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Mismatch between Demand and Supply among higher education graduates in the EU

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Authors

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Abstract

The misalignment between demand and supply contributes to the labour market problems experienced by many recent graduates in Europe. Not only does the growth in the number of recent university graduates differ from the growth in job vacancies potentially available for them, but also a large number of individuals end up completing their tertiary degree in subjects for which there is little demand or for which there is an excess of supply relative to demand. In an attempt to investigate whether the EU is expected to generate the appropriate number and type of graduates, this study compares projections on forecasted graduate labour market development tendencies made by Cedefop between 2016 and 2030 with estimated trends in the supply of tertiary graduates during the same period. The analysis predicts that, while a rough balance between graduate demand and supply is likely to emerge at aggregate level, there will be a small surplus of graduates in the fields of ICT and a more relevant one in Science and Engineering. Results, however, significantly differ across individual EU Member States.

1 Introduction

In Europe, the last two decades have seen a greater demand for workers with cognitive, non-routine and high-level Information and Communication Technology (ICT) skills (OECD, 2017), which has been accompanied by a remarkable increase in the educational attainment of the young generations[1]. However, while one would have expected labour demand to be able to absorb the rise in tertiary graduates, this does not seem to have occurred. The labour market situation of young graduates has, in fact, not improved[2]. Has educational attainment gone beyond the needs of the economy, with supply growth surpassing demand growth? Or alternatively, is tertiary education endowing graduates with skills that are not well matched with those required by firms? Are the problems faced by recent graduates of temporary nature (Frei and Sousa-Poza, 2012) as it takes them a relatively long time to find a(n) (appropriate) job, especially in more regulated and less flexible labour markets (Di Pietro, 2002)?

In an attempt to shed light on the graduate mismatch problem, this report focuses its attention on the role played by the misalignment between demand and supply. A large number of individuals complete their tertiary degree in subjects for which there is little demand or for which there is an excess supply. This would help to explain why many graduates are unfortunately unable to find employment, are forced to accept jobs for which a lower level of education is typically required (over-education or vertical mismatch), or have occupations that require a tertiary degree but in a different field from the one they have been trained (horizontal mismatch). All this has a relevant cost for individuals, firms/organizations and society as a whole. Horizontally and vertically mismatched workers are likely to receive a lower wage than adequately matched workers. Horizontal and vertical mismatches are associated with lower job satisfaction and higher turnover (Béduwé and Giret, 2011). Matching job requirements with graduates' field-specific skills is very important, as students make their educational choices with the expectation of being able in the future to find employment in field-related occupations (Betts, 1996). On the other hand, companies hiring horizontally mismatched workers may have to spend money and time to train them, and this has a negative effect on productivity. Additionally, from a public finance perspective, mismatches are undesirable because they signal a low return to public investment in education and generate low tax revenues, while unemployment benefits rise (Zhu, 2012).

Traditional macro models relate productivity growth to human capital (proxied, for instance, by the number/share of individuals with tertiary educational attainment). Similarly, in the literature on skill-biased technological change, the relative supply of highly skilled workers is often measured using the ratio of college equivalents[3] to non-college equivalents[4] (Autor et al., 1998). However, while these approaches focusing on the "quantity" of education are appropriate in these contexts, they are not fully informative when attempting to analyse the labour market experience of tertiary graduates. It is well-established that the type and "quality" of educational investment (e.g. field of study, institution attended, etc.) have a strong impact on labour market prospects (employment and earnings) and mounting evidence shows that there are differential labour market returns across degree subjects. Wahrenburg and Weldi (2007) find that in Germany graduates in Medicine earn, on average, the highest income followed by Law, Economics and Social Studies. Similar conclusions have been reached by a recent study by Belfield et al. (2018) for the UK. Using a rich dataset of school, university and tax records created by the UK Department of Education, they find that Medicine, Economics and Business are among the courses associated with the highest earnings returns. Despite this, many university students seem to choose their subject of study without considering information about the relative labour market benefits of different educational options. Such lack of information may be especially relevant for students from less advantaged backgrounds. A few experiments (e.g. Pekkala Kerr et al., 2015) have been conducted to study the behavioural impact of providing students with information on the relationship between education level, field of study and earnings. This additional information is found to significantly affect students' attitudes toward educational investment decisions.

While respecting students' preferences and abilities is crucial, it is also useful to help students make informed decisions regarding field of study at tertiary level. For this it would be desirable to understand in advance

(1) Since the beginning of the 2000s the share of Europeans in the age interval 30-34 with tertiary education has experienced a significant growth, satisfying the EU-28 target for tertiary educational attainment in 2018 (set at 40%).

(2) In the EU, the unemployment rate among people aged 30 to 34 with tertiary education increased from 4.6 in 2002 to 4.8% in 2017. In the EU, the employment rate among recent tertiary graduates (aged 20-34) not in education and training decreased from 86.9% in 2008 to 85.5% in 2018.

(3) Expressed as the sum of those with a Bachelor's or graduate degree and half of those with some college but not a four-year degree.

(4) Expressed as the sum of those without a Bachelor's or graduate degree and half of those with some college but not a four-year degree.

what are the occupations -and related subject areas- where additional jobs will be created, as opposed to those where a reduction in jobs is foreseen. On the other hand, one should be aware that making projections of future labour demand needs is inherently risky, and more so when the time horizon spans beyond 10-15 years.

This study investigates the extent to which the EU is foreseen to generate the appropriate number and type of graduates. Data on employment projections from the Cedefop Skills Forecast 2018 (Cedefop, 2018) - expected to capture the skills needed in the future in the EU- are compared with estimated trends in the supply of EU tertiary graduates, based on Eurostat data. Such a comparison is made at aggregated level, but also at a finer level, since employment projections are available at occupational level, and several occupations can be associated with a specific field of study.

Providing data analysis and intelligence on skills and labour markets is important for several reasons. First, skill imbalances and mismatches can be viewed as a constraint on economic growth and development and may hinder the achievement of broader governmental goals such as social inclusion and poverty reduction (Fisher and Campbell, 2017). Second, the results of this exercise may help to make the provision of education and training more congruent with the needs of society and the economy. Third, they can also be used by policymakers to anticipate future challenges and adjust policies (e.g. immigration policies).

The remainder of the report is as follows. Section 2 presents forecasted employment data for highly skilled occupations for the EU as a whole and for each Member State. Section 3 shows the estimated number of new tertiary graduates that the EU expects to produce over the next 15 years (overall as well as in each Member State), under the assumption that recent trends will not change in the future. Section 4 examines the extent to which the estimated supply will be able to meet the future demand of graduates. This analysis is carried out at the aggregate level, and for two fields of study (ICT and Science and Engineering). Concluding remarks and policy implications are outlined in Section 5.

2 Forecasted demand of tertiary graduates

Cedefop projections on future labour demand forecast the number of jobs that are expected to become available during the period 2016-2030 (i.e. total requirement). This number is the sum of two different components: i) expansion demand, reflecting the new jobs that will be opened due to new positions and ii) replacement demand, capturing the number of jobs that will become available because workers will leave their current position, temporarily or permanently[5]. This report concentrates its attention on highly skilled occupations, given the focus on the graduate labour market. The *International Standard Classification of Occupations* (ISCO-08) is used to identify those occupations requiring tertiary education. They correspond to *ISCO-08 one digit* occupations 1 to 3 (managers, professionals, technicians and associate professionals)

Table 1 displays employment change projections between 2016 and 2030 at EU-28 level for broader two-digit occupational categories in ISCO-08 *one-digit* level 1 to 3. Results indicate that 68,822 thousands new jobs will become available during this period (see bottom of column (5)), resulting from the sum of 12,146 thousands due to expansion demand and 56,676 thousands due to replacement demand. Therefore, overall employment is projected to increase by about 13% across highly skilled occupations. Replacement demand is consistently found to be more relevant than expansion demand, suggesting that employers would need to replace many people leaving the workforce due to retirement or other factors. These new jobs could be filled by new graduates, migrant workers, workers presently employed in other occupations, or even individuals who are currently unemployed or out of the labour force.

Positive growth in employment levels can be seen for all highly skilled occupations with the exception of teaching professionals. Although the reasons for the latter result cannot be determined here, some possible explanations are: a) the demographic trends in Europe[6] (Lutz et al., 2019), b) computers partially replacing teachers in some instances (Edwards and Cheok, 2018), c) the growth of free online courses, such as Massive Open Online Courses, (OECD, 2016), negatively affecting the development of paid lifelong learning courses and d) lower public contribution to education providers, leading to larger class sizes[7]. The greatest growth in employment is predicted to take place in the Legal, social, and cultural professionals and associate professionals categories (21% and 53%, respectively).

Table 1. Projected employment change by occupation. 2016-2030. Managerial, Professional and Associate professional sub-major groups (ISCO08 1-3). EU28

Two Digit ISCO08 Occupations 1-3	Employment in 2016 (thousands) (1)	Forecasted employment in 2030 (thousands) (2)	Expansion demand 2016-2030 (thousands) (3) i.e. (2) – (1)	Replacement demand 2016-2030 (thousands) (4)	Total requirement 2016-2030 (thousands) (5) i.e. (3) + (4)	Net change in % of 2016 employment (6) i.e. [(2)/(1) – 1]*100
1.1 Chief executives, senior officials and legislators	1,776	1,998	222	1,719	1,942	13%
1.2 Administrative and commercial managers	3,721	4,367	646	2,428	3,074	17%
1.3 Production and specialized services	4,708	5,330	622	3,395	4,017	13%

(5) Permanent separations arise due to retirement, emigration, sickness and family formation.

(6) Current and projected low fertility rates in Europe are expected to significantly reduce the student population, thereby having a detrimental effect on the number of future teaching vacancies. For instance, in Italy, according to projections based on Eurostat data, there will be a decline in the number of school age children (3 to 18 years old) from the current 9 million to 8 million in 2028 (Fondazione Agnelli, 2018). This, in turn, could lead to a loss of more than 50,000 teaching posts.

(7) The findings of a 'shift-share' analysis performed by Cedefop show that the forecasted decline in numbers for teaching professionals can be mainly attributed to occupational changes, which tend to happen regardless of variations in economic conditions, and are the result of organisational changes in the workplace and job restructuring.

managers						
1.4 Hospitality, retail and other services managers	4,157	4,664	507	3,050	3,557	12%
2.1 Science and engineering professionals	6,427	7,572	1,145	3,796	4,941	18%
2.2 Health professionals	5,828	6,218	389	4,125	4,514	7%
2.3 Teaching professionals	10,051	9,788	-263	6,411	6,148	-3%
2.4 Business and administration professionals	8,263	9,882	1,619	4,577	6,196	20%
2.5 Information and communication technology professionals	3,562	3,976	415	1,339	1,753	12%
2.6 Legal, social and cultural professionals	5,898	7,107	1,209	4,049	5,258	21%
3.1 Science and engineering associate professionals	7,898	8,290	393	4,517	4,910	5%
3.2 Health associate professionals	6,120	6,755	635	3,363	3,998	10%
3.3 Business and administration associate professionals	16,478	18,415	1,937	10,048	11,985	12%
3.4 Legal, social, cultural and related associate professionals	4,903	7,495	2,592	3,197	5,789	53%
3.5 Information and communications technicians	1,917	1,995	78	662	740	4%
Total	91,707	103,852	12,146	56,676	68,822	13%

Source: Cedefop,and Eurofound (2018). *Note: Expansion demand* estimates how many new positions will be created between 2016 and 2030. *Replacement demand* estimates how many jobs will become available in the time interval 2016-2030 due to existing workers leaving temporarily or permanently their position. *Total requirement* is the sum of *Expansion demand* and *Replacement demand*, and it represents the actual number of job positions that will become available in the period 2016-2030.

3 Estimated supply of tertiary graduates

The next step in the analysis is to estimate the number of new tertiary graduates that the EU will produce between 2016 and 2030. These estimates are based on a linear extrapolation of all tertiary education leavers in the EU between 2013 and 2016[8] (data are supplied by Eurostat). Extrapolation assumes that recent and historical trends will continue (past behaviour is a good predictor of future behaviour).

The relevant data and the corresponding estimates are shown in Table 2. In each Member State, the number of new tertiary graduates in 2016 is taken as a starting point (see Column (1)), and it is assumed that every year this will increase at a constant fixed rate, which is equal to that observed in the period from 2013 to 2016[9] (see Column (2))[10]. As shown at the bottom of Column (3), according to the estimates, 69,581,083 tertiary graduates will become available over the next 15 years in the EU as a whole[11]. It is interesting to observe that in several Member States new tertiary graduates have experienced a declining trend in recent years. As already argued, demographic factors (i.e. the decrease in the size of the cohort of young people) may play an important role here.

Table 2. Estimated supply for graduates: All fields of study EU28

Country	Number of new graduates in 2016 (1)	Linear annual growth rate of new graduates in the period 2013-2016* (2)	Estimated number of new graduates between 2016 and 2030 (3)
Belgium	119,141	3.4%	2,275,917
Bulgaria	60,383	-3.1%	731,952
Czechia	90,725	-3.2%	1,096,655
Denmark	85,290	8.7%	2,439,597
Germany	556,800	3.9%	11,102,026
Estonia	10,262	-1.9%	135,130
Ireland	72,952	6.0%	1,694,670
Greece	69,929	1.8%	1,194,844
Spain	438,661	2.5%	7,880,675
France	772,779	1.8%	13,126,786
Croatia	34,028	-2.6%	426,450

([8]) For the Netherlands, data only refer to the period 2013-2015. We estimated the value for 2016 as G_{15} $(1+r_{13\text{-}15})$ where G_{15} is the number of graduates in 2015 and $r_{13\text{-}15}$ is the average growth of new graduates in the country between 2013 and 2015 calculated as follows: $((G_{15}/G_{13})^{1/2})-1$.

([9]) Calculated as follows: $((G_{16}/G_{13})^{1/3})-1$.

([10]) G_t (number of graduates in year t) = G_{t-1} $(1+r)$ where r is the average annual growth of new graduates between 2013 and 2016.

([11]) This estimate is the sum of new graduates in 2016 plus the forecast made using the above formula for years from 2017 to 2030.

Italy	373,775	1.1%	6,051,568
Cyprus	8,545	10.4%	279,801
Latvia	15,796	-9.9%	126,013
Lithuania	29,683	-8.9%	251,069
Luxembourg	1,682	1.7%	28,424
Hungary	68,110	-2.6%	857,216
Malta	4,576	6.4%	109,495
Netherlands	154574	3.8%	3,045,232
Austria	83,396	-0.7%	1,188,082
Poland	487,640	-6.6%	4,740,947
Portugal	73,086	-2.5%	921,366
Romania	121,788	-10.9%	919,375
Slovenia	30,967	17.3%	1,784,894
Slovakia	56,280	-7.0%	532,400
Finland	56,066	2.1%	974,201
Sweden	78,112	2.4%	1,388,913
United Kingdom	754,301	-1.6%	10,124,016
EU-28	4,709,327	-0.2%	69,581,083

Sources: Cedefop (2018); Eurostat.

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4 Demand and supply of tertiary graduates

It is now time to put together the forecasts of new jobs (potentially filled by new graduates) and the estimates for the supply of tertiary graduates. The objective is to investigate if the estimated supply will be able to satisfy the likely future demand of graduates. One approach to this consists in first computing the implicit rate of growth, and then comparing it with the annual linear rate of growth of new graduates between 2013 and 2016 (Column (2) of Table 2). The implicit rate of growth identifies what is the linear yearly rate of change in the number of new tertiary graduates (using those in 2016 as the starting point) that would match the number of highly skilled jobs that are expected to become available throughout the 2016-2030 period.

Let *Y* be the total requirement between 2016 and 2030 (Column (5) of Table 1) and *X* be the number of new tertiary graduates in 2016 (Column (1) of Table 2). Having as a reference the fifteen years between 2016 and 2030, the implicit rate of growth, *g*, can be expressed as:

$$X + X(1+g)^1 + X(1+g)^2 \ldots . + X(1+g)^{14} = Y \qquad (1)$$

Equation (1) can be re-written as:

$$X\{1 + (1+g) + (1+g)^2 \ldots . + (1+g)^{14}\} = Y \qquad (2)$$

or as:

$$X\{\sum_{n=0}^{N=14}(1+g)^n\} = Y \qquad (3)$$

Using the formula $\sum_{n=0}^{n=N} \alpha^n = \frac{\alpha^{N+1}-1}{\alpha-1}$ for finite series, if α is replaced by $1+g$, Equation (3) becomes:

$$\frac{(1+g)^{15}-1}{g} = \frac{Y}{X} \qquad (4)$$

Table 3 illustrates how the difference between the implicit rate of growth (i.e. the value of *g* that would solve Equation (4)) and the annual linear rate of growth of new tertiary graduates can be interpreted in terms of shortages/surpluses.

Table 3. Relationship between the implicit rate of growth and linear annual growth rate of new graduates

Implicit rate of growth (1)	Linear annual growth rate of new graduates (2)	Difference (3)
+	+	If (1) > (2) shortage If (2) > (1) surplus
+	_	shortage
_	+	surplus
_	_	If (1) > (2) shortage If (2) > (1) surplus

Columns (1) and (2) of Table 4 report the implicit rate of growth and the annual linear rate of growth of new tertiary graduates during the 2013-2016 period for the EU as a whole as well as for each Member State. Looking at the EU-28, while both rates are negative, the implicit rate of growth is found to be slightly smaller than the annual linear rate of growth of new tertiary graduates. This means that, though the number of tertiary graduates is expected to experience a small decline, a slightly more pronounced reduction would be required in order to match all the vacancies for skilled workers that are forecasted to become available in the future. However, the difference between the two rates (i.e. 0.2%) is so small that one can practically conclude that no significant mismatch between demand and supply appears to be foreseen. What is perhaps more interesting, is to look at differences across individual Member States. Significant[12] shortages of highly skilled labour are projected in Luxembourg, Latvia, Lithuania, Estonia, Romania, Italy, Sweden and Czechia. By contrast, significant surpluses are forecasted in Slovenia, Ireland, Cyprus, Denmark, Greece, Malta, Spain, Belgium, France and Poland. One would expect intra-EU mobility among skilled workers to at least partially compensate for the imbalance at the Member State level.

It is important to note that the approach used in this study has two limitations. One is related to the demand side, whereas the other concerns the supply. As regards the former, the implicit assumption made here is that all the new jobs (*Total requirement 2016-2030*) are potentially available for new tertiary graduates. However, it is quite possible that some of these jobs might be taken up by graduates currently employed in non-graduate jobs or even by currently unemployed graduates. This could lead to a slight overestimation of the number of jobs actually available for new graduates. On the other hand, concerning the supply, it is reasonable to expect that a proportion of new tertiary graduates are from non-EU countries and they will return back home following completion of their studies regardless of EU labour market conditions. The other way round is also possible. A proportion of people from the EU who will complete tertiary education in a non-EU country is expected to move back to Europe following graduation.

([12]) We refer to 'significant' shortages/surpluses when the difference between the implicit rate of growth and the annual linear rate of growth of new tertiary graduates is equal or greater than 4 percentage points in absolute value.

Table 4. Demand and supply for graduates: All fields of study

	Implicit rate of growth (1)	Annual linear growth rate of new graduates (2)	Shortage/surplus (3)
Belgium	-2.7%	3.4%	significant surplus
Bulgaria	-1.1%	-3.1%	small shortage
Czechia	1.0%	-3.2%	significant shortage
Denmark	-0.2%	8.7%	significant surplus
Germany	5.0%	3.9%	small shortage
Estonia	4.0%	-1.9%	significant shortage
Ireland	-7.4%	6.0%	significant surplus
Greece	-5.5%	1.8%	significant surplus
Spain	-3.9%	2.5%	significant surplus
France	-3.8%	1.8%	significant surplus
Croatia	-0.5%	-2.6%	small shortage
Italy	5.6%	1.1%	significant shortage
Cyprus	-1.6%	10.4%	significant surplus
Latvia	1.4%	-9.9%	significant shortage
Lithuania	-1.1%	-8.9%	significant shortage
Luxembourg	24.8%	1.7%	significant shortage
Hungary	0.9%	-2.6%	small shortage
Malta	-0.7%	6.4%	significant surplus
Netherlands	3.5%	3.8% (a)	small surplus
Austria	-1.3%	-0.7%	small surplus
Poland	-10.9%	-6.6%	significant surplus
Portugal	0.0%	-2.5%	small shortage
Romania	-5.0%	-10.9%	significant shortage
Slovenia	-7.7%	17.3%	significant surplus

Slovakia	-5.4%	-7.0%	small shortage
Finland	1.9%	2.1%	small surplus
Sweden	6.6%	2.4%	significant shortage
United Kingdom	-0.2%	-1.6%	small shortage
EU-28	-0.4%	-0.2%	small surplus

Notes:

(a) Eurostat data on graduates are not available for 2016.They are estimated as $G_{2015}*(1+r_{13-15})$.
(b) 'Significant' shortages/surpluses refers to the difference between the implicit rate of growth and the annual linear rate of growth of new tertiary graduates being equal or greater than 4 percentage points in absolute terms.
(c) 'Small' shortages/surpluses refers to the difference between the implicit rate of growth and the annual linear rate of growth of new tertiary graduates being lower than 4 percentage points in absolute value

Sources: Cedefop (2018); Eurostat.

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Next, the analysis reported in Table 4 is replicated for two fields of study: ICT, and Science and Engineering. This choice is driven by the following two considerations. First, ICT, Science and Engineering, and Health and Welfare are fields of study for which there is a clear alignment with specific ISCO-08 two-digit occupational categories (legislators, senior officials and managers are in fact potentially related to more than one field of study). Second, unfortunately, we had to exclude Health and Welfare given the unavailability of Eurostat data on recent graduates for several Member States. Table 5 illustrates how each occupational category is linked to each of the two selected fields of study.

Table 5. Correspondence between two-digit ISCO08 occupations and ISCEDF13 fields of study

Two-digit ISCO08 occupation	**Higher education field of study (ISCEDF13)**
2.1 Science and engineering professionals 3.1 Science and engineering associate professionals	F05 Natural sciences, mathematics and statistics F07 Engineering, manufacturing and construction
2.5 Information and communication technology professionals 3.5 Information and communication technology associate professionals	F06 Information and Communication Technologies

Table 6. Demand and supply for graduates: ICT, and Science and Engineering

	ICT			Science and Engineering		
Country	Implicit rate of growth (1)	Annual linear growth rate of new graduates (2)	Shortage/Surplus (3)	Implicit rate of growth (4)	Annual linear growth rate of new graduates (5)	Shortage/Surplus (6)
Belgium	10.0%	-0.6%	significant shortage	-11.2%	3.3%	significant surplus
Bulgaria	5.0%	-2.4%	significant shortage	-6.3%	-5.2%	small surplus
Czechia	2.9%	-8.3%	significant shortage	2.5%	-1.9%	significant shortage
Denmark	4.2%	10.7%	significant surplus	-2.1%	8.2%	significant surplus
Germany	-0.6%	5.7%	significant surplus	-3.1%	4.0%	significant surplus
Estonia	8.8%	4.5%	significant shortage	-1.7%	-3.0%	small shortage
Ireland	-13.6%	20.8%	significant surplus	-18.2%	7.3%	significant surplus
Greece	-17.6%	-12.0%	significant surplus	-14.0%	0.3%	significant surplus
Spain	-1.6%	0.5%	small surplus	-10.2%	0.4%	significant surplus
France	-3.5%	0.8%	significant surplus	-4.7%	1.9%	significant surplus
Croatia	7.4%	3.9%	small shortage	-7.1%	0.8%	significant surplus
Italy	13.1%	2.0%	significant shortage	-2.0%	-0.2%	small surplus
Cyprus	4.5%	-5.8%	significant shortage	-0.7%	7.2%	significant surplus
Latvia	-1.5%	-0.9%	small surplus	-1.2%	-9.4%	significant shortage
Lithuania	7.7%	-10.7%	significant shortage	-23.5%	-8.2%	significant surplus
Luxembourg	22.0%	12.6%	significant shortage	27.0%	2.9%	significant shortage

Hungary	-7.5%	10.9%	significant surplus	0.2%	2.4%	small surplus
Malta	-24.5%	-3.0%	significant surplus	6.0%	-2.3%	significant shortage
Netherlands	NA (a)	NA (a)	-	-1.6%	7.6% (d)	significant surplus
Austria	-3.7%	-2.1%	small surplus	-4.9%	1.9%	significant surplus
Poland	-13.7%	-3.3% (c)	significant surplus	-14.7%	-0.7% (c)	significant surplus
Portugal	16.8%	-6.7%	significant shortage	-12.3%	-0.9%	significant surplus
Romania	-54.3%	57.2%	significant surplus	-14.9%	-13.3%	small surplus
Slovenia	-12.7%	15.1%	significant surplus	-10.8%	15.2%	significant surplus
Slovakia	-9.0%	-0.6%	significant surplus	-9.9%	-7.7%	small surplus
Finland	2.2%	4.0%	small surplus	-1.7%	3.3%	significant surplus
Sweden	8.8%	5.5%	small shortage	-2.2%	2.9%	significant surplus
United Kingdom	2.6%	-1.4%	significant shortage	-21.4%	0.1%	significant surplus
EU-28	0.5%	2.0% (b)	small surplus	-7.2%	0.7%	significant surplus

Notes:

(a) As Eurostat data on new graduates in ICT are only available for 2015, it has not been possible to calculate the annual linear growth rate of new graduates.

(b) EU-28 growth rate is based on aggregated data (available or estimated) from the 28 countries in 2013 and 2016. As regards ICT, however, only data from 27 counties are available. To address this problem, an estimation of NL data in 2013 and 2016 was carried out and added to the sum of the remaining 27 countries. The NL estimation was based on a linear extrapolation using G_{2015} in NL and applying the growth rate of the EU without NL (2%).

(c) Eurostat data on graduates are not available for 2013. They are estimated as $G_{2014}/(1+r_{14\text{-}16})$.

(d) Eurostat data on graduates are not available for 2016. They are estimated as $G_{2015}*(1+r_{13\text{-}15})$.

(e) 'Significant' shortages/surpluses refers to the difference between the implicit rate of growth and the annual linear rate of growth of new tertiary graduates being equal or greater than 4 percentage points in absolute value.

(f) 'Small' shortages/surpluses refers to the difference between the implicit rate of growth and the annual linear rate of growth of new tertiary graduates being lower than 4 percentage points in absolute value.

Sources: Cedefop (2018); Eurostat.

JRC B.4 Elaborations

Starting with the ICT field, one may observe that at EU level both the implicit rate of growth and the annual linear rate of growth of new graduates are positive (Columns (1) and (2) of Table 6). However, the latter is larger than the former, suggesting that the EU overall is likely to experience a small surplus of ICT graduates. There are, however, some Member States that are expected to suffer significant skill shortages in ICT. These

are: Portugal, Lithuania, Italy, Czechia, Belgium, Cyprus, Luxembourg, Bulgaria, Estonia and the UK. On the other hand, significant surpluses of ICT professionals are forecasted in Romania, Ireland, Slovenia, Malta, Hungary, Poland, Slovakia, Denmark, Germany, Greece, and France[13].

The findings for Italy and the UK are consistent with those reported by Gareis et al. (2014)[14]. They conclude that both countries are likely to face skill shortages in ICT due an expected strong demand. Additionally, the issue of shortfall of ICT graduates in the UK is not a new phenomenon as it has been already recognized since the mid-2000 from the British Computer Society (Richards, 2007). The result for Lithuania is also in line with the conclusions of a report (European Commission, 2014) claiming that in this country the shortage of ICT specialists is increasing. This is again driven by an expected stronger demand (for instance, many international banks are opening or are planning to open branches in Lithuania).

Although our analysis at EU level seems to be at variance with the claim often made that there will be a shortage of ICT workers, it is important to keep the following three considerations in mind. First, there is the possibility that several forecasting studies have overestimated the ICT skill gap (Teffer, 2017). For instance, Empirica, a German research and consultancy firm, shows that, though a shortage in ICT is still expected in 2020, its size is lower than what initially estimated (van der Linden et al., 2018). Second, while our analysis forecasts a small surplus of ICT in the period 2016-2030, similar forecasting studies (e.g. European Commission, 2016) predicts a shortage in 2020. These results, however, might not contradict each other as it is possible that a shortage in 2020 may transform into a surplus at some point throughout the 2020s (for instance, the supply may over-react to demand, given the persistent shortage of ICT graduates)[15]. Third, while our study focuses on ICT graduates, the majority of similar forecasting studies looks at the broader category of ICT professionals. Therefore, in contrast to our analysis, the latter studies consider future vacancies for both graduate and non-graduate jobs in ICT.

As far as Science and Engineering are concerned, it is forecasted that there will be an excess of graduates at EU-28 level (Column (6) of Table 6). While the annual linear rate of growth of the supply of graduates in the period 2013-2016 is slightly positive (i.e. 0.7%), the implicit rate of growth turns out to be negative (i.e. -7.2%). Only four Member States (Luxembourg, Malta, Latvia and Czechia) are predicted to face significant shortages in this subject area since their recent trends in the number of relevant graduates are found to lag behind the corresponding projected labour needs.

Although the expected surplus of graduates in Science and Engineering may appear to be surprising, this result is in line with the findings of a forecasting analysis performed for the US. When the number of tertiary graduates with technical majors who completed their studies in 2015-2016 is compared with annual job opening projections for 2014 through 2026, the former is found to outpace the latter in the following fields: Life Sciences, Engineering, Physical Sciences and Mathematical Sciences (Lohr, 2017). Using US Bureau of Labor Statistics employment forecasts in STEM categories, Lazowska[16] shows that, in the decade ending in 2024, only about 6% of STEM job growth will be in Physical Sciences and Life Sciences.

Additionally, it is important to remember that here, by assumption, STEM subjects are linked to STEM occupations only. There is evidence showing that a relatively large proportion of STEM graduates end up in non-STEM occupations[17]. In the UK, STEM graduates are more likely to work in teaching and management than in areas such as Science, Engineering and ICT (Smith and White, 2018). Similar evidence exists also for the US. The US Census Bureau (2014) finds that in 2012 only 33% of Engineering graduates aged between 25 and 64 were working in engineering occupations. This therefore suggests that the surplus of tertiary graduates in specific STEM fields may have less negative consequences in the labour market than what the forecasting result would seem to imply.

([13]) The results at individual Member State level are broadly consistent with those included in a recent JRC report (Gonzalez Vazquez et al., 2019) that employs the same data and a similar methodology in order to compare the future demand and supply of ICT graduates. However, the findings differ across 4 countries. While in Finland, Slovenia and Latvia our analysis predicts a surplus, a shortage is forecasted in the JRC report. The opposite occurs for Bulgaria and Cyprus. These different conclusions can be essentially attributed to updated recent data on ICT graduates becoming available in these countries.

([14]) Projections made by this study are up to 2020 and they examine future vacancies for ICT practitioners and ICT management level employees.

([15]) Unfortunately we are unable to study how the gap between the demand and the supply of ICT graduates changes on a yearly basis as the data on the demand side only refer to the estimated number of jobs for ICT graduates for the entire period 2016-2030.

([16]) https://www.finfacts-blog.com/2018/09/shortage-of-stem-graduates-myth-in.html

([17]) A similar consideration can also be made for ICT graduates. For instance, in Estonia only just above 50% of ICT graduates work in the field of information and communication (Leppik, 2017).

5 Conclusions

Europe experiences mismatches in the tertiary graduate labour market. On the one hand, a large pool of highly educated individuals are unable to find a job, or have an occupation for which they are over-educated, or their occupation is in a different field from the one in which they have been trained. On the other hand, a large number of companies have problems in filling their vacancies. This has detrimental effects for individuals (in terms, for instance, of earnings and satisfaction), companies (e.g. long-term unfilled positions may negatively affect productivity) and society at large (e.g. more unemployment benefits and less taxes).

At least part of the graduate labour market mismatches are due to a significant misalignment between demand and supply. Supply and demand show different rates of change over time, but most importantly there are remarkable and persistent shortages and surpluses at occupational/field of study level.

In an attempt to reduce undesirable consequences from potential future labour market imbalances, forecasting exercises are typically undertaken. They provide occupational guidance to perspective labour market entrants and, at the same time, help firms to strategically plan what they need to do to ensure they have an appropriate workforce (Neugart and Schömann, 2002). Additionally, forecasts assist policymakers in the development of those education and training policies that are needed in order to respond to shifts in the demand for skills and qualifications.

This report has exploited employment projections made by Cedefop between 2016 and 2030 in order to investigate if the EU is foreseen to generate the appropriate number and type of graduates. While in the EU as a whole our analysis shows that there will not be any significant mismatch between the demand and supply of graduates, important differences are found at the Member State level (for instance, considerable shortages of highly skilled labour are projected in Romania, Italy, Sweden and Czechia, whereas the opposite is forecasted to occur in Denmark, Spain, Belgium, France and Poland). Moving to specific subject areas, it is predicted that, at EU level, in 2030 there will be a small excess of graduates in ICT and a more relevant one in Science and Engineering. However, results greatly differ across Member States. For example, while Cezchia is expected to experience a shortage of graduates in ICT and Science and Engineering, exactly the opposite happens, for instance, in Ireland and Germany.

What can be done in an attempt to reduce the risk that labour supply is misaligned with labour demand?

Students need to be encouraged to think more about the (labour market) consequences of their educational decisions. This should occur relatively early, as, for instance, in many countries, by the age of 15 students have to decide whether to pursue an academic or a vocational track. More and better quality information about different career paths should be provided to students throughout their educational journey, keeping in mind that other factors -such as interests and abilities- have an important bearing on the decision to pursue tertiary education and on the selection of the field of study.

Students could be exposed to subjects in which a shortage of skilled labour is expected at a very early age. For instance, especially in countries persistently characterised by a shortage of skilled ICT workers, it may be important to introduce children at school to the excitement of computing and information technology. Primary schools could be encouraged to organise coding workshops where children have the opportunity to develop their problem solving, logical and computational thinking.

The mismatch between demand and supply of graduates cannot be attributed solely to "quantity" related issues, but also "quality" considerations should be taken into account. As stated in the introduction, a large number of employers report that they are dissatisfied with the skills learnt by tertiary graduates during their academic training. Education providers should better understand the expectations and the skills needed by the employers, and this could be obtained by increasing the contacts and exchanges between the two (McKinsey, 2014). As suggested by Quintini (2011), it is also important that tertiary education institutions adopt initiatives to raise the academic performance of students at the bottom end of the distribution, in an attempt to ensure that they graduate with the minimum competences expected by employers from someone with their level of qualification. But rising the performance of the lower tail of the skill distribution requires investments and policies that begin early in life, starting from primary education or even earlier, and involve the whole education sector.

This study, like many others, assumes that the link between occupation and education is determined exclusively on the basis of hard skills, i.e. the sets of technical abilities and competencies that are taught/required in a specific subject area. However, there is growing evidence that employers increasingly

place value on soft skills (e.g. teamwork, work ethic, communication skills, etc.). Less importance, however, is typically given to this type of skills by educational providers. Therefore, it would be beneficial to support the acquisition of soft skills, and graduates should try to signal to potential employers the extent to which they possess them.

Also related to the above point, one should observe that the analysis carried out in this study is based on education rather than on a broader concept of human capital. Education is the key component of human capital, which includes also, for instance, on-the-job training and cognitive skills. Therefore, an alternative approach would be to look at the skills and competences possessed by recent graduates and compare those with employers' needs. We leave this to future research.

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