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Tackling the Challenge of Skill Mismatch through Apprenticeship

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Le competenze sono ampiamente ritenute necessarie per aumentare la produttività, stimolare l'innovazione e creare nuovi posti di lavoro, mentre gli skill mismatches sono responsabili della mancanza di dinamismo del mercato del lavoro. Sistemi di istruzione e formazione ben progettati, efficienti ed accessibili, con un forte collegamento con il mercato del lavoro, sono cruciali per formare e mantenere i livelli di competenze richiesti nella forza lavoro e per ridurre gli skill mismatches. Da questo punto di vista, una tradizionale tipologia di formazione professionale in grado di fornire le competenze necessarie ad inserirsi mondo del lavoro è l'apprendistato. Studi recenti dimostrano che l'apprendistato in uso nei paesi con un forte sistema duale può aiutare a soddisfare la domanda di competenze delle aziende e migliorare la condizione occupazionale dei giovani. Da una parte, grazie all'apprendistato un giovane acquisisce l'esperienza manuale utile ad evitare i gap di competenza presenti nel mercato del lavoro. Dall'altra, schemi di apprendistato di qualità consentono ai datori di lavoro di offrire una formazione innovativa in linea con i loro bisogni immediati ed associata ad una più elevata produttività, maggiori opportunità di un'occupazione duratura e migliori condizioni di lavoro.

Skills are widely regarded as being necessary for boosting productivity, stimulating innovation, and creating new jobs, while skill mismatches are considered responsible for a lack of dynamism in the labor market. Well-designed, efficient and accessible education systems and training schemes, with strong link to the labour market, are crucial for building up and maintaining the required level of skills in the labour force and to reduce skill mismatches. From this perspective, a traditional form of vocational training that seek to provide skills in need to individuals in the labour market is the apprenticeship. Recent research demonstrates that apprenticeship schemes in countries with strong dual education systems can help to better meet the skill needs of companies and improve the employment picture for young people. Hands-on work experience helps to avoid skill gaps and to provide training relevant to labour market demand. Quality apprenticeships enable employers to offer innovative training which responds to their immediate needs and is associated with higher productivity, better opportunities for sustained employment and better working conditions.

In the last decades, the world has known significant shifts in the labor demand which have favored more skilled and educated workers[1]. The shift toward more skilled workers appears to have accelerated in the last 20 years. Over this period, the demand has strongly shifted from low and middle-wage occupations and skills toward highly rewarded jobs and tasks, those requiring exceptional talent, training, autonomy or management ability.

The overall effect has been both large and widespread, substantially shifting relative wages in the top, middle, and bottom of the income distribution[2]. An impressive body of empirical studies shows that a significant component of this effect is attributable to skill-biased technical change[3]. Skill-biased technical change

[1] C. Goldin - L. Katz, *The Returns to Skill in the United States Across the Twentieth Century*, NBER Working Paper No.7,126 (1999); D. Autor - L.Katz - A. Krueger, *Computing Inequality: Have Computers Changed the Labor Market?*, «Quarterly Journal of Economics», 113 (1998), 4, pp. 1169-1213.

[2] D. Acemoglu - D. Autor, *Skills, tasks and technologies: Implications for employment and earnings*, in D. Card - O. Ashenfelter (eds.), *Handbook of Labor Economics,* Vol. 4, 2011, pp. 1043-1171.

[3] D. Acemoglu, *Technical Change, Inequality, and the Labor Market*, «Journal of Economic Literature», 4 (2002), 1, pp. 7-72; D. Card - J.E. Di Nardo, *Skill-biased technological change and rising wage inequality: Some problems and puzzles*, «Journal of Labor Economics», 20 (2002), 4, pp. 733-783; A. Spitz-Oener, *Technical Change, Job Tasks, and Rising Educational Demands: Looking outside the Wage*

(SBTC) means technical progress which shifts the demand toward more highly skilled workers relative to the less skilled.

While there is a lot of consensus about the crucial role of skills for individuals, businesses and societies, an extremely difficult task is to define what 'skills' truly are. The term 'skill' in standard English dictionaries is, as a noun, 'the ability to do something well', whilst, as an adjective, it is 'having or showing the knowledge, ability, or training to perform a certain task or activity well'[4]. Translating the whole idea of 'skills' into an univocal indicator is even more arduous and it entails several empirical and theoretical challenges, many of which are still unresolved today.

Skills acquisition is a long and articulated process. We reap them throughout all life. People learn, adapt and form their skills through a multitude of interactions and mechanisms, within the household and neighborhood, during the formative years of schooling, at work and during training. For this reason, this concept encompasses a wide range of attributes. It can refer to both *generic skills* and *job/occupation/sector specific skills*. *Generic skills* may include *cognitive skills*, such as information-processing skills (e.g. verbal ability, working memory, numeracy, and problem-solving) as well as *non-cognitive skills* (such as perseverance, self-organisation, reliability, discipline, team-work and other so-called *soft skills*). *Job-specific skills*, by contrast, possess a particular condition, that is they are generally not transferrable from one job/occupation/sector to another. They refer, for example, to firm-specific knowledge about the functioning and culture of the organisation, technical knowledge or practical competencies which are specific to a particular sector or occupation (e.g. accounting, hairdressing, etc.).

In broad terms, skills can be considered the outcome of individuals' choices of education, training and of their work experience, combined with innate abilities and preferences. The *Recommendation of the European Parliament and of the Council on the establishment of the European Qualifications Framework for Lifelong Learning* defines the ability to apply knowledge to complete tasks and solve problems[5]. This concept is therefore a multifaceted nature spreading across several distinct domains. Green[6] looks at the different uses of the concept - in economics, sociology and psychology - and suggests a functional concept of skills, according to which 'skills' have three key features, that is they are: productive, expandable and social determined.

Skill system: a conceptual framework

A focus on skill requires a conceptual framework including both skill formation services and the deployment of skilled labour: two interacting markets. Skill formation services refers broadly to all activities provided to enable someone to learn, including teaching, training, learning resources and access to the environment of a learning organisation; whereas the word 'market' here refers to a circuit of value, not to any specific institution. This skill model should be able to face important challenges, such as:

- How to match the supply of skills delivered by training systems with the types and level of skills needed by industry in the immediate and longer term.
- How to time and locate the supply of skills to the time and location of the demand for skills.
- How to encourage workers and employers to invest in skills, anticipated in view of a future need.

From this point of view, Green offers a good conceptual framework (as depicted in Figure 1) organised around key actors, operating as demanders or suppliers or both. The three actors depicted are employers (including the government itself), skilled workers and external

Structure, «Journal of Labor Economics», *24* (2006)., pp. 235-270; S. Machin - J.Van Reenen *Changes in Wage Inequality*, *Centre for Economic Performance, Special Paper,* 18 (2007).

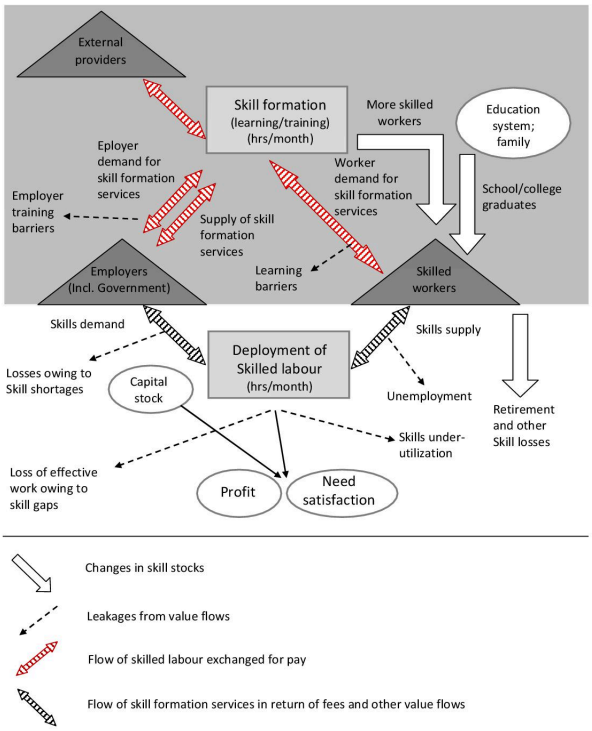
[4] J. Pearsall, *The New Oxford Dictionary of English*, Oxford University Press, Oxford 1998.

[5] Recommendation 2006/962/EC of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning [Official Journal L 394 of 30.12.2006], available at: http://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:32006H096 2&from=EN

[6] F. Green, *Skills and skilled work: an Economic and Social Analysis*, Oxford University Press, Oxford 2013.

providers of training (school, university, etc.). Each market in practice comprises many submarkets, corresponding to multiple skills and spaces: the diagram is therefore a simplification.

Fig. 1 – A skill framework: skill formation and the deployment of skilled labour



Source: Green (2013)

On one side of the market for skilled labour, depicted in the lower half of the diagram, is the employers skills demand. The demand for skill is the amount of skilled labour (measured by hours of work) that an employer would like to deploy, given the productive and market environment (level of wages). Changes in technology that are complementary with skilled work, evolving forms of work organisation and employer human resource policies, product market strategies, industrial restructuring, demographic trends and expanding trade with (and outsourcing to) less developed economies, are the factors underpinning employers skill demand[7].

On the other side of this market lies skills supply, which refers to the hours that people with various skills are willing and able to work in a particular job or industry, given the wage rates and other relevant working conditions. Education, training, new technologies for domestic labour and demographic trends are the main sources of change in skills supply[8]. Education not only leads to a more skilled population, but commonly raises the willingness to participate in the labour market[9].

The 'stock of skills' is an expression used to capture the totality of skills held by the population or sometimes, more narrowly, by the economically active population (those able and willing to do paid work). This expression reflects the many different types of skills possessed by people. In the economically active population it is net result of actions taken in the past – processes of skill formation, minus any losses of skills. School or college graduates join the labour force, while other retires; the existing workforce gains and loses skills. Since gaining skills does not come for free, there is also a market for this activity. Parallel to the demand for and supply of skilled labour, therefore, are the skill formation services for which there is also a demand and supply, which are depicted in the top half of Figure 1. The accumulation and waste of stock of skills forms the first analytical link between the two markets. The second link is to be found in the roles of the the two actors, employers and workers. In fact they plays in both markets with related strategies. For example, an employer with a high demand for skills may – but need not – also to have a high demand for skill formation services[10].

The demand for skill formation comes from two sources: employers and workers (or potential workers). The former have a demand because they want their employees to become more skilled, hence more productive. The latter also have a demand for skill formation services (or demand for learning) because learning the right skills can give them access to skill work, which

[7] T. F. Bresnahan, E. Brynjolfsson and L. M. Hitt, *Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence*, «The Quarterly Journal of Economics», 117 (2002), pp. 339-376.

[8] ILO Anticipating and matching skills and jobs, guidance note, 2015, retrieved at: http://www.skillsforemployment.org/KSP/en/Details/?dn=WCMSTEST4_155653.

[9] F. Green, *Skills and skilled work: an Economic and Social Analysis*, cit.

[10] *Ibidem.*

is attractive both for its pay premium and for its offer of greater fulfillment (the consumption benefits linked to learning). The supply is delivered by employers themselves and by education and training institutes (school, universities). Even if prior education and initial training are needed (sometimes for relevant knowledge and for the ability to learn new skills) skill acquisition at work is effective and hard or impossible to substitute through other channels[11].

The factors affecting employers' demand for skill formation services include their benefits and costs, the uncertainties of the economy and labour market (including the mobility of workers) and managerial culture, capacities and beliefs about incentives. In a similar context, the workers' demand for learning is driven by a complex process entailing not just benefits and costs, but an interdependent system of beliefs/expectations about costs, benefits and constraints of skill formation; personal resources (include capacity to process information and self-efficacy); preferences over types of work; dispositions towards learning itself, aspiration for the future and motivation. Employers' supplies of skill formation services depend especially on their own demands[12]. The providers in this market are often owned by governments or subsidized.

To sum up, in the skills framework there are two articulated markets: one for skilled labour hours, the other for hours of skill formation services. Workers are suppliers of skilled labour and demanders of skilled formation services. The metric is time: each can be measured in units of so many hours service per month. Employers are the demanders of skilled labour, but both suppliers and demanders of skill formation services.

Skill matching

Equilibrium occurs in each market when supply matches demand, and the term 'skills equilibrium' describes the state where both markets are in equilibrium.

The outcome in the skilled labour market is, from the firms perspective, the deployment of skilled work, leading to the generation of value: this outcome is what makes it possible to characterize those personal qualities as skills. It is conventional to assume that employers aim at maximizing profits or, in the case of public employers supplying non-market services, maximizing the net social value of outputs provided. However, economic performance for employers depends also on the deployment of other inputs, such as physical (for example machineries) and financial capital, as well on the management of labour – that is, securing the commitment of, an control over, workers, so that they work as effectively as possible while employed. For workers the outcome is the extent to which the features of the job, including its opportunities for doing skilled work and its learning environment, are meeting people's needs, namely earning a living and being satisfied in what you do.

The outcome of the skill formation market is the potential learning raising the stock of skills for the following period. It is workers who acquire these additional skills, with employers benefiting indirectly from workers' greater productivity. The magnitude by which skills are increased depends on the effectiveness of the learning environment and on the capacity and readiness of people to learn. The net change in the stock of skills is the difference between this increase and skills loss through time, or through retirements, or through skills obsolescence.

However, supplies do not necessarily match demands. Like any markets, the relative price (wages) of skilled labour plays some role: workers' earnings in a market economy depend fundamentally on their productivity - that is, the value they produce through their labor. And, in turn, workers' productivity depends on two factors. One is the level of their human capital (the amount of skills they own), namely the tasks they can accomplish. A second one is their scarcity: the fewer workers available to accomplish a task, the more employers need that task accomplished, the higher the workers' economic value in that task. In other terms, the skill premium depends upon what skills employers require (skill demand) and what skills workers have acquired (skill supply). In a perfectly competitive labour market, price and

[11] K. Ulrich Mayer - H. Solga, *Skill Formation: Interdisciplinary and Cross-National Perspectives,* in K. Ulrich Mayer and H. Solga (Eds.), *Skill Formation: Interdisciplinary and Cross-National Perspectives*, Cambridge University Press, Cambridge 2008 pp. 1-20.

[12] F. Green, *Skills and skilled work: an Economic and Social Analysis*, cit.

quantity adjust organically until the markets clears: firms adapt production processes to the available stock of human capital (stock of skills) and workers seek the amount and type of training currently required (or foreseen) in an economy[13].
In other words, when skilled labour is scarce, its price will raise; similarly; the price of training services rises when they are scarce. Matching also requires that training provides respond positively to price increases (offering more courses, and so on) and/or that workers and firms reduce their demands. The supplies and demands in the two markets are connected, both through the increase in skills - the outcomes of the skill formation market - and through the incentives anticipated (a higher price of skill induces greater demand for learning). Given however three conditional factors - price rigidities, the long-term aspects of skill formation and the context of deep uncertainty - the process of adjustment of supply and demand via the price mechanism may be very slow. Alternative adjustment occurs via quantities. For example, firms unable to recruit enough skilled workers, rather than raise their wage offers may reduce their demand for skilled workers. Alternatively, through collective foresight employers might anticipate shortages and have planned ahead.
In this skill system there is an ever-present tendency for imbalances in the two markets. This model relies on an assumption of perfect information. Actually, workers, employers and both education and training institutions may not be well informed about the skills required in the immediate, medium and long term. Facing incomplete information, the time lag between the decision to enter a training program and that of entering in the labour market may lead individuals to under or over-estimate employment prospects leading to skills mismatches. On the one hand workers spend periods looking for their best job (that is, matching their skill); and they take time to find the right learning course. On the other hand, as many of the attributes (include skills) of the jobseeker are not easily observable by the employer, they can spend time and resources recruiting employees with the suitable skills or devising new training and learning programmes in order to fill some skills deficit of workers.

Skill mismatch

Even if in the skill model aforementioned, an equilibrium looks like always being approached, is not automatic the process of matching diversely skilled job seekers with available vacancies. Indeed, skilled labour market are frequently perturbed by rapid technological developments, new sources of job creation, newly created forms of work organization and demographic change (for example, when come and mature new waves of well-educated people). All these circumstances can create imbalances between demand and supply. Adjustments to these imbalances - based on market mechanisms and wage movements of skilled workers - can be slow. Furthermore deep uncertainties can limit the sensitivity of supply and demand to wage signals. Hence, skills mismatches - the gap between the skills required on the job and those possessed by individuals - arise and may persist in the long run They may be conceived as *leakages* from the two value circuits – that is, reductions in the value exchanged and generated (they are indicated by dotted lines on Figure 1).
Some mismatch is indisputable, as the labour market involves complex decisions both by employers and workers, and depends on many external factors. In particular, in a dynamic, continuously changing economy, there are always unfilled positions, even if some people are unemployed; and there are always individuals occupied in a job not fully matching their skills profile. Skill mismatch has become more prominent in the crisis. However, high and persistent skills mismatch is costly for employers, workers and society at large. Therefore, reducing skill mismatches is crucial. From the workers' perspective, if people do jobs under the standard of their educational achievements and so their skills are under-utilized, they are likely to become disillusioned and dissatisfied; moreover, they can experience lower wages than expected. For employers, skills mismatches increase hiring costs and lower productivity; while for the all economy it

[13] J. Hartog, *Over-education and earnings: where are we, where should we go?*, «Economics of Education Review», 19 (2000), 2, pp. 131–147.

entails lower economic output[14].

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Standing the extensiveness of the term "skill mismatch" (or leakages) it refers to various types of imbalances between skills offered and skills needed in the world of work:

Skills shortage describes a situation where the demand for a particular skill exceeds the supply of available people owing that skill at market clearing wage rates[15]; or, in other words, it is a state when a job vacancy is hard to fill because of a lack of applicants with the requested skill. Since vacancies depend on demand, the level of skills shortages in the economy tends to rise and fall with the economic cycle.

In 2013, around 40% of employers in Europe reported difficulties in finding employees with the required skills[16]. According a recent research of Cedefop[17] between a half and two thirds of EU firms with difficulties finding skilled workers face the problem for reasons other than lack of skills: unattractive job offers (unwillingness or inability to offer a competitive market wage; bad job quality; precarious contracts); and lack of employer commitment to talent management. The remaining firms meet genuine skill shortages: inability to find job applicants with the right skills, despite their willingness to pay the price for the skills sought.

Skill shortages may arise because of the differential dynamics between skill *demand* and *skill supply*, particularly when the latter may not respond (or respond with a significant lag) to changing market signals, notably the wage rate. A shortage of skill may be apparent in knowledge-intensive sectors and/or occupations, given that the demand for new skills may outpace existing supply for a given period of time. Further, the demographic change is also often a cause of (current and anticipated) skill shortages. For example, the demographic crunch in the European population[18] is likely to exert considerable strain on the age dependency ratio and to result in high demand for particular professionals, such as in the health care sector. Unless appropriate market and policy responses are undertaken to anticipate such trends, skill shortages may occur. Recurrent shortages of STEM skills (Science, technology, engineering and maths) in the European economy are also often reported; these are believed to have arisen because of the low attractiveness of jobs in the manufacturing sector. For example the ICT sector seems to be confronted by lack of professionals with highly technical skills in areas such as ICT security and cloud computing[19]. A growing shortage of ICT professionals and experts in Europe has been predicted, with an estimated shortfall of as many as 900 000 professionals by 2020, which has prompted the institution by the European Commission of the so-called Grand coalition for digital jobs[20].

Skill shortages (particularly high-skill labour shortages) can have negative implications for the economy and the labour market. They

14 J. Haskel - C. Martin, *Do Skill Shortages Reduce Productivity? Theory and Evidence from the United Kingdom,* «Economic Journal, 103» 1 (1993), 417, pp 386-394.

15 C. Veneri, *Can occupational labour shortages be identified using available data?*, «Monthly labor review», 122(3) (1999). pp. 15-21; C. Shah - G. Burke, *Skill shortages: concepts, measurement and implications*, «Australian Bulletin of Labour», 31(2005), pp. 44-71; Cedefop, *The skill matching challenge: analysing skill mismatch and policy implications*. Luxembourg: Publications Office of the European Union 2010.

16 European Commission, *Work-based learning in Europe: practices and policy pointers,* Luxembourg: Publications Office of the European Union 2013.

17 Cedefop, *Skill shortages and gaps in European enterprises: striking a balance between vocational education and training and the labour market*, Luxembourg: Publications Office of the European Union 2015a; Cedefop, S*kills, qualifications and jobs: the making of a perfect match? Evidence from Cedefop's European skills and jobs (ESJ) survey*, Luxembourg: Publications Office of the European Union 2015b.

18 J. Peschner - C. Fotakis, *Growth potential of EU human resources and policy implications for future economic growth*, Publications Office. European Commission, Luxembourg 2013; Cedefop, *Projected labour market imbalances in Europe: policy challenges in meeting the Europe 2020 employment targets*, in *Matching economic migration with labour market needs*, OECD Publishing, Paris 2014, pp. 315-348.

19 European Commission, *Employment and social developments in Europe 2012*, Luxembourg: Publications Office of the European Union 2012.

20 European Commission. Digital agenda for Europe: skills and jobs: Grand coalition. https://ec.europa.eu/digital-agenda/en/grand-coalition-digital-jobs.

increase hiring costs and lower productivity as vacancies remain unfilled for a longer period of time. In addition, shortages can induce a field-of-study mismatch as workers form other fields seeking employment in sectors experiencing shortages[21].

Skills under-utilizations is just the opposite case, occurring where an individual is unable to fully use acquired skills in the current job (this situation is also called ***over-skilling***). This state is loosely related to ***over-****education* – when an individual has completed more years of education than the current job requires – sometimes alternatively named ***over-qualification*** – where someone holds a higher qualification than the current job requires[22]. About 21% of workers in OECD countries report that they have higher qualifications than those required for their jobs, and 13% are under-qualified (Italy shows an opposite trend with 23% of workers under-qualified and 14% over). The average rate of over-qualification in Europe has risen by about 5% from 2004 to 2010[23]. About 1.5% of this total occurred during the economic recession (2008-2010), presumably because individuals, faced with stronger job competition, more readily accepted jobs that did not match their qualifications and skills. Over-qualification is also often associated with field-of-study mismatch, when people accept jobs with lower qualifications than they actually possess, but in an area in which they have little or no expertise. Quintini[24] finds that, in advanced countries, as much as 40% of the overqualified are working in areas outside their expertise. Also the Survey of Adult Skills shows that skills under-utilization in the workplace are also pervasive; when asked to subjectively assess the relevance of their skills in relation to their job demands, about 32% of European employees believed that they possessed skills in excess of their job duties (over-skilled), while 13% felt that they were in need of further training to cope with their jobs (under-skilled)[25].

The Survey of Adult Skills confirms that both over-qualification and over-skilling are associated with a significant underuse and "waste" of human capital and skills, including numeracy, literacy, ICT and problem solving at work[26]. It is a matter of concern for public policy and enterprises because this state has adverse effects, both at aggregate and individual levels. At the individual level, over-qualification and over-skilling entail lower earnings, lower job satisfaction, and higher risk of unemployment relative to well-matched workers[27]. For example, over-qualified workers working on their field are expected to suffer an 18% wage penalty compared to well-matched workers[28]. For firms, this situation is actually associated with lower labour productivity and higher staff turnover rate[29]. At the macroeconomic level, this contributes to structural unemployment and reduces growth in gross domestic product (GDP) of about 1% through workforce underutilization and a reduction in productivity (Mavromoras, 2009). But in addition to efficiency losses, these type of mismatches entail significant equity costs, as young people, migrants and those working in part-time and fixed-term jobs are more affected by over-qualification and over-skilling[30].

A ***skills degicit*** occurs when the level of skills of the existing workforce in a firm is less than required to perform a job adequately or to match the requirements of a job (this state can also called ***under-skilling,*** or *under-education* or *under-qualification*).

According to the Cedefop's ESJ survey, in 2014

[21] C. Shah - G. Burke, *Skill shortages: concepts, measurement and implications*, cit.

[22] Cedefop, *The skill matching challenge: analysing skill mismatch and policy implications*. Luxembourg: Publications Office of the European Union 2010.

[23] OECD, *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*, OECD Publishing, Paris 2013.

[24] G. Quintini, *Over-Qualified or Under-Skilled: A Review of Existing Literature*, *OECD Social, Employment and Migration Working Papers, No. 121*, OECD Publishing, Paris 2011.

[25] OECD *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*, cit.

[26] *Ibidem.*

[27] F. Green - Y. Zhu, *Overqualification, job satisfaction, and increasing dispersion in the returns to graduate education*, «Oxford Economic Papers», 62 (2010), 4, pp. 740-763.

[28] OECD, *Employment Outlook 2014*, Paris: OECD Publishing 2014.

[29] M. Adalet McGowan - D. Andrews, *Labour Market Mismatch and Labour Productivity: Evidence from PIAAC Data*, «OECD Economics Department Working Papers», 1209 OECD Publishing, Paris 2015.

[30] Cedefop, *The skill matching challenge: analysing skill mismatch and policy implications*. Luxembourg: Publications Office of the European Union 2010.

about 22% of EU employees considered themselves as being under-skilled[31].

Skill deficit may emerge because workplaces are dynamic environments. The balance of skill demand and supply can also change over time due to evolving technologies, changing consumers' tastes or other economic/social shocks, leading to skills obsolescence. Temporary skill gaps may sometimes be acceptable, as with newly- hired workers who typically require an induction period of training to get accustomed to the way in which the organisation operates. Another acceptable misalignment between the skills required for the job and the skill set possessed by workers occurs when candidates have little or no work experience, – as in school to work transition. Candidates may possess the necessary technical and theoretical knowledge, but they often lack the mindset as well as the applied knowledge and skills needed to function properly in the workplace[32]. A temporary wedge between the skills needed to carry out jobs and workers' skills could also develop because of the dynamic nature of work: workers change jobs (promotions, job rotation, and career developments), job requirements change (new machinery or changes in the way production is organised), or because organisations themselves change (merger, acquisitions or changes in work organisation). In general, skill deficits tend to be greater in jobs needing high-level skills to be performed, when skill needs change fast over time (e.g. due to new technologies) or if employees do not receive adequate skill development opportunities to keep up with the changing nature of their job tasks. For example, in Italy, considering only the ICT sector, the gap between workers' available ICT skills and required ICT skills is particularly consistent. An inventory of available ICT skills shows that workers in public administrations are lagging far behind those in the commercial sector. In the latter, workers have attained some 71% of the required ICT skills, in public administrations this figure stands at just under 40%[33]. To mitigate skill deficits in jobs, the European Commission has emphasized the relevance of skill development for the future knowledge economy in lifelong learning policies[34]. Skill development depends on individual factors, particularly on the learning motivation and attitudes of individuals which enable coping with changing workplace requirements[35]. Nevertheless, the workplace is also crucial to continuing individual skill development: fostering a learning climate in the workplace, with emphasis on the provision of support for learning opportunities to employees by management and among colleagues; supporting work complexity, including the ability of workers to use a variety of skills in their daily work routines and to have a certain degree of control when engaging in abstract tasks; enabling a better balance between work and life responsibilities, given that skill development is an investment requiring time, so work-life conflicts may lead to larger skill gaps.

The problems arising from under-skilling may match those arising from over-skilling, concretely lower productivity (due to the insufficient skills) and consequently lower salaries or higher risk of being fired (due to the poor performance). Furthermore, firms may find more problematic to act against under-skilling than over-skilling. In cases of over-skilling, firms may arrange the problem by redefining (upgrading) tasks or changing jobs, and therefore, in some cases, it could be even used as an internal opportunity to develop the human resource function. In cases of under-skilling, instead, firms will be forced to invest in training in order to cover the skills deficit, making, for example, their contribution to the educational systems (via taxes) less attractive for them[36].

[31] Cedefop, *Skill shortages and gaps in European enterprises: striking a balance between vocational education and training and the labour market*, Luxembourg: Publications Office of the European Union 2015a.

[32] European Commission, *Employer's perception of graduate employability: analytical report*. Flash Eurobarometer; 304, 2010; P.I. Hettich - E.R. Landrum *Your undergraduate degree in psychology: from college to career*, Sage, Thousand Oakes, 2014.

[33] Agenzia per l'Italia Digitale (2016). Osservatorio per le competenze digitali 2015, retrived at: http://www.assinform.it/In-Evidenza/Osservatorio-Delle-Competenze-Digitali-2015.kl.

[34] European Commission, *Work-based learning in Europe: practices and policy pointers,* Luxembourg: Publications Office of the European Union 2013.

[35] P. Candy, et al., *Developing lifelong learning through undergraduate education*. Canberra: Australian Government Publishing Service 1994.

[36] I. Livanos - I. Nunez, *Rethinking under-skilling: evidence from the Cedefop European skills and jobs*

Unemployment, where workers, unemployed and looking for a job, indicate that all their skills are unused, thus leaking the circuit of value. Under-employment, where workers are employed but fewer hours than desire, is the fractional equivalent. Sometimes, the expression 'under-employment' has a more encompassing meaning, including skills under-utilization. Moreover Employees with outdated skills may run a high risk of becoming unemployed[37].

Unemployment may also lead to ***skills obsolescence***, «*the degree to which professionals lack the up-to-date knowledge or skills necessary to maintain effective performance in their current or future work roles*»[38]. Skills obsolescence is typically subdivided into two main types; obsolescence due to skill depreciation – a reduced ability to perform a set of tasks due to unemployment, sickness or ageing – labelled 'technical obsolescence'; and a second type called 'economic obsolescence', which is particularly relevant in the context of changing skill needs in economies because it results from changes in the work environment[39]. In contrast to technical obsolescence, economic obsolescence does not imply that the skills of workers have decreased. Employees can have the same set of skills as before, but a wider skill gap arises because of insufficient adaptation of their skills to changes in the work environment. This progressively reduces the economic value of their skills, which in turn become less needed at work while the employee's knowledge in using modern techniques, whereas procedures becomes inadequate[40]. The degree of obsolescence can vary but will lead to the same negative consequences as other forms of skill mismatch: higher unemployment risks, lower productivity, and lower job satisfaction. On an aggregate level this may also affect the productivity of enterprises and ultimately lead to negative macro level effects, with productivity losses in the economy[41].

Worker training barriers (or *learning barriers*) are obstacles preventing individuals from accessing and achieving a demand for learning which would be best for them, given their circumstances. An example of learning barrier is age: overall, the substantial body of empirical research on the determinants of training suggests that older workers are typically less likely to receive, and participate in training. Consistent with human capital theory[42], indeed, employers do not randomly provide training opportunities to workers. Instead, training is offered to workers when the costs of that training are lower than the long-term benefits the firm expects to derive from providing the training. Likewise, employees do not indiscriminately participate in training; instead, they undertake those training activities which they believe will be advantageous to them. The extent to which the training is expected to benefit the firm and the employee is said to be dependent on two factors: perceptions of length of future job tenure; and the likely effectiveness of the training. From this perspective, older employees have fewer years of employment in which to recoup (via pay and promotions) any costs of training they incur, and thus they will be both less motivated to seek out training and less willing to accept offers of training from their employer. Employers, on the other hand, are thought to be likely to view the length of job tenure of older workers as shorter than that of other workers, thus limiting the length of time over which they can amortize any training investments they make. Other potential training barriers for workers is the level of education and sex: on the one side, better-educated workers would be expected to have better

survey, research paper presented at the Cedefop/IZA workshop on skills and skill mismatch, 29-30 November 2015 Thessaloniki: retrieved at: http://www.iza.org/conference_files/2015_Skill_Mismatch/livanos_i5629.pdf.

[37] R. Johnston, *Jobs, unemployment and education for work*, «Studies in Continuing Education», 16 (1994), 1, pp. 37-51.

[38] H.G. Kaufman, *Obsolescence and professional career development*, Amacom, New York 1974, p. 23.

[39] J. Van Loo - A. de Grip - M. de Steur, *Skills obsolescence: causes and cures,* «International journal of manpower», 22(1/2) (2001), pp. 121-137.

[40] Rosen, S. (1975). *Measuring the obsolescence of knowledge*, in F.T. Juster, (Ed.), *Education, income and human behavior*, NBER, National Bureau of Economic Research, Cambridge 1975, pp. 199-232.

[41] M. Manacorda, and B. Petrongolo, *Skill mismatch and unemployment* in OECD countries. «Economica», 66 (1999). pp. 181-207.

[42] G.S. Becker, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, NBER, University of Chicago Press, Chicago 1964.

access to training by their employer because of their ability to learn[43]; while, on the other side, employers are more sensible to invest in training for men because males do not tend to interrupt their career for family reasons[44] . To sum up, it is deductive that among the key characteristics associated with a poor access to training , all else being equal, are earning low wages (low-quality jobs), having a lower education, being an older worker and, in particular, being a woman. Worker training barriers are shown in Figure 1 as a leakage from the workers' demand for learning.

Employer training barriers are to be seen when employers lack sufficient information or capacity to adequately assess the benefits of training for their organization, or if external providers are unavailable. Such barriers can result in too little training opportunities, reducing the organization's performance in the long term. In line with Becker's theory, many employers decide not to provide training based on the rational fear of losing their investments because of other firms will bid up the worker's wage, once the worker becomes well trained and more productive (this phenomenon is also called *poaching*). Another commonly cited barrier is the difficulty of measuring the costs and benefits of training. When a skilled worker spends time training a less skilled worker, the lost production is not always clear[45]. A third barrier to employer-led training in general is the lack of knowledge about what type of training will work best for the organization. As Bassi (2011) points out, the characteristics of training programs yielding the highest returns vary with the size, maturity, industry and other business needs. Employers thinking about providing occupational training (for example, in the form of apprenticeship) must determine content standard (what completers should be able to accomplish), a curriculum, the role of class-based courses vs. work-based learning, the effectiveness of tutors and the methods for determining whether the trainee is achieving sufficient mastery in an occupation to graduate. Measurement and evaluation of training impacts is difficult to prove[46]. A forth barrier is scale: setting up a formal training program and exposing workers to a wide range of tasks is particularly difficult for small companies. They often lack the expertise and the cost per worker becomes prohibitive since the training will cover few workers. Genuine employer training barriers are less commonly discussed than worker training barriers, for fear of sneaking into the autonomy of private business.

Addressing skill mismatches: apprenticeship for all

The available evidence illustrates that, considered all together, skill shortages, skill deficits, underutilization of work skills, skills obsolescence, as well as workers learning barriers and employer training barriers, imply a collective waste of talent and resources with potentially significant economic and social implications.

Weak labour markets and demand have resulted in a serious jobs crisis in a number of countries (including Italy), primarily affecting young people. Particularly high youth unemployment and increasing rates of over-qualification among those who find a job indicate that young people have serious difficulties when entering the labour market. As enterprises find it difficult to retain their current workforce and few new jobs are created, it becomes exceptionally difficult for those with no prior work experience to successfully enter the job market. It is also necessary to maintain and increase the job readiness of the unemployed and to generate economic dynamism for driving new job creation.

Education and training systems are the primary

[43] C. Underhill, *Training through the ages*, «Perspectives on Labour and Income», 7(10) (2006). pp. 17-27; M. Hurst, *Work-related training*, «Perspectives on Labour and Income», 9 (2008), 4, pp. 12-21.

[44] M. Dieckhoff - N. Steiber, *A re-assessement of common theoretical approaches to explain gender differences in continuing training participation*, «British Journal of Industrial Relations», 49 (s1) (2011), pp. 135-157.

[45] R.I. Lerman, *Why Firms Do and Don't Offer Apprenticeships*, in M. Pilz, (Ed.), *Vocational Education and Training in Times of Economic Crisis*, Berlin 2017 Springer, pp. 305-320.

[46] L. Bassi - D. McMurrer, *How's Your Return on People?* «Harvard Business Review», 82(3), (2004), p. 18.

instruments to provide and update skills that are required in the labour market. Nevertheless employers commonly report a lack of practical experience among school graduates. But job-specific and work-based skills are difficult to learn other than on the job. In this context, work-based learning programmes such as apprenticeship schemes provide young people with work experience and a mix of job specific and transversal skills, necessary for overcoming the negative perceptions of employers regarding the work attitudes, soft skills and behavioural traits of younger individuals[47].

Although there are different types of apprenticeship programs, they all use job experience to integrate education and learning. The most developed and discussed is the "dual model," which is typical of Central Europe. In the recent past, the dual system has been praised as an effective approach to high unemployment due to comparably low unemployment rates among participants in these schemes[48]. Apprenticeship combines class-based learning, which focuses on developing general skills that can be used in any job, with learning acquired on the job and through actual work experience within the training company. Its successful completion leads to an externally recognised vocational qualification[49].

Recent research demonstrates that apprenticeship schemes in countries with strong dual education systems can help to better meet the skill needs of companies and improve the employment picture for young people. Hands-on work experience helps to avoid skill gaps and to provide training relevant to labour market demand. Quality apprenticeships enable employers to offer innovative training which responds to their immediate needs and is associated with higher productivity, better opportunities for sustained employment, better working conditions and higher skill transfer within and across sectors[50].

In Switzerland, Germany, Austria and Denmark, the dual system is credited with fast and structured employment integration, following the completion of the apprenticeship program. The dual system requires more than the right economic incentives, as it is based on a social contract between employers (to offer places and invest in the future career of apprentices as a common good), trade unions (to accept below minimum-wage payment for trainees) and government (to fund vocational schools and ensure quality control)[51].

The dual model is an effective system to tackle skill mismatches, though not easy to be replicated in other settings because high are the institutional requirements. For successful implementation, it is crucial to rely on the following elements:

(i) support from employers to provide on-the-job training to support longer-term job prospects in productive jobs;
(ii) young people and trade unions to view apprenticeships with lower earnings as a form of skill acquisition;
(iii) the vocational training system itself to supply job-relevant training in close cooperation with government, employers and trade unions within a clear regulatory framework including permanent adaptation to improve the relevance of the learning contents and methods.

[47] Cedefop, S*kills, qualifications and jobs: the making of a perfect match? Evidence from Cedefop's European skills and jobs (ESJ) survey*, Luxembourg: Publications Office of the European Union 2015b.

[48] F. Rauner - E. Smith (eds), *Rediscovering apprenticeship: research findings of the international network on innovative apprenticeship*, Springer, Dordrecht 2010; M. Parey, *Vocational Schooling versus Apprenticeship Training. Evidence from Vacancy Data, mimeo*, 2009; G. Quintini - T. Manfredi, *Going Separate Ways? School-To-Work Transition in the United States and Europe*, *OECD Social, Employment and Migration Working Papers, No. 90*, OECD Publishing, Paris 2009.

[49] S.C. Wolter - P. Ryan, *Apprenticeshi*p, in R. Hanushek, S. Machin and L. Wössmann (Eds.), *Handbook of the Economics of Education,* Vol. 3, Elsevier, Amsterdam 2011, pp. 521-576.

[50] H. Steedman, *Overview of apprenticeship systems and issue*, ILO contribution to the G20 Task Force on Employment, Skills and Employability Department, International Labour Organization 2012; Cedefop, *Benefits of VET in Europe for people, organisations and countries*, Luxembourg: Publications Office of the European Union 2013.

[51] C. Biavaschi - W. Eichhorst - C. Giulietti - M.J. Kendzia - A. Muravyev - J. Pieters - A.N. Rodríguez-Planas - R. Schmidl - K.F. Zimmermann, *Youth Unemployment and Vocational Training*. Background Paper for the World Development Report 2013.

From an educational point of view, apprenticeship can produce different benefits.
Firstly, in a positive way it can affect the students' motivation: the situated learning characterising apprenticeship is for some learners both more motivating and easier to undertake than the less situated learning of classroom-based programmes[52]. Secondly, the skills produced by apprenticeship are closer to the production method in a firm[53]. Indeed, the ability of individuals is boosted in order to apply knowledge learnt during training in difficult practice settings, through spontaneous actions or judgment[54]. Thirdly, the end of formal schooling does not necessarily means the end of skill development. In fact, individuals continue to develop skills right up to the end of their working lives. Research has shown that jobs themselves shape social attitude and skills, especially at a young age[55]. Thus, a positive job experience can have an impact on developing attitudes and behavior, which can support the development of socially cohesive societies. In the fourth place, work-based learning can also facilitate the transmission and sharing of knowledge, as workers are constantly interacting on a daily basis (so-called *knowledge spillovers*). The direct training of learning such technical skills are of course private: an increase in what one subsequently learns. Indirectly, however, this effect again increases *what others can learn from you*. Thus apprenticeship may have positive externalities for the somewhat less obvious reason that it increases what *you can learn from others*[56].

Lastly, jobs can stimulate skill building by putting employees in contact with a wider external environment and a set of influences. Through working in foreign-owned or international companies, employees can gain new technical and managerial skills (Almeida et al., 2012)

Skills are widely regarded as being necessary for boosting productivity, stimulating innovation, and creating new jobs, while skill mismatches are often cited as being responsible for a lack of dynamism in the labor market.
Well-functioning labour markets rely on a match between the skills and formal qualifications of the workers and those that the jobs require and employers look for. The number of graduates from particular programmes should respond to employment prospects in the respective fields. Comparing graduation trends and employment prospects informs about the responsiveness of skill supply to skill demand.
As mentioned in this papers, when workers have either fewer or more skills than jobs require, skills mismatch occurs. Mismatches result from imbalances labour demand and the skill produced in formal education training; imbalances also occurs as a result of changes in job characteristics and lags in workers' and employers' adaption to these changes.
Some mismatch is inevitable, as the labour market involves complex decisions by employers and workers and depends on many external factors (rapid technological development, new sources of job creation, newly created forms of work organization and demographic change). In particular, in a dynamic, continuously changing economy, there are always some unfilled positions, even if some people remain unemployed; and there are always some individuals who are in a job which does not fully match their skills profile. However, high and persistent skills mismatch is costly for employers, workers and society at

[52] P. Ryan, *Apprenticeship: between theory and practice, school and workplace*, M. Pilz (Ed.), *The Future of Vocational Education in a Changing World*, Springer, Wiesbaden 2012, pp. 403-432.
[53] *Ibi*, p. 409.
[54] D. Schön, *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, New York 1983; D. Pratt - J. Johnson, *The Apprenticeship Perspective: Modelling Ways of Being*, in D. Pratt, (Ed.). *Five Perspectives on Teaching in Adult and Higher Education* Malabar FL: Krieger Publishing Company, 1998.
[55] F. Cunha - J.J. Heckman - S.Schennach, *Estimating the technology of cognitive and noncognitive skill formation*, «Econometrica», 78 (2010), pp. 883-931.
[56] J. Benhabib - M.M. Spiegel, *Human Capital and Technology Diffusion*, in P. Aghion and S. Durlauf, (eds), *Handbook of Economic Growth*, Vol. 1, 2005, pp. 935-966; W. W. McMahon, *The Social and External Benefits of Education*, in G. Johnes and J. Johnes (Eds.), *International Handbook on the Economics of Education*, Edward Elgar, 2004, pp. 211-259.

large. Although there is some evidence of the skills mismatch rising after the global financial crisis of 2008, it is primarily a structural issue and as such it already existed prior to the recent global economic slowdown.

Well-designed, efficient and accessible education systems and training schemes, with strong links to the labour market, are crucial for building up and maintaining the required level of skills in the labour force and to reduce skill mismatches. Furthermore, in any education and training system particular attention should be devoted to the workers currently disadvantaged on the labour market, namely young individuals, low-skilled, unemployed and inactive. From this perspective, a traditional and currently intensively discussed form of education and training that seek to provide skills in need to individuals in the labour market is the apprenticeship in the dual system. Offering a wider range of apprenticeships and other work-based experience schemes can be a helpful short-term tool for assuring a smooth transition from school to work. In fact, young people and the unemployed become active in the labour market and acquire useful skills to find suitable work in the economy. In addition, apprenticeships are attractive to young people as they combine theory with practice, training with earnings ("learn as you earn"), access to social protection and labour rights and a higher likelihood of post-training employment.

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