

## Skills Requirements for the 30 Most-Frequently Advertised Occupations in the United States

An analysis based on online vacancy data

Miroslav Beblavý, Brian Fabo and Karolien Lenaerts

No. 132 / March 2016

### Abstract

Using a sample of approximately 2 million job advertisements published online, this paper assesses which educational, skills and other requirements US employers demand the most. Our analysis is focused on the 30 most-frequently advertised occupations in the United States, of different levels of complexity. Our results suggest that employers are demanding in their job advertisements, even when these concern low- or medium-skilled occupations. Although vacancies for more complex occupations are generally more demanding than those for less complex ones, there is a lot of variation across the 30 occupations. Formal education is the most important criterion for employers in the United States; it is required in 67% of the vacancies examined. Specialised training and licenses, in contrast, appear to be less important. Of the cognitive and non-cognitive skills, service skills in particular are high in demand (called for in 49% of the vacancies). Other non-cognitive skills, both of a social and personal nature, are frequently included as well. Experience is the third key criterion that employers use to screen job applicants. It appears in 38% of the vacancies.



**InGRID**  
Integrating expertise in inclusive growth

This paper was written within the framework of the InGRID project. Funded by the European Union's 7th Framework Programme for Research, the InGRID project (Inclusive Growth Research Infrastructure Diffusion) involves 17 European partners, including CEPS. It aims to integrate and innovate existing, but distributed European social sciences research infrastructures on 'Poverty and Living Conditions' and 'Working Conditions and Vulnerability' by providing transnational data access, organising mutual knowledge exchange activities and improving methods and tools for comparative research.

ISBN 978-94-6138-510-9

Miroslav Beblavý is Associate Senior Research Fellow at CEPS and Brian Fabo and Karolien Lenaerts are Researchers at CEPS. Financial support of the Eduworks Marie Curie Initial Training Network Project (PITN-GA-2013-608311) of the European Commission's 7th Framework Programme is gratefully acknowledged. The authors kindly thank Burning Glass for providing them with the data on which their analysis is based.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, mechanical, photocopying, recording or otherwise – without the prior permission of CEPS.

Available for free downloading from the CEPS website ([www.ceps.eu](http://www.ceps.eu))  
© Centre for European Policy Studies 2016

## TABLE OF CONTENTS

---

Executive Summary .....	1
Introduction.....	4
Related literature.....	5
Why opt for a vacancy analysis based on job advertisements that are extracted from an online job portal?.....	6
On the basis of a sample of approximately 2 million vacancies collected from Burning Glass .. ....	8
... Employers' demands for applicants for the 30 most-advertised occupations were explored. ....	10
Overall, employers in the United States are relatively demanding in terms of education, skills and other requirements - a result that holds for all occupations. ....	12
Education is the most commonly used filter across occupations .. ....	17
... While only 16% of all job advertisements requires specialised training or licenses. ....	17
On average, 25% or less of the job advertisements analysed call for cognitive skills .. ....	19
... but some cognitive skills, and specifically computer skills, analytical skills and language skills, seem to be more important than others - at least for some occupations .. ....	19
... Since having a driver's license and the ability to learn are only included in about one-tenth - or even less - of the job advertisements. ....	22
With regards to the non-cognitive skills, both social and personal skills prove to be relevant for employers.....	23
Of the social skills, service skills are requested more than team-working skills and communication skills (but some of these skills appear to be in demand only for specific occupations) .. ....	24
... While the demand for personal skills varies from 3% to 33% .. ....	26
Experience is required in 38% of the vacancies .. ....	27
... But other factors appear to matter less. ....	29
On the basis of a factor analysis of the six sets of requirements and skills in Figure 1, five factors are identified .. ....	29
... And an analysis is done to discover which factors are more important for which occupations.....	31
Conclusions .. ....	34
References.....	36

## List of Figures and Tables

Figure 1. Overview of the skills and requirements under examination .....	11
Figure 2. Overview of the non-cognitive skills, subdivided into social skills and personal skills.....	24
Figure 3. Overview of the factors.....	30
Table 1. Overview of the 30 most-frequently advertised occupation in the United States, their ISCO and O*NET codes and the number of vacancies collected for each of these occupations.....	8
Table 2. Sum of the percentage of job advertisements across occupations with education and formal qualifications requirements and sum of the percentage of job advertisements across occupations with all requirements .....	13
Table 3. Example of the calculation of the sum of skills and the sum of all requirements for the occupation 'general and operations managers' (based on 30,641 vacancies) .....	14
Table 4. Average sum of skills and sum of all requirements by ISCO class.....	16
Table 5. Percentage of job advertisements across occupations with education and formal qualifications requirements .....	18
Table 6. Percentage of job advertisements across occupations calling for ICT and computer, analytical and language skills.....	20
Table 7. Percentage of job advertisements across occupations listing communication skills, service skills and team-working skills requirements .....	25
Table 8. Overview of the five occupations with the highest percentage of vacancies that require each of the seven skills listed .....	26
Table 9. Percentage of job advertisements across occupations that require experience .....	28
Table 10. Overview of the most relevant factors for each of the 30 occupations .....	32
Table 11. Summary of the average percentage of vacancies across all 30 occupations .....	35



# **Skills Requirements for the 30 Most-Frequently Advertised Occupations in the United States**

**An analysis based on online vacancy data**

**Miroslav Beblavý, Brian Fabo and Karolien Lenaerts**

**CEPS Special Report No. 132 / March 2016**

---

## **Executive Summary**

This paper analyses a sample of approximately two million job advertisements obtained from an online job portal called “Burning Glass”, in order to identify employers’ demands for the 30 most-frequently advertised occupations in the United States. With this sample of vacancies, we investigate how demanding employers are for occupations of different levels of complexity (two low-skilled, 20 medium-skilled and eight high-skilled occupations). We also examine which types of education, skills and other requirements are mentioned in the vacancies and how these requirements differ across the occupations. To this end, we calculate the percentage of job advertisements (in general and for individual occupations) in which one or more requirements are present and compare these numbers across occupations. In our study, we focus on education and formal qualifications, cognitive skills, non-cognitive skills, experience and several other factors (including appearance, criminal record, drug testing and citizenship). In terms of education, we consider formal educational requirements and requirements for specialised training and licenses. The set of cognitive skills comprises *specific skills*, which are computer skills, analytical skills, language skills and possessing a driver’s license, and *generic skills* (captured by the ability to learn). In our work, the non-cognitive skills can be divided into two groups: *social skills* and *personal skills*. The former include communication, service and team-working skills. The latter group comprises punctuality, independence, reliability, good manners, creativity, flexibility and resistance to stress.

Our work builds upon earlier studies that perform job vacancy analysis using a set of vacancies published offline or online. Some of these studies use a similar dataset or have a similar focus. Our findings may be of interest to job-seekers, employment agencies, educational institutes and the government, because they provide more insight into what employers are actually looking for in their search for job applicants.

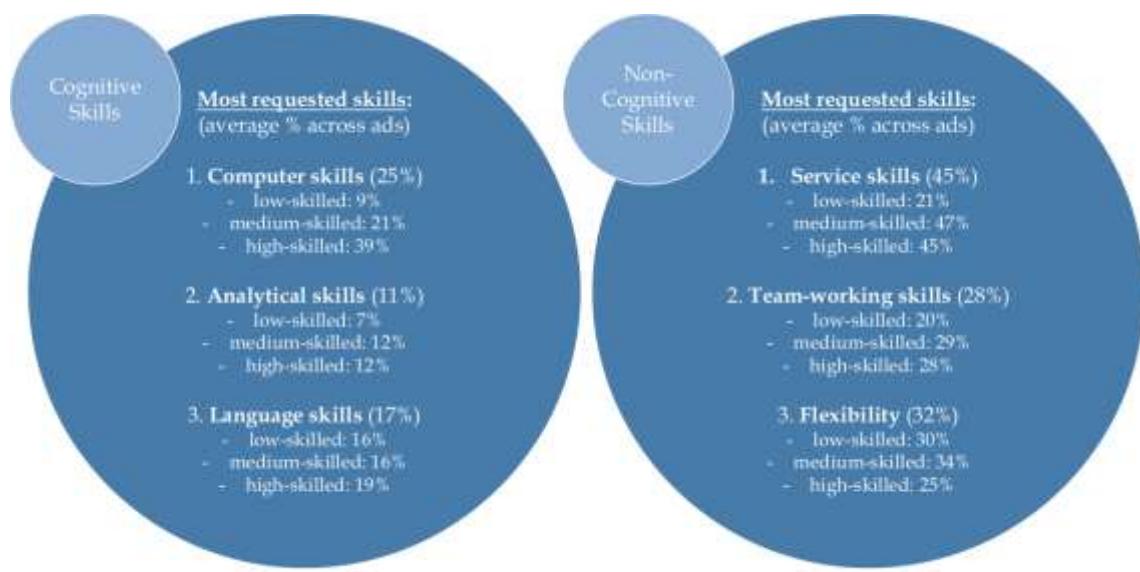
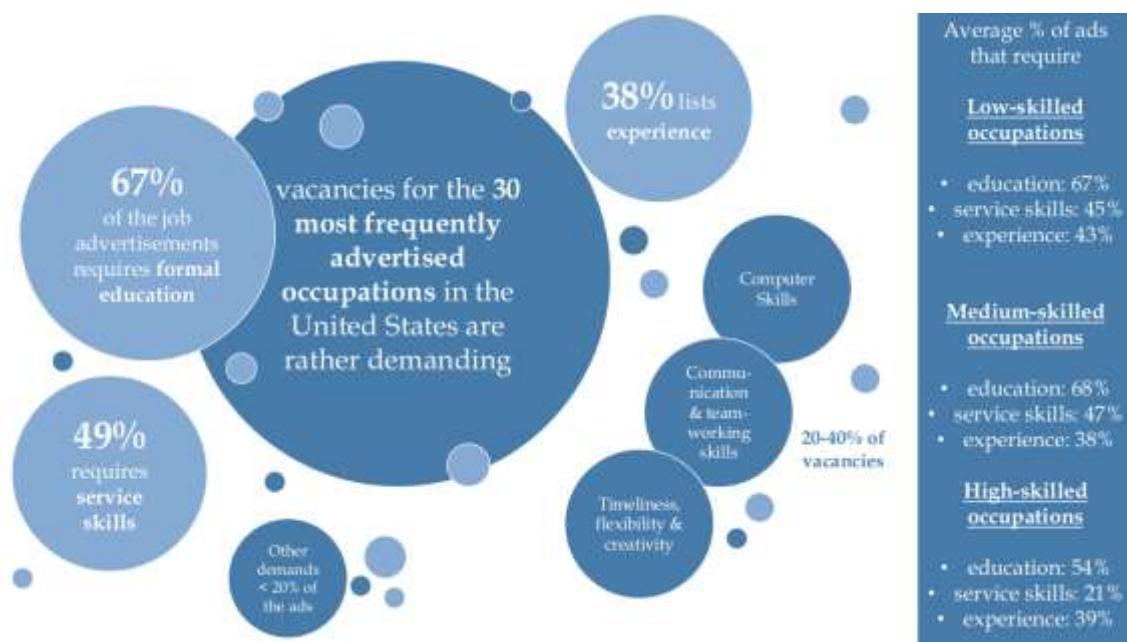
Our main conclusions:

1. **Employers are demanding in their job advertisements**, even when these concern low- or medium-skilled occupations. The **skill intensity** in the advertisements – measured on the basis of the requirements for education (formal education and specialised training or licenses), cognitive skills (specific and genuine skills) and non-cognitive skills (social and personal skills) – is relatively high. In general, more complex jobs appear to have a somewhat higher skill intensity. For example, the vacancies for janitors and cleaners and

labourers (both ‘unskilled’ jobs) have the lowest skill intensity of all 30 occupations. The highest skill intensities are reported for security guards, tellers (both are medium-skilled jobs) and meeting, convention and event planners (a high-skilled job). Nevertheless, there clearly is **a lot of variation across the 30 occupations**. The skill intensity in the advertisements for the occupation with the highest demand is over twice that of the occupation with the lowest intensity. When **all requirements** are considered simultaneously (education and skill intensity, experience, appearance, criminal record, drug testing and citizenship), similar conclusions are reached. These results were also documented in earlier work on the US labour market (see Maxwell, 2006). This **trend therefore seems likely to continue** in the future as well.

2. **Formal education remains the most important criterion for employers** in the selection and recruitment of job applicants in the United States. For the 30 most-often advertised occupations, **67% of the vacancies contain education requirements** (which correspond to a high school degree or more in our study). This number ranges from 45% to 83% of the job advertisements when individual occupations are considered. In fact, for 28 out of the 30 occupations examined, which includes labourers, over 50% of the vacancies demand some formal education. Importantly, this finding **applies to all occupations**, also to the low-skilled (2 out of 30 occupations in the sample) and medium-skilled ones (20 out of 30). **Specialised training and licenses, in contrast, appear to be less important** (only demanded in about 16% of the vacancies). This type of education is particularly relevant for health-related occupations. Interestingly, these results are fairly different from those in other studies, notably on the European labour market. Education is also (highly) requested in some European countries like Slovakia (where education is listed in the vacancies for the majority of the occupations, Kureková et al., 2012), the Czech Republic and Ireland (Kureková et al., 2015b). However, in many of these countries, experience is even more important than education. In fact, in Denmark education does not appear to be a major selection criterion at all (Kureková et al., 2015b). In the United States, however, formal education remains the most common requirement.
3. **Experience is another key criterion** that employers use to screen job applicants, but interestingly it comes in **third place**. Overall, in **38% of the vacancies** for the 30 most-frequently advertised occupations, some previous experience is demanded. Across the occupations, between 21% and 51% of all job advertisements list experience as a requirement. For 28 occupations, experience is demanded in at least one-quarter of the vacancies. For none of the 30 occupations, is experience ranked higher than formal education. The largest discrepancies are recorded for the security guards, cashiers, personal care aides, retail sale persons and sales workers supervisors, for which the percentage of vacancies that request education is substantially higher than the share of vacancies that list experience. In many other studies, the importance of experience has been noticed as well (Kureková et al., 2012 and Kureková et al., 2015b). In several European countries, such as Slovakia, the Czech Republic and Ireland, it is the most persistent request. Our results for the US labour market, in contrast, indicate that formal education still dominates previous work experience.
4. For the 30 most-frequently advertised occupations, we find that **both cognitive and non-cognitive skills** are high in demand. Interestingly, the number of vacancies referring to non-cognitive skills appears to be somewhat higher than the number calling for cognitive skills. For the non-cognitive skills, we find that **both social and personal skills** are highly requested. Across all 30 occupations, about 49% of the advertisements lists service skills and about 30% of the job vacancies call for team-working skills. As for the personal non-cognitive skills, especially flexibility (33%) and punctuality (27%) are

required by employers. With regards to the **cognitive skills**, on average between 10% and 25% of the advertisements include computer skills (25%), analytical skills (12%) and language skills (16%). Across the 30 occupations, there is a positive relationship between the complexity of an occupation and the demand for computer skills: demand seems to go up as occupations become more complex. A similar pattern is found for communication skills and punctuality. In contrast, for other skills such as language and service skills, there does not appear to be a relationship with the complexity of the job.



Especially specific cognitive skills appear to matter (no generic cognitive skills in the list).

Both social and personal non-cognitive skills appear in the top three list.

## Introduction

In this **research note**, we perform a **micro-level analysis of the characteristics of labour demand in the United States with a sample of approximately two million job advertisements published online**. Our work aims to contribute to the literature on job-matching, which has largely focused on the supply side of the labour market so far. The sample of vacancies that we use, however, allows us to analyse the requirements that employers actually have, by focussing on the vacancies that they circulate. Our paper is embedded in a rapidly growing strand of the literature that uses web-based data for labour market analysis (Askatas & Zimmermann, 2015).

Our main goal is to **outline the education, skills and other requirements of employers in the United States**. To this end, we use a sample covering about two million job advertisements obtained from Burning Glass (a popular online job portal in the United States)<sup>1</sup> for the **30 most-frequently advertised occupations**. By focusing on the 30 most-frequently advertised occupations, we are able to gather a large sample of vacancies for a range of occupations (which implies that our sample and analysis cover jobs with different levels of complexity, different sets of responsibilities and tasks, different industries, etc.). With this analysis, we strive to further our understanding of the qualifications that employers are actually looking for when they search for job applicants. This information is highly valuable for job-seekers, matching agencies, the education sector, the government and other economic agents.

Our **main results** suggest that in their job advertisements for the 30 most-frequently advertised occupations, employers are relatively demanding. This applies to all occupations in our sample: the low-, the medium- and the high-skilled ones. Still, more-complex occupations tend to have more demanding requirements than less-complicated occupations. When we analyse the employers' demands in more detail, we find that they especially value **formal education** (this appears in 67% of the vacancies), **service skills** (49%) and **experience** (38%). There is some variation across the occupations, but these criteria nevertheless prove to be consistently important.

We document our results in the **form of a research note**. We chose this format because we were eager to share our results with others interested in the topic. The format further allows us to thoroughly describe all our findings (for all skills and requirements, and for all occupations), without having to focus on a couple of key results (as one would usually do in an 'academic-style' contribution). We concentrate on reporting our findings and pay less attention to the related literature. We do point the reader to some related work, but this section is much shorter than it would be in a fully-fledged academic contribution. Instead, we prefer to let the data speak for themselves in the body of our work and indicate similarities or discrepancies with existing literature in a few occasions. This also implies that our paper is still a work-in-progress.

The remainder of this research note is organised as follows. First, we briefly point the reader to some **related literature** and other work with similar aims. In the second part, we explain

---

<sup>1</sup> We kindly thank Burning Glass for providing us with the job vacancy data.

why we chose to conduct our analysis based on a sample of **job advertisements** published on an online platform. Furthermore, we draw attention to the advantages and limitations of this approach and provide more details on our data source. We then continue by giving an **overview of the 30 occupations** that compose our sample and of the **skills and requirements** that are examined. We consider six dimensions, which include formal education, cognitive skills, non-cognitive skills, experience, appearance/look and other demands. The following sections of the research note present our empirical results. First, we take a 'helicopter view' and study the **overall requirements and demands** of employers in the United States, without making a distinction between specific types of skills for instance. We find that job advertisements are relatively demanding in general, and that this applies to occupations of different levels of complexities. We then focus on **formal education** and discover that employers use this as their main filter in the selection of job applicants. Specialised training and licenses seem to be less important than formal qualifications.

When we turn to the **cognitive skills**, we find that some of these skills are more relevant than others across all occupations (i.e. computer, analytical and language skills matter more than having a driving license and the ability to learn). Some cognitive skills matter for specific occupations only (e.g. there is a clear link between 'computer skills' and the occupation 'computer support specialist'). With regards to **non-cognitive skills**, our results suggest that both social and personal skills are important across occupations. Of the social skills, service skills in particular are in high demand (in 49% of the vacancies extracted). For the personal skills, a pleasant demeanour and flexibility seem to matter the most. We also examine **experience**, which proves to be the third-most commonly used filter (requested in 38% of the vacancies). We also look into other factors, such as appearance, drug testing, criminal record and citizenship, but these appear to be much less important. As a final part of our study, we do a **factor analysis** and examine which factors are the most relevant for which occupations. The note **concludes** with a brief summary of our main findings. Each of these sections is relatively short and discusses one topic or one result only, allowing the reader to quickly browse through the note and easily find information of pertinence to his or her own interests.

## Related literature

Our work is inspired by two other papers that analyse online job advertisements for the European labour market: Kureková et al. (2012) and Kureková et al. (2015b). Both papers focus on low-skilled to medium-skilled occupations. **Kureková et al. (2012)** create a sample of advertisements using the online job portal profesia.sk. With this sample, the authors investigate the competences (in terms of formal qualifications and non-cognitive skills) required from workers in Slovakia. **Kureková et al. (2015b)** perform a similar analysis for three European countries on the basis of job advertisements extracted from EURES, the online job board managed by the European Commission. More specifically, Kureková et al. (2015b) use vacancy data for the Czech Republic, Denmark and Ireland for low-skilled to medium-skilled occupations in different sectors. They compare the demand for formal qualifications, cognitive and non-cognitive skills.

Similarly as Kureková et al. (2015b), we draw on two strands of literature. The first strand comprises papers on the **role of formal qualifications and skills**, the second strand consists of work on **demand for skills**. In the first strand of literature, formal qualifications are used as a proxy for '**merit**': upward social mobility is closely related to formal qualifications. Research shows that individuals who have formal qualifications have a higher probability to be employed than individuals without any qualifications. Other work indicates that firms increasingly focus on the basis of individual achievements in the recruitment and selection process (the 'increased merit selection' hypothesis). Most of this work deals solely with formal qualifications and does not consider other skills. The second strand of literature covers the demand for skills more explicitly. Part of this literature addresses the typology of education regimes and skill differentiation globally. Questions central to this literature are what skills are needed (in general, specific sectors or companies) and how these skills can be acquired (via education, vocational training and on-the-job training).

This research note also builds on other work that uses **Burning Glass data** for labour market analysis in the United States. A recent example of such work is Sasser Modestino et al. (2015), who use a sample of vacancies for middle-skill occupations obtained from Burning Glass to examine upskilling during the great recession. For the United States, they report that employers responded to the larger supply of job-seekers during this period by raising their education and experience requirements. They conclude that increases in the number of job-seekers can account for about 30% of the total increase in employer skills requirements in this period. Another recent paper, which focuses on a similar topic but for period 2010-14, is Hershbein & Kahn (2015). These authors reach a similar conclusion: they find evidence of upskilling in areas where the recovery after the great recession progressed more slowly. In comparison to an economic upturn, at least one additional month of education or experience is required during a downturn. Upskilling further appears to be concentrated among firms that already were more demanding in terms of education and among occupations with more routine tasks. Finally, upskilling appears to be of a more structural nature, and results from an increased job polarisation in the United States.

## **Why opt for a vacancy analysis based on job advertisements that are extracted from an online job portal?**

**Analyses of vacancies** have been at the core of many studies in the field of labour economics, as job advertisements are a particularly interesting source of information. Since finding and responding to a job advertisement are commonly the first steps in a selection and recruitment process, vacancies can be extremely valuable for labour market research. Moreover, job advertisements usually have a clear structure, are fairly detailed and are publicly available. They contain information on the emergence of new jobs (which jobs, in which companies, in which sectors, and located where), the responsibilities and tasks that certain positions call for, the demands of employers in terms of skills and qualifications, and other details (e.g. salary information, field of activity). Job vacancies also have clear time and space dimensions and are available in real time. Furthermore, using printed job advertisements allows for historical

analyses of employer demands. Vacancies reflect employers desired qualifications for a position.

While earlier studies mostly relied on printed job advertisements (Jackson et al., 2005; Jackson, 2007; Dörfler & van de Werfhorst, 2009), recent work has turned to **published online vacancies**. Collecting data from an online job portal has several advantages to the more traditional approach. In comparison with traditional data sources, web data have the benefit of being more detailed and providing information that may not have been available before. Online data also allow researchers to gather larger and more diverse samples. Other advantages are the flexible, fast, easy and cheap data collection process. Recent studies that make use of online job vacancies have thus enriched the literature and furthered our understanding of the labour market.

Nevertheless, there are some **limitations** to online vacancy data that researchers have to take into account (Carnevale et al., 2014; Kureková et al., 2015a). Some well-known caveats are that not all job vacancies are published, not all vacancies are published online and not all vacancies correspond to real (or new) positions. Moreover, Carnevale et al. (2014) conclude that online job advertisements mainly target highly-educated job candidates, looking for white-collar and STEM (sciences, technology, engineering and mathematics) positions with high-skill demands. These caveats, however, are unlikely to impede our analysis because we have a very large sample of vacancies (of about two million) for the 30 most-widely advertised occupations in the United States. This sample is likely to be fairly representative and not biased towards certain occupations in that respect. Nevertheless, we are aware that vacancy data are characterised by problems with their representativeness, and that the results in general cannot be generalised.

Nowadays, most online job boards have developed into employment websites that go beyond the publication of job advertisements. Many portals also allow job seekers to post their CV and resume and provide job-search and career advice as well as other information. Job-seekers benefit from using online job portals as they can browse through a large number of positions, using search criteria to find an opening that matches their profile and acquiring a better understanding of employers' requirements (Carnevale et al., 2014). For firms and recruiters, job boards offer advantages too, such as the possibility to publish job openings while keeping advertising costs low. Online job boards further serve as a useful source for workforce agencies and colleges, as they facilitate the identification of emerging occupations, new education and skill needs and other trends. The value of online job boards for labour market analysis has been acknowledged in several recent contributions (Kureková et al., 2015a; Carnevale et al., 2014; Kuhn, 2014; Kuhn & Mansour, 2014).

**Burning glass** is a particularly interesting platform to use as a data source because it aggregates job advertisements from about 15,000 online portals and company sites. These job vacancies are coded and categorised. Data include occupational codes, industry codes, company names and location. Many advertisements also contain information on educational and experience requirements. Burning Glass also focuses on the skills and certifications demanded in the vacancies.

## On the basis of a sample of approximately 2 million vacancies collected from Burning Glass ...

Over a 12-month period (September 2013-August 2014),<sup>2</sup> 1,998,000 vacancies published on the Burning Glass platform were collected. In this research note, we focus on the 30 most-frequently advertised occupations within the US labour market (see **Table 1**). The average number of advertisements across the 30 occupations is 66,292 vacancies. For five occupations, we count more than 100,000 advertisements in our sample. At the lower end of our sample, we still managed to collect about 30,000 vacancies. More specifically, we find 29,722 vacancies for cashiers (the occupation with the lowest number of vacancies in our sample). The five most-frequently advertised occupations in the United States are retail salesperson (233,851 vacancies, customer service (CS) representative (197,232 vacancies), sales worker supervisor (164,298 vacancies), secretary (114,918 vacancies) and sales representative wholesale (111,177 vacancies).

*Table 1. Overview of the 30 most-frequently advertised occupation in the United States, their ISCO and O\*NET codes and the number of vacancies collected for each of these occupations*

ISCO	O*NET	Occupation	Number of vacancies
1	11102100	General and Operations Manager	30,641
2	15115100	Computer Support Specialist	37,705
2	13107100	HR Specialist	36,243
3	43303100	Bookkeeping, Accounting, Auditing Clerk	43,445
3	43101100	First-Line Office Supervisor	35,841
3	31909200	Medical Assistant	40,127
3	13112100	Meeting, Convention, Event Planner	32,204
3	31101400	Nursing Assistant	96,937
4	41201100	Cashier	29,722
4	43405100	Customer Service Representative	197,232
4	43601300	Medical Secretary	35,263
4	43906100	Office Clerk	42,948
4	43601400	Secretary	114,918
4	43307100	Teller	68,339
5	35302100	Combined Food Preparation Worker	46,912
5	35201400	Cooks, Restaurant	30,252
5	27102600	Merchandise Displayer	60,100
5	39902100	Personal Care Aid	38,106
5	41203100	Retail Salesperson	233,851
5	41101100	Sales Worker Supervisor	164,298
5	41303102	Sales Agent, Financial Services	36,172
5	41401200	Sales Representative, Wholesale	111,177

<sup>2</sup> By using a 12-month period, we avoid issues regarding the seasonality of certain occupations.

<b>5</b>	33903200	Security Guard	66,122
<b>5</b>	35101200	Supervisor of Food Preparation, Serving Workers	45,957
<b>7</b>	49909900	Installation, Maintenance, Repair Worker	43,157
<b>7</b>	49907100	Maintenance Worker	94,066
<b>8</b>	53303200	Heavy Truck and Tractor Driver	33,180
<b>8</b>	53303300	Light Truck, Delivery Service Driver	38,405
<b>9</b>	37201100	Janitors and Cleaner	33,779
<b>9</b>	53706200	Labourer	71,669

**Table 1** further presents the ISCO code and the O\*NET code of each occupation (in the first two columns). The first column of the table reports the **ISCO-08** classification, which is a classification of occupations developed by the International Labour Organization (ILO). ISCO is short for *International Standard Classification of Occupations*. The revision published in 2008 is the most recent one. ISCO-08 contains nine major groups of occupations, categorised on the basis of the skill level and the skill specialisation needed to perform the job: 1 Managers, 2 Professionals, 3 Technicians and associate professionals, 4 Clerical support workers, 5 Service and sales workers, 6 Skilled agricultural, forestry and fishery workers, 7 Craft and related trades workers, 8 Plant and machine operators, and assemblers, and 9 Elementary occupations (not considering 0 Armed forces occupations). As such, ISCO occupations are classified according to their level of complexity. Occupations with a higher ISCO code are less complex and vice versa.

Kureková et al. (2015b) label the occupations with ISCO code 9 as low-skilled and with codes 4-8 as medium-skilled. Occupations with codes 1-3 can therefore be considered as high-skilled. Out of the 30 occupations in our sample, one has ISCO code 1, two ISCO code 2, five ISCO code 3, six ISCO code 4, ten ISCO code 5, two ISCO code 7, two ISCO code 8 and ISCO code 9. This suggests that the sample of vacancies covers a wide range of occupations, of various levels of complexities and with, in some cases, vastly different education and skill requirements. Following the classification of Kureková et al. (2015b), our sample is composed of two low-skilled occupations (ISCO 9, i.e. janitors/cleaners and labourers), 20 medium-skilled occupations (ISCO 4-8), and eight high-skilled occupations (ISCO 1-3). Some of these occupations are specific to certain sectors, while others can be found throughout the economy. Our sample thus is an excellent tool with which to study skill requirements in the United States (although we do not have an occupation of ISCO class 6 'Skilled agricultural, forestry and fishery workers'). As ISCO is a quick and easy way to get an idea of the complexity of an occupation, the ISCO code is reported in each of the tables presented below.

The second column in **Table 1** gives the O\*NET classification of the occupation. O\*NET is the *Occupational Information Network* of the US Department of Labor/Employment and Training Administration. O\*NET is an important information source on occupations in the United States. The underlying database that supports the website is updated regularly. We include the O\*NET classification in **Table 1** for two reasons. First, as indicated above, this classification is used extensively in labour market research for the US and could thus be

relevant for other researchers. Secondly, more details on the occupations can be found on O\*NET (and browsing the website is easier with the codes at hand).

One of the main advantages of Burning Glass is that the website provides us with **micro-level data** on the labour market dynamics of one of the major global economies. Another key advantage is that the advertisements published on the site are highly **structured**, which facilitates the data collection process. In another recent study based on online job advertisements obtained from Burning Glass, Carnevale et al. (2014) detect more than 70 'data fields' in a single job post. Similarly as Carnevale et al. (2014), we assembled a dataset using a **web-crawling** or '**spidering**' technique. In their paper, these authors explain how a database of job advertisements can be created by employing a 'spider' or web bot that crawls the Internet. Data are then extracted from this database and parsed into smaller fragments, to be coded. This process is very complex and highly dependent on the structure and content of the job advertisements. The clear structure of the advertisements therefore is an obvious advantage of our data source. Two other recent articles that use web-spidering to compile a database of advertisements are Capiluppi & Baravalle (2010) and Kuhn & Shen (2013). In this note, we contribute to an emerging literature that makes use of these innovative methodological and data collection techniques for labour market analysis.

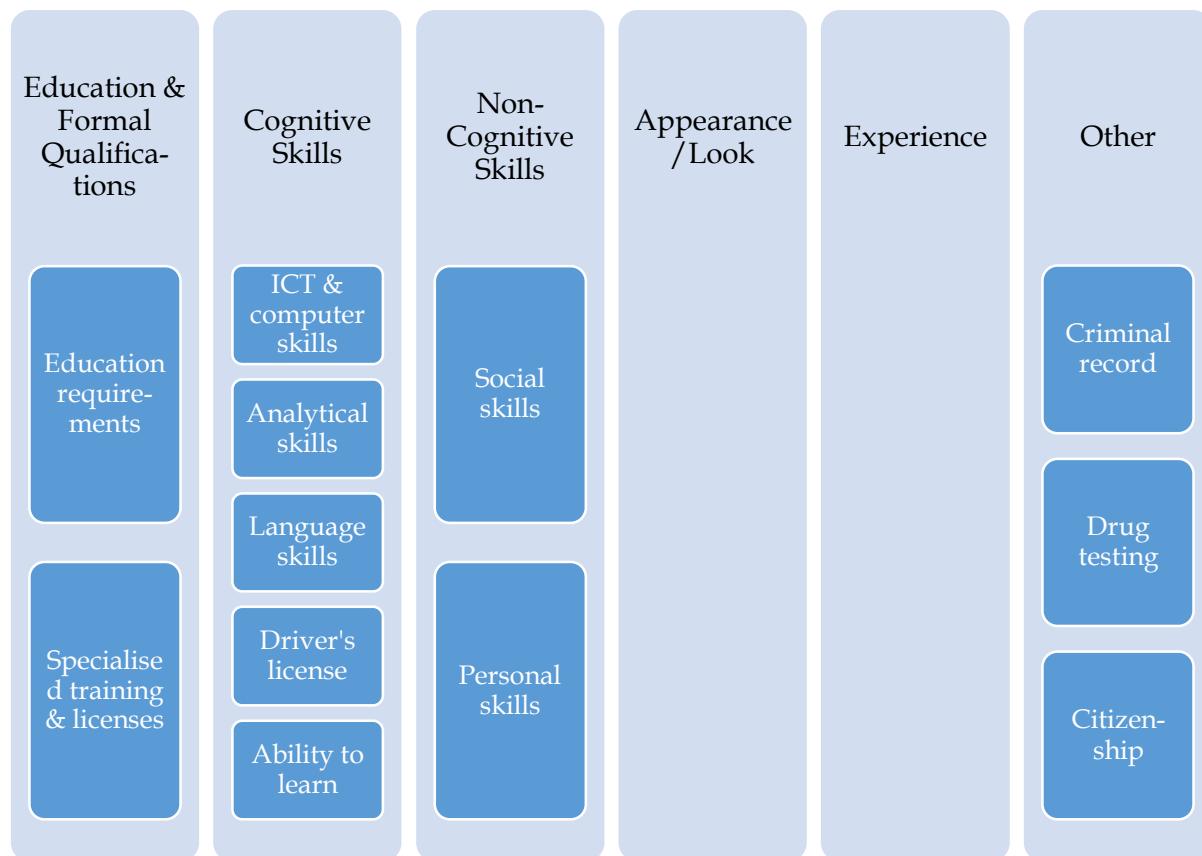
### **... Employers' demands for applicants for the 30 most-advertised occupations were explored.**

For the 30 most-frequently advertised occupations in the United States, we examine the required skills, educational qualifications and other characteristics that employers mention in their job advertisements. An overview of the six dimensions that we explore is given in **Figure 1**. The first three dimensions cover education and skills in the broad sense. The last three dimensions are related to the personal characteristics of the job applicant, experience and other aspects.

The first pillar in **Figure 1** is **education and formal qualifications**. It captures the requirements in terms of education and in terms of specialised training and licenses. The second pillar is the set of **cognitive skills**. Our understanding of cognitive skills is based on the work of Kureková et al. (2015b), who describe these as skills "typically identified with intelligence and the ability to solve abstract problems" (p. 8). Commonly used proxies for cognitive skills therefore are IQ tests and standardised tests such as PISA. For this reason, formal education and training can also be regarded as cognitive skills. Nevertheless, we follow Kureková et al. (2015b) and separate education and formal qualifications from other cognitive skills such as ICT/computer, analytical and language skills, having a driving license and the ability to learn. In our study, the pillar cognitive skills is composed of these five groups. Kureková et al. (2015b) label the first four of these cognitive skills as '**specific**' and the last one as '**generic**'. Another example of a specific cognitive skill is the ability to read specialised / technical papers or materials. Other examples of generic cognitive skills are problem-solving skills, the ability to quickly understand issues, and the ability to take into account the context in which they arise. Although the difference between specific and generic cognitive skills is less pronounced in our work than in the paper of Kureková et al. (2015b), it is important to keep this distinction

in mind as Kureková et al. (2015b) maintain that the latter are unlikely to appear in job advertisements for low-skilled workers. In our work, however, we notice that 'ability to learn' is hardly requested for any of the occupations regardless of their level of complexity, with the expectation of 'retail salespersons' (where it is found in 13% of the vacancies).

*Figure 1. Overview of the skills and requirements under examination*



The third pillar in **Figure 1** is the set of **non-cognitive skills** or '**soft skills**'. Similarly as for the cognitive skills, we use the approach of Kureková et al. (2015b) to identify non-cognitive skills in our dataset. According to Brunello & Schlotter (2011), non-cognitive skills can be defined as 'personality traits that are to some extent correlated with intelligence measures'. Non-cognitive skills have both a 'characteristics' and an 'attitude' dimension (Anderson & Ruhs, 2008). In their paper, Kureková et al. (2015b) do not rely on the traditional five factor taxonomy of non-cognitive skills – agreeableness, autonomy, conscientiousness, emotional stability and extraversion – but instead distinguish between social and personal non-cognitive skills. **Personal non-cognitive skills** are related to personal predispositions that characterise how one approaches tasks. **Social non-cognitive skills**, on the other hand, are applied in relation to the need to communicate and cooperate with others. In this note, the pillar of non-cognitive skills covers social and personal skills. The former consists of three skills sets (**Figure 1**): communication skills, service skills and team-working skills. The latter contains seven categories of skills or traits, namely timeliness, independence, reliability, manners, creativity, flexibility and stress-resistance.

In recent years, the roles of cognitive and non-cognitive skills in the education and the labour market outcomes of individuals have been debated. Research shows that non-cognitive skills may be particularly important in service jobs. In the light of the shift from manufacturing to a services-based economy in many developed countries, a careful analysis of skill demand can be extremely valuable. An interesting contribution on this topic is Maxwell (2006), who reports that there is a lot of heterogeneity of required skills throughout the economy, but also across low-skilled occupations and industries.

In addition to education and formal qualifications, cognitive skills and non-cognitive skills, the presence of three additional factors in the sample of job advertisements is examined. The first factor is the **appearance or look** of the job applicants. Furthermore, we are also interested in the extent to which **experience** is required on the US job market. Finally, we consider three other elements: whether or not the applicant is expected to have a clean **criminal record**, whether or not the worker will be subject to **drug testing** and whether or not the job candidate should hold US **citizenship**. These additional factors are displayed in **Figure 1** as well.

## **Overall, employers in the United States are relatively demanding in terms of education, skills and other requirements - a result that holds for all occupations.**

**Table 2** details the overall skill requirements and other demands of employers for the 30 most-frequently advertised occupations. It presents for every occupation the **sum of skills** and the **sum of all requirements**. For each occupation, the former is obtained as the sum of the percentage of job advertisements with requirements with regards to 1) education and formal qualifications, 2) cognitive skills and 3) non-cognitive skills (the first three columns in **Figure 1**). The latter is equal to the sum of the percentage of vacancies with requirements in terms of 1) education and formal qualifications, 2) cognitive skills, 3) non-cognitive skills, 4) appearance/look, 5) experience and 6) other factors (all columns in **Figure 1**). More specifically, for the sum of skills we consider 17 skills demands, for the sum of all requirements we use the 17 skill demands and information of five other factors (22 factors are considered in total). Many of the broad categories listed above have sub-categories of skills or factors, which are explored in more depth in the following sections.

An example of how the sum of skills and the sum of all requirements are calculated is presented in Table 3. Example of the calculation of the sum of skills and the sum of all requirements for the occupation 'general and operations managers' (based on 30,641 vacancies)**Table 3** for the general and operations managers. The sum of skills is the sum of the percentage of vacancies with requirements in terms of education and formal qualifications (75% + 13%), the cognitive skills (32% + 14% + 17% for the specific cognitive skills; + 2% + 6% for the genuine ones) and the non-cognitive skills (27% + 48% + 48% for the social non-cognitive skills; + 40% + 25% + 1% + 7% + 38% + 33% + 5% for the personal ones). The sum of all these percentages is 431% and gives an indication of the **skill intensity of the occupation in question**. The sum of all requirements builds on the sum of skills, but also contains other information. More specifically, for the general and operations managers, it is equal to 431% (sum of skills) + 1% (percentage of vacancies with requirements in terms of appearance/look) + 40% (experience)

+ 16% (other factors: criminal record 7%, drug testing 7%, citizenship 2%). This results in a figure of 488%. This number can be regarded as a measure for the **requirements intensity** of an occupation. The **sum of skills** and **sum of all requirements** measures may not seem so meaningful in absolute terms (and may not have a clear interpretation in this way); they serve as easy and clear tools to compare different occupations with (in relative terms). In this note, the sum of skills and sum of all requirements are only used in a relative way.

*Table 2. Sum of the percentage of job advertisements across occupations with education and formal qualifications requirements and sum of the percentage of job advertisements across occupations with all requirements*

ISCO	Occupation	Sum of skills	Sum of all requirements
<b>1</b>	General and Operations Managers	431%	488%
<b>2</b>	Computer Support Specialists	405%	467%
<b>2</b>	HR Specialists	375%	460%
<b>3</b>	Bookkeeping, Accounting, Auditing Clerks	358%	425%
<b>3</b>	First-Line Office Supervisors	430%	500%
<b>3</b>	Medical Assistants	340%	418%
<b>3</b>	Meeting, Convention, Event Planners	453%	607%
<b>3</b>	Nursing Assistant	321%	382%
<b>4</b>	Cashiers	357%	410%
<b>4</b>	CS Representatives	420%	484%
<b>4</b>	Medical Secretaries	341%	399%
<b>4</b>	Office Clerks	333%	399%
<b>4</b>	Secretaries	373%	442%
<b>4</b>	Tellers	477%	542%
<b>5</b>	Combined Food Preparation Workers	318%	384%
<b>5</b>	Cooks, Restaurant	300%	370%
<b>5</b>	Merchandise Displayers	422%	501%
<b>5</b>	Personal Care Aides	269%	326%
<b>5</b>	Retail Salesperson	386%	430%
<b>5</b>	Sale Worker Supervisors	419%	466%
<b>5</b>	Sales Agents, Financial Services	415%	479%
<b>5</b>	Sales Representative Wholesale	380%	447%
<b>5</b>	Security Guards	525%	650%
<b>5</b>	Supervisors of Food Preparation, Serving Workers	364%	415%
<b>7</b>	Installation, Maintenance, Repair Workers	376%	472%
<b>7</b>	Maintenance Worker	298%	379%
<b>8</b>	Heavy Truck and Tractor Drivers	316%	400%
<b>8</b>	Light Truck, Delivery Service Drivers	349%	440%
<b>9</b>	Janitors and Cleaners	225%	289%
<b>9</b>	Labourers	255%	331%
	Across occupations (all vacancies considered at once): total (average)	377% (368%)	445% (440%)

*Table 3. Example of the calculation of the sum of skills and the sum of all requirements for the occupation 'general and operations managers' (based on 30,641 vacancies)*

Education & formal qualifications	Cognitive skills	Non-cognitive skills	
<ul style="list-style-type: none"> <li>• Education requirements: 75%</li> <li>• Specialised training &amp; licenses: 13%</li> </ul> <p>Sum = 88%</p>	<p><i>Specific cognitive skills</i></p> <ul style="list-style-type: none"> <li>• ICT &amp; computer skills: 32%</li> <li>• Analytical skills: 14%</li> <li>• Language skills: 17%</li> </ul> <p><i>Generic cognitive skills</i></p> <ul style="list-style-type: none"> <li>• Driving license: 2%</li> <li>• Ability to learn: 6%</li> </ul> <p>Sum = 71%</p>	<p><i>Social non-cognitive skills:</i></p> <ul style="list-style-type: none"> <li>• Communication skills: 27%</li> <li>• Service skills: 48%</li> <li>• Team-working skills: 48%</li> </ul> <p><i>Personal non-cognitive skills:</i></p> <ul style="list-style-type: none"> <li>• Timeliness: 40%</li> <li>• Independence: 25%</li> <li>• Reliability: 1%</li> <li>• Demeanour: 7%</li> <li>• Creativity: 38%</li> <li>• Flexibility: 33%</li> <li>• Stress-resistant: 5%</li> </ul> <p>Sum = 272%</p>	<p><i>Sum of skills = 431%</i>  <math>= 88\% + 71\% + 272\%</math></p>
Appearance/look	Experience	Other	
Pleasant physical appearance: 1% <p>Sum = 1%</p>	Experience: 40% <p>Sum = 40%</p>	<ul style="list-style-type: none"> <li>• Criminal record: 7%</li> <li>• Drug testing: 7%</li> <li>• Citizenship: 2%</li> </ul> <p>Sum = 16%</p>	<p><i>Sum of all =</i>  <math>488\% + 1\% + 431\% + 1\% + 272\% = 445\%</math></p>

In **Table 2**, the **sum of skills** across all occupations is 377% (when all vacancies are considered at once, the average across occupations is 368%). For individual occupations, this number ranges from 225% to 525%. There clearly is a lot of variation across the 30 occupations and the occupation with the highest sum of skills has over twice the skill demand as the occupation with the lowest sum of skills. A lower number for the sum of skills measure points to a lower skill intensity (which means that the occupation is less demanding than other occupations in terms of education and formal qualifications, cognitive skills and non-cognitive skills). Higher numbers, in contrast, suggest the opposite. For four occupations, the sum of skills does not reach the 300% level: 'janitors and cleaners', 'labourers', 'personal care aides' and 'maintenance workers'. For 16 occupations, the percentage is between 300% and 400%. It varies between 400% and 500% for nine occupations and exceeds 500% for one occupation only. The five most skill-intensive occupations are security guards (525%), tellers (477%), meeting, convention and event planners (453%), general and operations managers (431%) and first-line office supervisors (430%). Some of the occupations on this list are rather surprising at first sight. Overall, however, more complex jobs do appear to have a higher skill-intensity. This relationship will be analysed more thoroughly below.

**Table 2** also presents the **sum of all requirements**, which is composed of the sum of skills and five other factors. In this case, the percentage is 445% when all vacancies are considered at

once (the average across occupations is 440%). This value varies between 289% and 650% across the 30 occupations. Again, the value for the highest sum of all requirements is more than twice that of the lowest sum. As before, janitors and cleaners have the lowest requirements intensity (of 289%, not reaching the 300% mark). Eight occupations show percentages that range from 300% to 400%. For 16 occupations, this ranges from 400% to 500%; and for three occupations, values between 500% and 600% are recorded. Two occupations have a sum of all requirements that rises above the 600% cut-off: security guards (650%) and meeting, convention, event planners (607%). These two occupations were also in the top five for the sum of skills.

With these results in mind, we go back to the contributions by Kureková et al. (2012), Kureková et al. (2015b) and Maxwell (2006). It is particularly interesting to compare our results with those of these first two papers, because they conduct similar analyses. Kureková et al. (2012) compute the sum of skills and sum of all criteria for 23 low- to medium-skilled occupations in Slovakia (their sample pools about 50,000 vacancies collected in 2007-11). The sum of skills in their paper captures cognitive (two specific, two general) and non-cognitive skills (three social, five personal). On average, it is equal to 204% (across occupations). The sum of all criteria captures the sum of skills, appearance and experience and is on average equal to 258%. Of the occupations considered, salesperson is the most demanding occupation while postmen is the least demanding one. Service occupations are particularly demanding in the paper. Kureková et al. (2015b) calculate these measures for the Czech Republic (110%, 171%), Denmark (171%, 205%) and Ireland (89%, 182%). In their paper, the sum of skills covers education, cognitive skills and non-cognitive skills, whereas the sum of all requirements comprises experience as well.

Both papers reach two conclusions that are also confirmed in our work. The first conclusion is that employers are relatively demanding in terms of their requirements, even for relatively simple jobs. For low- and medium-skilled workers, the variety of skills and other requests demanded is relatively high as well. This result has also been documented by Maxwell (2006) for the US labour market. However, there are differences in terms of the types of skills required in Europe and the US for low- and mid-skilled occupations. Maxwell (2006) suggest that especially 'new basic skills' are demanded for these occupations (e.g. communication, problem-solving), while Kureková et al. (2012) point to the role of non-cognitive social skills and personal traits. Nevertheless, there are also large differences between European countries. Kureková et al. (2015b) show, for example, that formal education is less important in Denmark, while English language skills are commonly requested in low-skilled manufacturing jobs in Ireland. The Czech labour market seems to be the most formalised. We find that employers indeed are relatively demanding in their vacancies in the United States. A second key result is the substantial variation in the skill and other demands across occupations. This variation is related to the complexity of the occupations (captured by the ISCO codes), to some extent. This finding also clearly arises in our analysis.

How comparable are the two series in Table 2, i.e. the sum of skills and sum of all requirements? Are there many changes if we switch from one to the other? The average difference in percentages is 72% (on average, the sum of all requirements is the sum of skills plus 72%). It is smaller than 72% for 20 of the occupations (which is about 67%). Eight out of

the 30 occupations (27%) hold the same position in both series. For these occupations, the average difference is 73%. This average is pushed up by the security guards, for which the difference between the sum of skills and the sum of all requirements is 125%. This occupation is not only demanding in terms of education, formal requirements and skills (cognitive and non-cognitive), but also in terms of the other factors (appearance, experience, criminal record, drug testing, citizenship). If it is excluded, the average difference for the occupations that hold their position in the ranking is 66%. About 73% of the occupations do take up another position in the ranking. Nine occupations only move one space up or down (cooks, restaurant; labourers; maintenance workers; meeting, convention, event planners; personal care aides; sales agents, financial services; sales representative wholesale; secretaries and tellers, with an average difference of 78%). Five occupations shift two places (cashiers; general and operations managers; HR specialists; merchandise displayers and nursing assistants, average difference of 67%). For four occupations, the shift is three places: medical assistants, medial secretaries, sale worker supervisors and supervisors of food preparation, serving workers (average of 59%). For three occupations, there is a shift of four positions (heavy truck and tractor drivers; installation, maintenance, repair workers; light truck, delivery service drivers) while for one occupation (retail salespersons) there is a shift of five places (average difference of 90% and 44%, respectively). Overall, as expected, there is a very high positive correlation between the two series (close to one).

*Table 4. Average sum of skills and sum of all requirements by ISCO class*

ISCO	Average sum of skills	Average sum of all requirements
1	4.3 (431%)	4.9 (488%)
2	3.9 (390%)	4.6 (464%)
3	3.8 (380%)	4.7 (466%)
4	3.8 (384%)	4.5 (446%)
5	3.8 (380%)	4.5 (447%)
7	3.4 (337%)	4.3 (426%)
8	3.3 (333%)	4.2 (420%)
9	2.4 (240%)	3.1 (310%)

We then calculate the average sum of skills and the average sum of all requirements by ISCO category. The results are presented in Table 4. These results, in combination with those detailed above, clearly demonstrate that the vacancies are rather demanding in terms of skills: for the 17 skill demands that make up the education and formal qualifications, cognitive skills and non-cognitive skills pillars, the average advertisement demands 3.6 skills. When the five other factors are introduced as well, the average is 4.4 requirements. This finding also applies to low-skilled and medium-skilled jobs (even though demands are decreasing, the average remains relatively high and are stable in the middle of the distribution). The correlation between the ISCO coding and the sum of skills is -0.51 (as occupations become more complex, skill requirements tend to increase, as one would expect). The correlation between the ISCO classification and the sum of all requirements is -0.42. There again is a negative relation, but

the coefficient is somewhat smaller now. This may be due to the variation across occupations for the five additional factors (as shown below).

We conclude that both the skills requirements and the overall requirements appear to be higher for the more complex positions, but that skills and overall requirements are relatively high in general. It would therefore be interesting to study these relationships in more detail and to identify which skills or requirements matter most for which occupations. These questions will be at the heart of the remainder of this report.

### **Education is the most commonly used filter across occupations ...**

**67% of all vacancies examined require formal education** gained through full-time study (on average across the 30 occupations, this number amounts to 67% as well). Across occupations, this percentage varies from 45% (for the heavy truck and tractor drivers) to 83% (tellers) of vacancies, as can be seen in Table 5. For 14 occupations, the average number of vacancies listing educational requirements is lower than 67%, while for 16 occupations the opposite holds. When the averages are calculated across the main ISCO groups, the averages range from 52% (ISCO group 8) to 75% (ISCO group 1). These results suggest that education is an important filter for **all employers** looking for qualified workers to fill their job openings (i.e. across occupations). In fact, for 28 out of the 30 occupations -including labourers- more than half of the vacancies demands at least some level or form of formal education. For 19 occupations, at least two-thirds of the advertisements comprise formal education requirements. In their related paper, Kureková et al. (2012) report that formal education is high on the list of demands of employers in Slovakia for low- to medium-skilled occupations (analysis based on nine education levels). The majority of the occupations demand at least secondary education and even for the unskilled occupations (ISCO code 9) often a vocational license is needed. Kureková et al. (2015b) find a similar result for the Czech Republic (especially for metal worker positions) and Ireland (especially for hotel and catering workers, in metal and machinery work). In Denmark, education seems to matter less. In addition, formal qualifications appear to become more important as occupations become more complex. Labour markets in the Czech Republic and Ireland are more formalised than in Denmark, which results in a higher share of vacancies demanding formal education and cognitive skills in these countries.

In this study, the lowest educational requirement considered is a high school degree. To identify the formal education requirements in the job advertisements, a search was done for the following keywords: diploma, GED, bachelor, college, university, degree, high school, and combinations thereof. When at least one of these words was present in the vacancy, it was considered to request formal education.

### **... While only 16% of all job advertisements requires specialised training or licenses.**

In total, 16% of all job advertisements that were collected comprise **specialised training or licenses requirements** (the average is slightly higher, at 18%). In this case, there is a lot **more**

**variation across occupations**, as evidenced by Table 5. For ten occupations, the percentage of job advertisements that demand specialised training or licenses is less than 10%, whereas for three occupations it is higher than 30%. These three occupations include meeting, convention, event planners (37%), medical assistants (64%) and nursing assistants (77%). Across ISCO groups, the average percentages of job advertisements including specialised training or licenses are 13% (ISCO 1), 15% (ISCO 2), 40% (ISCO 3), 12% (ISCO 4), 14% (ISCO 5), 20% (ISCO 7), 10% (ISCO 8) and 22% (ISCO 9). We infer from this analysis that specialised training and licenses are important especially for certain occupations. More specifically, of the six occupations for which the number is 25% or higher, four health-related professions are found. Two of these occupations in fact have the highest percentages of all 30 occupations considered ('the top three'). The remaining two occupations are the security guards and the meeting, convention and event planners.

*Table 5. Percentage of job advertisements across occupations with education and formal qualifications requirements*

ISCO	Occupation	Percentage of ads with education requirements	Percentage of ads with specialised training and licenses requirements
1	General and Operations Managers	75%	13%
2	Computer Support Specialists	73%	16%
2	HR Specialists	69%	14%
3	Bookkeeping, Accounting, Auditing Clerks	65%	9%
3	First-Line Office Supervisors	72%	14%
3	Medical Assistants	59%	64%
3	Meeting, Convention, Event Planners	60%	37%
3	Nursing Assistant	64%	77%
4	Cashiers	81%	5%
4	CS Representatives	66%	8%
4	Medical Secretaries	56%	25%
4	Office Clerks	66%	16%
4	Secretaries	70%	13%
4	Tellers	83%	4%
5	Combined Food Preparation Workers	63%	13%
5	Cooks, Restaurant	67%	23%
5	Merchandise Displayers	66%	6%
5	Personal Care Aides	78%	26%
5	Retail Salesperson	67%	3%
5	Sale Worker Supervisors	73%	9%
5	Sales Agents, Financial Services	72%	8%
5	Sales Representative Wholesale	68%	9%
5	Security Guards	80%	27%

5	Supervisors of Food Preparation, Serving Workers	72%	12%
7	Installation, Maintenance, Repair Workers	69%	21%
7	Maintenance Worker	62%	20%
8	Heavy Truck and Tractor Drivers	45%	9%
8	Light Truck, Delivery Service Drivers	59%	11%
9	Janitors and Cleaners	49%	13%
9	Labourers	58%	11%
	Across occupations (all vacancies considered at once): total (average)	67% (67%)	16% (18%)

The identification of specialised training and license requirements relies on a search across the vacancies for keywords related to apprenticeship, training, card (e.g. health card, guard card), certificate/certified/certification, among other terms (including CDA, ASE, CPR, AED).

### On average, 25% or less of the job advertisements analysed call for cognitive skills ...

We consider five categories of cognitive skills or requirements: ICT and computer skills, analytical skills, language skills, possession of a driver's license and ability to learn (see Figure 1). The first four sets of skills or requirements can be regarded as specific cognitive skills, while the ability to learn is an example of generic cognitive skills. In contrast to the education requirements, which were present in an extensive range of vacancies, cognitive skills appear in less than one-fourth of the vacancies across occupations. Nevertheless, **there is a lot of variation – both across occupations and across the sets of cognitive skills and requirements examined.** This finding confirms previous work of Kureková et al. (2012) and Kureková et al. (2015b).

### ... but some cognitive skills, and specifically computer skills, analytical skills and language skills, seem to be more important than others – at least for some occupations ...

A closer look at the five sets of cognitive skills reveals that between 12% and 25% of the job openings call for **ICT and computer skills/knowledge, analytical skills or language skills.** More specifically, across all the occupations, 25% of all vacancies refer to ICT and computer skills, 12% to analytical skills and 16% to language skills (the respective averages are 25%, 11% and 17%). Across the 30 occupations, between 3% and 62% of the job vacancies request computer skills, between 1% and 29% request analytical skills, and from 7% and 53% request language skills.

*Table 6. Percentage of job advertisements across occupations calling for ICT and computer, analytical and language skills*

ISCO	Occupation	Percentage of ads with ICT and computer skills	Percentage of ads with analytical skills	Percentage of ads with language skills
1	General and Operations Managers	32%	14%	17%
2	Computer Support Specialists	62%	16%	9%
2	HR Specialists	39%	12%	13%
3	Bookkeeping, Accounting, Auditing Clerks	45%	19%	10%
3	First-Line Office Supervisors	38%	13%	12%
3	Medical Assistants	19%	10%	22%
3	Meeting, Convention, Event Planners	57%	1%	53%
3	Nursing Assistant	24%	7%	16%
4	Cashiers	11%	15%	8%
4	CS Representatives	35%	8%	18%
4	Medical Secretaries	38%	12%	20%
4	Office Clerks	44%	12%	15%
4	Secretaries	53%	13%	15%
4	Tellers	25%	29%	20%
5	Combined Food Preparation	8%	4%	14%
5	Cooks, Restaurant	3%	4%	29%
5	Merchandise Displayers	22%	14%	13%
5	Personal Care Aides	9%	8%	13%
5	Retail Salesperson	20%	17%	11%
5	Sales Worker Supervisors	14%	18%	7%
5	Sales Agents, Financial Services	22%	21%	16%
5	Sales Representative Wholesale	26%	7%	16%
5	Security Guards	11%	15%	38%
5	Supervisors of Food Preparation, Serving Workers	11%	5%	16%
7	Installation, Maintenance, Repair Workers	23%	12%	9%
7	Maintenance Worker	24%	13%	11%
8	Heavy Truck and Tractor Drivers	5%	5%	10%
8	Light Truck, Delivery Service Drivers	6%	5%	23%
9	Janitors and Cleaners	5%	5%	17%
9	Labourers	13%	9%	15%
	Across occupations (all vacancies): total (average)	25% (25%)	12% (11%)	16% (17%)

The occupations that are the most **ICT- and computer skills**-intensive, as reflected in vacancy announcements, are computer support specialists (62%), meeting, convention, event planners (57%), secretaries (53%), bookkeeping, accounting, auditing clerks (45%) and office clerks (44%) (in the first column of Table 6). The occupations in which the smallest percentages of job listings require computer or ICT skills are cooks (3%), janitors and cleaners (5%), heavy truck and tractor drivers (5%), light truck and delivery service drivers (6%), combined food preparation workers (8%) and personal care aides (9%). For one-third of the occupations, more than 30% of vacancies call for ICT and computer skills. For three occupations, such skills are included in more than half of the vacancies. These percentages, and the differences detected across occupations, are in line with the expectations of what the positions entail (in terms of tasks and responsibilities). As a result of technological progress, many 'office jobs' nowadays require at least some level of computer skills (e.g. secretaries, office clerks, bookkeeping, accounting, and auditing clerks, to draft texts, perform calculations, make slides, etc.). Over time, some of these skills may even become '*implicit skills*' that will no longer be mentioned in a vacancy announcement. Instead, employers could simply expect all job applicants to possess these qualifications. In their advertisements, employers often specify those requirements that are extremely important (e.g. given the position within the firm or due to the activities of the company) or that may be somewhat unexpected. Note that there is a strong negative correlation of -0.63 between the level of the ISCO code and the extent to which vacancies demand computer skills. This correlation implies that as jobs become more complicated and reach higher levels in the occupational hierarchy (a lower ISCO code), they become more ICT- and computer-intensive. Manual or blue-collar jobs, on the other hand, do not require much computer knowledge. The identification of ICT and computer skills is based on the following set of keywords: computer, PC, CRM (customer relationship management), Microsoft (e.g. Office, Word, Excel, Power Point, Outlook, and Access), Windows, SAP and so on.

When we turn to analytical skills, we find that these skills are not so high in demand overall. There does appear to be some variation across the 30 occupations, as depicted in Table 6, with the lowest percentages of vacancies demanding analytical skills for the meeting, convention and event planners (1%), combined food preparation workers and heavy truck and tractor drivers (both 4%). The highest percentages are reported for tellers (29%), sales agents, financial services (both 21%) and bookkeeping, accounting, auditing clerks (20%). There is a small negative correlation of -0.31 between the ISCO classification codes and the demand for analytical skills. This identification relies on the keywords mathematics, analytical, logic and quantitative. Note that initially we set out to determine the demand for STEM skills. Our findings from this exercise, however, were counterintuitive for several occupations. For example, for the computer support specialists, STEM skills were hardly in demand whereas they appeared to be important for the convention, meeting, and event planners. We suspect that these results were driven by our identification strategy, which also included keywords such as 'literacy'. Another potential explanation is that we do not count many STEM occupations in our sample: e.g. there are no scientists or engineers among the 30 most-frequently advertised occupations (this may be due to the fact that these occupations are not so highly demanded as some of the other occupations or to the fact that Burning Glass is a general job portal, and that some more 'specialised' occupations may be unlikely to be posted

on it). We therefore decided to take a different approach and focused on analytical skills instead.

Finally, Table 6 presents the demand for language skills in the vacancies across the 30 occupations. In this case, again, there is some variation across the occupations, but this appears to be relatively limited. For 27 out of the 30 occupations, less than 25% of all job advertisements have language requirements. The percentage of advertisements that comprise language skills is higher for cooks (29%), security guards (38%) and meeting, convention and event planners (53%). Language skills are identified on the basis of the keywords bilingual, English, Spanish and language (and variations of these terms). Given that English is the main language in the United States, we expect that the language requirements in the vacancies mainly refer to the ability to speak and understand English (perhaps with the exception of the meeting, convention and event planners). In that sense, the results reported above are not very surprising (neither the low percentages nor the variation across occupations). Kureková et al. (2012) also point to the role of the specific cognitive skills (computer and language skills, especially the latter) in Slovakia, which in general appear to dominate the non-cognitive social skills. Kureková et al. (2015b) state that cognitive skills are requested in almost 75% of the vacancies for office staff in the Czech Republic. In Ireland, cognitive skills appear to be relevant for all occupations. Finally, in Denmark, cognitive skills do not appear to be very prominent, as was the case for the overall education requirements. In our work, we do see that cognitive skills can play an important role (e.g. ICT and language skills are demanded in 20-30% of the ads), but vast differences exist across occupations.

The three sets of cognitive skills discussed above do not show high correlations. The correlation between computer and analytical skills is 0.23, the correlation between analytical and language skills is -0.32 and the correlation between computer and language skills is 0.1.

### **... Since having a driver's license and the ability to learn are only included in about one-tenth – or even less – of the job advertisements.**

About 3% of the job advertisements require a **driver's license** (the average is 5%). There is a lot of variation for this criterion (as percentages recorded vary between 0% and 72%), which is not very surprising because being able to drive is a crucial skill for some occupations in the list (e.g. the heavy- and light-truck drivers) but not necessary at all for others. Whether or not a worker needs a driver's license is likely to depend both on his or her occupation and on other factors, such as the company, sector or the specific role a worker holds within the firm. For 28 occupations, less than 10% of all vacancies specify the need to have a driver's license. For two occupations, over 40% of the advertisements require a driver's license. The requirement is highest among light-truck, delivery service drivers (42%) and heavy-truck and tractor drivers (72%). For these two occupations, it is likely that a 'special' license is needed (e.g. a permit to operate a truck). The correlation between the ISCO classification codes and the percentages is 0.47.

Although the **ability to learn** could be thought of as a useful skill for any occupation, on average it is only mentioned in about 10% of the job advertisements (with an average of 9%). For 11 occupations, the percentage of vacancies that include the ability to learn is above the

10% mark, and for two occupations it is above the 20% cut-off: tellers (21%) and sales agents, financial services (23%). Similarly, for Slovakia, Kureková et al. (2012) indicate that general cognitive skills – captured as analytical skills and the ability to learn – are not very much in demand.

### **With regards to the non-cognitive skills, both social and personal skills prove to be relevant for employers.**

This section is devoted to the non-cognitive skills that workers must possess in order to qualify for the jobs advertised. As shown in Figure 2, non-cognitive skills can be separated into two categories: social skills and personal skills, which in turn are composed of multiple sub-categories of skills. Three types of **social skills** are considered in the analysis: **communication skills, service skills and team-working skills**. The first set is identified on the basis of the following keywords: communication, speak, write, articulate, verbal, interact and communicate as well as different versions and combinations of these same words. For the second set of skills, the keywords client, customer, guest, needs and attention are considered, among other variations. Finally, the third set is identified through the keywords team, attitude, focus, leader work, environment, spirit and so on. With regards to the **personal skills**, seven types are distinguished: **timeliness and punctuality** (keywords: timely manner, deadlines, act quickly, punctual, prioritise), **independence** (self-motivated, initiative, independent), **reliability** (attention to detail, dependable, reliable), **pleasant demeanour/ manners** (attitude, positive, mature, helpful, confident, enthusiastic, professional), **creativity** (creative), **flexibility** (flexible, stay overnight, travel, shifts, work evenings), and **stress-resistant** (calm, stress, crisis situations).

As will become clear below, neither social skills nor personal skills appear to be dominant for the employers. Instead, a mix of non-cognitive skills is required. However, there are substantial differences between the sub-categories within the groups of social and personal skills and across occupations. Nevertheless, the range of values (i.e. the percentages of job advertisements that contain the skills) is extensive.

Other studies have reached the following conclusions. In Slovakia, non-cognitive skills appear in a higher number of advertisements than general cognitive skills (Kureková et al., 2012). Of the non-cognitive skills, communication skills, responsibility, independence, flexibility and good manners seem to be the highest in demand. Kureková et al. (2015b) report that in the Czech Republic, 9% of the vacancies demand social non-cognitive skills and 25% personal non-cognitive skills. In Ireland these percentages amount to 11% and 15%, and for Denmark the numbers are 32% and 52%. These stark differences clearly suggest that in Denmark, employers care a lot about the non-cognitive skills of their workers. In fact, these percentages are much higher than those for formal education (14%), and comparable to cognitive skills (31%) and experience (33%).

*Figure 2. Overview of the non-cognitive skills, subdivided into social skills and personal skills*

Social skills	Personal skills
<ul style="list-style-type: none"> <li>• Communication skills, Communicativeness</li> <li>• Service skills, customer approach, client-oriented</li> <li>• Team-working skills</li> </ul>	<ul style="list-style-type: none"> <li>• Timeliness, punctuality</li> <li>• Independence</li> <li>• Reliability</li> <li>• Pleasant demeanour, manners (w.r.t. behaviour)</li> <li>• Creativity</li> <li>• Flexibility</li> <li>• Stress-resistance</li> </ul>

**Of the social skills, service skills are requested more than team-working skills and communication skills (but some of these skills appear to be in demand only for specific occupations) ...**

**Communication skills or communicativeness** are called for in 23% of the job advertisements (the average is 22%). Across occupations, it is present in 3% to 63% of the vacancies, which illustrates that overall it is a relatively important skill. The correlation between the share of vacancies and the ISCO classification codes is -0.15, which suggests that communication skills become more important as the jobs performed become more complex. This result is in line with our expectations. Out of the 30 occupations, 26 fall within the range of 3% to 30%. The meeting, convention, event planners, sales agents, financial services, labourers and heavy truck and tractor drivers are at the lower end of this range. For four occupations, communication skills are listed in at least 30% of the vacancies. These occupations are installation, maintenance, repair workers (31%), first-line office supervisors (32%), merchandise displayers (38%) and security guards (63%). For each of these occupations, it is clear why good communications skills would be useful for the positions.

**Service skills** (which also captures applicants' customer approach, client-orientation) appear in about 49% of the advertisements (and 45% if the average is calculated). This number varies between 7% and 91%. Variation across occupations is thus rather large. The correlation between the ISCO coding and the percentages is -0.22 (low and negative). For 12 occupations, over half of the vacancies refer to service skills. For five occupations, no less than two-thirds of the vacancies mention service skills. These five occupations are customer service (CS) representatives (66%), tellers (74%), retail salesperson (80%), sales agents, financial services (82%) and meeting, convention, event planners (91%). Given the nature of these occupations, which are all in the sales, services and support domains, it does not come as a surprise that they are at the top of the list in terms of percentages. One may wonder whether the percentage of advertisements that includes service skills should not be even higher for these occupations. It may be the case, however, that for many of these positions, employers implicitly assume that applicants have these qualifications and therefore do not add them explicitly to the vacancy announcement.

Finally, **team-working skills** are found in 31% of the job advertisements (and 28% when the average is used). For most of the occupations in the list, team-work skills could be valuable. Of course, the role of the worker within the company and the firm's internal organisation can also have an impact on whether or not team work is needed. The percentage of vacancies that refers to team-working skills ranges from 5% to 49%. The correlation between the ISCO classification and the percentages is -0.31. Twelve occupations show higher percentages than the average. The five occupations with the highest percentages are supervisors of food preparation, serving workers (49%), general and operations managers (48%), combined food preparation workers (46%), retail salesperson (41%) and tellers (39%). For each of these five occupations, one can imagine that team-working skills are an important part of the position.

*Table 7. Percentage of job advertisements across occupations listing communication skills, service skills and team-working skills requirements*

ISCO	Occupation	Percentage of ads listing communication skills	Percentage of ads listing service skills	Percentage of ads listing team-working skills
1	General and Operations Managers	27%	48%	48%
2	Computer Support Specialists	23%	54%	28%
2	HR Specialists	24%	34%	30%
3	Bookkeeping, Accounting, Auditing Clerks	21%	34%	25%
3	First-Line Office Supervisors	32%	57%	34%
3	Medical Assistants	19%	27%	26%
3	Meeting, Convention, Event Planners	3%	91%	5%
3	Nursing Assistant	18%	12%	25%
4	Cashiers	27%	58%	23%
4	CS Representatives	20%	66%	38%
4	Medical Secretaries	22%	29%	21%
4	Office Clerks	18%	33%	21%
4	Secretaries	23%	30%	24%
4	Tellers	30%	74%	39%
5	Combined Food Preparation Workers	17%	44%	46%
5	Cooks, Restaurant	19%	21%	29%
5	Merchandise Displayers	38%	46%	31%
5	Personal Care Aides	14%	7%	21%
5	Retail Salesperson	22%	80%	41%
5	Sale Worker Supervisors	28%	61%	37%
5	Sales Agents, Financial Services	8%	82%	24%
5	Sales Representative Wholesale	21%	62%	33%
5	Security Guards	63%	51%	27%

5	Supervisors of Food Preparation, Serving Workers	22%	43%	49%
7	Installation, Maintenance, Repair Workers	31%	56%	24%
7	Maintenance Worker	18%	19%	22%
8	Heavy Truck and Tractor Drivers	13%	35%	16%
8	Light Truck, Delivery Service Drivers	20%	43%	19%
9	Janitors and Cleaners	16%	16%	17%
9	Labourers	12%	26%	23%
	Across occupations (all vacancies): total (average)	23% (22%)	49% (45%)	31% (28%)

### ... While the demand for personal skills varies from 3% to 33%.

At first sight, **personal non-cognitive skills** appear to be somewhat less related to specific jobs or occupations than the social skills. The percentages indeed vary from 3% to 33% across the seven sets of skills (the averages range from 3% to 32%). More specifically, the percentage of job advertisements that list timeliness and punctuality is 27% (ranging from 6-55%), independence 18% (2-44%), reliability 3% (0-13%), pleasant demeanour, manners 15% (5-47%), creativity 24% (3-44%), flexibility 33% (15-60%) and stress-resistance 5% (0-35%) (considering all occupations). The highest correlations between the percentage of vacancies and the ISCO classification are found for timeliness (-0.45) and creativity (-0.48). As before, the negative relationship indicates that punctuality and creativity are more in demand as occupations become more complex. **Table 8** below presents an overview of the five occupations with the highest percentage of job advertisements requiring a specific skill for the seven sets of personal non-cognitive skills. Note that if the percentage was the same for multiple occupations, all of these occupations are reported. Interestingly, there are a number of occupations that are in the top five for several skills: security guards, general and operations managers, meeting, convention, event planners, first-line office supervisors and tellers are present for at least three of the skills. This result is in line with the 'sum of skills' analysis performed earlier.

*Table 8. Overview of the five occupations with the highest percentage of vacancies that require each of the seven skills listed*

	Timeliness	Independence	Reliability	Demeanour
1	Meeting, Convention, Event Planners	Security Guards	Tellers	Security Guards
2	Security Guards	Merchandise Displayers	Personal Care Aides	Cashiers
3	General and Operations Managers	HR Specialists, Secretaries	Bookkeeping, Accounting, Auditing Clerks	Meeting, Convention, Event Planners
4	First-Line Office Supervisors		First-Line Office Supervisors, CS	Merchandise Displayers

			Representatives, Office Clerks, Secretaries	
5	Sales Representatives Wholesale	General and Operations Managers		Medical Secretaries
	Creativity	Flexibility	Stress-resistance	
1	Sales Worker Supervisors	Merchandise Displayers	Security Guards	
2	Tellers	Sales Agents, Financial Services	Medical Secretaries	
3	Computer Support Specialists	Meeting, Convention, Event Planners	First-Line Office Supervisors	
4	CS Representatives, General and Operations Managers	Sales Worker Supervisors	Personal Care Aides, Medical Assistants	
5		Tellers		

Note: In some cases more than five occupations are listed. If there were multiple occupations with the same percentages, 1 = highest percentage.

### Experience is required in 38% of the vacancies ...

Experience is one of the most highly requested qualifications. More specifically, about 38% of the job advertisements demand experience (39% when the average is calculated). The share of advertisements that include experience ranges from 21% to 51% across all occupations. These numbers are relatively high. Experience is the **third-most demanded qualification (after formal education and service skills)**, and its relevance appears to be relatively widespread (i.e. across occupations). With the exception of 13 occupations, at least 40% of the job advertisements call for 'experience' (across the remaining 17 occupations). The largest shares of vacancies that demand experience are found for the HR specialists (51%), computer support specialists (49%), medical assistants, bookkeeping, accounting, auditing clerks, secretaries and medical secretaries (47% in each case). **Table 9** shows the percentage of job advertisements that require experience across the list of the 30 most-frequent occupations in the United States. Other studies have also pointed to the attention that employers pay to their workers' level of experience. Kureková et al. (2012) indicate that it is the most highly demanded requirement in Slovakia (mentioned in 52% of the advertisements). Kureková et al. (2015b) find experience called for in 33% of the vacancies in Denmark, 94% in Ireland and 61% in the Czech Republic. Across the three countries, it is the most-frequent demand. Interestingly, in the sample of vacancies for the United States that we use in this paper, experience is highly requested but it is requested less often than formal education. This is a particularly interesting result that differs from earlier work (see above).

The keywords used to identify experience in the sample of job advertisements are: 'experience' in combination with year, month, work, preferred, desirable and other terms. There does not seem to be a clear link between education, skills and experience demanded generally. The largest correlations are reported for experience and computer skills (0.48), experience and a pleasant demeanour, manners (-0.52), and experience and flexibility (-0.38). There is a small negative correlation between the ISCO classification coding and the percentage of vacancies

of -0.24. As occupations become more and more complex, they tend to require more experience as well. Note that although one can expect that the level of experience required for a job is likely to depend on the position to be filled within a company, it is clear that experience is an important filter in the selection and recruitment process. Moreover, for many occupations it is a qualification that workers need in order to be able to perform the work.

*Table 9. Percentage of job advertisements across occupations that require experience*

ISCO	Occupation	Percentage of ads requiring experience
1	General and Operations Managers	40%
2	Computer Support Specialists	49%
2	HR Specialists	51%
3	Bookkeeping, Accounting, Auditing Clerks	47%
3	First-Line Office Supervisors	44%
3	Medical Assistants	47%
3	Meeting, Convention, Event Planners	31%
3	Nursing Assistant	36%
4	Cashiers	32%
4	CS Representatives	40%
4	Medical Secretaries	47%
4	Office Clerks	43%
4	Secretaries	47%
4	Tellers	43%
5	Combined Food Preparation Workers	33%
5	Cooks, Restaurant	46%
5	Merchandise Displayers	37%
5	Personal Care Aides	31%
5	Retail Salesperson	24%
5	Sales Worker Supervisors	32%
5	Sales Agents, Financial Services	41%
5	Sales Representative Wholesale	42%
5	Security Guards	21%
5	Supervisors of Food Preparation, Serving Workers	35%
7	Installation, Maintenance, Repair Workers	44%
7	Maintenance Worker	46%
8	Heavy Truck and Tractor Drivers	31%
8	Light Truck, Delivery Service Drivers	39%
9	Janitors and Cleaners	36%
9	Labourers	42%
	Across occupations (all vacancies): total (average)	38% (39%)

### **... But other factors appear to matter less.**

11% of the job advertisements specify no **criminal record** (or require background checks; varying between 3% and 37%, the average is 12%, correlation of 0.25 with ISCO coding), while 11% requires **drug testing** (average is 12%, ranging from 3% to 37% of the vacancies across occupations, correlation of 0.25 with ISCO). Note that these numbers are highly similar, because both variables include keywords that capture 'drugs' and 'drug testing'. For a small number of occupations, **US citizenship** is a selection criterion as well (4%, on average 4% across occupations as well; this ranges from 0% to 30%). For two occupations, over 30% of the job advertisements require that applicants do not have a criminal record. The highest number of vacancies with this criterion are found for the meeting, convention, event planners (37%), security guards (36%), installation, maintenance, repair workers (23%), light truck, delivery service drivers (22%), and heavy truck and tractor drivers (21%). These occupations either involve a relationship of trust or handling (valuable) goods. Similar results are obtained when it comes to drug testing. For the remaining occupations, these percentages are below 20%. The occupation with the highest number of advertisements requesting citizenship is security guard (30%). In their paper, Kureková et al. (2015b) also consider having a clean criminal record and references from previous employers as requirements. These appear in about 9% of the Czech vacancies, 13% of the Irish vacancies and 14% of the Danish vacancies. A clean criminal record is particularly important for sales, services and elementary cleaning occupations in the Czech Republic and Denmark.

Another factor that could be present in job advertisements is the **physical appearance or look** of a job candidate. Although the majority of countries have laws that prohibit discrimination in the selection and recruitment of applicants, previous research does show that this does occur (see the work of Kuhn & Shen, 2013 on the Chinese labour market). In the sample of advertisements for the American market, about 3% of the vacancies refer to the appearance or look of the candidates (based on an analysis with keywords as well-groomed, clean/neat/professional appearance). The average across the 30 occupations is 5% and the correlation between the ISCO code and the percentages is -0.06. Interestingly, the percentage of advertisements that contain requirements on the look or appearance of the applicants varies substantially across occupations: from 0% to 49%. In five occupations the percentage of vacancies that refers to appearance is over 4%: meeting, convention, event planners (49%), combined food preparation workers (22%), merchandise display workers (13%), light truck, delivery service drivers (6%) and heavy truck and tractor drivers (5%). Kureková et al. (2015b) detect the highest number of vacancies that refer to appearance in Denmark (about 5%) (less than 1% in the Czech Republic and Ireland). Kureková et al. (2012) show that 21% of the Slovak vacancies refer to appearance.

### **On the basis of a factor analysis of the six sets of requirements and skills in Figure 1, five factors are identified ...**

As a following step in this research note, we perform a **factor analysis**. This technique is widely used in the social sciences because it allows researchers to identify the underlying relationships between a set of variables (which may not be directly measured). With this

technique, a large set of variables can be replaced by a smaller number of 'factors', which reflect what the variables have in common with one another. In other words, factor analysis is a data reduction technique that can be used to remove redundancy or duplication from a set of correlated variables and replaces these with a smaller set of factors, from which it may be easier to interpret and derive conclusions. In our work, we identify the underlying relationships between the education, skills and other qualifications demanded in the job advertisements. By identifying the underlying factors - which can be regarded as 'profiles' - we can substantially reduce the list of qualifications and skills that we have been using so far to simplify the subsequent analysis. In this way, we can acquire more insights into the general characteristics and the combinations of requirements that employers have in mind when publishing vacancies.

How was this factor analysis executed? In a factor analysis, observed variables are modelled as linear combinations of the potential factors plus error terms. The information gained about the interdependencies between observed variables can be used to decrease the number of variables in a dataset. In our analysis, we start from a set of 22 skills and end up with 5 factors (which now combine 18 skills and qualifications). Initially, we obtained 17 factors, but only 6 of them had an eigenvalue that was at least equal to 1. When the eigenvalue of a factor is equal to one or higher, it explains more variance than a single observed variable. We then excluded 12 factors, by restricting the eigenvalue to be at least equal to one when re-running the analysis; also restricting the number of factors to five and the factor loadings to at least 0.6 (after rotation) (following Field, 2005). We also considered the uniqueness of the variables. The results that were obtained from the factor analysis and skills and other qualifications that they comprise are depicted in **Figure 3**.

*Figure 3. Overview of the factors*



As indicated above, we started our analysis with a set of 22 skills and requirements. As **Figure 3** shows, five factors were identified that group 18 individual qualifications and skills. **Factor I** includes communication skills, independence and stress-resistance (all three non-cognitive skills) and citizenship. **Factor II** comprises team-working skills, creativity (both non-cognitive skills), no criminal record and drug testing (team-working skills and creativity show a negative sign). **Factor III** is composed of language skills (cognitive), service skills, timeliness,

a pleasant demeanour (all non-cognitive), and appearance/look. **Factor IV** covers specialised training and licenses, ability to learn and flexibility (specialised training has a negative sign). Finally, **Factor V** is composed of computer skills and experience. From the factor analysis it is clear that education, analytical skills, possessing a driver's license and reliability are not positively correlated with any of the factors. Some of these skills and requirements can be expected to be relevant in a broad sense, and may therefore be not really related to any of the other skills or requirements.

The factors that are identified in this analysis differ from the classification that one would arrive at based on the literature. Following the literature, one may be inclined to separate cognitive from non-cognitive skills, to distinguish between experience and education, to put the other factors (pillars four to six in **Figure 1**) in a distinct category, and so on. In this note, we purposely do not follow the literature, but instead **let the data speak**. This approach is based on five factors, most of which are a combination of cognitive and non-cognitive skills, cognitive skills and other demands or non-cognitive skills and other requirements. These five factors indeed are different from the common classifications used in the literature but nonetheless are in line – at least to some extent – with what one could expect (see the following examples). The skills and requirements embedded in the third factor are strongly related to the concepts of 'communication' and 'interaction with others'. They capture not only a knowledge of language and a customer-orientation, but also the assumption that workers have a professional behaviour and look. Factor I integrates three skills that are related to each other: communication skills, independence and stress-resistance are qualities that workers may need when times get tough (e.g. in rapidly changing sectors).

### **... And an analysis is done to discover which factors are more important for which occupations.**

After the identification of the five factors and the substantial reduction of the list of 22 skills and requirements, we continue with an analysis of the factors that matter most for each of the 30 occupations. For each occupation and each factor, the average number of vacancies is calculated and reported in **Table 10**.

For example, for the occupation '*general and operations managers*', the percentage for Factor I is the average of the percentages of advertisements that demand communication skills (27%), independence (25%), stress resistance (5%) and US citizenship (2%). More precisely, it is the average of 27%, 25%, 5% and 2%, which amounts to 15%. Factor II is the average of the percentage of vacancies listing team-working skills (48%), creativity (38%), no criminal record (7%) and drug testing (7%). This average is equal to about 25%. Factor III is the average of the percentage of vacancies requiring language skills (17%), service skills (48%), timeliness (40%), a pleasant demeanour (7%) and appearance/look (1%); it amounts to 23%. Factor IV is equal to 18%, the average of the percentage of advertisements with specialised training and licenses (13%), ability to learn (6%) and flexibility (33%). Factor V is the average of the percentage of advertisements that demand computer skills (32%) and experience (40%), which is 36%.

We first **go through each of the five factors** in **Table 10**, across all occupations. For the different factors, the percentages range from 2% to 43% (Factor I), 11% to 26% (Factor II), 8%

to 57% (Factor III), 11% to 32% (Factor IV), and 16% to 55% (Factor V) (in blue). The most variation across occupations is detected in the Factors I, III and V. Interestingly, the meeting, convention and event planners and the security guards appear more than once at the top or bottom of the list. Factor I reaches the highest numbers for security guards (43%), merchandise displayers (17%), HR specialists (17%) and first-line office supervisors (17%). For these occupations, stress-resistance, independence and communication skills indeed seem important. The lowest percentages are found for meeting, convention and event planners, sales agents, financial services, labourers and combined food preparation workers. For Factor II, the highest percentage is recorded for the security guards (26%) as well. Other occupations with high averages are tellers (25%), general and operations managers (25%), CS representatives (24%) and sales worker supervisors (23%). The lowest-ranking occupations are the medical secretaries, janitors and cleaners, cashiers, personal care aids and office clerks. With regards to Factor III, the range of percentages found is relatively similar to that of Factor II. The highest percentages are recorded for the meeting, convention, event planners (57%), security guards (37%), sales agents, financial services (28%), tellers (27%), CS representatives (27%) and retail salespersons (27%). On the other end of the distribution, we find labourers, janitors and cleaners, personal care aides, nursing assistants and maintenance workers. For Factor IV, nursing and medical assistants appear on top of the ranking (32% and 29% respectively). Meeting, convention, event planners also score high (28%), as do merchandise displayers (28%) and sales agents, financial services (27%). Lower percentages are obtained for bookkeeping, accounting, auditing clerks, secretaries, computer support specialists, office clerks and HR specialists. Finally, we look at Factor V for which there is quite some variation across the occupations. Security guards have the lowest percentage (16%), while computer support specialists (55%), secretaries (50%) and bookkeeping, accounting, auditing clerks (46%) have the highest numbers. Other traditional 'office jobs' score high too (e.g. office clerks, medical secretaries, tellers).

*Table 10. Overview of the most relevant factors for each of the 30 occupations*

ISCO	Occupation	Factor I	Factor II	Factor III	Factor IV	Factor V
1	General and Operations Managers	15%	25%	23%	18%	36%
2	Computer Support Specialists	13%	19%	19%	14%	55%
2	HR Specialists	17%	20%	18%	14%	45%
3	Bookkeeping, Accounting, Auditing Clerks	11%	19%	18%	11%	46%
3	First-Line Office Supervisors	17%	22%	24%	17%	41%
3	Medical Assistants	11%	17%	17%	29%	33%
3	Meeting, Convention, Event Planners	2%	20%	57%	28%	44%
3	Nursing Assistant	10%	15%	11%	32%	30%
4	Cashiers	12%	13%	25%	15%	22%
4	CS Representatives	11%	24%	27%	18%	38%
4	Medical Secretaries	12%	11%	19%	18%	43%
4	Office Clerks	11%	14%	17%	14%	44%

<b>4</b>	Secretaries	15%	16%	18%	14%	50%
<b>4</b>	Tellers	11%	25%	27%	23%	34%
<b>5</b>	Combined Food Preparation Workers	8%	17%	25%	16%	20%
<b>5</b>	Cooks, Restaurant	9%	15%	17%	21%	25%
<b>5</b>	Merchandise Displayers	17%	21%	24%	28%	29%
<b>5</b>	Personal Care Aides	9%	14%	<b>8%</b>	21%	20%
<b>5</b>	Retail Salesperson	10%	19%	27%	17%	22%
<b>5</b>	Sale Worker Supervisors	15%	23%	22%	23%	23%
<b>5</b>	Sales Agents, Financial Services	5%	19%	28%	27%	32%
<b>5</b>	Sales Representative Wholesale	11%	20%	25%	17%	34%
<b>5</b>	Security Guards	<b>43%</b>	<b>26%</b>	37%	20%	<b>16%</b>
<b>5</b>	Supervisors of Food Preparation, Serving Workers	12%	22%	20%	17%	23%
<b>7</b>	Installation, Maintenance, Repair Workers	14%	22%	20%	23%	33%
<b>7</b>	Maintenance Worker	11%	16%	12%	20%	35%
<b>8</b>	Heavy Truck and Tractor Drivers	9%	17%	16%	19%	18%
<b>8</b>	Light Truck, Delivery Service Drivers	9%	18%	23%	21%	23%
<b>9</b>	Janitors and Cleaners	9%	12%	12%	17%	21%
<b>9</b>	Labourers	7%	16%	12%	17%	28%

We then study **how the five factors differ for individual occupations** in Table 10. We will not discuss each occupation but instead pick out some of the more interesting results. First, we devote our attention to **security guards**. This occupation is rather skills- and requirements-intensive (which is reflected in the fact that the occupation is present in many top-5 lists described above). In the factor analysis, the highest average percentage of vacancies is found for security guards for two of the five factors. Factors I and II seem to be the most important ones for the occupation. Overall, our sample suggests that security guard is a rather demanding position in the United States. Applicants for security guard positions are faced with a high demand for communication and team-working skills. Furthermore, they are expected to be independent and stress-resistant and to be a US citizen. Other common requirements for this occupation are no criminal record and willingness to be subjected to drug testing. Another occupation with a high skill demand are the **meeting, convention, event planners**. Especially in terms of Factor III and V, requirements are substantial. Factor I, on the other hand, appears to be of little importance. Interestingly, the average percentages across all factors for security guards and meeting, convention and event planners are similar (28% and 30%, respectively). Nevertheless, these occupations are very different in terms of their tasks and responsibilities. In addition, if one calculates the average percentage across all factors, the same number (17%) is reached for **cashiers, combined food preparation workers** and **cooks**. Again, these occupations have fairly different tasks and responsibilities (especially the former versus the two latter).

A closer look at the five factors reveals that the percentages are (nearly) identical for several of the factors. The largest differences are found for Factor III. Another interesting result for the

bookkeeping, accounting and auditing clerks and the CS representatives is that for both occupations Factor V (computer skills and experience) is the main one, followed by Factors II and III. A similar comparison can be performed for two of the medical occupations: **medical assistants** and **medical secretaries**. Both occupations show similar numbers for Factors I to III, but for Factor IV and V, the differences are larger. This finding could suggest that medical secretaries have an 'office-job' and need to rely more on computer skills to perform their tasks (compared to medical assistants). Finally, we compare five occupations with an average of 24% across factors. These occupations are **computer support specialists** (ISCO 2), **first-line office supervisors** (ISCO 3), **CS representatives** and **tellers** (ISCO 4), and **merchandise displayers** (ISCO 5). Notwithstanding that these five occupations have the same average, they have different ISCO codes and a different composition in terms of factors. The computer support specialists are dominant in Factor V, although this factor is relatively important for all of these occupations. In fact, it is the factor with the highest percentage overall. Factors II and III appear to play a role as well.

## Conclusions

In this research note, we used an extensive sample of job advertisements extracted from Burning Glass to shed more light on the education, skills and other requirements that employers demand in the United States for the 30 most-frequently advertised occupations (of various levels of complexity: two low-skilled occupations, 20 medium-skilled occupation and eight high-skilled occupations). For each of these 30 occupations, we calculate the percentage of vacancies that require education and formal qualifications (education requirements or specialised training and skills), cognitive skills (specific or generic), non-cognitive skills (social or personal) and experience. We further track the percentage of job advertisements that refer to the appearance or look of the candidates and to three other factors (criminal record, drug testing and US citizenship). **Table 11** below summarises these percentages for each of these different requirements. In total, 67% of the vacancies include education requirements, 49% demand service skills and 38% refer to experience. These three factors constitute the main filters that employers use in their selection and recruitment process.

Interestingly, other non-cognitive skills are important for employers as well. Across the 30 occupations, between 30% and 40% of the vacancies refer to a pleasant demeanour (manners) and flexibility. Some 20% to 30% of the job advertisements contain communication skills, timeliness and creativity. These results illustrate that both social and personal skills matter for employers. Less than one-third of the job advertisements, on average, require specialised training or licenses, cognitive skills, (other) non-cognitive skills or point to other factors (e.g. no criminal record). These findings lend support to previous work on cognitive skills and non-cognitive skills, suggesting that the latter may matter more than the former (although computer skills appear to be relatively important as well). As expected, there are substantial differences among the 30 occupations, which are explored in more depth in the body of this note. Our results for the United States do match to a relatively large extent those of earlier studies for Europe, but there are some notable differences as well. For example, Kureková et al. (2012) and Kureková et al. (2015) point to the role of experience and non-cognitive skills,

but education appears to be a much more important filter in the US than in the European countries studied.

In general, job advertisements in the United States prove to be relatively demanding in terms of the requirements that applicants have to meet, and this also applies to low-skilled and mid-skilled jobs. In fact, security guard is the most skill-intensive occupation in the market on the basis of our sample. Still, employers tend to be more demanding as the level of complexity of an occupation increases (at least for some requirements). This research contributes to the growing literature on job-matching and labour market dynamics that relies on web data (see Askitas & Zimmermann, 2015). Our work focuses particularly on the skills dimension and can be of interest to job-seekers wanting to discover employers' demands for specific occupations, and educational institutes aiming to track recent developments to develop appropriate educational programmes.

*Table 11. Summary of the average percentage of vacancies across all 30 occupations*

TOP 3	Highest averages are reported for:
67%	Education requirements
49%	Service skills
38%	Experience
Remaining	Lower averages are reported for:
30%-40%	Team-working skills, flexibility
20%-30%	Computer skills, communication skills, timeliness, creativity
10%-20%	Specialised training and licenses, analytical skills, language skills, independence, pleasant demeanour/manners, criminal record, drug-testing
0%-10%	Driver's license, ability to learn, reliability, stress-resistance, appearance/ look, citizenship

Note: *Yellow*=education and training; *red*=cognitive skills; *black*=non-cognitive skills; and *blue*=other elements.

## References

- Anderson, Bridget and Martin Ruhs (2008), "A Need for Migrant Labour? The Micro-Level Determinants of Staff Shortages and Implications for a Skills Based Immigration Policy", Centre on Migration, Policy and Society (COMPASS), Oxford University.
- Askitas, Nikolaos and Klaus F. Zimmermann (2015), "The Internet as a Data Source for Advancement in Social Sciences", *International Journal of Manpower*, 36(1): 2-12.
- Brunello, Giorgio and Martin Schlotter (2011), "Non Cognitive Skills and Personality Traits: Labour Market Relevance and their Development in Education & Training Systems", IZA Discussion Paper No. 5743, Institute for the Study of Labor (IZA), Bonn.
- Capiluppi, Andrea and Andres Baravalle (2010), "Matching Demand and Offer in On-Line Provision: A Longitudinal Study of Monster.com" in *WSE 2010 Proceedings the 12th IEEE International Symposium on Web Systems Evolution* (WSE 2010), Timisoara, 17-18 September.
- Carnevale, Anthony P., T. Jayasundera and D. Repnikov (2014), "Understanding Online Job Ads Data: A Technical Report", McCourt School on Public Policy, Center on Education and the Workforce, Georgetown University, Washington, D.C., April.
- Dörfler, Laura and Herman G. van de Werfhorst (2009), "Employers' Demand for Qualifications and Skills", *European Societies*, 11(5): 697-721.
- Field, Andy (2005), *Discovering statistics using SPSS*, Second edition, London: Sage.
- Hershbein, Brad and Lisa Kahn (2015), "Is College the New High School? Evidence from Vacancy Postings" ([http://works.bepress.com/brad\\_hershbein/6](http://works.bepress.com/brad_hershbein/6)).
- Jackson, Michelle (2007), "How Far Merit Selection? Social Stratification and the Labour Market", *British Journal of Sociology*, 58(3): 367-390.
- Jackson, Michelle, John H. Goldthorpe and Colin Mills (2005), "Education, Employers and Class Mobility", *Research on Social Stratification and Mobility*, 23: 3-33.
- Kuhn, Peter and Kailing Shen (2013), "Gender Discrimination in Job Ads: Evidence from China", *Quarterly Journal of Economics*, 128(1): 287-336.
- Kuhn, Peter (2014), "The Internet as a Labor Matchmaker", IZA World of Labor No. 18, Institute for the Study of Labor (IZA), Bonn.
- Kuhn, Peter and Hani Mansour (2014), "Is Internet Job Search Still Ineffective?", *The Economic Journal*, 124(158): 1213-1233.
- Kureková, Lucia Mytna, Miroslav Beblavý and Corinna Haita (2012), "Qualifications or Soft Skills? Studying Job Advertisements for Demand for Low-Skilled Staff in Slovakia", NEUJOBS Working Paper D.4.3.3, August.
- Kureková, Lucia Mytna, Miroslav Beblavý and Anna Thum-Thysen (2015a), "Using Internet Data to Analyse the Labour Market. A Methodological Enquiry", IZA Discussion Paper No. 8555, Institute for the Study of Labor (IZA), Bonn.
- Kureková, Lucia Mytna, Miroslav Beblavý, Corinna Haita and Anna Thum-Thysen (2015b), "Employers' Skill Preferences across Europe: Between Cognitive and Non-cognitive Skills", *Journal of Education and Work*, 03/2015.
- Maxwell, Nan L. (2006), "The Working Life: The Labor Market for Workers in Low-Skilled Jobs", *WE Upjohn Institute*, California State University, East Bay, CA.
- Sasser Modestino, Alicia, Daniel Shoag and Joshua Balance (2015), "Upskilling: Do Employers Demand Greater Skill When Workers are Plentiful?", Federal Reserve Bank of Boston, Boston, MA, 21 January.

## ABOUT CEPS

Founded in Brussels in 1983, CEPS is widely recognised as the most experienced and authoritative think tank operating in the European Union today. CEPS acts as a leading forum for debate on EU affairs, distinguished by its strong in-house research capacity and complemented by an extensive network of partner institutes throughout the world.

### Goals

- Carry out state-of-the-art policy research leading to innovative solutions to the challenges facing Europe today
- Maintain the highest standards of academic excellence and unqualified independence
- Act as a forum for discussion among all stakeholders in the European policy process
- Provide a regular flow of authoritative publications offering policy analysis and recommendations

### Assets

- Multidisciplinary, multinational & multicultural research team of knowledgeable analysts
- Participation in several research networks, comprising other highly reputable research institutes from throughout Europe, to complement and consolidate CEPS' research expertise and to extend its outreach
- An extensive membership base of some 132 Corporate Members and 118 Institutional Members, which provide expertise and practical experience and act as a sounding board for the feasibility of CEPS policy proposals

## Programme Structure

### In-house Research Programmes

Economic and Finance  
Regulation  
Rights  
Europe in the World  
Energy and Climate Change  
Institutions

### Independent Research Institutes managed by CEPS

European Capital Markets Institute (ECMI)  
European Credit Research Institute (ECRI)  
Energy Climate House (ECH)

### Research Networks organised by CEPS

European Climate Platform (ECP)  
European Network of Economic Policy Research Institutes (ENEPRI)  
European Policy Institutes Network (EPIN)