Training and skills to improve innovation in firms

Compendium of Evidence on the Effectiveness of Innovation Policy Intervention

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The compendium is organised around 20 innovation policy topics categorised primarily according to their policy objectives. Currently, the following reports are available:

- Fiscal Incentives for R&D
- The Impact of Regulation on Innovation
- Supporting Transfer of Codified Knowledge
- Training and Skills to Improve Innovation Capabilities in Firms

All reports are available at [http://www.innovation-policy.org.uk](http://www.innovation-policy.org.uk). Also at this location is an online strategic intelligence tool with an extensive list of references that present evidence for the effectiveness of each particular innovation policy objective. Summaries and download links are provided for key references. These can also be reached by clicking in the references in this document.
Table of Contents

Table of Contents .............................................................................................................................. II
Table of Figures ................................................................................................................................. II
Table of Boxes ................................................................................................................................. II
List of Tables ................................................................................................................................. II
Executive summary ........................................................................................................................... 1
1 Introduction ...................................................................................................................................... 2
2 Conceptual Background ................................................................................................................... 4
  2.1 Innovation linkages .................................................................................................................... 4
3 Scope of the literature review .......................................................................................................... 7
4 Innovation impact ........................................................................................................................... 8
  4.1 Findings from empirical studies ................................................................................................ 8
  4.2 How to value and utilise skills for innovation success? .............................................................. 10
  4.3 The Costs and Financing of Training at Enterprise Level ........................................................... 11
5 Conclusions .................................................................................................................................... 18
References .......................................................................................................................................... 19

Table of Figures

Figure 1: A model of interlinkages between components of skill systems and innovation .......... 5

Table of Boxes

Box 1: Country examples of direct reimbursement of training ......................................................... 13

List of Tables

Table 1: Summary of evaluations of the contribution of training to improved performance ............ 9
Table 2: Levy schemes, policy lessons and country examples .............................................................. 13
Table 3 Advantages and Limitations of Levy Systems .................................................................... 17
Executive summary

Skills and innovation are often claimed to be the twin engines of economic growth but there is a surprisingly limited appreciation of how these core features combine and interact. Governments around the world, especially in high-income countries, have invested in higher education to improve ‘human resources in science and technology’, as well as to grow the pool of ‘knowledge workers’ equipped with skills of problem-solving and analytical thinking ready to contribute to expanding knowledge-intensive industries. There is thus an apparent consensus that skilled workers are needed to create and diffuse the knowledge needed for successful innovation performance. But what evidence underpins this policy consensus? In particular:

- Do innovative firms tend to utilise a more skilled workforce than non-innovative firms?
- Do innovative firms devote more resources to training provision than non-innovative firms?
- What are the interlinkages between skill types and innovation types and do these vary by industry (e.g. services versus manufacturing)? and
- How important is high-level, tertiary education as opposed to intermediate, vocational training for innovation?

At the conceptual level, a cursory reading of the innovation literature reveals a rather oblique interest in matters of worker skill and firm provision training. Notions of ‘in-house capacity’, ‘knowhow’ and ‘human capabilities’ are theorised in preference over more real-world notions of on-the-job training, apprenticeships, graduate training, shared training programmes, and so on. This makes it difficult to draw the inferences for training and skill from the conclusions of innovation research. Nevertheless, this report distils four key analytical concepts from innovation studies and makes the relevant links with innovation performance at firm level. These are: knowledge (e.g. knowledge cumulativeness implies a need for sustained commitment to skill development for innovation); skill (e.g. project skills are critical for radical innovations but we understand very little about how to organise these mixed tacit and formal skills); training (e.g. training expenditures are critical for technology diffusion and to support technology investments); and firm competences (e.g. competences play a key role in underpinning absorptive capacity). While there are many useful insights in the literature, for the most part the training/skill-innovation interlinkages remain under-researched. Most studies set out with the rather modest task of analysing simple associations, for example between R&D spending and the share of qualified scientists and engineers in the sector or firm. Where there is a focus on the effects of differences in training provision or skill-mix at the level of the firm the analysis tends to focus on the productivity and profitability effects rather than innovation.

A state-of-the-art review of the limited empirical evidence on the association between training/skill and innovative performance at the firm level reveals two key findings:

1. there appears to be a positive association between innovative firms and the level of expenditures on formal and informal training compared to non-innovative firms; and
2. firms benefit from a significant positive effect by developing their ‘knowledge pool’, particularly with respect to the organisation’s legacy of past innovations and the technical competences of owner-managers in small and medium-sized firms.

Key issues for policy follow from these and other insights presented in the report:

- high skill-mix in firms needs to be developed through better incentives;
higher education is valuable but so too are intermediate skills – in particular there is a clear positive innovation effect of intermediate technical skills and firm's investment in ‘technicians';

- innovative performance is associated with the making rather than the buying of skills because of the way skill development enhances absorptive capacity; and

- evidence of sector-specific interlinkages between training and innovation supports the need to further reinforce institutions such as sector skill councils.

There are nevertheless gaps in our knowledge. We do not know much about what groups of workers and managers within an organisation need particular training for the skills required to enhance innovation performance. Also, surveys show that many skills are underutilised by firms suggesting that workers do not often enjoy the opportunity to contribute to improving innovation performance. Moreover, many firms do not systematically calculate the costs or measure the benefits of training; Eurostat company surveys indicate that almost three in five companies do not evaluate the effects of their training provision.

As a particular example of policy, the report considers the relative merits of levy schemes for encouraging training as a relatively straightforward means of intervention with the goal to improve innovation performance. An international review of country experiences of levies, tax rebates and tax incentives draws out several lessons for policy. Compulsory systems have the advantage of an economy-wide approach but may require strong engagement of social partners to establish a lasting reputation. The careful positioning of a levy scheme within the wider skill formation system of an economy is fundamental to its design since there is a positive opportunity to develop the wider training infrastructure through new agencies in the public and private sectors. Schemes can be targeted, for example with special provisions for small and medium-sized firms or for sectors such as construction or social care. Finally, given the tendency for employers to favour skills tailored to the needs of their business some schemes are notable in that they usefully incorporate incentives to encourage the development of general, transferable skills.

Further empirical research is urgently required in this important policy area. The report concludes with several recommendations including: exploring the innovation consequences of targeted sector-based training investments; cross-national evaluations of the innovation effects of varying training levy schemes; and new methods for firms to assign value to their stock of skills and prospective training investments.

1 Introduction

The policy dialogue on innovation has generally held that governments should facilitate the creation and transfer of knowledge and remove unnecessary impediments to its diffusion. Typically this means governments should subsidise the creation of new knowledge through publicly funded scientific research and support for higher education and better quality schooling, as well as the coordination and/or investment in vocational education and training. In many countries, therefore, governments have intervened with numerous innovation policy initiatives to expand the tertiary education sector and increase R&D expenditures, including for example the recent policy focus on expanding ‘Human Resources in Science and Technology’ (HRST). This recent policy focus responds to the wider policy objective, common to most
Training and skills to improve innovation in firms

Jones and Grimshaw

advanced capitalist countries, of moving towards a knowledge-based innovative economy as the mechanism for successful competitive growth; in particular, it seeks to meet a rising demand for a particular bundle of skill and expertise that includes conceptual problem-solving and analytical reasoning (Brown et al. 2001, Gallie 2009).

Yet it also reflects a growing awareness over recent years that innovation combined with the development and accumulation of skills potentially act as the ‘twin engines of growth’ (Lloyd-Ellis and Roberts, 2002), which can be guided by appropriate policy measures at the firm, regional and national levels. A skilled workforce is a key conduit for the creation, transfer and diffusion of knowledge and provides a foundation for innovation to occur.

While investments in HRST and leading-edge scientific and engineering endeavours are undoubtedly critical for productivity and economic growth, policies with a narrow HRST focus are likely to generate deficits in the wider stock of essential technical and intermediate-level skill and knowledge (Bosch and Charest 2009, Steedman 1991, Grubb 1996), which is typically developed through combinations of school and workplace-based vocational education and training. Careful consideration of the roles played by HRST and more general technical and intermediate skills in fostering and sustaining innovation is thus required in order to support an effective policy framework.

Nevertheless, the formulation of policy in a context of deep uncertainty and instability in economic prosperity, along with fast-changing technologies, a much-shortened product life cycle across multiple markets and intensified global competition, is a complex task. Recent decades have witnessed waves of obsolescence of skills as a result of wholesale replacements of technologies and their associated infrastructures. Moreover, in the context of the ongoing recession and austerity, firms and governments lack the incentives to invest in new skills because of uncertainty about both their ability to recoup the returns and whether or not the new skills will fit with new technological developments. The low-risk response is to invest in ‘generic’ or ‘adaptable’ skills often at the expense of under-investing in specialist scientific and technical skills and knowledge at both intermediate and high levels. The key issue here is that markets are not designed to send effective signals to the various actors (students, workers, employers and governments) to allocate the required funds for skill development. The problem of ‘market failure’ of education and training systems is widely recognised, as is the danger of under-investment which can easily lead to a vicious downward spiral of deskilling, whereby capital investment adjusts its technological level to that of the low level of skills available, in turn creating more demand for lower level skills, which discourages further investment in higher level skills (Snower 1996).

A further issue is that training and patterns of learning occur in multiple forms. Formal and informal mechanisms of interaction and learning within firms enable employees to share information, challenge existing routines and practices, and experiment and collaborate to improve products and processes. The form of training provision and the wider skill formation system provide a set of limits and opportunities for guiding innovation performance at all levels of the economy. Training is thus defined by conditions internal and external to the firm – including on the one hand the organisation-specific design of jobs and informal/formal training provision, as well as the human resource policies of recruitment, pay and careers that nurture a

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1 This approach is linked to the longstanding view in economics that skill is a driver for economic growth at the level of the firm (Becker 1964, Bowles et al. 2001).
particular skill-set among the workforce, and, on the other hand, the external institutional forms of schooling, higher education and the roles of government, employers and unions in delivering vocational training (e.g. Keep and Mayhew 2010, Warhurst et al. 2004).

This report reviews the key impacts of training policy on innovation performance. It begins by setting out the relevant conceptual background for understanding the interlinkages between components of skill systems and innovation. Section 3 describes the scope of the literature and policy review that is undertaken in section 4. Section 5 concludes by drawing out the lessons for policy.

2 Conceptual Background

Despite its obvious relevance for innovation and its role in enhancing competitiveness, the innovation literature has been remarkably laggard in appreciating the need for detailed interrogation of the character and meaning of skills formation and training systems (although see Lorenz and Lundvall 2006, Tether et al. 2005). Indeed, Edquist (2005) has argued relatively recently that,

'[there] is little systematic knowledge about the ways in which the organization of education and training influences the development, diffusion and use of innovations’ (2005: 185).

Within the innovation and business studies literature (encompassing many different approaches to innovation) there is agreement that firms require people with particular bundles of skills to pursue different product-market strategies: employees with ‘general’ or ‘multi-tasking’ skills are said to be needed for radical product innovation (RPI), workers with ‘firm-specific’ or ‘occupational specialization’ skills are seen to facilitate incremental product innovation (IPI) and low qualified (inexpensive) labour is claimed to be required for low cost production based on product imitation (PI) (Porter 1990, Freeman and Soete 1997, Hall and Soskice 2001, Casper and Whitley 2004, Nooteboom et al. 2007, Patel and Pavitt 1994). Underpinning this model is the accepted notion that the increased exposure of people to new ideas – be it in the form of employees changing firms more regularly, be it in the form of scientists as autonomous and performance oriented in their choice of research projects – is crucial for the emergence of radical innovations.

What is not clear, however, is whether firms need to hire scientists, for example, with a particular knowledge profile in addition to a workforce with distinct qualifications or particular skill profiles in order to pursue RPI, IPI, and/or PI strategies of innovation, respectively. A focus on the specific types, qualities and compositions of such skills embedded in specific occupations and industries, along with attention to the changing nature and evolution of skills in the most innovative and technologically advanced areas of the economy, have both been absent from the main body of the innovation studies literature at considerable cost to our understanding of the interaction processes.

2.1 Innovation linkages

This next section briefly hypothesises the various interlinkages between the concepts of knowledge, skill, training and firm competencies and the resulting innovation. Figure 1 presents a stylised portrayal of the mechanisms bridging skill and training with innovation.
Links between knowledge and innovation:

- the degree of accessibility of knowledge is critical to innovation impacts. Greater accessibility of knowledge among firms within a given sector brings lower appropriability, since competitors gain knowledge and can imitate new products/processes for example (Malerba 2004);
- the degree of cumulativeness of knowledge impacts upon innovation. For example, a first-mover advantage enjoyed by a firm may generate a ‘success breeds success’ environment where the knowledge is highly cumulative (Malerba 2004).

Figure 1: A model of interlinkages between components of skill systems and innovation

- accessibility of knowledge
- cumulativeness of knowledge
- knowledge transfer
- project work
- cognitive dissonance
- technology diffusion
- technology investment
- learning
- firm adaptability
- absorptive capacity
Linkages between skill and innovation

- Skilled workers can play a critical role in the transfer of knowledge between firms, sectors and countries, whether through collaboration on R&D and technical problem-solving by firms involved in supply-chains (Lundvall, 1992), mobility of highly-qualified engineers and scientists between firms (Mason et al., 2004) or in facilitating the acquisition of client-specific knowledge in complex models of outsourcing plus staff transfer (Miozzo & Grimshaw, 2011);

- An increasing number of persons are employed in activities where skills are developed in and through innovative project work. The acceleration of the development of new skill-sets and technologies is combined with a tendency for developmental, design, and implementation work to be carried out by multi-disciplinary teams often working on specific projects (Whitley, 2006). In these environments it is difficult to assign skills to individuals, since while working on problems individuals develop tacit or local knowledge of specific aspects of the work which do not necessarily belong within the area of their core competence. The design industry is illustrative. Recent studies suggest large design firms are organised ‘around a multi-unit skill system to leverage economies of scope ... [reliant upon] a combination of professional knowledge bases and somewhat formalised processes to provide unique service offerings’ (Miozzo et al., 2010: 12). The skills and knowledge within such firm units are also a function of spillovers from contact with workers in other firms which may be quite different from one locality or firm to another. Since many workers in such situations use computer software or other analytical tools which have a great potential for different uses they can develop different paths to innovative outcomes which may never be replicated by a team composed of persons with different knowledge and skills;

- Fast-changing environments (related to product markets, work organisation, new technologies) can lead to problems of cognitive dissonance between employees and managers in relation to the definition of skills and training which can have adverse or unintended consequences for innovation. The problems are often represented as skill gaps or skill shortages, as well as failures in the understanding of how existing skills are being transformed in the innovation process. At the same time, problems of skill gaps can in certain circumstances be compatible with a successful innovative economy for the following reasoning. Successful innovation creates a demand for new levels of skills and skill-sets, which the education and training systems can only gradually meet because of the normal lags of policy response. As such, it would be unreasonable to expect an innovative economy to be one without shortages of skilled labour.

Linkages between training and innovation

- Training can be construed as a mechanism for technology diffusion where the effective deployment of technology and improved operational techniques invariably involve changes in human capital requirements.

- Linkage effects tend to be sector-specific since much depends on the level of technological investment and type of product market competition

- Forms of learning are shaped by distinctive and path-dependent conventions/traditions with respect to how to solve employment and innovation problems through single-firm approaches, sector initiatives, government-subsidised methods or coordinated actions among government and social partners (see Bosch and Charest, 2009).
Training and skills to improve innovation in firms

Linkages between firm competencies and innovation

- A key firm strategy is to exploit its competencies in order to 'build capacity', that is, the ability to develop and realise strategies to adapt to new circumstances. In order for firms to identify and make effective use of knowledge, ideas and technologies generated elsewhere, what is required is dynamic capability and absorptive capacity, which may be created through the development or acquisition of high levels of workforce skills (Teece et al. 1997, Teece & Pisano 1998, Griffith et al. 2004).

- Underlying and assisting the development of absorptive capacity is the ability and skills of the workforce that firms have to draw upon. The stock of skills inevitably sets limits on how much firms can develop this capacity. Increasing the stock of skills and distributing their deployment to where they are best operationalised within the value chain is then critical to achieving greater international competitiveness.

3 Scope of the literature review

The literature search looking for empirical studies on the impact of skills based CVET for innovation including evaluations of policy impacts, for studies as to how firms valued training for skills and funding for training at firm level was conducted on the Web of Science, and databases of ERIC, CEDEFOP, ILO, UNEVOC and OECD Studies in Innovation. Very few studies emerged that were specifically focused on demonstrating an empirical causal relationship between skill formation and innovation or on the impact of policies specifically targeted at training, skill formation and innovation; most were concerned with the effect of training on productivity and/or profitability and on the work environment. This may be because data regarding on-the-job training and probably most in-company training schemes are under-reported and fragmented (Nilsson 2010) making it difficult to assess the impact of firm training on innovation and the impact of policies aimed at enhancing skill formation for innovation.

A further problem, at a conceptual level, is that the complex nature of training and skill development has been somewhat obscured by the application of Becker's simplified dualist categorisation of training as either general or firm-specific, which makes it difficult to extrapolate a real-world connection with innovation performance (Smits 2008). Becker’s (1964) categories suppose general training adds to the value of trained labour in any occupation and specific training is only of value to a specific employer. If this were true, it would be relatively easy to assign the cost of training to one partner or the other and the impact of training on productivity/profitability. The problem is that cases of pure general or pure specific training are rare: most training necessarily contains both general and specific elements. In different economic sectors the boundaries between general and specific are inherently different depending on the degree to which work processes can be varied: the degree of specificity varies and so does market evaluation of the skills.

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2 See, for example, Leitch Review of Skills (2006), and BIS (2009) for further evidence.
4 Innovation impact

4.1 Findings from empirical studies

Several studies have sought to investigate the impact of training and skill development on dimensions of economic performance, including in some cases innovation performance (summarised in table 1). Two international reviews provide a valuable starting point. These meta-analyses include a major OECD (1998) evaluation of 19 studies covering 10 countries and a more recent Cedefop report (Descy & Tessarin 2005) that summarises 13 studies from eight countries.

Two outcomes from these meta-analyses are clear. First, firms that provide training enjoy productivity gains and these gains are approximately divided between the workforce (wage increases) and the firm (increases in productivity). Second, both reviews generally confirm that firm-based training has the greatest impact on performance when undertaken in connection with wider changes in work organisation, job structure, and, in some instances, technological innovation. Overall, it is striking that only four studies out of 32 reviewed in these two reports referred explicitly to innovation in the context of skills and training. The impact of training policies was primarily discussed in terms of its macroeconomic implications for job growth under conditions of skill shortages or mismatches.
### Table 1: Summary of evaluations of the contribution of training to improved performance

<table>
<thead>
<tr>
<th>Study</th>
<th>Evaluation focus</th>
<th>Relevant findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abreu et al. (2010)</td>
<td>What are the different training-innovation linkages between services and manufacturing firms?</td>
<td>• Services firms in the UK tend to commit a higher share (than manufacturing) of spending to training with an explicit innovation component</td>
</tr>
<tr>
<td>Amara et al. (2008)</td>
<td>What investments in training are required for innovation?</td>
<td>• firms require an adequate knowledge pool of skilled manpower to develop both incremental and radical innovations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• this pool of knowledge can be enhanced through investments in staff training</td>
</tr>
<tr>
<td>Baldwin and Johnson (1996)</td>
<td>What are the features of training provision in more/less innovative firms?</td>
<td>• more innovative firms offer formal and informal training more often and with greater continuity than less innovative firms</td>
</tr>
<tr>
<td>Danish Ministry of Business and Industry (1996)</td>
<td>What are the implications of technological and organisational change for labour demand, firm performance and industrial policy?</td>
<td>• Firms that introduced process/product innovations plus training were more likely than non-innovators to report output growth, job growth and labour productivity growth</td>
</tr>
<tr>
<td>Freel (2004)</td>
<td>What is the association between firm-level innovativeness and a variety of indicators of skills, skill requirements and training activity (in UK SMEs)?</td>
<td>• importance of intermediate ‘technical’ skills, rather than higher level ‘technology’ skills, for innovation performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• innovation depends on acquisition and development of skill not simply their presence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• strong relationship between training intensity and product/process innovation</td>
</tr>
<tr>
<td>Human Resources Development Canada and OECD (1997)</td>
<td>What workplace strategies deliver better outcomes in a context of technological and organisational change?</td>
<td>• Bundles of organisational innovations, including training, can result in better performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Technologically and organisationally innovative firms place a premium on highly skilled workers and tend to pay them more</td>
</tr>
<tr>
<td>Laplage and Bengsted (1999)</td>
<td>What is the impact of general training and innovation on the performance of workplaces in Australia?</td>
<td>• Poor training is a significant contributor to below-average productivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Innovation performance a key contributor to high productivity firms</td>
</tr>
<tr>
<td>Leiponen (1996)</td>
<td>What are the education/skill characteristics of workforces in innovative vs non-innovative firms?</td>
<td>• Innovative firms have a more educated workforce, are more profitable than non-innovating firms and are more dependent on educational competence for generating their profit;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Complementarities exist between different general skills acquired in tertiary education</td>
</tr>
<tr>
<td>Albaladejo and Romijn (2000)</td>
<td>What are the determinants of innovative capabilities among UK small firms?</td>
<td>• The skill-mix of a workplace (especially the share of highly educated) has a positive impact on innovation performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Owner’s technical education and prior work experience positively impact on innovation performance</td>
</tr>
</tbody>
</table>

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3 Source: own compilation from cited studies as well as those referenced within OECD (1998) and Descy and Tessarin (2005).
Both international reviews had a similar focus in that they tried to establish not only productivity effects but also the distribution of accruing benefits, for example wage increases for employees or the value of training for the firm. Both included studies that were designed to reveal causal relationships, not just correlations, between training and productivity. Both reported that whilst many studies reported measurable effects from training, not all of them did and that productivity increases were observed also in the absence of explicit training or capital investments. Both sets of studies at firm level indicated that training on average had positive economic effects but that these effects were not universal; training did not automatically increase productivity and increasing productivity did not automatically translate into increased profitability.

These empirically based studies appear to indicate that in general:

- innovative or innovating firms engage in more training than non innovating firms;
- the skill composition of a firm’s workforce is an important contributing factor but the type of skill-mix best suited to innovation performance is contingent;
- innovative or innovating firms spend more on training (both acquisition and development of skill).

### 4.2 How to value and utilise skills for innovation success?

At the heart of the problem is the difficulty of assigning an appropriate value to the benefits of training. In particular:

- it is difficult to assess the quality of training programmes and the links to job prospects in advance;
- where employers invest resources, some of the benefits may be lost for that specific firm if the employees take up new jobs or are poached;
- there is ‘asymmetric information’ in the labour market for skills due to the lack of certification, namely a lack of recognition of acquired qualifications or skills making it difficult to ‘inform’ other market parties of the additional capabilities obtained; and
- it is difficult to finance education and training since it is an intangible investment good that by its character cannot serve as collateral.

A major disincentive to training (especially in SMEs) arises from the fact that neither employers nor employees can be sure of receiving an adequate return on investment in human capital due to market imperfections (Crouch et al. 1999, Miller 1996). For employers this is because of uncertainty about the productivity outcome of training as there is no body of publicly or commercially available information which allows firms to evaluate the future income likely to be generated by investment in training comparable to that available on investment in physical capital. This is a crucial underlying reason why most OECD countries do not provide formal recognition of human capital as an asset in financial accounting and reporting systems at any level (Miller 1996). It is often thought that the reason why human capital cannot be treated as an asset by the firm is because individual employees can exit, but it is also a result of the fact that employment contracts are vague precisely because of the inadequate methods for measuring human capital and its outcomes. If the value of training was more adequately known, then long-term agreements between employers and employees about how to finance training would become possible. There is already widespread contractual agreement between employees and employers about the financing of training, but at present this is often
conceptualised primarily as some form of loan, without explicit valuation of the training as an asset. This means that the creation of human capital is seen as a current expense rather than as an investment, creating an institutional disincentive to invest in human as opposed to physical capital. Miller’s (1996) analysis (and confirmed by the OECD’s (1998: 91-5) meta-analysis) lists several options for government policies to contribute to create a positive environment for human capital investment:

- Strengthening market valuation of training and competences - A transparency and competence-based skills validation system would encourage both validation of prior learning and incremental addition of new modular skills, by providing greater assurance of later market valuation.
- Capitalisation allowing firms to collateralize and amortize knowledge – which could allow projection of skills depreciation and upgrade costs, and give some warning of obsolescence and natural loss through aging.
- Clear ownership allowing direct financing of knowledge acquisition - If clearly defined competences are linked to productivity outcomes the question of which party should finance training are greatly simplified
- Transparency of labour contract as this would bring out both employee assets and employer benefits which are currently hidden. At a further stage of development of a transparency-based system skills can be treated as a leased asset for accounting purposes, allowing the employer to use depreciation accounting while the employee can more easily recover costs of acquiring or upgrading skills.
- Validation of alternative learning acquisition - a competence-based skills system could reduce artificial distinctions between formal and informally acquired knowledge.
- Identification of investment patterns - if training is recorded as an investment with relatively predictable outcomes it becomes possible to recognise patterns of ‘over’ or ‘underinvestment’.
- Discouragement of ‘unfair’ rents, reduction of information 'noise' and discrimination – this could reduce discrimination on the basis of prejudice and ascribed characteristics, benefiting marginalised groups and individuals enhancing entry to and mobility within labour markets.

4.3 The Costs and Financing of Training at Enterprise Level

Market imperfections and externalities affecting training referred to above have resulted in many countries (including the UK) considering the introduction or extension of levies on firms to encourage investment in training. In a context of market failures in the provision of training, levies are regarded as a means of mobilizing additional resources for skills development. While levy type policies are generally not targeted directly at strengthening innovation capacity, they can be assumed to have a positive impact by boosting the skill base. A review of country policies and their effectiveness highlight a number of issues. Levy schemes can increase the volume of training. Levy schemes can support the development of a wider network of infrastructure in skill and training. Levy schemes may be suitably adapted so as to provide targeted assistance or

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4 The recent UK Leitch Review (2006: 79), for example, advocates a reinvigorated levy/grant system as a means of encouraging employers to engage training activities, to meet current needs and to enhance continuing vocational training and lifelong learning for skill formation.
exemptions for small and medium-sized firms. Finally, levy schemes may be designed around either a universal model or a highly differentiated reimbursement schemes depending on the perceived merits in particular situations of general versus specific skills, for example, or particular sectors of the economy. The key issues and country examples are summarised in table 2.

Recent international reviews (e.g. Dar et al. 2003, EIM/SEOR 2005) of levy-grant schemes identify multiple forms:

i) those where fund administrators use earmarked levies to distribute grants to employers for approved training, as in Singapore and previously in the United Kingdom;

ii) training levy rebate schemes, where employers are partially reimbursed for approved training out of their payroll levies (Malaysia, Nigeria and the Netherlands);

iii) levy exemption schemes where employers are exempt from levy payments provided they spend a given percentage of their payroll on training (France, Korea, and Morocco); and

iv) tax incentives for approved training paid out of general revenues (Chile and previously in Malaysia) (Dar et al. 2003).

Levy schemes may cover all sectors of the economy or target specific sectors. They are extremely common within the EU - accounting for an estimated one in ten demand-oriented instruments for fostering workforce training (EIM/SEOR 2005). A number of countries have resorted to imposing payroll taxes on enterprises to contribute towards the funding of training in specialized institutions and/or in enterprises. The key principle behind such schemes appears to be “who benefits pays”; while the cost of general training ought in principle to be shared with the trainees, employers should assume the bulk of firm-specific training costs. Payroll taxes are also attractive to governments because they provide a sheltered source of revenue for training and a means of mobilizing funds that may otherwise be unavailable to the public sector.

Data from the World Business Environment Survey (a survey of 10,000 firms in 80 countries 1998-mid 2000) reported by Batra et al (2003) and Batra and Tan(2002) show that several East Asian economies have used direct reimbursement of approved training expenses, funded through payroll levies, to encourage firms to train their employees. Successful schemes evaluated were shown to be flexible, demand-driven, and often accompanied by an information campaign and technical assistance to smaller firms (see box 1).
Box 1: Country examples of direct reimbursement of training

**TAIWAN:** The introduction of such a scheme in Taiwan (China) led to dramatic increases in training, which continued after the program ended in the 1970s.

**SINGAPORE:** Uses a levy on the wages of unskilled workers to upgrade worker skills through the Skills Development Fund: to raise awareness of training among firms, to support development of company training plans, and to provide assistance through industry associations. There has been a steady rise in training, especially among smaller firms.

**KOREA:** Scheme required training last a minimum of six months or that firms pay a fine, many firms paid the penalty rather than train to this standard so acted as a disincentive. However grants for developing training plans, organized regional courses on training need assessments, and a variety of subsidized programs targeting small enterprises indicate that these aspects of scheme have increased the incidence of training in enterprises.

**MALAYSIA:** Human Resource Development Fund (HRDF) set up in 1993 with matching grant from government. Eligible employers with 50 employees and above are required to contribute 1 percent of payroll to the HRDF. Those who have contributed a minimum of six months are then eligible to claim a portion of allowable training expenditures up to the limit of their total levy payments for any given year. The HRDC set rates of reimbursement, varying by type of training and generally lower for larger firms Impact studies not available

Table 2: Levy schemes, policy lessons and country examples

<table>
<thead>
<tr>
<th>Relevant features of levy schemes</th>
<th>Policy lessons</th>
<th>Country examples</th>
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</table>
| 1. Compulsory economy-wide application | Maximum impact on increasing training volumes  
Engagement of social partners facilitates building a strong reputation | • France's training levy |
| 2. Positioning in wider skill formation system | Can support the wider development of skill/training infrastructure  
Increased expenditures directly boosts the development of a market (public and/or private) for training provision | • Japan, Korea |
| 3. Coverage of SMEs | SMEs least likely to invest in training therefore need targeting  
Need to balance unwelcome costs versus targeted subsidies | • Australia construction sector |
| 4. Differentiated schemes | Schemes can be designed to reduce employer bias against training in general skills  
Differentiation in fees/reimbursements possible by sector, firm size, firm age | • Malta, UK construction sector |

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5 Source Batra and Tan (2002).
In France\(^6\), the training levy has been in continuous use since 1925. In 1971 the Further Training Act stipulated that French private companies (with more than 10 employees) spend 1.6% of their wages and salaries bill on further training activities or pay the equivalent into funds set up for this purpose. A minimum of 0.9% must be allocated to a training plan drawn up and implemented by the employer, while 0.7% must be allocated to various types of compulsory contribution (e.g. individual training leave, sandwich courses for young unemployed people). France also uses payroll tax exemption and firms can reduce or eliminate their levy obligations by the amount of training they provide or purchase. It is assumed that as firms know what their training needs are, they will spend their money on appropriate training programs. In France under the levy-exemption scheme and also in Singapore through the Skills Development Fund, the amount of training undertaken by employers increased (Kuruvi\(^{\text{a}}\)lla 1999 and Tzannatos and Peresson 2000 cited in Dar \textit{et al.} (2003) Tzannatos and Peresson 2000 cited). There are criticisms of the French universal levy. In terms of increasing enterprise based training, Giraud (2002) reports that despite having a national training levy, only 58% of French workers reported receiving further training compared with 84% of workers in Germany, were no such levy is enacted. Therefore, there can be no guarantee that mandated levies will produce higher levels of participation in enterprise-based training.

Another form of levy are matching grants schemes which are reported as having been successful (Batra and Tan, 2002) in supporting the development of a training culture by providing an incentive and a means of investing in training encouraging, a high level of training capacity in enterprises and a high propensity for workers to undertake training, so that enterprises continue to invest in training. The Basic Law for Vocational Training (1976) in Korea is designed to encourage in-company training by designating funding for training as a percentage of company wage bills: and strong training cultures have been established in some Asian countries (Japan, Korea, Singapore) and some northern European countries (Germany, Netherlands, Scandinavia). A reported side benefit has been the development of a network of industry management training consultants that are available to enterprises that want to invest in enterprise-based training. Singapore has undertaken a program to build up its stock of industry trainers, and Japan's Industrial and Vocational Training Association has trained over 30,000 industry trainers in the past 30 years. In Japan most managers have a training function, and regularly engage workers in informal training. But Batra and Tan (2002) found that a matching grants scheme alone will not lead to an expansion of the training market if such grants are restricted to state-run training institutions. Funds should support strengthening and diversifying the supply of training and stimulating demand.

There are many other mechanisms for distributing training funds: directed selectively to enterprises on the basis of training plans (Germany, Korea, Singapore), or distributed through open tender, with the state as purchaser rather than supplier of training (Australia, Chile). A different pathway has been the use of user or trainee voucher schemes, such as the United Kingdom Training Credits scheme.

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Four valuable country examples include the following:

- **Netherlands**
  Many sectoral training funds exist which are financed by levy systems and used to subsidise training activities (a similar role for sectoral agreements on training funds financed by levies is present in Belgium and Denmark). Companies can recover part of their training costs through a subsidy of the Education and Development Fund (O&O fondsen) of their particular sector or branch. The funds are based on levies of all firms covered by the collective agreement under which the fund is established. The levies vary by sector and range from 0.1% to 0.7% of the gross wage bill. The O&O funds are used to finance individual training leaves, and support training programmes detailed in training plans submitted by employers. The fund may support up to 50% of the costs of a training programme, and award collective training days for a certain sector (Trampusch et al 2010).

- **Australia**
  A construction industry training fund exists and is funded by a levy of around 0.1–0.2% on building value. In many cases these funds have been used to support apprenticeships in the industry and have not been used widely for continuous vocational training (Stone, 2010).

- **UK**
  There are currently two Industry Training Boards with the power to raise levies to subsidise training in their industries: the construction ITB (CITB) and the engineering construction ITB (ECITB). Levy rates are based on 0.5% of direct labour payments (PAYE) and 1.5% on labour-only sub-contract payments (LOSC). Small firms, whose wage bill is below the threshold level of £73,000, are exempted from paying the levy. Training grants issued to construction companies are diverse and come under the following categories: ‘new entrant training’ (NET) for young apprenticeships; ‘adult craft’ for new-entrant adults as well as existing workers; ‘plant’ for plant operatives; ‘management’ for management training, such as site management and safety training courses; ‘qualifying workforce’ for certifying the skills of the existing workforce, which includes schemes, such as On-Site Assessment and Training (OSAT); and ‘training plans’ for supporting the development and implementation of a company training plan (CITB 2002). There is currently no clear assessment of the impact\(^7\) of the UK CITB\(^8\) and ECITB levies in terms of skill transfer to the workplace and potential contribution to business performance and whether such schemes have maintained a training base in industries characterised by contract labour and high turnover. Both industries are ideal for testing the validity of both employers’ claims and government skills policy assumptions, because of extensive coverage of the levy and not least, because these sectors will be significant in the greening of the infrastructure (requiring new and adapted workforce skills).

There are few robust impact assessment or evaluation studies of these policy instruments and the true impact - in terms of ongoing skill formation, business performance and productivity...
and innovation - cannot therefore be elaborated because of this. The EIM study (2008) which covered these schemes across the EU, found that:

- tax schemes had the advantage of building on existing institutional arrangements allowing companies to apply for the incentive with limited additional administrative costs;
- the conditions for applying were usually very transparent and straightforward but that the checking of applications afterwards is, not very intensive. This is because the volume of applications is often high and the checking is done by fiscal authorities not specifically specialised in training policy issues;
- the advantage of limited conditions may be linked to high deadweight loss of these tax deductions, because targeting and conditions for additionality are limited. (not empirically tested);
- relatively limited conditions and high deadweight losses are expected to apply to levies, although there is little research about the effectiveness of levies in various countries, in spite of the fact that they play a central role in the training system of many countries; and
- from a public spending viewpoint, levies are - compared to fiscal deductions - much cheaper, because in essence it is a transfer of money from companies with low investments in training to companies with high investments and in that sense a counterbalance to market imperfections.

Johanson (2009 p.14) taking a global perspective and emphasising the importance of understanding the context in which these instruments operate came to similar conclusions.,

generalised in Table 3.
### Table 3  Advantages and Limitations of Levy Systems

<table>
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<tr>
<th>Advantages</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>Earmarked payroll levies can be viewed as “benefit taxation,” - those that benefit (employers and workers) pay for the training</td>
<td>Earmarked taxation does not conform well with the principles of sound public finance and weaken attempts to unify the national tax system.</td>
</tr>
<tr>
<td>Levy systems can augment substantially the resource base for training.</td>
<td>Payroll levies raise the cost of labor to the employer, possibly discouraging employment.</td>
</tr>
<tr>
<td><strong>Increased training resources</strong>, in turn, can substantially increase the incidence of training</td>
<td>Employers may shift the incidence of the levy on to workers in the form of lowered wages; in this case, workers and not the employers bear the burden of the tax.</td>
</tr>
<tr>
<td>Levis can provide a steady and protected source of funding for training, particularly in the context of unstable public budgets.</td>
<td><strong>Insecurity of income</strong>: Under fiscal pressure, government may divert levy proceeds into general public tax revenues for non-training uses</td>
</tr>
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<td>Levy-grant systems can encourage firms to intensify their training efforts, increase training capacity and raise training quality.</td>
<td><strong>Unequal access</strong>: many firms, particularly small ones, do not benefit from the scheme; this breeds resentment, opposition and compromises the status of training levies as “benefit taxation”</td>
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<td>Training levies collected from formal sector employers can serve as a vehicle for cross subsidization, e.g. for smaller employers and especially for firms in the informal sector.</td>
<td><strong>Inefficiency</strong>: Payroll levies may constitute an over-sheltered source of funding, leading to unspent surpluses, inefficiencies and top-heavy bureaucracies</td>
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<tr>
<td>Funds with tri-partite management can forge cooperation among the social partners and facilitate formulation of appropriate training policies.</td>
<td><strong>Red tape</strong> may erect high barriers for firms to access funds</td>
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<tr>
<td>Funds can influence the quality of training through accreditation procedures and helping to stimulate a competitive training market.</td>
<td></td>
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<tr>
<td>Levy-financed funds can also help correct imbalances in training access by pooling funds – e.g. for training disadvantaged segments of society, unemployed, those in the informal sector. This redistribution can be termed “cross-subsidization.”</td>
<td></td>
</tr>
<tr>
<td>Establishment of a separate training fund account can facilitate transparency and minimize distrust between employers and the public sector</td>
<td></td>
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<tr>
<td>Source: <a href="#">Johanson (2009)</a> page 14</td>
<td></td>
</tr>
</tbody>
</table>

Subsidised work-based training in Britain has also focused on subsidies to employers delivered through the now discontinued Train to Gain (T2G). A [National Audit Office (2009)](#) report on T2G cited survey based evidence which indicates the level of deadweight in the scheme at around 50%. A study by [Mason and Bishop (2010)](#) found that while government programmes such as T2G aimed at increasing qualifications levels for the least qualified were effective, they operated in a less than ideal UK labour market context which has witnessed declining levels of employer commitment to training evidenced by a reduction in the average level of job-related training over the decade investigated.

The findings from international experience ([Batra et al. 2003](#), [Batra and Tan 2002](#), [Dar 2003](#)) suggest the following lessons from experience with levies:
Countries which had vested supervision of levies in industrial bodies had more successful outcomes than those that did not;

Levy funds were not cost-effective when they supported only government training providers so policies should be designed to increase competition in training provision;

Funding levels are better maintained with levies than with government grants which tend to decline with shrinking budgets;

These schemes have typically been used by large firms and enterprises that already have a high skills base—so more defined and rigorous support mechanisms are needed for small and medium firms to participate;

Levies may be particularly appropriate for micro-firms or self employed contractors in highly fragmented industries which are geographically dispersed;

Training in small firms is relatively sensitive to the availability of subsidies – as its incidence rose significantly in those enterprises assisted – where both qualified and unqualified workers were found to have received training; and

These schemes are more effective under conditions of economic growth.

5 Conclusions

Our review suggests there is a lack of attention in the innovation literature to the question of how we theorise and empirically analyse the multiple linkages between the components of skill formation systems and their varying innovation effects. Questions of obvious and direct relevance for policy are under-researched.

Overall, the evidence to date reviewed in this report indicates that further empirical analyses to inform future policy design is needed to:

- Understand the innovation consequences at firm level of targeted, sector-based investments in skill and training – in terms of what types of investments work, under what conditions of stakeholder participation and what sector conditions;
- Consider the roll-out of a programme of skill-innovation evaluations delegated to sector skill councils to explore the relationship between employer commitment to training and innovation performance across different sectors;
- Assess in a cross-country comparative context the effectiveness of training levy/grant schemes for innovation performance – for example, what are the relative merits of schemes that seek to stimulate enterprises to undertake more skill development, as opposed to ‘training credits’ made available directly to adult workers who fall below a certain level of skill or require updating in new skills?
- Research various methods that might improve the capacity of organisations to assign value to their skills-base and training investments in a manner that complements their investments and valuing of innovation performance – for example, by encouraging changes in financial accounting and reporting practices and related institutional arrangements.
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