i] + \varepsilon_i \quad (13)$$

Labour supply and demand characteristics

151. The final two models incorporate aspects of both the supply and demand side of the labour the market. Model 4 is similar but it is augmented with a measure that gauges the fit between observed skills and skill use, namely a skill match-mismatch variable.

Model 3: labour supply and demand characteristics

152. Model 3 incorporates all supply and demand side characteristics that are considered in this chapter, as shown in Equation (14).

$$\ln[Y_i] = \beta_0 + \beta_s^o S_i^o + \beta_s^u S_i^u + \beta_X X_i + \beta_R R_i + \beta_J J_i + \varepsilon_i' \quad (14)$$

153. Substituting (6-8) and (11-12) into (14) yields empirical model 3 in (15) as follows:

$$\begin{aligned} \ln(Y_i) = & \beta_0 + [\beta_1 SKILL_i] + [\beta_2 EDLEV_i + \beta_3 \ln(AGE_i)] + [\beta_4 MEN_i + \beta_5 NIMM_i] \\ & + [\beta_6 OCC_i + \beta_7 IND_i + \beta_8 FIRM_i] + [\beta_9 READ_i + \beta_{10} WRITE_i + \beta_{11} NUM_i] + \varepsilon_i' \end{aligned} \quad (15)$$

Model 4: labour supply and demand characteristics augmented with a skill match/mismatch variable

154. Model 4 is augmented with an interactive measure that is based on observed skills and skill use, namely a skill match-mismatch variable, as shown in (16).

$$\ln[Y_i] = \beta_0 + \beta_s^u S_i^u + \beta_X X_i + \beta_J J_i + \beta_M M_i + \varepsilon_i' \quad (16)$$

155. Where,

M_i variable reflecting situation of skill match-mismatch for individual i (4 categories: high-skill match, low-skill match, surplus mismatch, deficit mismatch)

β_M vector of average growth rate of earnings for each match-mismatch situation

156. Substituting (6-8), (11-12), and (17) into (16) yields empirical model 4 in (18) as follows:

$$M_i = MATCH_i \quad (17)$$

157. Where,

$MATCH$ Skill mismatch: High-skill match, surplus mismatch, deficit mismatch and low-skill match (reference)

$$\begin{aligned} \ln(Y_i) = & \beta_0 + [\beta_1 EDLEV_i + \beta_2 \ln(AGE_i)] + [\beta_3 MEN_i + \beta_4 NIMM_i] \\ & + [\beta_5 OCC_i + \beta_6 IND_i + \beta_7 FIRM_i] + [\beta_8 MATCH_i] + \varepsilon_i' \end{aligned} \quad (18)$$

Table 6.1A. OLS regression weights showing the adjusted relationship between various labour demand/supply characteristics and the monthly log of earnings for adults aged 16-65

	Model 0		Model 1		Model 2		Model 3		Model 4	
Constant	6.52	(0.01) ***	6.46	(0.02) ***	6.95	(0.03) ***	6.44	(0.03) ***	6.48	(0.03) ***
Country (reference=Canada)										
Switzerland	0.17	(0.01) ***	0.18	(0.01) ***	0.04	(0.02) **	0.06	(0.02) ***	0.46	(0.01) ***
Italy	-0.06	(0.02) ***	-0.01	(0.02)	-0.01	(0.02)	0.01	(0.02)	-0.37	(0.02) ***
Norway	-0.11	(0.01) ***	-0.12	(0.01) ***	0.06	(0.02) ***	0.04	(0.01) **	2.05	(0.01) ***
Bermuda	0.54	(0.02) ***	0.54	(0.02) ***	0.60	(0.02) ***	0.57	(0.02) ***	0.37	(0.02) ***
United States	0.09	(0.02) ***	0.11	(0.02) ***	0.06	(0.02) ***	0.07	(0.02) ***	-0.12	(0.02) ***
New Zealand	-0.17	(0.01) ***	-0.16	(0.01) ***	-0.16	(0.01) ***	-0.16	(0.01) ***	0.06	(0.01) ***
Netherlands	-0.03	(0.01) **	-0.03	(0.01) **	-0.15	(0.02) ***	-0.12	(0.01) ***	-0.38	(0.01) ***
Hungary	-0.72	(0.02) ***	-0.70	(0.02) ***	-0.51	(0.02) ***	-0.53	(0.02) ***	4.02	(0.02) ***
Age (reference=16 to 35)										
36-50	0.44	(0.01) ***	0.45	(0.01) ***			0.36	(0.01) ***	0.36	(0.01) ***
51-65	0.46	(0.01) ***	0.48	(0.01) ***			0.40	(0.01) ***	0.40	(0.01) ***
Gender (reference=women)										
Men	0.45	(0.01) ***	0.46	(0.01) ***			0.36	(0.01) ***	0.37	(0.01) ***
Immigrant status (reference=immigrants)										
Non-immigrant	0.06	(0.01) ***	0.03	(0.01) **			0.01	(0.01)	0.01	(0.01)
Education (reference=less than upper secondary)										
Upper secondary	0.33	(0.01) ***	0.29	(0.01) ***			0.17	(0.01) ***	0.20	(0.01) ***
> Upper secondary	0.73	(0.01) ***	0.65	(0.01) ***			0.37	(0.01) ***	0.40	(0.01) ***
Functional literacy skill level (reference=Level 1)										
Level 2			0.06	(0.01) ***			-0.08	(0.01) ***		
Level 3			0.16	(0.01) ***			-0.05	(0.01) ***		
Level 4/5			0.23	(0.01) ***			-0.04	(0.02) **		
Occupational type (reference=unskilled)										
Skilled					0.46	(0.02) ***	0.36	(0.02) ***	0.44	(0.01) ***
Semi skilled					0.12	(0.02) ***	0.11	(0.01) ***	0.15	(0.01) ***
Industry type (reference = primary industries)										
High-technology manufacturing					0.01	(0.03)	-0.01	(0.03)	0.05	(0.02) **
Low-technology manufacturing					-0.06	(0.03) **	-0.05	(0.03) **	-0.01	(0.02)
Knowledge-intensive market services					-0.18	(0.03) ***	-0.11	(0.02) ***	-0.05	(0.02) **
Public administration, defense, education & health					-0.32	(0.03) ***	-0.25	(0.02) ***	-0.20	(0.02) ***
Other community, social & personal services					-0.43	(0.03) ***	-0.35	(0.03) ***	-0.31	(0.02) ***
Utilities & Construction					0.13	(0.03) ***	0.06	(0.03) **	0.10	(0.02) ***
Wholesale, retail, hotels & restaurants					-0.54	(0.03) ***	-0.41	(0.02) ***	-0.34	(0.02) ***
Transport and storage					0.03	(0.03)	-0.03	(0.03)	0.04	(0.03) *
Firm size (reference= < 20 employees)										
20-99 employees					0.15	(0.01) ***	0.15	(0.01) ***	0.14	(0.01) ***
100-499 employees					0.21	(0.01) ***	0.19	(0.01) ***	0.16	(0.01) ***
500-999 employees					0.23	(0.02) ***	0.21	(0.02) ***	0.16	(0.01) ***
>=1000 employees					0.29	(0.01) ***	0.26	(0.01) ***	0.21	(0.01) ***
Reading engagement at work (reference=low engagement)										
Medium low engagement					0.18	(0.01) ***	0.15	(0.01) ***		
Medium high engagement					0.31	(0.01) ***	0.24	(0.01) ***		
High engagement					0.47	(0.02) ***	0.33	(0.02) ***		
Writing engagement at work (reference=low engagement)										
Medium engagement					0.11	(0.01) ***	0.11	(0.01) ***		
High engagement					0.22	(0.01) ***	0.22	(0.01) ***		
Numeracy engagement at work (reference=low engagement)										
High engagement					0.11	(0.01) ***	0.09	(0.01) ***		
Skill match-mismatch (reference=low skill match)										
High skill match									0.31	(0.01) ***
Surplus mismatch									-0.04	(0.01) ***
Deficit mismatch									0.21	(0.01) ***
R-squared (adjusted)	0.29		0.30		0.34		0.44		0.42	

Source: Adult Literacy and Lifeskills Survey, 2003-2007.

Notes: *** p<.01; ** p<.05 ; * p<.1.

Table 6.1B. OLS regression weights showing the adjusted relationship between various labour demand/supply characteristics and the monthly log of earnings for adults aged 16 to 65, continuous years of schooling and observed literacy proficiency

	Model 0-b	Model 1-b	Model 3-b
Constant	5.42 (0.02) ***	5.05 (0.03) ***	5.66 (0.04) ***
Country (reference=Canada)			
Switzerland	0.08 (0.01) ***	0.10 (0.01) ***	0.01 (0.02)
Italy	-0.15 (0.02) ***	-0.08 (0.02) ***	-0.02 (0.02)
Norway	-0.11 (0.01) ***	-0.13 (0.01) ***	0.02 (0.01)
Bermuda	0.57 (0.02) ***	0.56 (0.02) ***	0.57 (0.02) ***
United States	0.07 (0.02) ***	0.09 (0.02) ***	0.07 (0.02) ***
New Zealand	-0.17 (0.01) ***	-0.16 (0.01) ***	-0.17 (0.01) ***
Netherlands	-0.16 (0.01) ***	-0.14 (0.01) ***	-0.18 (0.01) ***
Hungary	-0.76 (0.02) ***	-0.74 (0.02) ***	-0.56 (0.02) ***
Age			
Continuous age	0.02 (0.00) ***	0.02 (0.00) ***	0.02 (0.00) ***
Gender (reference=women)			
Men	0.44 (0.01) ***	0.46 (0.01) ***	0.35 (0.01) ***
Immigrant status (reference=immigrants)			
Non-immigrant	0.07 (0.01) ***	0.02 (0.01) *	0.00 (0.01)
Education			
Continuous years of schooling	0.07 (0.00) ***	0.06 (0.00) ***	0.03 (0.00) ***
Functional literacy skill level			
Continuous skill score		0.00 (0.00) ***	0.00 (0.00) ***
Continuous skill score X 10		0.02 (0.00) ***	0.00 (0.00) ***
Continuous skill score X 25		0.05 (0.00) ***	0.01 (0.00) ***
Occupational type (reference=unskilled)			
Skilled			0.35 (0.02) ***
Semi skilled			0.11 (0.01) ***
Industry type (reference = primary industries)			
High-technology manufacturing			-0.02 (0.03)
Low-technology manufacturing			-0.06 (0.03) **
Knowledge-intensive market services			-0.11 (0.02) ***
Public administration, defense, education & health			-0.26 (0.02) ***
Other community, social & personal services			-0.36 (0.03) ***
Utilities & Construction			0.07 (0.03) **
Wholesale, retail, hotels & restaurants			-0.40 (0.02) ***
Transport and storage			-0.04 (0.03)
Firm size (reference= < 20 employees)			
20-99 employees			0.15 (0.01) ***
100-499 employees			0.20 (0.01) ***
500-999 employees			0.22 (0.02) ***
>=1000 employees			0.27 (0.01) ***
Reading engagement at work (reference=low engagement)			
Medium low engagement			0.15 (0.01) ***
Medium high engagement			0.24 (0.01) ***
High engagement			0.32 (0.02) ***
Writing engagement at work (reference=low engagement)			
Medium engagement			0.09 (0.01) ***
High engagement			0.20 (0.01) ***
Numeracy engagement at work (reference=low engagement)			
High engagement			0.10 (0.01) ***

Source: Adult Literacy and Lifeskills Survey, 2003-2007.

Notes: *** p<.01; ** p<.05 ;* p<.1.

Estimation results

158. Estimation results for the five models are reported in Tables 6.1A and B. The results confirm that job characteristics including skill requirements are at least as important as individual characteristics in predicting earnings. Earnings are found to be significantly related to labour supply characteristics (gender, age, level of education, literacy skill level) as well as labour demand characteristics (firm size and level of engagement in reading, writing and numeracy practices at work). Detailed results for each model are discussed below.

Model 0: labour supply characteristics

159. Consistent with previous research based on the Mincerian approach, the average growth in monthly earnings associated with an additional year of schooling is approximately 7% (see Table 6.1B). Looking at the non-linear results associated with education levels in Table 6.1A, it can be seen that workers who have completed upper secondary receive on average about 33% more in monthly earnings when compared to those who have not completed upper secondary. Workers who have attained a qualification higher than upper secondary receive on average about 74% more in monthly earnings than those who not completed upper secondary.

Model 1: labour supply characteristics augmented with a direct measure of skills

160. Augmenting the model with a direct measure of foundation skills, namely literacy proficiency, reduces the strength of years of schooling as a predictor of earnings. The average growth in earnings per additional year of schooling is about 18% less when literacy proficiency is accounted for in the model (see Table 6.1A).

161. Independent of their level of schooling, workers who score 10 points higher on the literacy proficiency scale which ranges from 0 to 500 points, receive on average about 2% more in monthly earnings (see Table 6.1B). Non-linear results associated with skill levels (see Table 6.1A) show that workers who score at Level 4/5, the highest level of literacy on the proficiency scale, receive on average about 23% more in monthly earnings than those who score at the lowest level of literacy proficiency.

Model 2: labour demand characteristics

162. Job characteristics alone are found to predict earnings significantly, explaining about 34% of the total variance in earnings. This is in contrast to about 30% of the variance that is explained when only labour supply characteristics are accounted for in the model.

163. Working in a skilled occupation is associated with a substantive earnings premium of about 46%. Similarly, working in a very large firm, one with over 1000 employees is associated with a substantial earnings premium of about 29%, independent of whether the job is skilled work or not. Interestingly, job requirements that are linked to the processing of texts are highly rewarded, with premiums ranging from 18% for medium low engagement to 47% for high engagement. This is the case even after controlling for the type of occupation.

Model 3: labour supply and demand characteristics

164. Adjusting for both individual and job characteristics accounts for over 44% of the total variance in earnings. This is a substantial boost compared to when labour supply or demand characteristics are considered in isolation.

165. Accounting for labour demand characteristics substantially reduces the increase in average monthly earnings which were associated with additional education in the preceding models, even if premiums remain significant for higher levels of education. Workers with upper secondary and higher than upper secondary receive on average about 17% and 37% respectively, more in monthly earnings.

166. Likewise, the earnings increase associated with additional literacy proficiency is eliminated. In fact, the differences become slightly negative (see Table 6.1A). This suggests that premiums associated with literacy proficiency depend on the nature of the job, i.e., they are present only if those skills are required by the job. There are many workers who have a high level of literacy proficiency but do not necessarily work in jobs that require literacy skills to a great extent. Thus, after adjusting for the requirement to read at work, the premium associated with literacy proficiency is eliminated.

Model 4: labour supply and demand characteristics augmented with a skill match/mismatch variable

167. Results in model 4 confirm the findings from Model 3 that adults with higher levels of literacy proficiency do not necessarily earn more on average. When skill match-mismatch is taken into account, workers who are in a skills surplus situation are found to experience a small earnings penalty. That is, even though they are observed to have high levels of literacy proficiency, they earn slightly less than workers with low proficiency. This is because those skills are not required at their job. This is analogous to the earnings penalty associated with overeducation, which is widely found in the research literature.

Discussion and implications

168. Findings related to the relationship between earnings and various labour supply and demand characteristics are grouped and discussed in turn with a focus on: skill supply characteristics; skill demand characteristics; and skill match-mismatch.

The earnings increase associated with skill supply characteristics

169. The results provide support for the human capital specification. Namely, individuals with higher levels of education are found to receive more in monthly earnings on average whatever the specification estimated in this study. Separating the skill supply into an observable and unobservable component however, reveals at least two findings about the relationship between skill supply characteristics and earnings that are worth pointing out.

170. First, the results reveal the importance that the labour market places on foundation skills like literacy by valuing them independently from educational attainment. While education is an important determinant of literacy proficiency, the two are not perfectly correlated – something that labour markets seem to recognize. This is perhaps not surprising since educational attainment measures do not reflect quality differences in the education received by labour market participants, nor do they reflect skill gain or skill loss that may occur after the point at which qualifications were gained. For example, some adults who have low levels of education but have high proficiency in literacy are rewarded accordingly. Conversely, many adults who have higher levels of education but have low proficiency are penalized on the labour market.

171. Second, accounting for proficiency in foundation skills, which are closely related to cognitive skills, reduces the growth rate in earnings associated with additional education by nearly 20%. This is less than that found in previous research. The Canadian and American labour markets have been found in previous research to reward literacy proficiency more highly. For example, Osberg (2001) found that in Canada, literacy proficiency reduced the earnings associated with additional education, by nearly 40-45%. The results in this study however, are based on a pooled dataset including nine countries.

172. Singling out specific skills and valuing them is a potentially useful exercise. Firstly, it recognizes that there are a variety of skills, some of which may be more relevant in certain types of jobs. Secondly, it can help to identify skills that are highly valued, and help to identify policies, which can target certain skills for development and maintenance throughout working life.

The earnings increase associated with skill demand and skill supply characteristics

173. Including all the supply and demand characteristics considered in this study in an earnings function reveals a number of important findings.

174. First, labour demand characteristics are more important than labour supply characteristics in explaining earnings differentials. In fact, the labour demand characteristics considered in this study explain more of the total variance in earnings than the labour supply characteristics considered (36% vs 29%). Accounting for both labour demand and labour supply characteristics explains about 46% of the total variance in earnings.

175. Second, the results provide support for the superiority of earnings specifications which emphasize both the supply and demand sides of the market, or alternatively assignment theory, as has been found in previous research (e.g., see Hartog, 1985; 1986a; 1986b; Sattinger, 1993).

176. Third, when measures of skill supply (i.e., education attainment and literacy proficiency measures) are accounted for in combination with measures of skill demand (i.e., reading, writing and numeracy engagement), the extent of reading engagement at work comes out as one of the strongest determinants of earnings.

177. Fourth, the *broad* measure of skill supply, namely education attainment, remains significant in the fully adjusted model, but its magnitude is reduced by about 50% compared to the base model. This implies that for a given level of education, earnings are significantly related to the type of tasks individuals are required to perform in their job – in particular the extent of engagement in text-based tasks (such as those involving reading, writing and numeracy) that the job entails. Conversely, for a given level of engagement in text-based tasks, those with more education continue to earn more on average. This makes sense since education provides other skills which may be required at work but are not accounted for in the model.

178. Fifth, the *specific* measure of skill supply, namely literacy proficiency, has an insignificant effect in the fully adjusted model. In fact, the relationship becomes significantly negative, albeit very small in magnitude. This suggests that the requirement to read or write at work is much more important in predicting earnings than actually having the skills to carry out these tasks. It suggests that while some workers have high levels of literacy proficiency, they do not necessarily get rewarded for this, precisely because they do not engage in tasks that require those skills. Conversely, it suggests that some workers receive a higher pay, even if they do not have a level of literacy proficiency that is commensurate with the skill requirements of their job.

179. Together, the findings suggest that on average, the characteristics of the job are more important than the characteristics of the individual in determining earnings – a finding that goes against the theory of human capital. The main implication of this is the need to consider more carefully the joint contribution of individual and job characteristics to marginal productivity. This finding also points to the relevance of considering whether low- and high-skill workers are either matched or mismatched in either low- or high-skill jobs when attempting to explain earnings differentials.

The earnings increase associated with skill match-mismatch situations

180. The results suggest that skill supply characteristics are important determinants of earnings, but not independent of skill demand characteristics. In other words, skills matter for earnings but only if they are required by the job. While this makes sense intuitively, a lot of the research on earnings functions has nevertheless been dominated by a supply side view of the labour market, namely the human capital approach, which has tended to underplay the role of the demand side of the labour market. By extension, this is also true of the discussion on education and training policy.

181. These findings are important because many workers are not in jobs that best suit their skills profile. The incidence of skill mismatch is not trivial. A number of findings are worth pointing out from the final earnings specification (i.e., Model 4) that considered whether workers are in situations of skill match or mismatch.

182. First, having a *high* level of literacy proficiency and working in a job that *requires* a high level of engagement in reading emerges as one of the strongest predictors of earnings differentials. Workers who are in this high-skill match situation receive on average about 31% more in monthly earnings than workers who are in a low-skill match situation. Results for the high- and low- skill match situations fit with the intuitive scenario mentioned earlier.

183. Second, having a *high* level of literacy proficiency and working in a job that *does not require* a high level of engagement in reading is associated with a small wage penalty. This is in comparison to those working in a job with similar low-skill requirements but only have a low level of literacy proficiency. The wage penalty for workers who are in this surplus mismatch situation is small (4% on average) but nevertheless statistically significant. The reasons for the wage penalty are less intuitive. Indeed, it suggests that skills alone are not enough – people need to be in jobs that require their skills in order to be rewarded for their skills, but why they earn less than the less skilled for the same job is less obvious. The penalty might reflect a number of unobserved reasons. For example, these workers may have high levels of foundation skills but otherwise have lower capabilities. Alternatively, they may have less tenure and be prone to changing jobs more often.

184. Lastly, having a *low* level of literacy proficiency and working in a job that *does require* a high level of engagement in reading is associated with a substantial pay premium. Workers who are in this skill deficit mismatch situation receive on average about 21% more in monthly earnings than those who also have a low level of literacy proficiency but who engage very little in literacy related activities at work. This finding is counterintuitive from the human capital perspective. It confirms the idea that the type of job and job tasks one performs is an important determinant of earnings regardless of one's human capital. It also lends support to the idea that for some workers in certain jobs, their pay is attached more to the marginal productivity of their job, not necessarily the marginal productivity that the individual brings to that job. In some cases, this may happen at the extreme such as that predicted by job competition or labour segmentation theory where only the marginal productivity of the job is said to matter. The more likely scenario however, is an interaction between the worker and the job they are performing as in assignment theory, where a particular job may be linked to a range of marginal productivity and hence pay, but individuals can still make a difference – namely the more highly skilled operate in the upper range of marginal productivity as reflected in the higher average pay found for those in high-skill match situations.

7. Adult education/training and literacy mismatch

185. This chapter aims to examine how both labour supply and demand characteristics may influence participation in adult education/training. Particular emphasis is placed on skill use at work as well as situations of skill match or mismatch between the observed skills of workers and the extent to which they report using those skills at work. As in previous chapters, the analysis is based on the data from ALLS. The purpose is to understand better the relationship between participation in adult education/training and workers' skills profiles, the extent to which those skills are used in their jobs, as well as in different situations of skill match or mismatch.

186. The theoretical discussion is generalized to apply to all types of adult education/training, but the empirical analysis and discussion focuses primarily on employer supported adult education/training. This is partly for the sake of parsimony but also because employers are the single most important source of financing of adult education/training (see for e.g., OECD/Statistics Canada, 2005), and therefore, have a major impact in determining who receives adult education/training and who does not. Participation in adult education/training however, is not solely dependent on employer support, nor is it solely the decision of employers, making it difficult to maintain a neat distinction between the multiple and often overlapping factors that affect participation. In the case of employer supported adult education/training, it is a joint decision, and it is argued in this chapter that this decision depends on both labour supply and demand characteristics. The analysis however, can easily be extended to understand better how both labour supply and demand characteristics may be related to adult education/training which is instead supported by governments or solely by the individual. Thus some empirical results are presented by source of financing to allow for an overview but the focus remains primarily on employer supported adult education/training.

187. The chapter is organized as follows. First, a variety of theoretical perspectives are brought together to consider how both individual and structural characteristics come together to influence participation in adult education/training. An emphasis is placed on the skill dimensions of both labour supply and demand. Second, a set of empirical models are introduced to explore the correlates of employer supported adult education/training. Third, empirical estimates are presented. Finally, there is a concluding discussion linking the results to potential strategies for addressing skill mismatch, including in situations of deficit or surplus mismatch.

Theoretical perspectives: the role of observed skills, skill use and skill mismatch in participation

188. Interpreting patterns of participation in the context of skills, skill use at work and skill mismatch requires careful consideration of the potential role of diverse factors including both individual and structural characteristics. The discussion in this section draws on elements from three bodies of literature, namely from economics of education, sociology of education, and adult education, which provide insights into how labour supply and demand characteristics may come together to influence participation in adult education/training.

Economics of education perspective: participation depends on cost/benefit ratios for participant and sponsors

189. From an economics perspective, human capital theory is the dominant framework for studying behavioural aspects of investing in education and training (Becker, 1964; Woodhall, 2001; Riddell, 2004; also see discussion of this theory in relation to mismatch in Chapter 3). The starting point is that individuals make a decision to invest based on an evaluation of the costs and benefits (Becker, 1964). The prediction of this theory is that the likelihood of participating increases as a function of the cost/benefit ratio (US Department of Education, 1998, p. 13).

190. Employers' incentives to invest in the adult education/training of their employees depend on expected benefits such as increased productivity, quality, and competitiveness of the firm, and not least as in the case of individuals, the cost/benefit ratio (Becker, 1964; Hum & Simpson, 2004; Vignoles, Galindo-Rueda & Feinstein, 2004). Following Becker's distinction between "general" and "specific" skills (Becker, 1964), it is expected that employers are only willing to support training that develops specific skills. This is because employers face too high risks of not being able to recuperate costs associated with investing in general skills, since employees may be able to use their general skills in other jobs.

191. Contrary to Becker's theory however, there is much evidence to suggest that firms invest in the development of general skills (see review by Eide & Showalter, 2010). However, this seems to apply under certain circumstances that vary depending on individual and/or structural characteristics. Evidence suggests, for example, that employers channel support to workers who are most likely to gain from adult education/training (Vignoles et al., 2004), which helps to optimize the cost/benefit ratio, shorten the payback period and thus minimize the risk of losing their investment to other employers. Multi-stakeholder models that help to pool risks and funds, such as tripartite arrangements between employers, the state, and unions in the Nordic countries, also seem to encourage adult education/training that fosters the formation of both general as well as specific skills (Eide & Showalter, 2010).

Sociology of education perspective: participation depends on structural factors at macro and micro levels

192. Despite Becker's work and that of others in the economics of training on integrating the employer perspective, applications of human capital theory have in general been criticized for not going far enough in terms of acknowledging the role of social structures and thus for being too individualistic in their approach. Blaug (1976) discussed the amenability of human capital theory to "methodological individualism" and the underlying role of personal agency in decision making.

193. Sociologists in particular have pointed out that structural elements associated with inequalities of income and education have tended to be reduced to individual psychological deficits in applications of human capital theory, rather than treated as outcomes of inequalities in power, wealth, and influence (Torres, 1996). Accordingly, sociologists have tended to emphasize that the decision to invest in human capital is also shaped by the role of social and economic institutions (government policy, organizations, industries, markets, and social classes) at the macro level, and the structure of work settings at the micro level (Brown, Green & Lauder, 2001).

Adult education perspective: participation depends on individual and structural factors

194. Building on sociological understandings, recent adult education research has attempted to integrate and elaborate the role of structural dimensions in shaping participation patterns (Rubenson & Desjardins, 2009; Ure & Saar, 2008). This should be seen as a response to the shortcoming of much adult education research on participation that otherwise has had a tendency to focus almost exclusively on the individual decision to participate, while ignoring the potential role of employers, and wider structures at both the micro and macro levels.

195. The dominance of a psychological orientation is evident in Cross's (1981) *chain of response-model* that has come to dominate much adult education research on participation. This model takes the individual as the starting point and employs psychological concepts to explain why some adults participate while others do not. Cross (1981) argues that this does not mean that societal aspects are ignored. At the same time, her approach does not elaborate on the relationship between participation and broader structural characteristics embedded in economic, social, cultural and not least public policy contexts. The importance of addressing these latter aspects is supported by findings on cross national patterns of participation (see Desjardins, Rubenson & Milana, 2006; Illeris, 2004a; Statistics Finland, 2000). Evidence suggests that

participation is best understood in terms of societal processes and structures as well as their interaction with individual consciousness and activity (Rubenson & Xu, 1997; Rubenson & Desjardins, 2009).

Synthesizing the perspectives: a model for understanding the role of skills, skill use and skill mismatch in participation

196. In summary, existing theoretical and applied work by economists, sociologists and recent research in adult education suggest that both individual and structural characteristics of work, the economy and society come together to influence participation in adult education/training. The following elaborates on an analytical model that draws in both individual and structural aspects which are explicitly linked to skills and skill use, and may affect participation. The purpose is to form a heuristic device that makes explicit the theoretical foundations underlying the empirical models of the correlates of participation which are estimated in this study.

The interplay between individual and structural characteristics in influencing participation

197. The structure of work settings as well as broader structural characteristics of the economy and society may facilitate or constrain opportunities to participate in adult education/training (Brown, Green & Lauder, 2001; Illeris, 2004b; Sawchuk, 2006). Thus the decision to participate lies not only in personal resources but also in workers' access to, and their positions in, those structures. Further, the two are inherently linked because individuals' access to, and position in, those structures is a function of their personal profile.

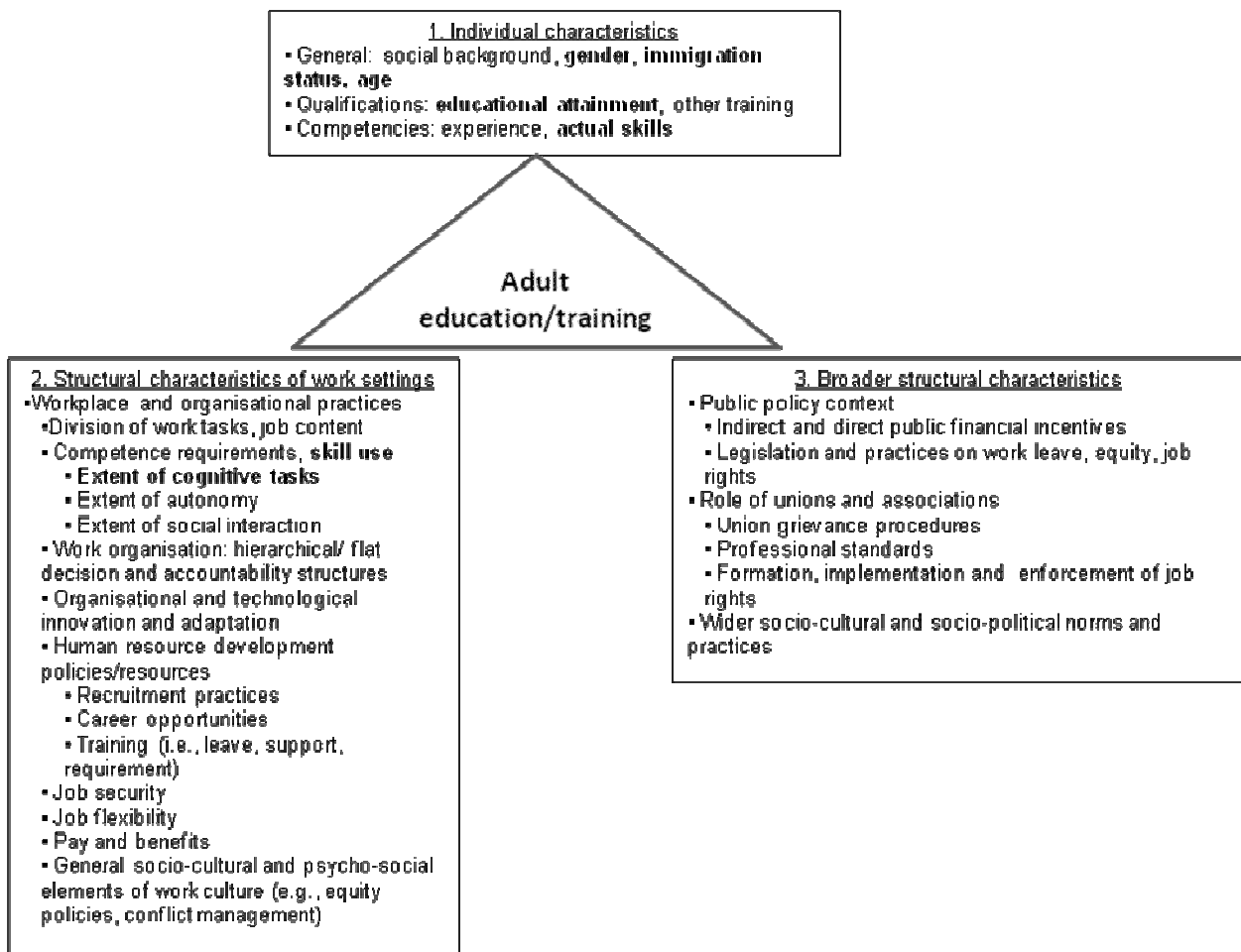
198. Helms-Jørgensen and Warring (2003) provided a fruitful analytical framework for considering how structural characteristics such as societal and institutional structures come together with individual consciousness and activity to shape learning in the workplace. In their model, learning in the workplace is conditioned by three elements: characteristics of employees (experience, education, training, and social background), characteristics of the technical-organizational learning environment (division of work and work content, autonomy and application of qualifications, possibilities of social interaction, strain and stress), and the social-cultural learning environment (communities or work, cultural communities, political communities). Based on an adaptation of their work, Figure 7.1 highlights the interplay between individual characteristics and different levels of structural characteristics, namely those of work settings and the broader social, political and cultural environment, which can all influence the distribution of participation adult education/training.

199. The structural characteristics of work settings which influence participation are a function of a variety of organizational and workplace practices as listed in box 2 in Figure 7.1. The organizational forms and their actions which are embedded in work settings emerge and persist through conscious rational-choice designs. Among others, these choices are driven by the pursuit of objectives, negotiated stakeholder models, compliance with legislation, and responses to structural incentives. But these are also conditioned by broader structural characteristics such as cognitive, cultural and political conventions which are inherent to prevailing social thoughts and actions. In summary, a variety of forces – including technological demands, professional association standards, union grievance procedures, legislation and judicial mandates for equal employment opportunities – converge to form, transform or reform work settings, and in turn, influence participation.

200. Another relevant strand of research is that of the so called “Institutionalists”. These scholars argue that a number of the above mentioned forces are converging to transform the workplace into a legalized institution in which employees increasingly expect a sense of participatory citizenship in their work roles (Kalleberg, Knoke, Marsden & Spaeth, 1996). “Organizational citizenship” is a concept coined

to understand better the emergence of norms and expectations about employee job rights and benefits, including access to, and support for, participation in adult education/training (Kalleberg *et al.*, 1996).

Figure 7.1. Individual and structural characteristics which are relevant for participation in adult education/training



A conceptual model of the determinants of participation emphasizing the role of workers' skills and the use of those skills at work

201. This section draws emphasis to the role of skills and skill use in accounting for who participates in employer supported adult education/training and under which circumstances. The model depicted in Figure 7.2A illustrates the interplay between individual characteristics, job characteristics, organizational characteristics, and broader structural characteristics at the macro level, such as the socio-political situation, and how these jointly influence the chances of participating in adult education/training. The conceptual model is used as a guide to *empirically* explore the relationship of individual characteristics and participation on the one hand, and job characteristics and participation on the other (see Figure 7.2B). Also considered is the extent to which being in a skill match or mismatch situation may play a role.

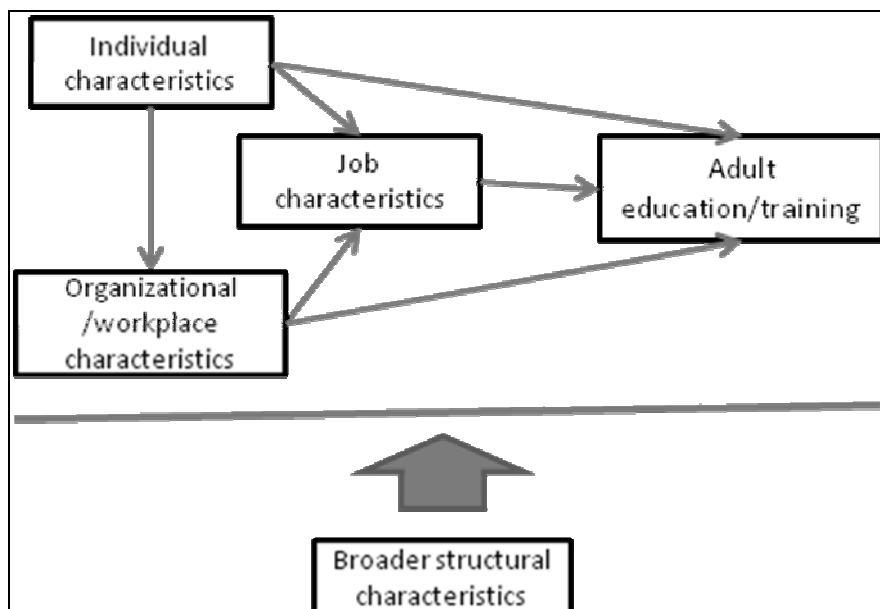
202. The logic of the model presented in Figure 7.2A is as follows: individuals entering a workplace have certain personal characteristics— such as personality traits, family background, acquired educational qualifications – which not only influence the kind of organisations that hire them, but also determine the types of job they are qualified for. The characteristics of the employing organisation such as firm size, the degree of technology application, labour relations, the composition of workforce, and internal labour market, influence the types of jobs available at the workplace and interact with individual characteristics to influence each worker’s job characteristics, such as literacy and cognitive related demands at work, the degree of autonomy and teamwork, and level of responsibility.

203. In turn, these factors influence the likelihood of accessing further learning opportunities. Individual characteristics, particularly educational attainment, directly and indirectly influence a person’s readiness to invest in adult education/training as well as his/her chances of receiving support from his/her employer. Organizational and workplace characteristics, directly and indirectly, as well as through an interaction with job characteristics, influence the chances of receiving adult education/training. Job characteristics also have a direct influence on the likelihood of receiving employer-supported adult education/training. These factors are all subject to influences from broader structural characteristics such as: prevailing ideologies; political, social and economic objectives of a nation; social structures; government interventions and contemporary political and economic situations.

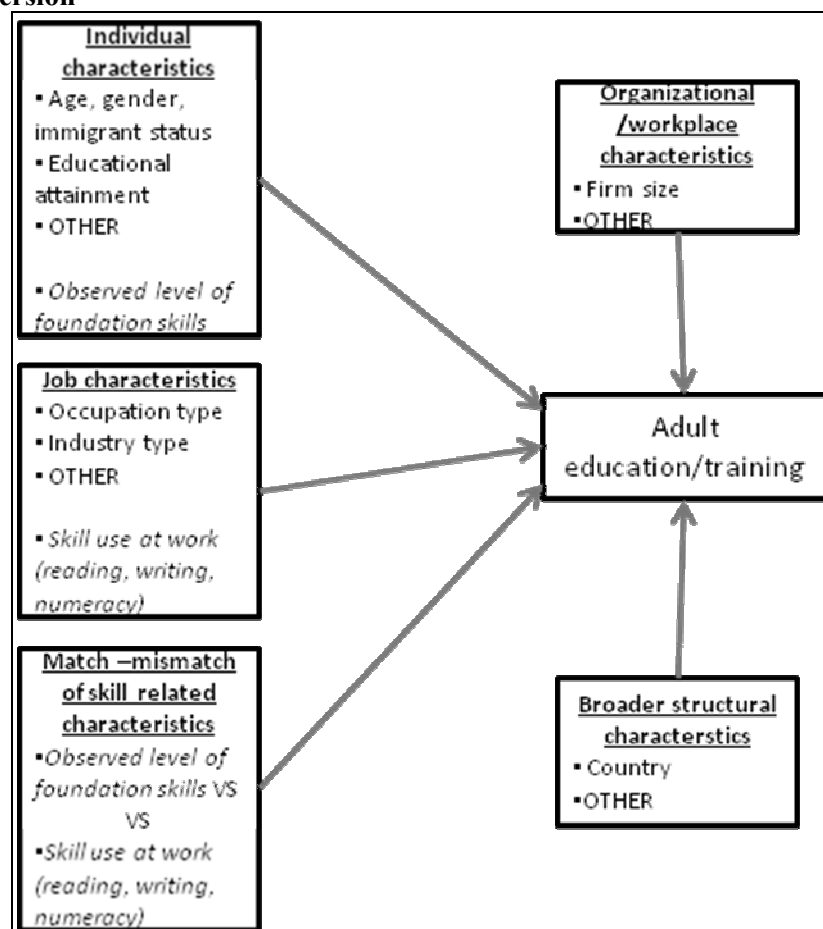
204. The operational version of the model in Figure 7.2B is simplified into a single equation. This enables a simple and focused comparison of the relative influence of each of the various individual (age, gender, immigration status, educational attainment, literacy skills) and job characteristics (occupation and industry type, skill use at work) as well as organizational/work-place (firm size) and broad structural characteristics (country).

Figure 7.2. Determinants model of participation in adult education/training

A. Conceptual version



B. Operational version



Participation rates by literacy mismatch and source of financing

205. This section provides an overview on the extent of participation of workers in each of literacy match-mismatch situations introduced in Chapter 4. Recent work suggests that literacy mismatch is an important correlate of participation in adult education/training and that this varies by source of financing (Rubenson, Desjardins & Yoon, 2008). It is thus interesting to contrast the relationship between mismatch and participation to other sources of financing, even if the focus in this chapter is on employer supported adult education/training. This is because employees who do not receive employer support may nevertheless choose to participate and this is related to whether they are in a match or mismatch situation at work.

206. Figure 7.3 shows how participation with different sources of financing vary with whether workers are in a literacy match or mismatch situation (see Table 7.1 for results by countries that participated in the study). The patterns are more or less consistent across countries. Four findings stand out as follows.

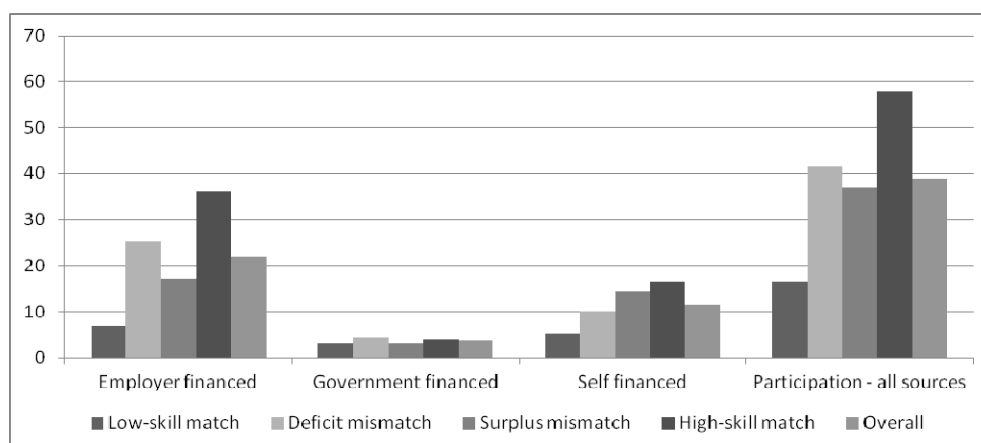
207. First, workers in high-skill matches tend to participate more in adult education/training than any other workers (77%). Workers in a deficit mismatch situation feature the second highest rate of participation (61%) followed by those in a surplus situation (54%). The lowest participation rates are among workers in a low-skill match situation (29%).

208. Second, employers display the highest propensity to invest in workers which are in high-skill matches, supporting around 36% of the employed population. This is followed by those in deficit situations (25%), surplus situations (17%) and low-skill match situations (7%).

209. Third, workers in high-skill matches display the highest propensity to self finance their investment in adult education/training (16%) followed by those in surplus situations (15%), deficit situations (10%) and low-skill match situations (5%).

210. Fourth, government financing appears to equally reach those in high-skill matched (4%) and surplus situations (3%) (i.e., those who already have high levels of foundation skills) compared to those who are in deficit mismatch (4%) or low-skill match situations (3%) (i.e., those who have low levels of foundation skills). The findings here point to inadequate strategies for targeting the low-skilled with public funds. Furthermore, this is consistent with findings that reliance on market based approaches and performance criteria used to allocate funding for targeted strategies end up benefiting those who already have the most skills because they are most likely to succeed.

Figure 7.3. Percent of adults aged 16 to 65 (excluding full time students aged 16 to 24) receiving adult education/training during the 12 months preceding the interview, by match-mismatch categories and type of financing



Notes: 1. Results are averaged over countries who participated in ALLS. Country by country results reported in Table 7.1.
Source: Adult Literacy and Lifeskills Survey, 2003-2007.

Table 7.1. Per cent of adults aged 16 to 65 participating in adult education/training programmes or courses during the 12 months preceding the ALL survey (full-time students 16 to 24 participating in programmes longer than 1000 hours duration excluded), by mismatch and source of financing¹, by country

		Low-skill match	DEFICIT mismatch	SURPLUS mismatch	High-skill match	Overall
		Participation rate				
Bermuda	Received some employer financing ²	8	15	14	23	16
	Receive government financing ³	2	1	0	3	2
	Self financed ⁴	6	14	12	20	14
	Received only other sources of financing	0	1	2	2	1
	Participation - all sources	16	31	27	47	33
	Other participation - financing unknown	7	15	13	15	13
Canada	Received some employer financing ²	8	25	17	35	24
	Receive government financing ³	3	3	3	2	3
	Self financed ⁴	8	10	14	17	13
	Received only other sources of financing	2	2	2	2	2
	Participation - all sources	21	39	36	56	41
	Other participation - financing unknown	9	16	14	16	14
Hungary	Received some employer financing ²	6	21	8	23	10
	Receive government financing ³	1	0	1	1	1
	Self financed ⁴	3	7	6	12	6
	Received only other sources of financing	0	2	1	2	1
	Participation - all sources	10	30	15	37	18
	Other participation - financing unknown	3	6	3	6	4
Italy	Received some employer financing ²	3	16	5	14	7
	Receive government financing ³	2	7	4	5	4
	Self financed ⁴	4	10	8	13	6
	Received only other sources of financing	1	2	2	3	1
	Participation - all sources	10	35	19	35	18
	Other participation - financing unknown	3	7	9	9	5
Netherlands	Received some employer financing ²	15	36	25	45	32
	Receive government financing ³	1	3	2	1	1
	Self financed ⁴	5	7	10	10	8
	Received only other sources of financing	0	1	1	1	1
	Participation - all sources	21	47	37	57	43
	Other participation - financing unknown	6	6	6	6	6
Norway	Received some employer financing ²	16	44	27	45	34
	Receive government financing ³	3	2	6	3	4
	Self financed ⁴	4	7	12	9	8
	Received only other sources of financing	1	2	2	2	2
	Participation - all sources	24	55	46	59	49
	Other participation - financing unknown	8	9	8	7	8
Switzerland	Received some employer financing ²	16	35	26	41	31
	Receive government financing ³	3	2	3	3	2
	Self financed ⁴	12	14	21	19	16
	Received only other sources of financing	2	1	2	1	1
	Participation - all sources	33	51	51	64	51
	Other participation - financing unknown	4	11	10	11	9
United States	Received some employer financing ²	7	26	18	37	24
	Receive government financing ³	4	5	3	5	4
	Self financed ⁴	5	10	16	17	12
	Received only other sources of financing	2	2	3	1	2
	Participation - all sources	18	42	40	60	42
	Other participation - financing unknown	16	21	20	21	20
Total	Received some employer financing ²	7	25	17	36	22
	Receive government financing ³	3	4	3	4	4
	Self financed ⁴	5	10	15	16	11
	Received only other sources of financing	1	2	2	1	2
	Participation - all sources	17	42	37	58	39
	Other participation - financing unknown	12	19	17	19	16

Notes: 1. Sources of financing are derived to be mutually exclusive according to the following priority: employer, government, and self financing. Other sources of financing add up to a very small number ranging from 1-3 % and are thus not reported here.

2. If respondents received any employer financing then they are included in 'received employer financing'.

3. If respondents received any government financing and did not receive any employer financing then they are included in 'received government financing'.

4. If respondents reported self financing, and did not receive any employer or government financing, then they are included in 'self financed'.

Source: Adult Literacy and Lifeskills Survey, 2003-2007.

Empirical model of the correlates of participating in employer supported adult education/training

211. In addition to examining the links between the supply of literacy skills and participation on the one hand, and between the demand for literacy skills and participation on the other, the empirical analysis also considers the potential role of the interaction between the supply of, and demand for, literacy skills as reflected in the literacy match-mismatch variable.

212. In previous research, the supply of skills has been typically characterized by an individual's level of education, while the demand for skills has been rarely taken into account. The ALLS dataset contains a direct measure of literacy skills, thus allowing for the indirect but broader measure of educational attainment to be complemented. This allows for a more comprehensive set of measures that help to account for skill supply. The ALLS dataset also contains measures of reading engagement at work which allow for the demand for literacy skills to be factored into an analysis of the correlates of participation. Together, the measure of literacy skills combined with indirect measure of reading engagement at work allow for a direct measure of skill match-mismatch as described in Chapter 4.

213. As has been shown in previous analyses (e.g., Boudard & Rubenson, 2003), job characteristics such as firm size are important correlates of participation in employer supported adult education/training. It is therefore, of interest to explore further the issue of whether it is job or individual characteristics that matter most in accounting for who participates and receives employer financing to do so. Key correlates of participation are included in the model as per Boudard and Rubenson (2003). These include age, education and literacy skill level, all of which reflect individual characteristics and more specifically human capital. Other socio-demographic variables of interest include gender and immigration status, which are known to interact with human capital and be related to labour market outcomes. These are also viewed as characteristics of labour supply. In contrast, firm size and skill use at work such as reading, writing and numeracy engagement are viewed as job characteristics, or alternatively labour demand characteristics.

214. Figure 7.2B summarizes the models graphically while equations 1 to 3 summarize the model formally, and equations 4 to 8 specify empirical models 0 to 4 which are sequentially reported in order to observe changes in the parameters of the characteristics associated with skill supply and demand.

$$Participation_i = \beta_0 + B^{Demand} S_i + B^{Supply} Z_i \quad (1)$$

$$B^{Demand} = B_{HC}^{Demand} + B_{Other}^{Demand} \quad (2)$$

$$B^{Supply} = B_{HC}^{Supply} + B_{Other}^{Supply} \quad (3)$$

Where,

Participation is the probability of participation in employer supported training in last 12 months

B_0 is a constant

S_i is the vector of labour demand characteristics

B^{Demand} are the coefficients associated with the vector of labour demand characteristics

Z_i is the vector of labour supply characteristics

B^{Supply} are the coefficients associated with the vector of labour supply characteristics

215. Model 0 is the base model estimating the coefficients associated with labour supply characteristics. Model 1 augments the labour supply characteristics with the direct measure of skills made available in ALLS. This is done to estimate separately the potential role of a broader indicator of human

capital, namely educational attainment, and a more specific indicator of human capital, namely a direct measure of the cognitive foundation skills (i.e., literacy). Model 2 estimates the coefficients associated with labour demand characteristics. Model 3 estimates the full model with coefficients associated with both labour supply and demand characteristics. Model 4 includes estimates for both labour supply and demand characteristics but augments the model with a skill mismatch variable, which picks up on the interaction between skill supply and demand characteristics. All residuals are assumed to be independently and identically normally distributed. Error terms are therefore omitted for simplicity.

Model 0: labour supply characteristics

$$\log it(p) = b_0 + [b_1 AGEGRP + b_2 MEN + b_3 NIMM + b_4 EDLEV] \quad (4)$$

Model 1: labour supply characteristics augmented with direct measure of skills

$$\log it(p) = b_0 + [b_1 AGEGRP + b_2 MEN + b_3 NIMM + b_4 EDLEV + b_5 SKILL] \quad (5)$$

Model 2: labour demand characteristics

$$\log it(p) = b_0 + [b_1 OCC + b_2 IND + b_3 FIRM + b_4 READ + b_5 WRITE + b_5 NUM] \quad (6)$$

Model 3: labour supply and demand characteristics

$$\begin{aligned} \log it(p) = b_0 + [b_1 AGEGRP + b_2 MEN + b_3 NIMM + b_4 EDLEV + b_5 SKILL] \\ + [b_6 OCC + b_7 IND + b_8 FIRM + b_9 READ + b_{10} WRITE + b_{11} NUM] \end{aligned} \quad (7)$$

Model 4: labour supply and demand characteristics augmented with a skill match/mismatch variable

$$\begin{aligned} \log it(p) = b_0 + [b_1 AGEGRP + b_2 MEN + b_3 NIMM + b_4 EDLEV] \\ + [b_5 OCC + b_6 IND + b_7 FIRM] + [b_8 MATCH] \end{aligned} \quad (8)$$

216. Where,

p	is the probability of participation in employer supported training in last 12 months
AGEGRP	Age: 16-35, 36-50 and 51-65 (reference)
MEN	Gender: Men and women (reference)
NIMM	Immigration status: Non-immigrant and immigrant (reference)
EDLEV	Education level: More than upper secondary, upper secondary and less than upper secondary (reference)
SKILL	Literacy skills level: Level 4/5, Level 3, Level 2 and Level 1 (reference)
OCC	Occupation type: Skilled, semi-skilled, unskilled (reference)
IND	Industry type: High-technology manufacturing; low-technology manufacturing; knowledge-intensive market services; public administration, defense, education & health; other community, social & personal services; utilities & construction; wholesale, retail, hotels & restaurants; transport and storage; primary industries (reference)
FIRM	Firm size: 500 or more employees, 200-499, 20-199, less than 20 (reference)
READ	Reading engagement at work: High intensity, medium high intensity, medium low intensity and low intensity (reference)
WRITE	Writing engagement at work: High intensity, medium intensity, low intensity (reference)
NUM	Numeracy engagement at work: High intensity, low intensity (reference)
MATCH	Skill mismatch: High-skill match, surplus mismatch, deficit mismatch and low-skill match (reference)

and,

$$\log it(p) = \ln \left[\frac{p}{1-p} \right]$$

217. Logistic regression is used to estimate the odds of participating in employer financed adult education/training (see Hosmer & Lemeshow, 1989). The dependent variable is a dichotomous variable indicating whether an individual has participated or not. The goal is to find a reasonable model to describe the relationship between participation in employer supported adult education/training and a set of individual as well as job characteristics. The parameters that are generated are a logit transformation of the probability of presence of participation, which maximize the likelihood of observing participation in employer supported adult education/training. The data tables however, present the odds ratios as per example presented in equation 9. Therefore, it is important to note that the standard errors are linked to the logit transformation of the odds.

$$odds = \frac{p}{1-p} = e^{b_0 + b_1 AGEGRP + b_2 MEN + b_3 NIMM + b_4 FIRM + b_5 EDLEV + b_6 SKILL} \quad (9)$$

Estimation results

218. Results for the five models are reported in Table 7.2 and the most important results are summarized in Figure 7.4. The results confirm that chances of participating in employer supported adult education/training are unequally distributed. The likelihood of participation with employer support is found to be significantly related to labour supply characteristics (gender, immigration status, age, level of education, literacy skill level) as well as labour demand characteristics (firm size and level of engagement in reading, writing and numeracy practices at work). Detailed results for each model are discussed below.

Model 0: labour supply characteristics

219. Only individual, or alternatively, labour supply characteristics are included in this first model, namely educational attainment, immigration status, gender and age. Educational attainment in this first model is found to be the strongest correlate of participation in employer supported adult education/training. Adults who have completed upper secondary are about 1.9 times more likely to have participated in employer supported adult education/training compared to those who did not completed upper secondary. The odds ratio climbs to 3.3 times for adults who attained a level of education higher than upper secondary.

220. From the employer's point of view, higher educated adults may be perceived as more trainable or more efficient trainees. On this basis, employers may be inclined to channel their support to adults who have more education. This is significant because employer-supported adult education/training is a substantial component of total adult education/training (OECD/HRDC, 1997; OECD/Statistics Canada, 2005). To the extent this is the case, it would also reflect a tendency to exacerbate inequalities associated with access to education/training and the concomitant economic and social outcomes.

221. Immigration status, gender, and age are also important correlates. Immigrants, women, and older adults aged over 50 are found to be the least likely to have participated in employer supported adult education/training. Non-immigrants are about 1.7 times more likely to have participated in employer supported adult education/training than immigrants. Men are about 1.2 times more likely to have participated in employer supported adult education/training than women. Likewise, younger cohorts ranging from ages 16 up to 50 are about 1.25 times more likely to have participated in employer supported adult education/training when compared to adults aged 51 to 65. Employers thus seem to be more likely to invest in early and mid career aged workers than older workers.

222. Employers in the Northern European countries who participated in ALLS showed a much greater propensity to invest in their employees than those in North American countries. More specifically, employers in the Netherlands, Norway and Switzerland are about 1.6-1.7 times more likely than those in

Canada or the US to have invested in their employees. Employers in Bermuda, Hungary and Italy are the least likely to have invested in their employees.

Model 1: labour supply characteristics augmented with direct measure of skills

223. Enhancing the model with an additional indicator of human capital, observed literacy skills, reduces the strength of education as a predictor. Similar to the pattern observed in respect to educational attainment, people with higher levels of literacy skills are more likely to have participated in employer supported adult education/training. Adults with at least Level 3 proficiency in literacy were over two times more likely to have participated in employer supported adult education/training than adults with the lowest level of literacy. Overall, education and literacy were both found to have a strong relationship with the likelihood of having participated in employer supported adult education/training.

224. In the same way as those with higher levels of education, workers with higher levels of literacy skills may be perceived by employers as more trainable. Educational credentials and the measure of literacy in ALLS both share the feature of reflecting readiness to learn and trainability. One's actual level of literacy however, is more difficult to observe than educational credentials. Literacy skills have to be inferred through a more direct or detailed evaluation of individual task performance such as on-the-job experience or track record. This is information typically sought by employers when hiring, and by extension can affect decisions to support adult education/training – above and beyond the information that is revealed by educational credentials.

225. Indeed, employer support appears to be directed to those with higher literacy skills above and beyond what would be expected from someone with a given level of education. Thus, the literacy measure in ALLS may reflect individual capabilities more precisely than credentials. To the extent that these skills are observed by employers, it may in part explain the higher rates of access of more proficient adults to employer-supported adult education/training.

226. Perhaps this is to be expected since literacy is seen as a necessary foundation skills for engaging not only in adult education/training but also in many job tasks, especially those that are text-based (e.g., ICT-based tasks). Furthermore, analysis from the ALLS data has confirmed that not all adults with the same level of education display the same level of literacy skills (OECD/Statistics Canada, 2000; 2005). The quality of education received varies substantially within countries, and also because adults can maintain, enhance or lose their literacy skills depending on the extent to which they use them at work and in daily life, as well as the extent of adult education/training they continue to receive as they age (OECD/Statistics Canada, 2005).

Model 2: labour demand characteristics

227. Model 2 includes only job, or alternatively, labour demand characteristics such as type of occupation and industry, firm size and the extent of engagement in reading, writing and numeracy at work.

228. Occupation and industry are broad indicators of job type. Workers in 'low technology manufacturing', 'wholesale, retail, hotels and restaurants', and 'knowledge-intensive market services' are less likely to have participated in employer supported adult education/training than employees in primary industries. Not surprisingly, workers in skilled or semi-skilled positions are more likely to have participated in employer supported adult education/training than unskilled labourers.

229. As found in previous research, firm size is a strong correlate of participation. This is a broad indicator which may incorporate the effects of many structural aspects of work settings which are correlated with firm size. For example, larger firms are more likely to have explicit human resource policies/resources, internal career opportunities and may be linked to increased job security. Workers in

firms with at least 1000 employees were found to be over three times more likely to have participated in employer supported adult education/training than those in firms with less than 20 employees.

230. The nature of work tasks as reflected by the extent of engagement in reading practices is found to have a strong relationship with the likelihood of employers extending support to their employees for the purposes of investing further in the development of their human capital. The effect of reading engagement at work is in the same order of magnitude as firm size. Workers who reported high engagement in reading at work are about 3.4 times more likely to have participated in employer supported adult education/training than workers who reported low engagement. Even those who reported medium-low or medium-high engagement in reading at work are at least two times more likely to have participated. High engagement in writing and numeracy practices is also linked to a higher likelihood of participating.

231. It can thus be inferred from the findings that jobs which require higher levels of literacy practice are associated with greater access to adult education/training. Further, other cognitive skills such as problem solving, planning, and organizational skills are likely to be associated with jobs that require comparatively high levels of reading practice. This may in part explain why the literacy practice at work measure is a better predictor of participation in adult education/training than the direct, but narrower measure, of literacy skills in ALLS. In summary, jobs that require comparatively higher levels of cognitive foundation skills seem to be associated with more learning, especially of the type that is organized.

Model 3: labour supply and demand characteristics

232. Model 3 adjusts for labour supply and demand characteristics simultaneously. The values of most parameters are similar in size to those of the preceding models other than those variables that reflect the skills of the labour supply and the skill content of jobs. On the labour supply side, educational attainment and observed literacy skills remain significant but their strength as predictors is reduced. Likewise, on the labour demand side, occupational type and reading engagement remain significant correlates but their strength as predictors is diminished. In relative terms, the labour supply characteristics lose much more of their strength than the labour demand characteristics. This suggests that the skill content of jobs is more important in predicting participation in employer supported adult education/training than the skills profile of workers.

233. Firm size continues to be a strong correlate of participation in employer supported adult education/training. Even after adjusting for a range of labour supply characteristics, the odds ratios associated with working in a firm of at least 100 employees remain at three or higher.

234. Interestingly, the extent of literacy practices at work remains a particularly strong predictor of participation in employer supported adult education/training, even after taking into account individual characteristics which proxy the level of human capital, namely educational attainment and level of literacy skills. Even workers who reported medium-low engagement in reading at work are two times more likely to have participated in employer supported adult education/training than workers who reported low engagement. This represents a higher chance of participating than for those who have attained higher than upper secondary or who have attained the highest level of literacy proficiency.

Model 4: labour supply and demand characteristics augmented with a skill mismatch variable

235. The final model adjusts for both labour supply and demand characteristics. The characteristics that reflect skill supply and skill demand are merged into a single skill match-mismatch variable with four categories: low-skill match, deficit mismatch, surplus mismatch and high-skill match.

236. Firm size continues to dominate as a predictor. However, being in a high-skill match or deficit situation ranks among the strongest predictors of participating in employer supported adult

education/training. It is important to note that both these categories (high-skill match and deficit mismatch) reflect medium- to high-engagement in reading practices at work, which are characteristics attached to the job.

237. These results provide a much more nuanced picture of the correlates of participation in employer supported adult education/training. For example, while having a high level of literacy skills is found to be associated with an increased likelihood of receiving employer support for participating in adult education/training, there is a sharp difference between those who need to use those skills at work and those who do not.

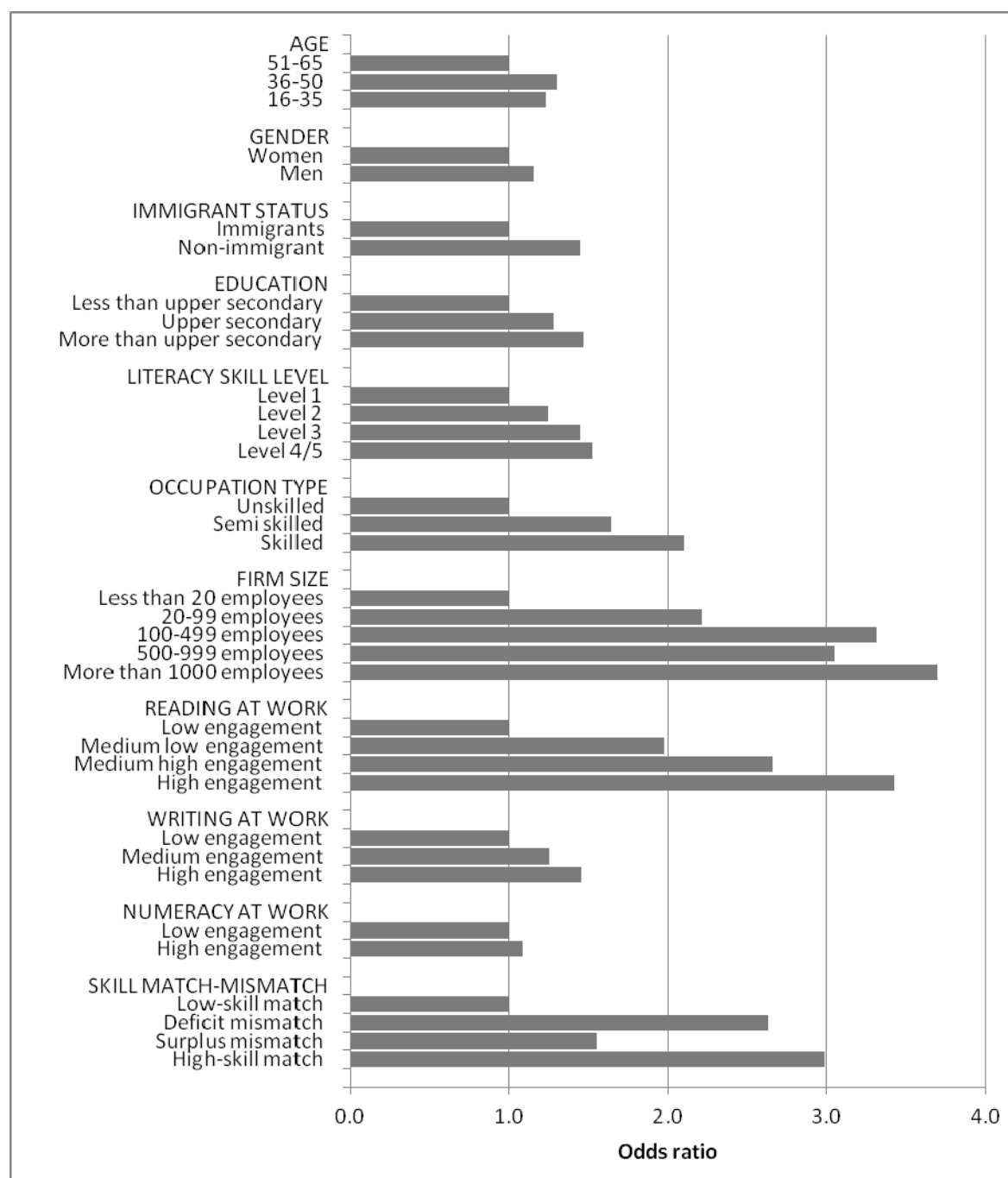
238. Adults in high-skill match situations – that is, those who do have the skills and report using them at work – attract the most employer support because they are likely to be in high performance jobs that require continuous learning and development. They also have a good foundation for further learning.

239. Adults in deficit mismatch situations – that is, those who do not have the required skills but report frequent engagement in activities at work which could make use of those skills – are also attracting employer support but probably for different reasons. One possible reason is the need to upgrade their skills in response to skill biased technological change. While a need for investment in adult education/training might be present however, the foundation skills necessary for efficient learning are at low levels. Low levels of foundation skills act as a barrier to investment in skill development, for both employees and employers. The findings show that many employers circumvent this barrier and nevertheless direct support for adult education/training to those who need it most. The conditions under which employers opt to do so or not, need to be better understood for policy purposes.

240. Adults in surplus mismatch situations – or those who are found to underutilize their cognitive foundation skills in the workplace – still attract some employer support but less than those in high-skill match and deficit mismatch situations. These adults have good foundation skills but they are likely facing difficulties in making the transition to a career path that makes full use of their cognitive foundation skills. Their current employers are also not taking advantage of the fact that they have the foundation skills for efficient learning, and the fact that they offer opportunities to adopt technologies and workplace practices that could help to increase productivity. Separately, it is worth noting that workers in surplus mismatch situations tend to have the second highest overall participation rate when other sources of support are also considered (i.e., employer as well as government and self supported participation), primarily because they have a high tendency to self finance their participation (See Table 7.1).

241. Together these findings support the notion that employer support for adult education/training is influenced by favourable demand side characteristics (i.e., high-skill job tasks, large firm) principally, but that individuals with favourable supply side characteristics (i.e., highly skilled, high education, young) combined with favourable demand side characteristics (i.e., high-skill match) benefit the most from employer support.

Figure 7.4. Adjusted odds ratios showing the likelihood of adults (excluding full time students aged 16 to 24) receiving employer financed adult education/training during the 12 months preceding the interview, by various correlates



Source: Adult Literacy and Lifeskills Survey, 2003-2007.

Notes:

1. Estimates for age, gender, immigrant status, education, occupation type, firm size and skill mismatch are based on Model 4.
2. Estimates for literacy skill level, reading at work, writing at work, and numeracy at work are based on Model 3

Table 7.2. Adjusted odds ratios showing the likelihood of adults (excluding full time students aged 16 to 24) receiving employer financed adult education/training during the 12 months preceding the interview, by various correlates

	Model 0	Model 1	Model 2	Model 3	Model 4
Country (reference=Canada)					
Switzerland	1.6 (0.04) ***	1.7 (0.04) ***	1.6 (0.04) ***	1.7 (0.05) ***	1.7 (0.05) ***
Italy	0.3 (0.07) ***	0.4 (0.07) ***	0.4 (0.07) ***	0.5 (0.07) ***	0.4 (0.07) ***
Norway	1.7 (0.04) ***	1.6 (0.04) ***	2.0 (0.04) ***	1.9 (0.04) ***	1.9 (0.04) ***
Bermuda	0.6 (0.06) ***	0.6 (0.06) ***	0.6 (0.07) ***	0.6 (0.07) ***	0.7 (0.07) ***
United States	1.0 (0.05)	1.1 (0.05)	1.0 (0.05)	1.0 (0.05)	1.0 (0.05)
Netherlands	1.7 (0.04) ***	1.7 (0.04) ***	1.6 (0.04) ***	1.6 (0.04) ***	1.6 (0.04) ***
Hungary	0.4 (0.06) ***	0.4 (0.06) ***	0.8 (0.07) ***	0.7 (0.07) ***	0.6 (0.07) ***
Age (reference=51 to 65)					
16-35	1.2 (0.04) ***	1.1 (0.04) ***		1.2 (0.04) ***	1.2 (0.04) ***
36-50	1.3 (0.03) ***	1.3 (0.03) ***		1.3 (0.04) ***	1.3 (0.04) ***
Gender (reference=women)					
Men	1.2 (0.03) ***	1.2 (0.03) ***		1.1 (0.03) #	1.2 (0.03) ***
Immigrant status (reference=immigrants)					
Non-immigrant	1.7 (0.04) ***	1.4 (0.04) ***		1.4 (0.04) ***	1.4 (0.04) ***
Education (reference=less than upper secondary)					
Upper secondary	1.9 (0.05) ***	1.6 (0.05) ***		1.2 (0.05) ***	1.3 (0.05) ***
> Upper secondary	3.3 (0.04) ***	2.5 (0.05) ***		1.3 (0.05) ***	1.5 (0.05) ***
Functional literacy skill level (reference=Level 1)					
Level 2		1.6 (0.06) ***		1.3 (0.06) ***	
Level 3		2.2 (0.06) ***		1.4 (0.06) ***	
Level 4/5		2.6 (0.06) ***		1.5 (0.06) ***	
Occupational type (reference=unskilled)					
Skilled			1.9 (0.08) ***	1.6 (0.08) ***	2.1 (0.08) ***
Semi skilled			1.5 (0.08) ***	1.4 (0.08) ***	1.6 (0.07) ***
Industry type (reference = primary industries)					
High-technology manufacturing			0.9 (0.10)	0.9 (0.10)	0.9 (0.10)
Low-technology manufacturing			0.6 (0.09) ***	0.6 (0.09) ***	0.6 (0.09) ***
Knowledge-intensive market services			0.8 (0.08) **	0.8 (0.09) **	0.9 (0.08)
Public administration, defense, education & health			1.0 (0.08)	1.0 (0.08)	1.0 (0.08)
Other community, social & personal services			1.0 (0.10)	0.9 (0.10)	1.0 (0.10)
Utilities & Construction			1.0 (0.09)	0.9 (0.10)	1.0 (0.09)
Wholesale, retail, hotels & restaurants			0.7 (0.08) ***	0.7 (0.09) ***	0.8 (0.08) ***
Transport and storage			0.8 (0.10)	0.8 (0.10)	0.9 (0.10)
Firm size (reference= < 20 employees)					
20-99 employees			2.2 (0.05) ***	2.2 (0.05) ***	2.2 (0.05) ***
100-499 employees			3.3 (0.05) ***	3.3 (0.05) ***	3.3 (0.05) ***
500-999 employees			3.1 (0.06) ***	3.0 (0.06) ***	3.1 (0.06) ***
>=1000 employees			3.7 (0.04) ***	3.6 (0.04) ***	3.7 (0.04) ***
Reading engagement at work (reference=low engagement)					
Medium low engagement			2.1 (0.05) ***	2.0 (0.05) ***	
Medium high engagement			2.9 (0.05) ***	2.7 (0.05) ***	
High engagement			3.9 (0.06) ***	3.4 (0.06) ***	
Writing engagement at work (reference=low engagement)					
Medium engagement			1.3 (0.05) ***	1.3 (0.05) ***	
High engagement			1.5 (0.05) ***	1.5 (0.05) ***	
Numeracy engagement at work (reference=low engagement)					
High engagement			1.1 (0.03) ***	1.1 (0.03) **	
Skill match-mismatch (reference=low skill match)					
Deficit mismatch					2.6 (0.05) ***
Surplus mismatch					1.5 (0.05) ***
High skill match					3.0 (0.04) ***

Source: Adult Literacy and Lifeskills Survey, 2003-2007.

Notes: *** p<.01; ** p<.05 ; * p<.1.

Discussion and implications

242. Findings related to the relationship between adult education/training and various labour supply and demand characteristics are grouped and discussed below with emphasis on three themes: skill supply characteristics; skill demand characteristics; and skill match-mismatch.

The role of skill supply characteristics in employer supported adult education/training

243. Consistent with prior research (e.g., Boudard and Rubenson, 2003), supply side characteristics which approximate the skills of individuals are found to play an important role in determining who receives employer adult education/training. In terms of the employee's decision to participate these characteristics may reflect the individual's capacity and motivation to take up adult education/training. In terms of the employer's decision to provide support for participation, the individual's characteristics may act as signals that are used to ascertain trainability. A distinction however, is worth making between two types of signals, each of which may be emitted at different stages because they are either more easy or difficult to accurately discern.

The role of credentials

244. First, there are characteristics that may operate as 'signals' of potential trainability which are more easily observed such as educational credentials, gender, age and ethnic background. Credentials for example, are visible when the hiring decision is made. Indeed, the findings in this study confirm the conclusion that employers use education credentials as signals for not so easy to observe skills not only when hiring, but also in their decision to support adult education/training. It has long been contended that education credentials may act as a 'signalling' device (Blaug, 1976; Thurow, 1975; Woodhall, 2001; also see discussion on signalling theory in relation to mismatch in Chapter 3). In line with discrimination theory, other supply side characteristics which are easily observed such as gender, age and ethnic background are also perhaps used as 'signals' of potential trainability. Training decisions based on these types of signals are presumably perceived by the employer as reducing the risks of investing in unstable or un-trainable employees (Holtzer, 1996).

The role of foundation skills

245. Second, there are characteristics which are not as easily observed and may change over time such as actual skills. Credentials are inadequate signals of skills since large proportions of the workforce are found to have low foundation skills even for those with higher levels of qualifications. There are several reasons for this, including heterogeneity in quality of schooling as well as possibilities for skill gain and skill loss over the life span. The findings in this study suggest that even if these are more difficult to observe, employers do seem to recognize foundation skills above and beyond what would be signalled from credentials or qualifications. Accordingly, they appear to channel support to those who have the highest proficiency in foundation skills, which is not necessarily those who have the highest credentials.

246. Ultimately, employers are likely to be most interested in those who already have a good level of foundation skills, so as to focus on the complementary aspects of training and thus the building up of specific skills.

Implications

247. The tendency for employers to support those who already have a good base of foundation skills and neglect those that do not has important implications for the development of the skill base of a nation

and especially for inequality. This is exacerbated by the fact that employers are the most important investor in skill formation beyond schooling.

248. The risk is that the skill base will become increasingly bifurcated, with skilled workers attracting more investment for continued skill development and less skilled workers will be left without any support. This is further exacerbated by the fact that high-skilled individuals already have the motivation to continue to learn, as indicated by their willingness to self-finance, while low-skilled workers are much less inclined to invest in themselves (see Table 7.1). Such tendencies on the market may do little to address potential skill shortages and/or the inefficiencies associated with skill deficits.

The role of skill demand characteristics in employer supported adult education/training

249. The second key finding is that the skill content of jobs seems to be an even stronger determinant of participation in employer supported adult education/training than educational attainment or literacy proficiency. The influence of demand characteristics tends to outweigh the influence of supply characteristics. This raises a number of issues.

Skill utilization drives investment in skill formation but upskilling may not be inevitable

250. First, it raises questions about the focus of recent thinking around skills for economic prosperity. Several policy documents have stressed that the answer to the present economic and social challenges is to improve the supply of skilled labour. This view tends to ignore the demand side and takes upskilling for granted or as inevitable. It also ignores the observation that the actual utilization of foundation skills is itself a major factor implicated in skill formation as found in this study, and that large segments of the workforce are still not required to use their foundation skills at work. Evidence thus suggests that there is a need for a more comprehensive view involving both the demand and supply sides.

251. Otherwise, a view based on the supply side only ignores the possibility that there are structural conditions in the economy that lower the demand for and utilization of skills, which in turn can affect not only investments in skill formation, but may lead to a lack of use of existing skills, and ultimately skill loss. For example, Brown, Green and Lauder (2001) pointed to structural conditions in the British economy that lower the demand for and utilization of skills. This is an issue that merits further investigation.

The link between adult education/training, skill use, innovation and industrial relations

252. Second, the findings draw attention to the link between employers' decisions to invest in the skill development of their employees on the one hand, and industrial relations, organizational/workplace practices, technological/organizational innovation, skills utilization and skill mismatch on the other.

253. Recent research on these links point to the institutional emergence of norms about employee job rights and benefits (e.g., Vignoles et al., 2004; Meredith, 2008). Some employers have been found to actively promote human resource development practices which encourage strong ties between the organization and its employees (Kalleberg *et al.*, 1996). The aim of these practices is to induce the commitment of employees to the organization via job security, comprehensive benefits and career opportunities (*ibid*). Adult education/training which helps them enhance those roles is increasingly becoming an issue of employee-job rights or part of the benefit package.

Implications

254. Skill formation is not just a supply side issue; it is just as much a function of work tasks and work organisation on the demand side. Policies thus need to take into account both the supply and the demand

side. Particular attention should be paid to identifying the mechanisms that help to foster the optimal utilisation of the existing skill base. Otherwise, many workers even with high qualifications risk losing their foundation skills due to a lack of use, leading to an erosion of value of educational investments.

The role of skill match-mismatch in employer supported adult education/training

255. The third key finding relates to skill match-mismatch. A substantial proportion of the workforce is found to have foundation skills that do not match the requirement of their jobs. Results based on the measure used in this study are similar in magnitude to those reported in studies making use of education mismatch measures. Skill surpluses and deficits are estimated to vary between 10 and 30%, depending on the country. But these do not correlate perfectly with education mismatch measures because as mentioned earlier, skills are not the same thing as qualifications.

256. It is important to consider education or skill mismatch in a dynamic framework that acknowledges the possibility for skill gain or loss on the supply side, and changing job content on the demand side. It is also important to acknowledge that a certain degree of mismatch may be inevitable and that there is probably a natural or normal rate of mismatch. What this rate is, cannot be answered with certainty, but high rates are likely to suggest a need for active policies that foster adjustments.

257. A number of policy implications follow from the findings on mismatch but these vary according to the different match-mismatch situations. Each is considered in turn below.

Match situations: distinguishing between low-skill and high-skill matches

258. The following focuses on workers who are in matched situations but a distinction is made between workers who are in low-skill vs high-skill match situations.

Situations where workers have low foundation skills and these are not required for their job (low-skill match)

259. Even in the most advanced industrialised nations, large segments of the adult population have been found to have low levels of foundations skills (i.e., literacy, numeracy, problem solving). According to ALLS and its predecessor (the International Adult Literacy Survey), the proportion of adults who score at Levels 1 or 2 on these skills ranges from 30-80% depending on the country. Levels 1 and 2 are thought to be too low for adults to cope with text-based tasks which are becoming increasingly common both at work and in daily life. For example, as a consequence of the ICT revolution. Low levels of foundation skills spread so widely poses a risk to the capacity of private and public organisations to innovate and increase productivity.

260. While many workers are found to have low levels of foundation skills however, many appear to not necessarily require high levels of these skills to carry out their jobs tasks. The group of people in low-skill match situations ranges from 18-58% of the workforce depending on the country (see Table 5.1A). Adults in this situation may be well-matched to the requirements of their job but nevertheless have low foundation skills, which may have negative consequences for economic and social progress.

261. At the individual level, low foundation skills may be associated with a heightened risk of experiencing economic and social disadvantage, typified by casual unfulfilling work and unemployment and often accompanied by psychological and health problems. At the societal level, high rates of low foundations skills may not only constrain productivity growth, but may also reduce the capacity of nations to enable their citizens to:

- Cope with uncertainty and change;
- Maintain global competitiveness;
- Increase flexibility, responsiveness and preparedness of labour markets;
- Deal with issues of population ageing;
- Participate fully as citizens in democracy and civic society; and,
- Find complex solutions to emerging challenges.

262. Fostering participation in adult education/training thus equally applies to low-skilled adults even if they do not report requiring those skills at their current jobs. This is the case because it helps to maintain a flexible workforce, allows for the potential to expand high value added production, avoids de-moralizing routine work, may lead to improved quality of goods and services, and in general enables all citizens to participate fully in economic, civic and social life.

263. This is not without challenge, however. Workers in low-skill match situations are the least likely to invest in themselves (see Table 7.1). They are also found to receive the least employer support for developing or sustaining their skills. Employers are more likely to be interested in supporting the skill formation of workers who already have a good level of foundation skills. Accordingly, employers who offer low-skill jobs and employ low-skill workers may thus be locked in a low-skill equilibrium with little incentives to upgrade production processes or workers' skills (see Finegold and Soskice, 1988).

Situations where workers have the required foundation skills (high-skill match)

264. Workers in high-skill match situations are found to receive the most employer support for participating in adult education/training. This reinforces the notion that employers are keen to support those who already have a good base of foundation skills. In this situation, incentives seem to be naturally aligned toward a high-skill equilibrium. The evidence confirms the intuitive idea that high skills and high-skill requirements are mutually reinforcing in promoting skill development.

Mismatch situations: distinguishing among the underlying reasons for observed skill deficits and skill surpluses

265. There are several reasons why mismatch may arise, and the relationship to adult education/training varies accordingly, as do the implications for policy (Messinis & Olekalns, 2007). The following considers the origin of different match-mismatch situations and how adult education/training and/or other policies may serve to ameliorate conditions under each set of circumstances. The skill mismatch measure used in this study does not distinguish among the different reasons that may underlie skill deficit and skill surplus situations. But these possible alternatives must nevertheless be carefully considered in light of the results.

Situations where workers never had the required foundation skills (deficit)

266. Among adults with low foundation skills, many are nevertheless found to require those skills to carry out their jobs tasks. This is the group of people in deficit mismatch situations, which ranges from 7-24% depending on the country (see Table 5.1A). This group is much more likely to participate in employer supported adult education/training when compared to those who are in low-skill match situations. In fact, the group is nearly as likely to receive employer supported adult education/training as those in high-skill match situations. Although there is evidence to argue that adult education/training opportunities are fundamentally related to the needs of the job, high skills and high-skill requirements as mentioned above seem to be mutually reinforcing in promoting skill development.

267. The results found in this study are similar to those found in research based on education mismatch measures. Undereducated workers have been found to be more likely to participate in adult education/training when compared to matched workers who have the same qualifications (Büchel & Mertens, 2004; Verhaest & Omeij, 2006). This is like comparing workers who are in deficit mismatch situations with those who are in low-skill match situations.

268. Unfortunately, the measures of mismatch used in this study do not allow to distinguish between workers who:

- Never had the required foundation skills;
- Had the required foundation skills, but those skills depreciated; and,
- Had the required foundation skills, but requirements increased due to innovation.

269. Each situation has different implications for policy and the role of adult education/training.

270. In the first situation, adults may never have had those skills, perhaps as a consequence of having had poor access to quality education. Policy must therefore ensure first and foremost quality education which delivers the foundations skills needed by all.

271. From the perspective of sustaining a good skill base for rapidly growing knowledge economies and addressing inefficiencies in the labour market that are due to low levels of foundation skills, it can be argued that public policy has an important role to play beyond relying almost exclusively on initial formal education to increase the supply of skills. For adults beyond initial education, governments have an important role to play in fostering the adult education/training necessary to redress low levels of foundation skills that are found among adults populations.

272. In particular, public policy has a role to play in helping to identify existing workers with low levels of foundation skills, devising schemes to incentivise (e.g., tax deductions) both employees and employers to invest in skill development, and in helping to coordinate with employers and other stakeholders efforts which aim to develop and implement basic skills programme. Even more strongly, it has a role to play in mandating the conditions necessary for fostering investment (e.g., training rights, job-leave). Otherwise, many workers risk not obtaining adequate support to develop or sustain their foundation skills at levels deemed to be a minimum for coping with everyday skill demands in modern societies, not only at work but also in home, civic and social life.

273. The role of public policy is particularly important because employers may lack the necessary incentives to invest in the foundation skills of their employees even if they may otherwise eventually benefit from it, albeit in indirect and unforeseen ways (e.g., positive feedback effects from more highly skilled consumers). Unless employees' needs are clearly aligned with firms' needs and the risks to investment are minimal, employers' incentives are not necessarily aligned to support the development of 'general' or 'foundation' skills. This is primarily an issue of costs and who should pay for the development of foundation skills needed not only for production, but also for consumption as well as for personal, civic and social life.

Situations where workers had the required foundation skills, but skills depreciated due to skill loss (deficit)

274. Other workers may find themselves in a skill deficit situation because their skills have depreciated over time. Allen and van der Velden (2002) highlighted different sources of skill depreciation ranging from ageing, career interruptions, lack of use of skills and technological/organizational change. The latter is discussed separately in the following section since it has a different set of implications.

275. The idea that certain skills depreciate with age is widely held in the cognitive sciences, but exactly at which point decline sets in and why is not entirely clear due in part to poor data (e.g., see Salthouse, 2009). In the economics literature, the idea already had some currency as early as the 1970s, with Rosen (1975) addressing this issue in the context of attempts to understand patterns of wage returns by age. Mincer and Ofek (1982) emphasized the ‘use it or lose it’ hypothesis, where skills are at risk of being lost if they are not used. For example, as a consequence of remaining outside the labour market for long periods or due to a lack of skill use. In the same line of reasoning, de Grip and van Loo (2002) suggest that skills deteriorate due to a lack of use, although they focus on obsolescence.

276. A related proposition is based on the “intellectual challenge” hypothesis (Staff, Murray, Deary & Whalley, 2004; Pazy, 2004; de Grip, Bosma, Willems & van Boxtel, 2007). Both the ‘use it or lose it’ and ‘intellectual challenge’ propositions suggest that skills are like muscles that develop if you use them, otherwise they can be lost. By extension, this may imply that workers who engage in simple and less challenging tasks than they are capable may thus lose some of their skills especially as they age.

277. The potential for skill loss poses a real risk to the value of educational investments which have increased markedly in most OECD countries over the last 40 years. In this scenario, the primary response is not necessarily only to foster adult education/training but may also include a wider consideration of work. Workplace and organizational practices, and the adoption of new technologies, particularly as they pertain to skill use become directly implicated in any efforts to mitigate skill loss. What people do at work can even be designed to promote skill gain through practice effects. In contrast, routine labour practices may have a particularly negative long run consequence for skill loss and hamper opportunities that may otherwise exist for innovation.

278. With recent estimates that increasing proportions of the workforce will be over the age of 50 by 2050, concern for skill loss due to a lack of use takes on added significance. For example, Toossi (2002) estimated that about 20% of the US workforce will be over the age of 55 by 2050.

Situations where workers had the required foundation skills, but requirements increased due to innovation (deficit)

279. Workers may have had the skills required in their job in the past, but due to technological or organisational change, they now find themselves in situations in which they no longer have the required skills to perform successfully in their jobs. In this situation, skill deficits arise due to changes in job content or work environment not because of skill loss. For example, the introduction of ICTs can lead to an increased demand for skills (MacDonald & Weisbach, 2004; de Grip, 2006).

280. The primary response is to complement the introduction of changes with adult education/training. Many studies have shown that adult education/training can be complementary to technological change (e.g., Baldwin & Johnson, 1995). Indeed, this is a major reason why firms provide adult education/training (e.g., in Australia about 54% of training in firms is provide on this basis, ABS Survey of Education, Training and Information Technology, 2001).

Situations where workers have the required foundation skills, but requirements decreased due to innovation (surplus)

281. Among adults with medium to high levels of foundation skills, many are nevertheless found to not require those skills to carry out their jobs tasks. This is the group of people in surplus mismatch situations, which ranges from 13-35% depending on the country (see Table 5.1A). This group are less likely to participate in employer supported adult education/training when compared to those who are in high-skill match situations, but they are much more likely than those who are in low-skill match situations.

282. The results found in this study are similar to those found in research based on education mismatch measures. Overeducated workers have been found to be less likely to participate in adult education/training when compared to matched workers who have the same qualifications (Hersch, 1991; van Smoorenburg & van der Velden, 2000; Büchel & Mertens, 2004; Verhaest & Omeij, 2006). This is like comparing workers who are in surplus situations with those who are in high-skill match situations. But overeducated workers have been found to be more likely to participate in adult education/training when compared to matched workers who are in similar jobs (Büchel, 2002; Verhaest & Omeij, 2006). This is like comparing workers who are in surplus situations with those who are in low-skill match situations.

283. As in the case of deficit mismatch, the ALLS data do not allow to distinguish between workers who:

- Were matched with the required foundation skills, but due to innovation they are now overskilled (i.e., deskilling);
- Were never in a well-matched job, and may not have the specific skills to obtain a job that would make use of their foundation skills (i.e., horizontal mismatch, a lack of opportunity)

284. Although there is no evidence of widespread deskilling as discussed in Chapter 3, deskilling processes are a real possibility and cannot be ruled out. Braverman's deskilling thesis carries little currency today, but his understanding of skill polarization is very much alive (Tinker, 2002) and research as cited in Chapter 3, has found evidence of tendencies toward both skill and wage polarization (Kolev & Saget, 2010; Acemoglu & Autor (2010). This has been linked to the structure of work settings and other labour market practices. For example, Kalleberg (2003) argued that US employers in their search for greater flexibility in their employment systems have relied on numerical and functional flexibility which has fed polarization.

285. Numerical flexibility is achieved through the use of non-regular workers to handle fluctuation in production. In some workplaces, Kalleberg (2003) found that 'flexible' workers are treated as disposable with little control over their work and with few benefits and little access to further adult education/training.

286. Functional flexibility involves the use of "high performance work organizations" that tend to encourage workers participation in decision-making and teamwork and links employee performance with organizational performance. This form of flexibility is otherwise associated with good access to adult education/training, but Kalleberg (2003) warned that while some see the use of high performance work organizations as having spread widely (Linbeck & Snower, 2000; Osterman, 2000) there is convincing evidence to suggest that they are still not that prevalent in the service sector, which plays a dominant role in advanced countries. Further, longitudinal research does not find strong evidence to support the claims of major changes in work organization (le Grand, Szulkin & Thålin, 2004; Lloyd & Payne, 2006).

287. The implications here are similar to those already stated, namely that skill formation policies need to pay attention to the demand side too. In particular, it is worthwhile to consider more carefully how the structure of work settings, including work and organisational practices, as well as other labour market practices may impact skill development and the value of such investments over time.

Situations where workers have the required foundation skills but not other more specific skills (surplus)

288. As mentioned in Chapter 3, there is unobserved heterogeneity among workers. Specifically, some workers may have high levels of some skills such as literacy and numeracy but may otherwise have low capabilities. Being literate is not enough – some skills signal potential to be highly functional in modern workplaces but some workers may have difficulty translating those skills into action and results. Put

another way, foundation skills may be necessary but not sufficient for the broader capabilities needed in the workplace.

289. In other cases, some workers may be in transition (mostly younger) seeking to find good jobs but lack opportunities, access to networks, and/or competences to find the right jobs. Adult education/training can be helpful to make the transition or retrain skills in a way that suits available opportunities.

290. Not least, an appropriate response to skill surpluses might involve active efforts to support the creation of more opportunities for high-skill and high-value added jobs.

8. Conclusion

291. In summary, three major points can be elucidated from the analysis in this study, which should be taken into account when considering the phenomena of skill mismatch. Each is taken up in turn:

- Firstly, it is important to equally consider how both the demand and supply side of the labour market are implicated in generating mismatch.
- Secondly, it is important to consider the dynamics of skill gain and skill loss over the lifespan of workers and how this interacts with changing job content.
- Thirdly, it is important to recognize the dynamics of the interaction between the supply of, and demand for, skills at the macro level

Taking into account both the supply and demand sides of the labour market

292. The analysis contained in this study emphasised the importance of the demand side of the labour market in determining earnings, training and skill mismatch. Most importantly, it was emphasized that skill formation is not just a supply side issue; it is just as much a function of work tasks and work organisation on the demand side. Policies on skills thus need to take into account both the supply and the demand side. Particular attention should be paid to identifying the potential mechanisms that help to foster the optimal utilisation of the existing skills base. Otherwise, many workers even with high qualifications risk losing their skills due to a lack of use, leading to an erosion of value of educational investments.

293. It is perhaps useful at this stage to highlight two major competing approaches to viewing and modelling labour market functioning as it pertains to skills, skill use and skill development. These can lead to very different lenses with which to view skill mismatch. By extension it can lead to the formulation of very different types of policy responses to skill mismatch.

294. The first approach is well grounded in the neoclassical school of thinking, particularly the supply side view of the human capital model. From this perspective there is a tendency to emphasise the supply of skills in labour market functioning. On the one hand, concerns for skills deficits should be addressed by a supply response. In some cases, if the deficits are in specific skills rather than general skills, then the demand side should respond by taking on a supply side role, thus providing training to meet the required skills. On the other hand, if there is excess human capital on the labour market, then the models implicated in this approach imply that the market will adjust accordingly, for example by adopting technologies or work practices, in a way that makes use of existing skills. Alternatively, workers (or the supply of skills) will find more suitable matches, preferably with better guidance from the suppliers of skills. The demand side behaviours are not modelled or accounted for explicitly but rather implicitly assumed to function according to standard neoclassical assumptions, such as profit maximizing behaviour and perfect competition. Under these market conditions, interventions to the demand side such as industrial or other structural policies should be kept to a minimum. Such interventions are seen as sub-optimal because they

introduce distortions to proper market functioning and governments do not have the necessary information to pick winners – markets are better positioned to do so.

295. From this perspective, skill mismatch tends to be seen as a phenomenon driven by supply side conditions. Mismatches are attributed to the inadequacies of the education and training system, since it is directly implicated in the formation of the skills supply. In a situation of overeducation, for example, the response is that education and training systems should aim to reduce the number of qualifications they produce. Overall, education and training systems should be made to be more responsive to the needs of the labour market, and to offer more guidance to minimize mismatch.

296. An alternative approach is well grounded in the new political economy of skills (Brown, Green & Lauder, 2001), which tends to focus on the demand side of the labour market. This approach draws on economic sociology and new institutionalism (Swedberg, 1996; Crouch & Streeck, 1997), which offers a pertinent critique of the supply side view of the human capital model. The approach emphasizes that economies can remain competitive without upgrading skills, and that the market does not necessarily provide the incentives consistent with a high-skills strategy or high-skills equilibrium. Routes to high-skill formation and the accompanying policies required vary a lot between countries, depending on their local conditions. As examples, the social partnership model of Northern Europe as well as the developmental model of Asian economies, are pointed to as economies that emphasize both supply and demand side policies in their approach to skills.

297. Skill mismatch as a phenomenon and thus the mix of policy implications, are seen quite differently when conditions and behaviours of the demand side of the labour market are taken into consideration.

298. The following lists several policy interventions that focus on the supply of, and demand for, skills, as well as coordination between the two:

- Policies that target the labour supply
 - Make education more responsive to labour market demand
 - Develop adult education and training systems and work based training
- Policies that target the labour demand
 - Promote the adoption of technologies and practices that maximize complementarities to available skills
- Policies that coordinate the labour supply and demand
 - Provide information and guidance
 - Facilitate steering and promote coordinated stakeholder approaches
 - The role of the state and policy
 - The role of workers and organized labour
 - The role of employers

Taking into account skill gain and skill loss over the lifespan vis-a-vis changing job content

299. Mismatch has often been treated uniformly even if it occurs at different career points. Whether mismatch is present for recent labour market entrants, early, middle or late career aged adults, can be for very different reasons, which have different policy implications.

300. Situating mismatch in a dynamic framework is thus important. Mismatch may arise because of skill gain or skill loss on the supply side. Alternatively, it may arise because of upskilling or deskilling on

the demand side. If this is the case, then a more responsive education system, or better matching at the source, for example, as a consequence of good guidance, may do little to avert mismatch.

Taking into account the dynamic interactions between skill supply and skill demand at the macro level

301. Is mismatch a bad thing? A certain degree of mismatch may be inevitable and normal. It may even be an important catalyst for stakeholders to respond to, setting off the adjustment processes necessary for long run productivity growth. This reverts back to a key question: is it the demand for skills that is driving the supply or vice-versa? Endogenous technical theory suggests it is the latter. If this is the case then overeducation may actually be a good thing.

REFERENCES

- Åberg, R. (2002). Överutbildning- ettarbetsmarknadspolitiskt problem?. In K. Abrahamson et. al. (eds), *Utbildning Kompetens och Arbete* (pp. 41-62). Lund: Studentlitteratur.
- Acemoglu, D. (1998). Why do technologies complement skills? Directed technical change and inequality, *Quarterly Journal of Economics*, vol. 113, pp. 1055-1090.
- Acemoglu, D. (1999). Changes in unemployment and wage inequality and the labor market: An alternative theory and some evidence, *American Economic Review*, vol. 89, pp. 1259-1278.
- Acemoglu, D. (2002a). Technology and the labor market, *Journal of Economic Literature*, vol. 40, pp. 7-72.
- Acemoglu, D. (2002b). Directed technical change, *Review of Economic Studies*, vol. 69, pp. 781-810.
- Acemoglu, D., & Autor, D. (2010). Skills, tasks, and technologies: Implications for employment and earnings, National Bureau of Economic Research, Cambridge, MA, Working Paper 16082.
- Aghion, P., & Howitt, P. (1997). *Endogenous Growth Theory*. Cambridge: MIT Press.
- Allen, J., & van der Velden, R. (2002). When do skills become obsolete, and when does it matter?. In A. de Grip, J. van Loo & K. Mayhew (eds), *The Economics of Skills Obsolescence: Theoretical Innovations and Empirical Applications* (pp. 27-50), Research in Labor Economics, vol. 21. Amsterdam: Elsevier Science.
- Arrow, K. (1971). The theory of discrimination, Department of Economics, Princeton University, Industrial Relations Section Working Papers.
- Arrow, K.J. (1973). Higher education as a filter, *Journal of Public Economics*, vol. 2, pp. 193-216.
- Autor, D., Levy, F., & Murnane, R. (2003). The skill content of recent technological change: An empirical exploration, *Quarterly Journal of Economics*, vol. 118, no. 4, pp. 1279-1333.
- Baldwin, J.R., & Johnson, J. (1995). *Human Capital Development and Innovation: The Case of Training in Small and Medium Sized-Firms*. Ottawa: Statistics Canada.
- Bartel, A.P., & Lichtenberg, F.R. (1987). The comparative advantage of educated workers in implementing new technology, *Review of Economics and Statistics*, vol. 69, no. 1, pp. 1-11.
- Battu, H., Belfield, C., & Sloane, P. (2000). How well can we measure graduate over-education and its effects?, *National Institute Economic Review*, vol. 171, pp. 82-93.
- Bauer, T. (2002). Educational mismatch and wages: A panel analysis, *Economics of Education Review*, vol. 21, pp. 221-229.
- Becker, G.S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy*, vol. 70, no. 5-2, S9-S49.

- Becker, G.S. (1964). *Human Capital: A Theoretical and Empirical Analysis with Special References to Education* (Editions revised in 1975 and 1993). Chicago: University of Chicago Press.
- Béjaoui, A. (2000). L'évolution de la prime associée aux qualifications et son implication quant aux changements de la structures des salaires (dissertation). Montréal: Université de Montréal.
- Bevan, S., & Cowling, M. (2007). Job matching in the UK and Europe, Sector Skills Development Agency, Research report RR25.
- Black, S.E., & Lynch, L.M. (1996). Human capital investments and productivity, *American Economic Review*, vol. 86, no. 2, pp. 263-267.
- Blau, F.D., & Kahn, L.M. (2001). Do cognitive test scores explain higher US wage inequality?, National Bureau of Economic Research, Cambridge, MA, Working Paper 8210.
- Blaug, M. (1976). The empirical status of human capital theory: A slightly jaundiced survey, *Journal of Economic Literature*, vol. 14, no. 3, pp. 827-855.
- Boothby, D. (1999). Literacy skills, the knowledge content of occupations and occupational mismatch, Applied Research Branch, Human Resource Development Canada, Hull, Quebec, Working Paper 99-3E.
- Boudard, E., & Rubenson, K. (2003). Revisiting major determinants of participation in adult education with a direct measure of literacy skills, *International Journal of Educational Research*, vol. 39, pp. 265-281.
- Bound, J., & Johnson, G. (1992). Changes in earnings differentials in the 1980s: Concordance, convergence, causes and consequences, National Bureau of Economic Research, Cambridge, MA, Working Paper 3901.
- Braverman, H. (1974). *Labor and Monopoly Capital*. New York: Monthly Review Press.
- Brown, P., Green, A., & Lauder, H. (2001). *High Skills: Globalization, Competitiveness, and Skill Formation*. Oxford: Oxford University Press.
- Büchel, F. (2002). The effects of overeducation on productivity in Germany: The firms' viewpoint, *Economics of Education Review*, vol. 21, pp. 263-275.
- Büchel, F., & Mertens, A. (2004). Overeducation, undereducation and the theory of career mobility, *Applied Economics*, vol. 36, pp. 803-816.
- Cain, G.G. (1976). The challenge of segmented labor market theories to orthodox theory: A survey, *Journal of Economic Literature*, vol. 14, no. 4, pp. 1215-1257.
- Card, D. (1999). The causal effect of education on earnings. In O. Ashenfelter and D. Card (eds), *Handbook of Labour Economics* (pp. 1801-1863). Oxford: Elsevier Science.
- CEDEFOP (2010a). *The Skill Matching Challenge: Analysing Skill mismatch and Policy Implications*. Luxembourg: Publications Office of the European Union.
- CEDEFOP (2010b). *Skills Supply and Demand in Europe: Medium-term Forecast up to 2020*. Luxembourg: Publications Office of the European Union.

- Chevalier, A. (2003). Measuring over-education, *Economica*, vol. 70, pp. 509-531.
- Chevalier, A., & Lindley, J. (2009). Overeducation and the skills of UK graduates, *Journal of the Royal Statistical Society Series A*, vol. 172, no. 2, pp. 307-337.
- Coulombe, S., Tremblay, J.F., & Marchand, S. (2004). *Literacy Scores, Human Capital, and Growth Across Fourteen OECD Countries*. Statistics Canada: Ottawa.
- Cross, K.P. (1981). *Adults as Learners: Increasing Participation and Facilitating Learning*. San Francisco: Jossey-Bass.
- Crouch, C., & Streeck, W. (1997). *Political Economy of Modern Capitalism*. London: Sage.
- Daly, M.C., Buchel, G., & Duncan, G.J. (2000). Premiums and penalties for surplus and deficit education evidence from the United States and Germany, *Economics of Education Review*, vol. 19, pp. 169–178.
- de Grip, A. (2006). Evaluating human capital obsolescence, Research Centre for Education and the Labour Market (ROA), Maastricht, Working Paper ROA-RM-2006/2E.
- de Grip, A., & van Loo, J. (2002). The economics of skills obsolescence: A review. In A. de Grip, J. van Loo and K. Mayhew (eds), *The Economics of Skills Obsolescence: Theoretical Innovations and Empirical Applications* (pp. 1-26), Research in Labor Economics, vol. 21, Amsterdam: Elsevier Science.
- de Grip, A., Bosma, H., Willems, D., & van Boxtel, M. (2007). Job-worker mismatch and cognitive decline, Institute for the Study of Labor (IZA), Discussion Paper 2956.
- Dennison, E. (1962). The sources of economic growth in the United States and the alternatives before us, Committee for Economic Development, New York
- Desjardins, R. (2004). Determinants of literacy proficiency: A lifelong-lifewide learning perspective, *International Journal of Educational Research*, vol. 39, no. 3, pp. 205-245.
- Desjardins, R. (2005). Skills and nature of the workplace. In OECD/Statistics Canada (eds), *Learning a Living: First Results of the Adult Literacy and Lifeskills Survey*, (pp. 105-128). Paris and Ottawa: Authors.
- Desjardins, R., Rubenson, K., & Milana, M. (2006). *Unequal Chances to Participate in Adult Learning: International Perspectives*. Paris: UNESCO.
- Devroye, D., & Freeman, R. (2001). Does inequality in skill explain inequality of earnings across advanced countries, National Bureau of Economic Research, Cambridge, MA, Working Paper 8140.
- Doeringer, P., & Piore, M. (1971). *Internal Labour Markets and Manpower Analysis*. Lexington, MA: Lexington Books.
- Dolton, P.J. & Silles, M.A. (2008). The effects of over-education on earnings in the graduate labour market, *Economics of Education Review*, vol. 27, no. 3, pp. 125–139.
- Dolton, P.J., & Vignoles, A. (2000). The incidence and effects of overeducation in the U.K. graduate labour market, *Economics of Education Review*, vol. 19, pp. 179–198.

- Duncan, G.J., & Hoffman, S. (1979). On-the-job training and earnings differences by race and sex, *Review of Economics and Statistics*, vol. 61, no. 4, pp. 594-603.
- Duncan, G.J., & Hoffman, S. (1981). The incidence and wage effects of overeducation, *Economics of Education Review*, vol. 1, no. 1, pp. 75-86.
- Finegold, D., & Soskice, D. (1988). The failure of training in Britain: Analysis and prescription, *Oxford Review of Economic Policy*, vol. 4, pp. 21-53.
- Foley, P., & Watts, D. (1994). Skill shortages and training: A forgotten dimension in new technology, *R&D Management*, vol. 24, no. 3, pp. 279-289.
- Forth, J., & Mason, G. (2006). Do ICT skill shortages hamper firms' performance? Evidence from UK benchmarking surveys, National Institute of Economic and Social Research, Discussion Paper 281.
- Freeman, R. (1976). *The Overeducated American*. New York: Academic Press.
- Frei, C., & Sousa-Poza, A. (2011). Overqualification: Permanent or transitory, *Applied Economics*, First published on: 01 April 2011 (iFirst), DOI: 10.1080/00036846.2011.554380
- Eide, E.R., & Showalter, M.H. (2010). Human Capital. In D.J. Brewer and P. McEwan (section eds), *International Encyclopedia of Education, Economics of Education Section* (electronic version). Oxford: Elsevier.
- European Commission (2008). The Bordeaux communiqué on enhanced European cooperation in vocational education and training. Communiqué of the European Ministers for vocational education and training, the European social partners and the European Commission, meeting in Bordeaux on 26 November 2008 to review the priorities and strategies of the Copenhagen process. Brussels: European Commission. Available from Internet: http://ec.europa.eu/education/lifelong-learning-policy/doc/bordeaux_en.pdf [cited 14.2.2011].
- European Communities (2004). Facing the challenge: The Lisbon strategy for growth and employment, Report from the High Level Group chaired by Kim Kok, November.
- Galasi, P. (2008). The effect of educational mismatch on wages for 25 countries, Institute of Economics, Hungarian Academy of Sciences, Budapest, Working Papers on the Labour Market 8-2008.
- Gallie, D. (1991). Patterns of skill change: Upskilling, deskilling or the polarization of skills, *Work, Employment and Society*, vol. 5, no. 3, pp. 319-351.
- Goldin, C., & Katz, L.F. (1999). The returns to skill in the United States across the twentieth century, National Bureau of Economic Research, Cambridge, MA, Working Paper 7126.
- Green, D.A., & Riddell, W.C. (2001). *Literacy, Numeracy and Labour Market Outcomes in Canada*. Ottawa and Hull: Statistics Canada and Human Resource Development Canada.
- Groeneveld, S. (1997). Passend meten, over definities en metingen van overscholing, *Tijdschrift voor Arbeidsvraagstukken*, vol. 13, no. 3, pp. 273-282.
- Groot, W., & Maassen van den Brink, H. (2000). Overeducation in the labor market: A meta-analysis, *Economics of Education Review*, vol. 19, no. 2, pp. 149-158.

- Halaby, C. (1994). Overeducation and skill mismatch, *Sociology of Education*, vol. 67, no. 1, pp. 47–59.
- Hansson, B. (2007). “Effects of tertiary expansion: Crowding-out effects and labour market matches for the higher educated”, *OECD Education Working Papers* n°10. doi: 10.1787/085513474523
- Hartog, J. (1980). Earnings and capability requirements, *Review of Economics and Statistics*, vol. 62, no. 2, pp. 230-240.
- Hartog, J. (1981). Wages and allocation under imperfect information, *De Economist*, vol. 129, no. 3, pp. 311-323.
- Hartog, J. (1983). To graduate or not: Does it matter? *Economics Letters*, vol. 12, pp. 193-199.
- Hartog, J. (1985). Earnings functions: Testing for the demand side, *Economics Letters*, vol. 19, pp. 281-285.
- Hartog, J. (1986a). Allocation and the earnings function, *Empirical Economics*, vol. 11, no. 2, pp. 97-110.
- Hartog, J. (1986b). Earnings functions: Beyond human capital, *Applied Economics*, vol. 18, no. 12, pp. 1291-1309.
- Hartog, J., (2000). Over-education and earnings: Where are we and where should we go? *Economics of Education Review*, vol. 19, pp. 131–147.
- Hartog, J., & Oosterbeek, H. (1988). Education, allocation and earnings in the Netherlands: Overschooling?, *Economics of Education Review*, vol. 7, no. 2, pp. 185–194.
- Haskel, J., & Martin, C. (1993). Do skill shortages reduce productivity? Theory and evidence from the United Kingdom, *The Economic Journal*, vol. 103, pp. 386-394.
- Heckman, J.J., Lochner, L.J., & Todd, P.E. (2005). Earnings functions, rates of return and treatment effects: The Mincer equation and beyond, Institute for the Study of Labor (IZA), Discussion Paper 1700.
- Helms-Jørgensen, C., & Warring, N. (2003). Learning in the workplace: The interplay between learning environments and biographical learning trajectories. In H. Salling-Olsen, (ed.), *Adult Education and the Labour Market VII*, Volume B. Roskilde: Roskilde University Press.
- Hersch, J. (1991). Education match and job match, *Review of Economics and Statistics*, vol. 73, pp. 140-144.
- Holzer, H. (1996). *What Employers Want: Job Prospects for Less-educated Workers*. New York: Russell Sage Foundation.
- Hosmer, D.W., & Lemeshow, S. (1989). *Applied Logistic Regression*. New York: John Wiley and Sons.
- Hum, D., & Simpson, W. (2004). What are Canadians doing after school: An analysis of post-school training activity. In J. Gaskell and K. Rubenson (eds), *Educational Outcomes for the Canadian Workplace. New Frameworks for Policy and Research* (pp. 89-117). Toronto: University of Toronto Press.

- Illeris, K. (2004a). A model for learning in working life, *Journal of Workplace Learning*, vol. 16, no. 8, pp. 431-441.
- Illeris, K. (2004b). Lifelong learning and the low skilled, *International Journal of Lifelong Learning*, vol. 25, no. 1, pp. 15-28.
- Jaoul-Grammare, M. (2007). The labour market segmentation: Empirical analysis of Cain's theory (1976), *Applied Economics Letters*, vol. 14, no. 5, pp. 337-341.
- Judy, R., & D'Amico, C. (1997). *Workforce 2020: Work and Workers in the 21st Century*. Indianapolis, IN: Hudson Institute.
- Katz, L.F. (2000). Technological change, computerization, and the wage structure. In E. Brynjolfsson and B. Kahin (eds), *Understanding The Digital Economy: Data, Tools, and Research* (pp. 217-244). Cambridge: MIT Press.
- Katz, L., & Murphy, K. (1992). Changes in relative wages, 1963-1987: Supply and demand factors, *Quarterly Journal of Economics*, vol. 107, no. 1, pp. 35-78.
- Kalleberg, A.L. (2003). Flexible firms and labor market segmentation: Effects of workplace restructuring on jobs and workers, *Work and Occupations*, vol. 30, pp. 154-175.
- Kalleberg, A.L. (2006). *The Mismatched Worker*. New York: W.W. Norton & Company.
- Kalleberg, A.L., Knoke, D., Marsden, P.V., & Spaeth, J.L. (1996). *Organizations in America: Analyzing their Structures and Human Resource Practices*. Thousand Oaks: Sage Publications.
- Kiker, B., Santos, M., & Mendes de Oliveira, M. (1997). Overeducation and undereducation: Evidence for Portugal, *Economics of Education Review*, vol. 16, no. 2, pp. 111-125.
- Kolev, A., & Saget, C. (2010). Are middle-paid jobs in OECD countries disappearing? An overview, International Labour Organization, Working Paper 96.
- Korpi, T., & Tåhlin, M. (2009). Educational mismatch, wages, and wage growth: Overeducation in Sweden, 1974-2000, *Labour Economics*, vol. 16, pp. 183-193.
- Krahn, H., & Lowe, G.S. (1998). *Literacy Utilization in Canadian Workplaces*. Ottawa and Hull: Statistics Canada and Human Resource Development Canada.
- Krueger, A. (1993). How computers have changed the wage structure: Evidence from microdata, *Quarterly Journal of Economics*, vol. 110, pp. 33-60.
- Lavoie, M., & Roy, R. (1998). Employment in the knowledge-based economy: A growth accounting exercise for Canada, Research Paper, Hull, Quebec, Applied Research Branch, Human Resources Development Canada.
- le Grand, C., Szulkin, R., & Tåhlin, M. (2004). Överutbildning eller kompetensbrist? Matchning på den svenska arbetsmarknaden 1974-2000". ("Overeducation or skill shortage? Matching in the Swedish labor market 1974-2000"). In M. Bygren, M. Gähler, and M. Nermo (eds), *Familj och arbete. Vardagsliv i förändring* (Family and Work. Everyday Life in Transition) (pp. 283-321). Stockholm: SNS Förlag.

- Leuven, E. (2001). *Studies in the Economics of Training*. Amsterdam: Universiteit van Amsterdam.
- Levy, F., & Murnane, R. (1992). U.S. earnings levels and earnings inequality; a review of recent trends and proposed explanations, *Journal of Economic Literature*, vol. 30, pp. 1333-1381.
- Lewis (2007). Braverman, Foucault and the labor process: Framing the current high-skills debate, *Journal of Education and Work*, vol. 20, no. 5, pp. 397-415
- Linbeck, A., & Snower, D.J. (2000a). Multitask learning and the recognition of work: From tayloristic to holistic organization, *Journal of Labor Economics*, vol. 18, no. 3, pp. 353-376.
- Linbeck, A., & Snower, D.J. (2000b). The division of labor and the market for organizations, Institute for the Study of Labor (IZA), Discussion Paper 119.
- Livingstone, D.W. (2005). Expanding conception of work and learning: Recent research and policy implications. In A. Cummings, N. Basica, A. Datnow, A.K. Leithwood, & D.W. Livingstone (eds), *International Handbook of Educational Policy Series*: Springer International Handbooks of Education, vol. 13. Retrieved February 3, 2006, from: http://wall.oise.utoronto.ca/resources/Livingstone_Springerbook_ch52.pdf
- Lloyd, C., & Payne, J. (2006). Goodbye to all that? A critical re-evaluation of the role of the high-performance work organization within the UK skills debate, *Work, Employment and Society*, vol. 20, no. 1, pp. 151-165.
- MacDonald, G., & Weisbach, M.S. (2004). The economics of has-beens, *Journal of Political Economy*, vol. 112, no. 1, pp. S289-S310.
- Martin, I. (2003). Adult education, lifelong learning and citizenship: Some ifs and buts, *International Journal of Lifelong Learning*, vol. 22, no. 6, pp. 566-579.
- Mavromaras, K., & McGuinness, S. (2007). Education and skill mismatches in the labour market: Editors' introduction, *Australian Economic Review*, vol. 40, no. 3, pp. 279-285.
- Mavromaras K., McGuinness, S., & Fok, Y. (2009a). Assessing the incidence and wage effects of over-skilling in the Australian labour market, *Economic Record*, vol. 85, pp. 60-72.
- Mavromaras K., McGuinness, S., & Fok, Y. (2009b). Overskilling dynamics and education pathways, Institute for the Study of Labor (IZA), Discussion Paper 4321.
- Mavromaras K., McGuinness, S., O'Leary, N., Sloane, P., & Fok, Y. (2010). The problem of overskilling in Australia and Britain, *Manchester School*, vol. 78, no. 3, pp. 219-241.
- Mavromaras, K., McGuinness, S., O'Leary, N., Sloane, P., & Wei, Z. (2010). Job mismatches and labour market outcomes: Panel evidence on Australian university graduates, Institute for the Study of Labor (IZA), Discussion Paper 5083.
- Mavromaras, K., McGuinness, S., & Wooden, M. (2007). Overskilling in the Australian Labour Market, *Australian Economic Review*, vol. 40, no. 3, pp. 307-312.
- McGoldrick, K., & Robst, J. (1996). Gender differences in overeducation: A test of the theory of differential overqualification, *American Economic Review*, vol. 86, pp. 280-284.

- McGuinness, S. (2006). Overeducation in the labour market, *Journal of Economic Surveys*, vol. 20, pp. 387-418.
- Mendes de Oliveira, M., Santos, M.C., & Kiker, B.F. (2000). The role of human capital and technological change in overeducation, *Economics of Education Review*, vol. 19, pp. 199-206.
- Meredith, J. (2008). *Mechanics of Class: Social Structure and Action in the Apprenticeable Skilled Trades at a Canadian Dockyard* (dissertation), University of British Columbia.
- Messinis, G., & Olekalns, N. (2007). Skill mismatch and training in Australia: Some implications for policy, *Australian Economic Review*, vol. 40, no. 3, pp. 300-306.
- Miller, P.W. (2007). Overeducation and undereducation in Australia: Policy forum: Education and skill mismatches in the labour market, *Australian Economic Review*, vol. 40, no. 3, pp. 292-9.
- Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of Political Economy*, vol. 66, no. 4, pp. 281-302.
- Mincer, J. (1962). On-the-job training: Costs, returns, and some implications. *Journal of Political Economy*, vol. 70, no. 5-2, pp. 50-79.
- Mincer, J. (1974). *Schooling, Experience, and Earnings*. New York: Columbia University Press.
- Mincer, J. (1997). Changes in wage inequality, 1970-1990. In S.W. Polachek and J. Robst (eds), *Research in Labor Economics*, vol. 16, pp. 1-18.
- Mincer, J. & Ofek, H. (1982). Interrupted work careers: Depreciation and restoration of human capital, *Journal of Human Resources*, vol. 17, no. 1, pp. 3-24.
- Murnane, R.J., Willet, J.B., Braatz, M.J., & Duhaldeborde, Y. (2001). Do different dimensions of male high school students' skills predict labour market success a decade later? Evidence from the NLSY, *Economics of Education Review*, vol. 20, pp. 311-320.
- Murnane, R.J., Willet, J.B., & Levy, F. (1995). The growing importance of cognitive skills in wage determination, *Review of Economics and Statistics*, vol. 77, no. 2, pp. 251-266.
- Nordin, M., Persson, I., & Rootha, D-O. (2010). Education-occupation mismatch: Is there an income penalty?, *Economics of Education Review*, vol. 29, pp. 1047-1059.
- OECD (1989). *Education and the Economy in a Changing Society*. Paris: Author.
- OECD (1996). *Lifelong Learning for All*. Paris: Author.
- OECD (2001). *Education Policy Analysis*. Paris: Author.
- OECD (2003). *Beyond Rhetoric: Adult Learning Policies and Practices*. Paris: Author.
- OECD/HRDC (1997). *Literacy Skills for the Knowledge Society: Further Results from the International Adult Literacy Survey*. Paris and Ottawa: Authors.
- OECD/Statistics Canada (1995). *Literacy, Economy and Society: Results from the First International Adult Literacy Survey*. Paris and Ottawa: Authors.

- OECD/Statistics Canada (2000). *Literacy in the Information Age: Final Report of the International Adult Literacy Survey*. Paris and Ottawa: Authors.
- OECD/Statistics Canada (2005). *Learning a Living: First Report of the Adult Literacy and Lifeskills Survey*. Paris and Ottawa: Authors.
- OECD/Statistics Canada (in press). *Learning for Life: Final Report of the Adult Literacy and Lifeskills Survey*. Paris and Ottawa: Authors.
- Oosterbeek (2000). Editorial: Introduction to special issue on overschooling, *Economics of Education Review*, vol. 19, pp. 129–130.
- Osberg, L. (2000). *Schooling, Literacy and Individual Earnings*. Ottawa and Hull: Statistics Canada and Human Resource Development Canada.
- Osberg, L., Wolff, E.N., & Baumol, W.J. (1989). *The Information Economy: The Implications of Unbalanced Growth*. Halifax: Institute for Research on Public Policy.
- Osterman, P. (1995). Skill, training, and work organization in American establishments, *Industrial Relations*, vol. 34, no. 2, pp. 125-146.
- Osterman, P. (2000). Work reorganization in an era of restructuring: Trends in diffusion and effects on employee welfare, *Industrial and Labor Relations Review*, vol. 53, no. 2, pp. 179–196.
- Pazy, A. (2004). Updating in response to the experience of lacking knowledge, *Journal of Applied Psychology*, vol. 53, pp. 436-452.
- Psacharopoulos, G. (1981). Returns to education: An updated international comparison, *Comparative Education*, vol. 17, no. 3, pp. 321-341.
- Psacharopoulos, G., & Patrinos, H.A. (2004). Returns to investment in education: A further update, *Education Economics*, vol. 12, no. 2, pp. 111-134.
- Quintini, G. (2010). Over-qualified or under-skilled: A review of existing literature. OECD document for official use [DELSA/ELSA/RD(2010)2].
- Raudenbush, S.W., & Kasim, R.M. (2002). *Adult Literacy, Social Inequality, and the Information Economy: Findings from the National Adult Literacy Survey*. Ottawa and Hull: Statistics Canada and Human Resource Development Canada.
- Reder, S. (1994). Practice-engagement theory: A sociocultural approach to literacy across languages and cultures. In B.M. Ferdman, R.M. Weber and A.G. Ramirez (eds), *Literacy Across Languages and Cultures* (pp. 33-74). Albany: State University of New York Press.
- Reder, S. (1998). Literacy selection and literacy development: Structural equation models of the reciprocal effects of education and literacy. In M.C. Smith (ed.), *Literacy for the Twenty-first Century: Research policy, practices and the National Adult Literacy Survey* (pp. 139-157). Westport, CT: Praeger.
- Reder, S. (2009a). The development of adult literacy and numeracy in adult life. In S. Reder and J. Bynner, J. (eds), *Tracking Adult Literacy and Numeracy Skills: Findings from Longitudinal Research* (pp. 59-84). Routledge: New York.

- Reder, S. (2009b). Scaling up and moving in: Connecting social practices views to policies and programs in adult education, *Literacy and Numeracy Studies*, vol. 16, no. 2, pp. 35-50.
- Riddell, C. (2004). Education, skills and labour market outcomes: Exploring the linkages in Canada. In J. Gaskell and K. Rubenson (eds), *Educational outcomes for the Canadian workplace. New frameworks for policy and research* (pp. 21-55). Toronto: University of Toronto Press.
- Riley, J.G. (1976). Information, screening and human capital. *American Economic Review*, vol. 66, no. 2, pp. 254-260.
- Rivera-Batiz, F.L. (1992). Quantitative literacy and the likelihood of employment among young adults in the United States, *Journal of Human Resources*, vol. 27, pp. 313-328.
- Robst, J. (2007). Education and job match: The relatedness of college major and work, *Economics of Education Review*, vol. 26, no. 4, pp. 397-407.
- Romer, P (1990). Endogenous technological change, *Journal of Political Economy*, vol. 98, S71-S102.
- Rosen, S. (1975). Measuring the obsolescence of knowledge. In F.T. Juster (ed.) *Education, Income and Human Behavior* (pp. 199-232). New York: McGraw-Hill.
- Rubenson, K., & Desjardins, R. (2009). The impact of welfare state regimes on barriers to participation in adult education: A bounded agency model, *Adult Education Quarterly*, vol. 59, no. 3, pp. 187-207.
- Rubenson, K., Desjardins, R., & Yoon E-S. (2007). *Adult Learning in Canada: A Comparative Perspective*. Statistics Canada: Ottawa.
- Rubenson, K., & Xu, G. (1997). Barriers to participation in adult education and training: Towards a new understanding, In P. Bélanger and A. Tuijnman (eds), *New Patterns of Adult Learning: A Six-country Comparative Study*. Oxford: Pergamon Press.
- Rumberger, R. (1987). The impact of surplus schooling on productivity and earnings, *Journal of Human Resources*, vol. 22, no. 1, pp. 24-50.
- Ryan, C., & Sinning, M. (2009). Skill matches to job requirements, National Centre for Vocational Education Research, Australia, Research Report.
- Salthouse, T. (2009). When does age-related cognitive decline begin? *Neurobiology of Aging*, vol. 30, no. 4, pp. 507-514.
- Sattinger, M. (1980). *Capital and the Distribution of Labor Earnings*. Amsterdam: North Holland Publishing.
- Sattinger, M. (1993). Assignment models of the distribution of earnings, *Journal of Economic Literature*, vol. 31, no. 2, pp. 831-880.
- Sawchuk, P.H. (2006). Use-value and the re-thinking of skills, learning and the labour process, *Journal of Industrial Relations*, vol. 48, no. 5, pp. 593-617.
- Schultz, T.W. (1961). Investment in human capital, *American Economic Review*, vol. 51, no. 1, pp. 1-17.

- Schultz, T.W. (1975). The value of the ability to deal with disequilibria, *Journal of Economic Literature*, vol. 13, no. 3, pp. 827-846.
- Sicherman, N. (1991). Overeducation in the labour market, *Journal of Labour Economics*, vol. 9, no. 2, pp. 101-122.
- Sicherman, N., & Galor, O. (1990). A theory of career mobility, *Journal of Political Economy*, vol. 98, no. 1, pp. 169-192.
- Sloane, P.J. (2003). Much ado about nothing? What does the overeducation literature really tell us?. In F. Büchel, A. de Grip and A. Mertens (eds), *Over-education in Europe: Current Issues in Theory and Policy* (pp. 11-48). Massachusetts: Edward Elgar Publishing.
- Sloane, P.J. (2007). Overeducation in the United Kingdom, *Australian Economic Review*, vol. 40, no. 3, pp. 286-291.
- Sloane, P.J., Battu, H., & Seaman, P. (1999). Overeducation, Undereducation and the British Labour Market, *Applied Economics*, vol. 31, pp. 1437-1453.
- Spence, A.M. (1973). Job market signalling, *Quarterly Journal of Economics*, vol. 87, no. 3, pp. 355-374.
- Spenner, K.I. (1983) Deciphering prometheus: Temporal change in the skill level of work, *American Sociological Review*, vol. 48, no. 6, pp. 824-837.
- Staff, R.T., Murray, A.D., Deary, I.J., & Whalley, L.J. (2004). What provides cerebral reserve?, *Brain*, vol. 127, pp. 1191-1199.
- Statistics Finland (2000). *Adult Education Survey 2000*. Helsingfors: Statistics Finland.
- Stigler, G. (1961). The economics of information, *Journal of Political Economy*, vol. 69, pp. 213-225.
- Swedberg, R. (1996) (ed.). *Economic Sociology*. Cheltenham: Edward Elgar.
- Thurow, L.C. (1975). *Generating Inequality: Mechanisms of Distribution in the U.S. Economy*. New York: Basic books.
- Tinbergen, I. (1956). On the Theory on Income Distribution. *Weltwirtschaftliches Archiv* 77, pp. 156-175
- Tinker, T. (2002). Spectres of Marx and Braverman in the twilight of postmodernistic labour process research, *Work, Employment and Society*, vol. 16, no. 2, pp. 251-281.
- Toossi, M. (2002). A century of change: The U.S. labor force, 1950-2050, *Monthly Labor Review*, vol. 125, no. 5, pp. 15-28.
- Torres, C.A. (1996). Adult education for development. In A. Tuijnman. (ed.), *International Encyclopaedia of Adult Education and Training*, 2nd edition (pp. 213-221). Oxford: Pergamon Press.
- Tuijnman, A.C. (2000). Education, literacy and wages in Poland in comparative perspective, Yellow Paper Series, Stockholm, Institute of International Education.

- UK Commission for Employment and Skills (2010). Skills for jobs: Today and tomorrow: The national strategic skills audit for England 2010, volume one: Key findings, UK Commission for Employment and Skills.
- US Department of Education (1998). Adult education participation decisions and barriers: Review of conceptual frameworks and empirical studies. National Center for Education Statistics, Washington D.C. Office of Educational Research and Improvement, Working Paper 98-10.
- Ure, O.B. & Saar, E. (2008). Some Micro - Meso - Macro Relations In Lifelong Learning, LLL2010 Working Paper No 17. (accessed May 27, 2011) http://lll2010.tlu.ee/publications/working-papers/lll2010-working-papers-on-overall-theoretical-framework/d13-2-lll2010-working-paper-17_ad-hoc.pdf/view
- Vahey (2000). The great Canadian training robbery: Evidence on the returns to educational mismatch, *Economics of Education Review*, vol. 19, pp. 219–227.
- Valla, S.P. (1990). The concept of skill: A critical review, *Work and Occupations*, vol. 17, no. 4, pp. 379–398.
- van der Meer, P.H. (2009). Investments in education: Too much or not enough?, *Economics Letters*, vol. 102, pp. 195–197.
- van Smoorenburg, M., & van der Velden, R. (2000). The training of school leavers, complementarity or substitution?, *Economics of Education Review*, vol. 19, pp. 207–217.
- Velloso, J. (1995). Income distribution and education. In M. Carnoy (ed.), *International Encyclopedia of Economics of Education, Second Edition* (pp. 230–234). Oxford: Pergamon Press.
- Verdugo, R., & Verdugo, N. (1989). The impact of surplus schooling on earnings, *Journal of Human Resources*, vol. 22, no. 4, pp. 690–695.
- Verhaest, D., & Omey, E. (2006). The impact of overeducation and its measurement, *Social Indicators Research*, vol. 77, pp. 419–448.
- Vignoles, A., Galindo-Rueda, F., & Feinstein, L. (2004). The labour market impact of adult education and training: A cohort analysis, *Scottish Journal of Political Economy*, vol. 51, no. 2, pp. 266–280.
- Weiss, A. (1995). Human capital vs. signalling explanations of wages, *Journal of Economic Perspectives*, vol. 9, no. 4, pp. 133–154.
- Welch, F. (1970). Education in production, *Journal of Political Economy*, vol. 78, no. 1, pp. 35–59.
- Wolf, A. (2003). *Does Education Matter?: Myths About Education and Economic Growth*. London: Penguin Books.
- Wolff, E.N., & Baumol, W.J. (1989). Sources of postwar growth of information activity in the United States. In L. Osberg, E.N. Wolff and W.J. Baumol (eds), *The Information Economy: The Implications of Unbalanced Growth* (pp. 17–46). Halifax: Institute for Research on Public Policy.
- Woodhall, M. (2001). Human capital: Educational aspects. In N.J. Smelser and P. Baltes (eds), *International Encyclopaedia of the Social and Behavioural Sciences* (pp. 6951–6955). Oxford: Elsevier.
- Zuboff, S. (1988). *In the Age of the Smart Machine: The Future of Work and Power*. New York: Basic Books.

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