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Employers' skills requirements in the Austrian labour market: On the relative importance of ICT, cognitive and non-cognitive skills over the past 15 years

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Employers' Skills Requirements in the Austrian Labour Market:

On the Relative Importance of ICT, Cognitive and Non-cognitive Skills over the Past 15 Years

Sandra M. Leitner and Oliver Reiter



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On the Relative Importance of ICT, Cognitive and Non-cognitive Skills over the Past 15 Years

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We wish to thank the online job portal karriere.at for making its data available for analysis. All errors remain our own.

Abstract

This paper analyses job advertisements to identify the particular skills, abilities and characteristics that are in demand on the Austrian labour market. It takes a novel approach and uses information extracted from over 1.5 million job advertisements over the past 15 years from Austria's largest online job portal, karriere.at, to shed light on employers' skills needs and the relative importance of, and demand for, different skill types over time. It develops a taxonomy which classifies observable skills into information and communications technology (ICT) skills (which are of increasing importance as a result of the ongoing digital revolution), cognitive skills, cognitively based skills and non-cognitive (soft) skills; but it also takes into account other factors that frequently appear in job advertisements, such as previous work experience, physical appearance, and the willingness to travel, work overtime, weekends or shifts, among others. It shows that Austrian employers are quite demanding: cognitive skills, previous work experience and ICT skills were the three most frequent requirements, appearing in (almost) every second job advertisement in 2019. Over the years, these categories have also become increasingly important to employers. Among cognitively based skills, language skills were the most important, also appearing in every second job advertisement. The ability to work as part of a team, communication skills, independence, flexibility and accuracy were the top five non-cognitive (soft) skills demanded by employers.

Keywords: Job advertisements, online job portal, skills requirements, ICT skills, cognitive skills, non-cognitive skills

JEL classification: J23, J24, J63

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1. Introduction

The world is changing continuously and at an unprecedented pace. As a result of new technological breakthroughs, globalisation and large demographic shifts, labour markets are experiencing profound structural changes in their occupational structures, with far-reaching implications also for the types of skills required. For instance, new technologies are replacing specific tasks previously carried out as part of these jobs, freeing up workers to focus on new tasks and leading to rapidly changing core skill sets in these occupations. As a result of advancing technological change and digitalisation, the task content of jobs is tending to shift away from physical tasks and towards more analytical and digital tasks. Likewise, even jobs that are less affected by technological change may require very different skills in the future, as a result of the rapidly changing environment. Skills supply is also evolving, but takes time to adapt to emerging skills needs.

Information on changes in employers' skill and qualification requirements is important, in order to prevent skills gaps and mismatches, and is therefore essential for policy-makers: it informs policies designed to adapt education and training systems to new and changing needs (e.g. in terms of training programmes and curricula adjustments); it supports job and career counselling services, by providing more accurate advice on future skills requirements; and it assists in developing measures which help people to get fit for the digital age and to acquire the skills that employers are increasingly demanding.

This study uses detailed information extracted from over 1.5 million job advertisements between 2008 and 2019 from Austria's largest online job portal (karriere.at) to analyse employers' skills needs and the relative importance of, and demand for, different skill types over the last 15 years. This long-term perspective allows us to shed light on longer-term trends and developments, which can be extrapolated into the future to help identify future skills needs and areas of policy intervention. It differentiates between different types of skills: namely information and communications technology (ICT) skills (which have become increasingly important as a result of the ongoing digital revolution and the associated increase in the use of new technologies at work), cognitive skills, cognitively based skills, non-cognitive (soft) skills and other factors which often appear in job advertisements.

The findings of this paper indicate that Austrian employers are quite demanding and generally request a diverse set of skills. Most frequently they require cognitive skills, previous work experience and ICT skills, and they also expect their (future) employees to possess all three of these requirements. Between 2008 and 2019, these top three categories also witnessed the greatest increases in demand: the frequency with which cognitive skills and previous work experience were mentioned in advertisements more than tripled, while demand for ICT skills more than doubled. Additionally, language skills were the most important cognitively based skills, appearing in every second job advertisement in 2019. Furthermore, of all the non-cognitive skills analysed, employers attach particular importance to the ability of employees to work as part of a team, and to their communication skills, independence, flexibility and accuracy: these appeared in 20% to 40% of all job advertisements.

The rest of the paper is structured as follows. Section 2 provides a review of the related literature and its key findings. Section 3 sketches the online job-portal market in Austria and discusses its main characteristics. The importance of online job advertisements for studying employers' skills requirements, the data used in the analysis, the taxonomy used to categorise skills and abilities, our indicators, and the technical details of how the comprehensive data were processed are all discussed in Section 4. Section 5 presents and discusses in detail our findings, while Section 6 provides a summary and conclusion.

2. Related literature

Research on skills and employers' skills requirements using information from online job advertisements is generally thin on the ground; but what research there has been has produced interesting insights. Most studies have analysed employers' skills demands to determine the importance of formal education, relative to other types of skills and qualifications, and to shed light on differences across occupational groups and classes in particular countries.

For instance, Kureková et al. (2016) use data from the publicly administered pan-European EURES Job Mobility Portal to quantify the different cognitive and non-cognitive skills requested by employers in selected low- and medium-skilled occupations. They focus on the three small European economies of the Czech Republic, Denmark and Ireland. They categorise frequently encountered skills requirements and differentiate between cognitive skills (proxied by the level of formal education requested), cognitively based/acquired skills (captured by ICT skills, language skills, driving skills, ability to learn) and non-cognitive skills (captured by communication skills, service skills and customer approach, timeliness, reliability, team-working skills, responsibility, flexibility, resistance to stress, independence and creativity). Furthermore, they include physical appearance, previous work experience and other factors (e.g. no criminal record, or references) as additional categories often found in job advertisements. They show that the skills mix demanded is diverse and very country specific. In the Czech labour market, formal education and previous work experience are widely requested, while non-cognitive skills (such as reliability and flexibility) are particularly important in low-skilled occupations. In the Irish labour market, previous work experience and a range of cognitive skills (particularly knowledge of English) are key and are more important than non-cognitive skills. Finally, in the Danish labour market, employers are less insistent on formal education and cognitive abilities, but are more likely to demand non-cognitive skills, such as flexibility, good customer skills and team skills.

Similarly, Beblavý et al. (2016c) analyse job advertisements to identify the importance of specific skills and characteristics that are demanded in the Slovak labour market in selected low- and medium-skilled occupations that are typical in the service, technical and manufacturing sectors. They use a similar (though less extensive) skills taxonomy as Kureková et al. (2016) and find that previous work experience was the most frequently requested characteristic. Furthermore, non-cognitive skills and specific cognitive skills – particularly language skills – were demanded more than general cognitive skills or appearance. Being responsible and flexible are the non-cognitive personal skills most sought after by employers, while the ability to communicate is the most requested social skill across all occupations analysed.

Beblavý et al. (2016a) analyse a sample of approximately 2 million job advertisements from the online job portal Burning Glass to identify employers' demands for the 30 most frequently advertised (low-, medium- and high-skilled) occupations in the United States. They show that, while the particular requirements differ across occupations, there are important similarities. Formal education is the most important criterion and is required in 67% of all vacancies examined. By contrast, specialised training and licences are less important. Of all cognitive and non-cognitive skills analysed, service skills (which capture applicants' customer approach and client orientation) are greatly in demand, requested in 49% of vacancy notices. Other non-cognitive skills – both social and personal in nature – are also frequently included as well. But instead of some specific non-cognitive skills, employers request a broad mix of non-cognitive skills. Experience, which appears in 38% of vacancies, is the third key criterion that employers use to screen job applicants.

Beblavý et al. (2016b) focus on the four Visegrád countries of the Czech Republic, Hungary, Poland and Slovakia to shed light on the relative importance of different foreign-language skills. They use information extracted from online job portals and show that English is the most requested foreign language in the region (mentioned in 52% of vacancies), gaining in importance as occupations become increasingly complex. By contrast, despite the cultural, historical and economic ties with their German-speaking neighbours, German is only the second most requested foreign language, irrespective of the complexity of an occupation. Other languages, such as French, Spanish and Russian, are hardly requested.

Similar analyses have also been conducted in some less-developed countries. Nomura et al. (2017) study the Indian online job portal Babajob, which was established in 2007 and is one of the country's leading job-matching websites, mostly advertising jobs based in the 10 most populous cities of Bangalore, Delhi, Mumbai, Chennai, Hyderabad, Pune, Kolkata, Thane, Patna and Lucknow. Their analysis points to the importance of previous work experience, formal education and language skills. However, in contrast to studies in other countries (see above), only a relatively small proportion of job advertisements requires non-cognitive skills.

Kupets et al. (2019) examine job vacancies posted on two private online job portals in Moldova and show that level of education and previous work experience are of key importance. As concerns the particular skills and individual characteristics demanded, the analysis finds that job-specific technical skills, work ethic (required in around 30% of all vacancies examined), the languages of Romanian and Russian, computer literacy, communication and English (or another foreign language) are the most important to employers in Moldova.

Furthermore, the analysis by Dörfler and van de Werfhorst (2009) is also worth mentioning, even though it uses paper-based job advertisements. The study examined around 980 job advertisements in three large daily Austrian newspapers over a period of 20 years (1985-2005) to identify the growing diversity over time of the skills required across – as well as within – occupations. The authors found that formal qualifications were demanded in 66% of all advertisements. Social skills, such as communication skills, the ability to work in a team with others and personal skills, were sought particularly (but not only) in the service sector. Furthermore, the demand for ICT skills had increased substantially, from 13% in 1985 to 40% in 2005.

Similarly, Cedefop's Skills OVATE (Skills Online Vacancy Analysis Tool for Europe) should also be mentioned in this context.¹ The tool presents data retrieved between July 2018 and December 2019 in 28 European countries from millions of online job advertisements, coming from thousands of sources, including private job portals, public employment service portals, recruitment agencies, online newspapers and employer websites. As yet, there are no official documents summarising the key findings, but the tool itself provides important insights into the skills that employers seek in the EU as a whole, as well as in individual EU member states. It shows that in the EU as a whole, adapting to change and teamwork are the most crucial, followed by computer/ICT skills and proficiency in English. For Austria, a somewhat different ranking is observable, with teamwork, followed by proficiency in English and computer/ICT skills the three most important skills.

¹ See <https://www.cedefop.europa.eu/en/data-visualisations/skills-online-vacancies>

3. The online job-portal market in Austria: a characterisation

Generally, job portals serve an important purpose, as they bring together the demand side and the supply side of the labour market, and offer both sides important advantages. Job seekers benefit from online job portals, as they can browse a large number of vacant positions, use particular search criteria to find a job in a particular geographical area (or industry) that (best) matches their qualifications, and gain a better understanding of employers' requirements. Firms benefit from online job portals, as they can list job openings on targeted websites, while keeping advertising costs low.

In Austria, the online job-portal landscape is rather fragmented, with the Austrian Public Employment Service (AMS) playing an important role, together with a large number of private online job portals.

The AMS offers a comprehensive Austrian job database – eJob-Room – to assist in the job-seeking process, as well as a detailed list of links to public and private resources. The database is open to all job seekers in Austria. The eJob-Room operates nationally, covers all sectors and offers its services to companies of all sizes. Since the primary users of the portal are registered unemployed persons, companies looking for highly qualified workers are less likely to post vacancies on the portal; thus eJob-Room mainly serves the labour market segment of the lower skilled.

There are a number of private online job portals in Austria, which mainly recruit specialists and skilled workers (Cedefop, 2013). For many years, Jobfinder.at was the leading private online job portal in Austria, but in 2006 it was overtaken by Stepstone.at – an international company, founded in 1996 in Norway. Since 2007, Monster.at has had a strong presence, with more than 2.6 million searches each month. Monster.at is active in more than 60 countries around the world and offers good opportunities for transnational job and employee search. Karriere.at is a relatively young portal: founded in 2004, it is currently the most important online job portal in Austria. Other important private online job portals are Job.at or Willhaben.at; this latter was initially an online market place (like eBay), but it has become an important player in the online job-portal market.

There are also portals which cater to particular target groups, such as Absolventen.at, which focuses specifically on attracting recent graduates.

Some job portals have evolved directly from (or remain connected to) national newspapers. For instance, the daily newspaper *Der Standard* developed its online job portal, which has been operating since 1996. It offers more than 3,500 job advertisements and continues to carry printed job advertisements each Saturday. Similarly, meinjob.at has become important in a relatively short period of time and currently offers around 10,000 jobs. This portal is part of Austria's largest media group (OE24).

Furthermore, social media are another important and growing aspect of online recruiting in Austria, using platforms such as Xing, LinkedIn and Facebook. Recently so-called profile-matching tools or apps like

Hokify have become increasingly important. Currently, Hokify has more than 350,000 users. In 2016, karriere.at invested in Hokify and currently holds 70% of the company's shares.

Because of the rather low cost of online job advertisements, private online job portals are the main source for personnel recruitment in Austria – around 80% of all companies use online job portals (Cedefop, 2013) – and companies often use more than one portal when placing an advertisement, sometimes posting to several private portals and the AMS simultaneously.

4. Data

4.1. JOB ADVERTISEMENTS AND EMPLOYERS' SKILLS REQUIREMENTS

Job advertisements are the first step in a screening process, and reflect an employer's views about the ideal candidate. Although only some of the requirements specified may eventually be taken into consideration in the actual recruitment process, job advertisements are still extremely informative for identifying the key competences required for a particular vacancy. Vacancy data offer timely information on employers' skills needs and are the most immediate way of assessing current needs in enterprises (Cedefop, 2013).

Generally, online job advertisements – which lie at the heart of online job portals – are ideal for this analysis, since they have several advantages over more traditional data sources and provide information at a more detailed level. Unlike printed advertisements, employers posting job vacancies on websites do not have to pay by the word, and thus can provide more detailed information on the knowledge and skills they require. In particular, the raw texts of the job advertisements at our disposal include detailed information on:

- › the job title;
- › particular educational and skills requirements; and
- › other information on the advertised/vacant position, such as geographical location (federal state, district), date of issuance, the company (company name and activity), type of job (full time, part time), salary,² benefits/perks offered, working conditions, etc.

Information on educational and skills requirements is particularly rich, as employers want to make sure that candidates with the right kind of knowledge, skills and expertise in specific fields relevant to the position are identified and apply for the position. Furthermore, there are detailed descriptions of behavioural personal attributes and soft skills/personality traits that are regarded as desirable and that add value to the formal skills; these are intended to attract those candidates who best fit the organisational profile, team, work environment and job requirements.

Moreover, job advertisements capture the skills language of businesses today – including language on 'soft skills' – and make it possible to shed light on important labour market dynamics, such as new and emerging occupations or the match/mismatch of labour supply and labour demand (Shapiro, 2014; Damarin, 2006).

Job vacancy data are, however, also subject to certain limitations. For instance, such data are, by their very nature, incomplete for a number of reasons. First, not all job openings are posted online: for instance, specialists and executives may be headhunted. For some jobs (such as waiters) notes in windows are often used, while for other jobs employers prefer internal recruitment or word of mouth, and they may approach potential candidates direct (such as young people in schools or universities).

² In Austria, it has been mandatory since March 2011 to state the minimum wage available in every job advertisement.

Carnevale et al. (2014) estimate for the USA that, in 2014, between 60% and 70% of job openings were posted on the internet. Since then, of course, more hiring has moved online. Similarly, according to Cedefop (2019), the share of vacancies published online in the EU ranges widely, from around 50% in Greece, Portugal and Romania to close to 100% in Estonia, Finland and Sweden.

Second, job advertisements do not always state all the skills and qualifications required for a position.

Third, job advertisements are not standardised: as employers create their own advertisements, these can vary greatly, which complicates the identification and parsing process.

Fourth, vacancies do not necessarily correspond to a real job opening, as employers often place 'ghost vacancies' to test the market or to gather a reserve list of resumes and CVs from suitable candidates.

Finally, such data are subject to selection, since particular websites and online platforms could attract specific users, and that affects data representativeness (Carnevale et al., 2014). This, of course, has an impact on the generalisability of results. Several approaches have been taken in this line of literature to adjust/reweight data from online job portals to improve their representativeness (see, for example, Van Ours and Ridder, 1992; Martikainen, 2010). However, by and large the process has proved very time and resource consuming, and the results have hardly been satisfactory, sometimes actually leading to less-consistent results. However, as emphasised by Kureková et al. (2014), due to the difficulties in identifying the structure of the population of vacancies – there is always a proportion of vacancies that are never publicly advertised – the adjustment of online job vacancy data by reweighting is not really possible. Instead, those authors suggest using job advertisements from an established portal – a requirement which *karriere.at* clearly fulfils – and interpreting the results with caution, in order to avoid potential biases.

4.2. DATA SOURCE

The data used in this study come from the largest online job portal in Austria – *karriere.at*, which was founded in 2004 and has been operating since 2005. Currently, the company has more than 180 employees in its two offices in Linz and Vienna. *karriere.at* is the market leader in online recruitment for professional and managerial workers, and therefore caters more to job seekers at the upper end of the skills hierarchy. It is the job portal with the greatest online reach in Austria, having acquired 80% brand recognition with more than 4.9 million visitors and over 30 million page views each month (GfK Austria 3/2019; Google Analytics 1/2019). The company has a wide strategic network, with around 50 partners in online and offline areas. It also has a far-reaching regional network, and for the purpose of maximum reach, it cooperates with over 600 Austrian municipalities to place job advertisements on municipality websites.³

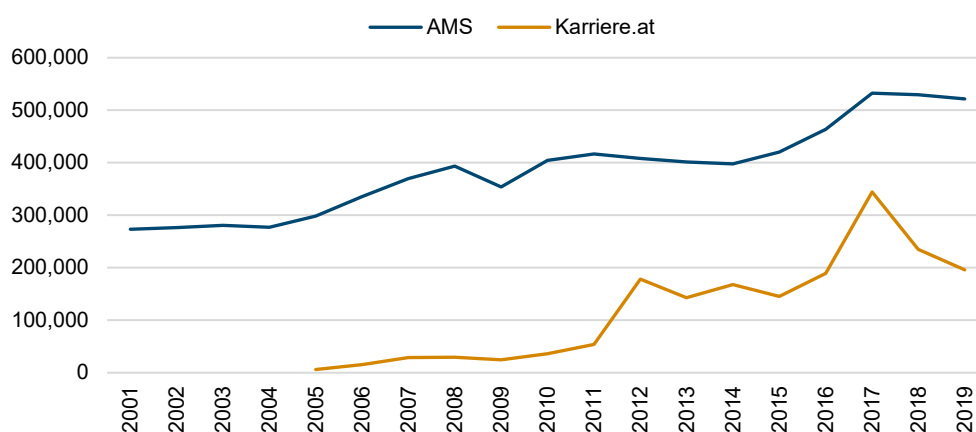
For the purposes of our analysis, *karriere.at* provided job advertisements that have been posted on its platform since it started operating in 2005 – over 1.5 million over the past 15 years. This long time series

³ *karriere.at* has an extensive portfolio of services. Applicants are able to create a CV with *karriere.at* quickly and easily, and companies can find the best candidates in the *talent.cloud* database with just a single click. The *talent cloud* is extensive and is growing rapidly, with around 2,500 new profiles per week. Additional services, such as *bewerber.manager* and the *One-Click-Application*, are included for all clients. It also offers several additional information services, such as *karriere.blog*, *karriere.at* podcasts, *karriere.tipps* for employees or *hr.tipps* for employers.

of job advertisements is of particular relevance, as it allows us to shed light on longer-term trends and developments from the past which can be extrapolated into the future to help identify future skills needs. In our analysis, however, we do not differentiate by particular occupation (or job title),⁴ but instead provide an overall picture of Austrian employers' skills requirements between 2008 and 2019.

Figure 1 depicts for the period 2005-2019 the development of the total number of job vacancies that were posted at karriere.at, in comparison to those registered at AMS. It reflects the important role played in Austria by the AMS, whose registered job vacancies number two to three times more than have been posted at karriere.at (particularly after 2011). As concerns karriere.at, the number of job vacancies has increased steadily since it started operating in 2005. Between 2011 and 2012, the number of job vacancies increased substantially following the merging of the job databases of karriere.at and a subsidiary. From then on, trends in job vacancies at karriere.at and AMS have been similar, and observable fluctuations reflect labour market trends in the post-crisis period, characterised by slow GDP growth until 2015/2016 and thereafter an increase in growth, coupled with an improvement in the labour market.

Figure 1 / Number of job vacancies at AMS and karriere.at



Source: karriere.at and labour market data online (<http://iambweb.ams.or.at/ambweb/>).

4.3. CATEGORISATION OF SKILLS AND ABILITIES: A TAXONOMY

For the purposes of this study, we developed a taxonomy based on a categorisation of those skills and abilities most often requested by employers in job advertisements (see Table 1 below for an overview and Table A.1 in the Annex for the equivalents in German). We did not include every possible skill or personality trait requested, but selected from each category a few that appeared most frequently during a pre-screening analysis of job advertisements. The pre-screening analysis was based on all job advertisements at our disposal, in order to avoid any potential year-specific bias and to guarantee that the skills language of businesses (which may change in the course of 15 years) is correctly reflected in our taxonomy. Those skills and personality traits that appeared most frequently were then selected and categorised, with the aim of including a broad range of relevant skill types.

⁴ This will be addressed in future research.

Table 1 / Categorisation of skills and abilities

Skill category	Particular types of skills	
<i>Digital skills</i>	Generic and specific ICT skills	
<i>Cognitive skills</i>	Formal degrees gained through full-time study Specialised training	
<i>Cognitively based skills</i>	Language skills	Problem-solving skills
	Driving skills	Presentation skills
	Ability to learn	Analytical skills
	Willingness to learn	Numerical skills
<i>Non-cognitive skills</i>	Extraversion	
	Communication skills	Enthusiasm
	Service skills	Persuasive skills
	Customer approach	Persistence
	Charisma	
	Empathy	
	Agreeableness	
	Flexibility	Ability to work in a team
	Willingness to cooperate	Etiquette
	Conscientiousness	
	Doer	Motivation
	Ambition	Organisational skills
	Initiative	Punctuality
	Commitment	Sense of structure
	Determination	Responsibility
	Engagement	Reliability
	Accuracy	Goal orientation
	Willingness to perform	
	Emotional stability	
	Resilience	Ability to deal with conflict
	Perseverance	
	Openness to experience	
	Independence	Individual responsibility
	Creativity	Innovativeness
<i>Experience</i>	Previous work experience	
<i>Physical appearance</i>	Pleasant physical appearance	
<i>Other</i>	References	Willingness to travel
	No criminal record	Willingness to work overtime
	Own car	Willingness to work weekends/shifts
	Non-smoker	

We group individual skills broadly into four groups: (1) digital skills, (2) cognitive skills, (3) cognitively based skills, and (4) non-cognitive skills.

Digital skills have become increasingly important as a result of the ongoing digital revolution and the associated increase in the use of digital technologies at work. As a result, workers across an expanding range of occupations have to develop and acquire new ICT skills along two lines. First, they need to acquire *generic* ICT skills to be able to use such new technologies in their daily work, e.g. access information online or use software. Second, the production of ICT products and services – software, web pages, e-commerce, cloud and big data – requires workers (ICT specialists) to acquire *specific* ICT skills to write programs, develop applications and manage networks (OECD, 2016). This differentiation into generic and specific ICT skills is also apparent in our

job advertisements, which demand generic ICT skills in terms of, for instance, general IT knowledge, computer literacy and knowledge of office software (MS Office, Word, Excel and PowerPoint), as well as specific ICT skills in terms of, for instance, specific programs, hardware and software skills and know-how.

Cognitive skills are typically associated with intelligence and a general mental capability involving reasoning, problem solving, planning, abstract thinking, the ability to grasp complex ideas and learn from experience (Gottfredson, 1997). Since cognitive skills are considered the best predictor of job performance, they are of key importance to employers. We use formal education and specialised (but still formal) training as a proxy for cognitive skills.

Furthermore, employers often request particular skills that are *cognitively based* or related to learning efforts in a formalised learning process. In this context, we categorise as cognitively based or acquired skills such things as language skills (good spoken and written command of German, English, other languages), driving skills (driver's licence B, C, CE, F, or for other machines, such as forklifts, cranes, etc.), ability to learn, willingness to learn, problem-solving skills, presentation skills, analytical skills and numerical skills.

Non-cognitive skills – often also referred to as ‘soft skills’ – capture personal characteristics, personality traits and attitudes which directly or indirectly affect productivity and are therefore valued in the labour market and important for labour market outcomes (see, for example, Kuhn and Weinberger, 2005; Lundin et al., 2019; Mueller and Plug, 2006; Heineck, 2011; Nyhus and Pons, 2011; Lindqvist and Vestman, 2011). Hence, such skills are often explicitly requested in job advertisements. To categorise non-cognitive skills, we follow Kureková et al. (2016) and expand their categorisation, based on the well-established five-factor model (FFM) which differentiates between extraversion, agreeableness, conscientiousness, emotional stability and openness to experience as the most universal traits (Costa and McCrae, 1992).

Extraversion is typically thought to consist of sociability. Judge et al. (1999: 624) emphasise that ‘extraverts tend to be socially oriented (outgoing and gregarious), but also are surgent (dominant and ambitious) and active (adventuresome and assertive)’. In our taxonomy, communication skills, service skills, customer approach, charisma, empathy, enthusiasm, persuasive skills and persistence all refer to this category.

Agreeableness generally describes how people relate to one another. It is indicated in empathic, sympathetic and kind behaviours, and agreeable persons are thought to be cooperative (trusting of others and caring) and likeable (good natured, cheerful and gentle). We use flexibility, willingness to cooperate, openness, etiquette and ability to work in a team as measures in our taxonomy.

Conscientiousness refers to an individual's sense of responsibility and duty, as well as foresight. In terms of labour-related skills, conscientiousness refers to a worker's ability and willingness to work hard, be disciplined, dutiful, responsible, organised and achievement oriented. It has been shown to be a useful predictor of job performance (see, for example, Judge et al., 1999 for references), and therefore important to employers. In our taxonomy, being a doer, ambition, initiative, commitment, determination, engagement, accuracy, willingness to perform, motivation, organisational skills, punctuality, sense of structure, responsibility, reliability and goal orientation all fall within this category.

Emotional stability refers to the degree to which a person is stable, stress resistant, relaxed and calm (as opposed to unstable, prone to stress, impulsive, anxious, tense and irritable). In our taxonomy, resilience, ability to deal with conflict, and perseverance fall into this category.

Openness to experience indicates an individual's inquisitiveness, reflectiveness, and need and preference for intellectual stimulus and change, but also unconventionality in terms of being unusual, imaginative, creative, autonomous and nonconforming. We use individual responsibility, innovativeness, creativity and independence as measures for this category.

Finally, we also include previous work experience, physical appearance and other factors, such as references, no criminal record, own car, non-smoker, willingness to travel, willingness to work overtime and willingness to work weekends/shifts, which frequently appear in job advertisements and are shown to be of importance for labour market outcomes and employer selection (see, for example, Nunley et al., 2016; Hamermesh and Biddle, 1994; Parrett, 2015; Schmitt and Warner, 2010; Agan and Starr, 2017; Prochaska et al., 2016).

Generally, as shown in Figure A.1 in the Annex, our skills taxonomy performs well: around 97% of all job advertisements mention at least one of the seven broad skill categories, and around 75% list at least two. Hence, it is comprehensive enough to cover the bulk of skills and characteristics mentioned in all advertisements.

4.4. INDICATORS

To capture employers' skills demands, a simple statistical tool is used: the frequency with which particular skills (i.e. corresponding keywords) appear in the text. Such skill frequencies are expressed in relative terms: the share of job advertisements in which a specific skill is explicitly demanded out of the total number of job advertisements.

4.5. DATA PROCESSING

To arrive at a list of skills that are required for a given job advertisement, we had to undertake a number of steps. Unfortunately, the texts of the job advertisements have different character encodings, some of which are incorrect. In view of this, we harmonised the texts by converting all to UTF-8 encoding and corrected wrong encodings (e.g. converting 'Ã¶' to 'ö', 'Ää' to 'ä', among many others). Furthermore, we removed any erroneous non-alphanumeric characters and converted all characters that were used as bullet points (such as *, >, ▪ and others) into a hyphen.

We then identified the language of the cleaned job advert requirements, using Google's Compact Language Detector 2;⁵ we found that 97% of all job advertisement texts were German. Among the other 18 languages that were detected, we found English texts (at 2%, the second largest share of languages) and Hungarian texts (0.02%, the third largest share). For the next steps, we only considered those job advertisements with German texts.

⁵ See Ooms and Sites (2017) for details of the implementation.

Subsequently, we removed common German ‘stop words’, such as *und*, *aber*, *der*, *die*, *das* and several others from the texts. As these stop words do not add to our understanding of the texts, they can be deleted without any loss of information.

Skills requirements often appear as bullet lists in the text. We separated a bullet list into its parts, in order to gain a more structured idea of the skills required. The resulting job requirements were then separated into n-grams: 1-grams, 2-grams, 3-grams and 4-grams. N-grams are *n* subsequent words in a text: for example, the sentence ‘the brown fox jumps over the lazy dog’ contains the following six 3-grams: ‘the brown fox’, ‘brown fox jumps’, ‘fox jumps over’, ‘jumps over the’, ‘over the lazy’, ‘the lazy dog’. Thus, one can think of a 3-gram as a phrase which contains exactly three words.

We then sorted the n-grams by the number of times they appeared in all texts, and kept only the 1,000 most frequently used n-grams. For example, the three most frequently used 3-grams are: *abgeschlossene kaufmännische Ausbildung* (which appears around 91,000 times in the over 1.5 million job advertisements at our disposal), *abgeschlossene technische Ausbildung* (which appears around 83,000 times) and *Englischkenntnisse Wort Schrift* (which appears around 82,000 times).

We used these lists of n-grams as the basis for our skills classification. For this purpose, we identified from the list of 1-grams the relevant keywords/skills and broadly categorised them into digital skills, cognitive skills, cognitively based skills, non-cognitive skills, experience, physical appearance and other. Next, we identified keywords which refer to similar skills and put them together into one skill name. For instance, as can be seen in Table A.2 in the Annex, *beharrlich*, *hartnäckig*, *durchsetzungsstark*, *durchsetzungsfähig* and *durchsetzungsgeschickt*, as well as the related nouns *Beharrlichkeit*, *Hartnäckigkeit*, *Durchsetzungskraft*, *Durchsetzungsvermögen*, *Durchsetzungsgeschick* and *Durchsetzungskompetenz* all refer to the same personality trait – a person’s persistence – and were therefore classified as such. As a result, the initial comprehensive list of skills was narrowed down. This categorisation was then further refined to differentiate within these broad categories those clusters or groups of skills that capture similar aspects. This was particularly the case for the broad and comprehensive group of non-cognitive skills, which, following the five-factor model, was further split into the following: extraversion, agreeableness, conscientiousness, emotional stability and openness to experience. As a result of this process, we ended up with a list of keywords (i.e. skills) for each of the broad categories, as well as for each of the five factors of non-cognitive skills. We then merged all n-grams into a single list and alphabetically ordered all the n-grams. Finally, we used the full list of relevant keywords/skills, and by means of word search systematically went through the whole list of n-grams and extracted the relevant ones. The resulting classification contains almost 5,500 n-grams (from 1-grams to 4-grams), which were classified into 54 individual skills, 11 skill types⁶ and seven skill categories⁷ (see Table 1 above).

In the next step, we iterated over all 54 skills to see if any of the associated n-grams could be found in a given job advertisement. We used an n-gram as a regular expression, where any non-Latin characters (such as ä, ö or ü) were replaced by wildcards. Wildcards can be matched to any single character, which

⁶ The 11 skill types partly overlap with the seven skill groups, but – following the five-factor model – further differentiate non-cognitive skills in terms of extraversion, agreeableness, conscientiousness, emotional stability and openness to experience.

⁷ The seven skill groups are ICT skills, cognitive skills, cognitively based skills, non-cognitive skills, experience, appearance and other.

makes the searching process more flexible. For example, if the character 'ä' in the word *Tätigkeit* is replaced with a wildcard character, it will match both the words *Taetigkeit* and *Tätigkeit*. Thus, we can match different spellings of the same word with one search term. If we found a positive match, we considered the skill to be present and set the skill variable for that job advertisement to 1. This gave us a simple dummy variable that indicated in which job advertisement a certain skill was requested.

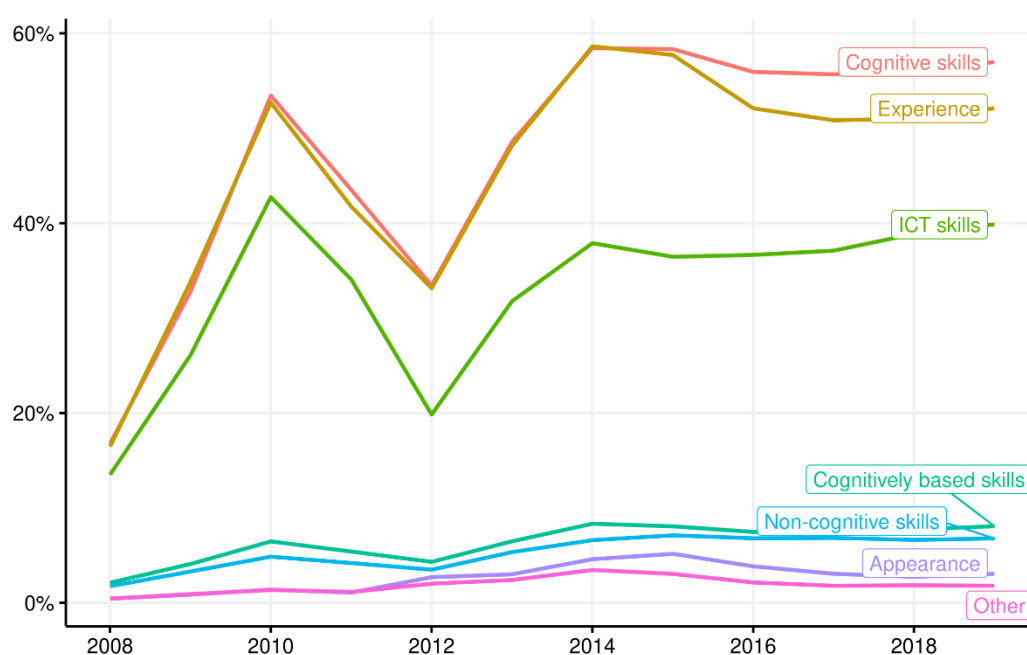
The 54 individual skills were then aggregated to the aforementioned 11 skill types, by taking the average over all skills in a given skill type. Similarly, the skill types were then aggregated to the seven skill categories, by taking the average over all skill types in a particular skill category.

5. Findings

The results of the analysis are presented in Figures 2 to 5 below for different skill categories and types. Each figure shows the skill frequency – in terms of the share of job advertisements where a particular skill was explicitly requested – between 2008 and 2019.

Figure 2 depicts, for the period 2008-2019, the relative importance in job advertisements of the seven broad skill categories (as defined in Table 1 above). Generally, it shows that, of the seven skill categories considered, cognitive skills (as captured by formal education and specialised training), previous work experience and (generic and specific) ICT skills were the three most important, irrespective of the year considered. Furthermore, these three skill categories have become increasingly important over the years. In 2008, around 18% of job advertisements required some cognitive skills or previous work experience. Over the years, this number more than tripled, so that by 2019 every second job advertisement requested some cognitive skills or previous work experience. A similar, albeit less pronounced, upward trend is also observable for ICT skills: in 2008, around 15% of all job advertisements requested these, whereas by 2019 the figure was around 40%. This increased demand for ICT skills is a result of the ongoing digital transformation and the greater use of all kinds of digital technologies in the workplace. Furthermore, the correlation plot of all seven broad skill categories (see Figure A.2 in the Annex) shows that the three most frequently requested skill categories are positively correlated, suggesting that employers tend to expect that their (future) employees should possess all three of the most important skills.

Figure 2 / Share of job advertisements requesting skills: by broad skill categories (in %)



Source: karriere.at, own calculations.

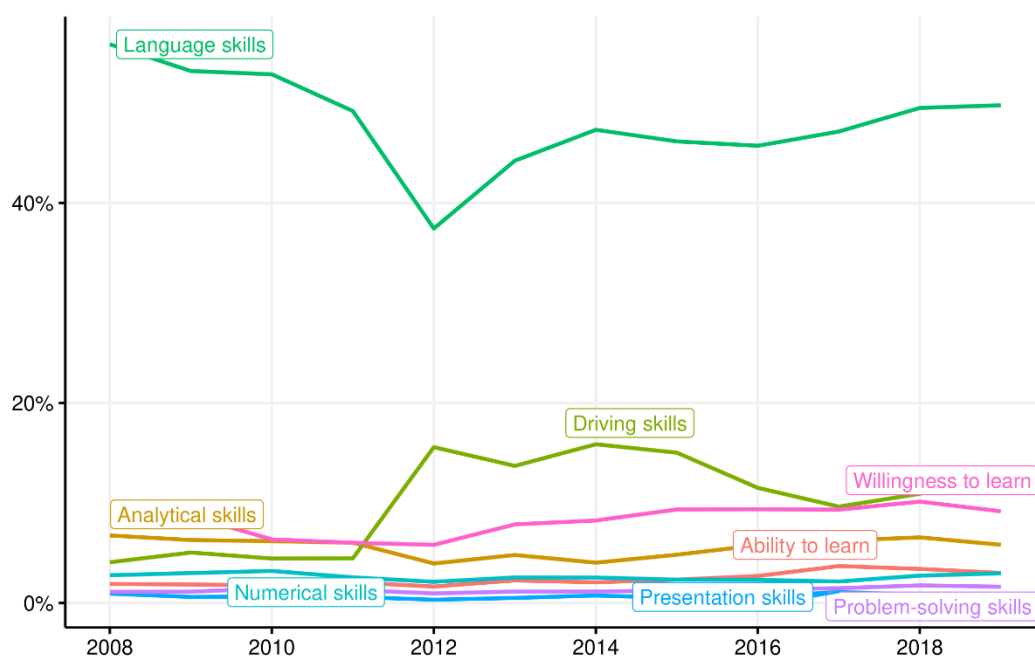
By contrast, the remaining skill categories were generally of lesser importance and also saw much more moderate upward trends (if any at all). In 2019, only around 10% of all job advertisements requested some sort of cognitively based skills or non-cognitive skills, while appearance and other characteristics were only mentioned in around 5% of all job advertisements.

Figure 2 also shows that the demand for certain skills fluctuates over the years, with a stronger dip between 2010 and 2014 and some levelling-off and stabilisation thereafter, particularly among the top three most important and most frequently requested skill categories. This dip may be indicative of a generally lower demand for more highly skilled workers between 2010 and 2014.

Figures 3-5 take a closer look at the three large and comprehensive skill categories of cognitively based skills (Figure 3), non-cognitive skills (Figure 4) and other skills (Figure 5), all as specified in Table 1 above. It shows which of the particular skills within each of these three categories employers value and demand the most.

Figure 3 depicts the relative importance of the various skills that are categorised as cognitively based skills in Table 1. It shows that language proficiency (i.e. written and spoken German/English or other languages) is the single most important cognitively based skill. Except for a short-term dip in 2012, language skills were demanded in every second job advertisement between 2008 and 2019.

Figure 3 / Share of job advertisements requesting skills: by particular cognitively based skills (in %)



Source: karriere.at, own calculations.

The remaining cognitively based skills were of much less importance and appeared in under 20% of all job advertisements. Of the remaining cognitively based skills, driving skills and willingness to learn were the two most important, appearing in around 10% of all job advertisements in 2019. Both types of skills

also gained in importance and were more frequently demanded over the years. But driving skills stand out: demand for these tripled from 5% of all job advertisements in 2008 to 15% between 2012 and 2015, before falling back to around 10% in 2019. The correlation matrix for all individual skills shows that driving skills correlate positively with people having a car of their own; this may indicate that employers expect not just that their employees should have driving skills, but also that they should use their private cars either to reach their workplace or to use on the job (see Figure A.4 in the Annex).

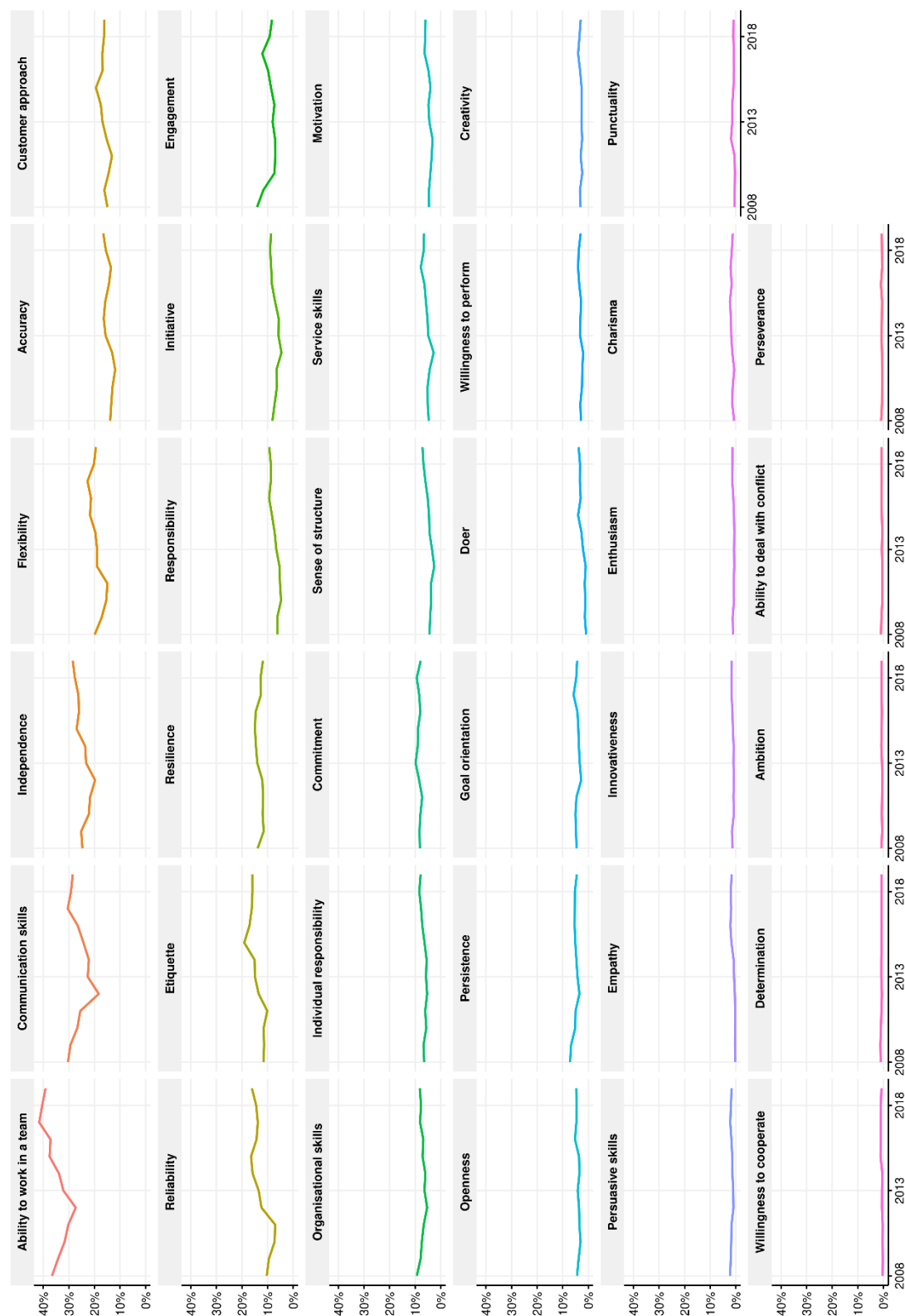
By contrast, ability to learn, numerical skills, problem-solving skills and presentation skills were the least important cognitively based skills, appearing in only 2-5% of all job advertisements.

The relative importance of the various non-cognitive skills (as listed in Table 1 above) is shown in Figure 4 below (ranked in descending order of importance in 2019). The figure shows that ability to work in a team, communication skills, independence, flexibility, accuracy and customer approach are the six most frequently requested 'soft' skills. Ability to work as part of a team is the single most important, appearing in 40% of all job advertisements; it is followed by communication skills and independence, which were requested in every third job advertisement. Flexibility appeared in every fifth job advertisement, while accuracy and customer approach were sought in every seventh to eighth job advertisement. Seen in the context of the five-factor model, the six most frequently requested non-cognitive skills relate to four of the five factors; this may suggest that employers tend to look for workers with well-balanced non-cognitive skills (see Figure A.3 in the Annex for a graphic representation according to the five factors). However, Figure A.4 in the Annex shows that the correlation between the six most important non-cognitive skills is negligible, which implies that employers tend to seek employees with very specific non-cognitive skills, rather than with a broader mix.

Interestingly, apart from some minor fluctuations over the years, the six most important non-cognitive skills show little, if any, trend behaviour, which suggests that they have neither lost nor gained importance for employers over the years. However, some other non-cognitive skills have become increasingly important to employers. For instance, reliability appeared in only around 10% of all job advertisements in 2008, but by 2019 the figure was 16%. Similarly, sense of structure doubled, from 4% in 2008 to 8% in 2019. Conversely, the frequency of persistence in job advertisements almost halved – from around 7% in 2008 to only 4% in 2019.

By contrast, willingness to cooperate, determination, ambition, ability to deal with conflict and perseverance were consistently the five least important non-cognitive skills, appearing on average in only 1% of all job advertisements between 2008 and 2019.

Figure 4 / Share of job advertisements requesting skills: by non-cognitive skills (in %)

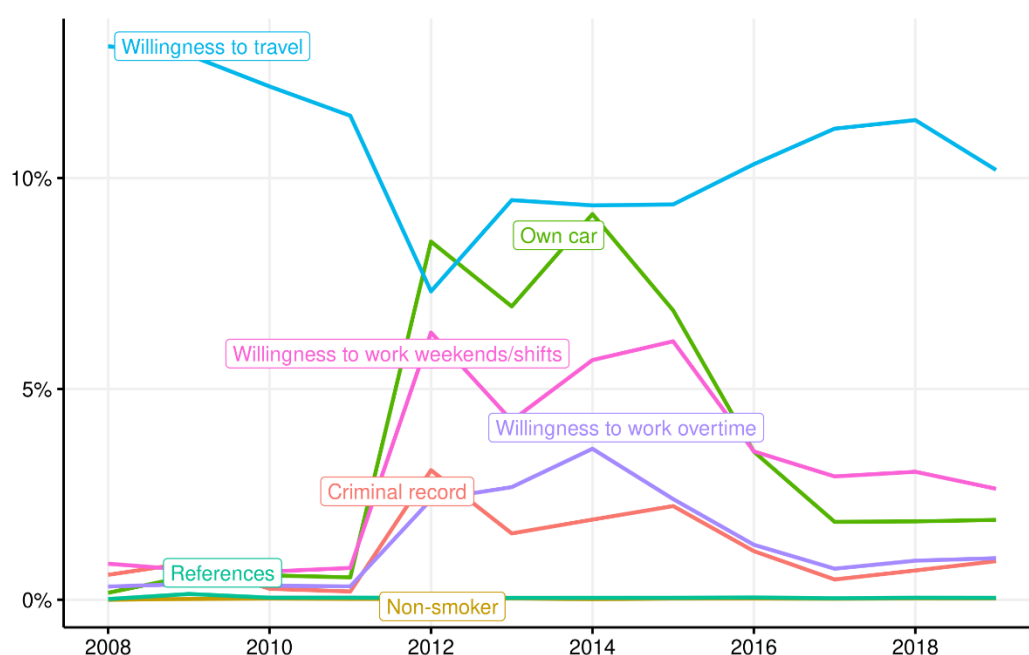


Source: karriere.at, own calculations.

Finally, Figure 5 shows the frequency with which other factors appear in job advertisements. It shows that willingness to travel is the single most important other factor, which initially appeared in around 15% of all job advertisements in 2008, but in only around 10% in 2019. Furthermore, owning a car and willingness to work overtime or weekends/shifts are also of importance to some employers (in particular occupations only).

By contrast, being a non-smoker and providing references were of little importance to employers. Both appeared in only around 1% of all job advertisements.

Figure 5 / Share of job advertisements requesting skills: by other skills (in %)



Source: karriere.at, own calculations.

6. Summary and conclusion

This paper uses detailed information from over 1.5 million job advertisements from Austria's largest online job portal (karriere.at) to analyse employers' skills needs and the relative importance of, and demand for, different skill types between 2008 and 2019. Online job advertisements are ideal for this analysis: since employers who post job vacancies on websites do not pay by the word, they are more explicit about the particular knowledge, skills and expertise they require of their future employees, as well as about the personal attributes and soft skills/personality traits they are looking for.

We developed a taxonomy to categorise the most frequent skills and personality traits found in job advertisements and differentiated between seven categories: ICT skills (to account for the increasing use of digital technologies at work), cognitive skills (proxied by formal education and specialised training), cognitively based skills (which are associated with learning efforts in a formalised learning process), non-cognitive skills (also referred to as soft skills), previous work experience, physical appearance and other factors which often appear in job advertisements (such as no criminal record, references or willingness to travel, work overtime or weekends/shifts).

The results demonstrate that Austrian employers are quite demanding and request a diverse set of skills from would-be employees. Cognitive skills (i.e. formal education), previous work experience and ICT skills are most frequently required by employers, who also expect their (future) employees to possess all three of the top categories. Over the past 15 years, these three skill categories have become increasingly important to Austrian employers: the frequency with which job advertisements stipulated cognitive skills or previous work experience more than tripled between 2008 and 2019, while the demand for ICT skills more than doubled (from around 15% to around 40%). Hence, in 2019, the top three skill categories appeared in every second job advertisement. Austrian employers also attach great importance to language skills (i.e. proficiency in written and spoken German/English or other languages): this requirement also appeared in every second job advertisement. Finally, among the broad set of non-cognitive (soft) skills analysed, employers most frequently sought an ability to work in a team, communication skills, independence, flexibility and accuracy; but they ascribed little importance to determination, ambition, ability to deal with conflict, and perseverance.

Our results have important policy implications: they point to the strong and increasing importance of formal education, language skills and ICT skills, which have become a prerequisite in ever more occupations. Hence, to prevent skills gaps and mismatches, education and training systems need to be adjusted to the growing need for formal education in general – and for ICT skills in particular – to ensure that people acquire the skills that employers are increasingly demanding.

In ongoing research, we make use of the (self-assigned) industry affiliation of the firm, so that we can break the trends down according to industry. Furthermore, there are two more dimensions that we will explore: using text-based machine learning algorithms, we will sort the given job titles into the ISCO classification, and assign a geographical location to each firm (based on the address and other geographical information given in the texts). This will allow us to monitor ongoing trends in more detail and to gain fresh insights into occupation-specific and regional differences and developments in employers' skills requirements in the Austrian labour market.

7. Annex

Table A.1 / Categorisation of skills and abilities in English and German

Skill category	Skill type (in English)	Skill type (in German)
<i>Digital skills</i>	ICT skills	IKT Fähigkeiten
<i>Cognitive skills</i>	Formal degrees gained through (full-time) study	Formale Abschlüsse
	Specialised training	Spezielle Ausbildung/ Fachausbildung
<i>Cognitively based skills</i>	Language skills	Sprachfähigkeiten
	Driving skills	Fahrfähigkeiten
	Ability to learn	Auffassungsvermögen
	Willingness to learn	Lernbereitschaft
	Problem-solving skills	Problemlösungsfähigkeiten
	Presentation skills	Präsentationsfähigkeiten
	Analytical skills	Analytische Fähigkeiten
	Numerical skills	Numerische Kompetenzen
<i>Non-cognitive skills</i>	Communication skills	Kommunikationsfähigkeiten
	Service skills	Dienstleistungsfähigkeiten
	Customer approach	Kundeneinstellung
	Charisma	Ausstrahlung
	Empathy	Empathie
	Enthusiasm	Begeisterungsfähigkeit
	Persuasive skills	Überzeugungsfähigkeit
	Persistence	Beharrlichkeit
	Flexibility	Flexibilität
	Willingness to cooperate	Kooperationsbereitschaft
	Openness	Offenheit
	Ability to work in a team	Teamfähigkeiten
	Etiquette	Umgangsformen
	Doer	Anpacker
	Ambition	Ehrgeiz
	Initiative	Eigeninitiative
	Commitment	Einsatzbereitschaft
	Determination	Zielstrebigkeit
	Engagement	Engagement
	Accuracy	Genauigkeit
	Willingness to perform	Leistungsbereitschaft
	Motivation	Motivation
	Organisational skills	Organisationsfähigkeit
	Punctuality	Pünktlichkeit
	Sense of structure	Strukturiertheit
	Responsibility	Verantwortungsbewusstsein
	Reliability	Zuverlässigkeit
	Goal orientation	Zielorientiertheit
	Perseverance	Ausdauer
	Resilience	Belastbarkeit
	Ability to deal with conflict	Konfliktfähigkeit
	Independence	Unabhängigkeit
	Creativity	Kreativität
	Individual responsibility	Eigenverantwortung
	Innovativeness	Innovationskompetenz
<i>Experience</i>	Previous work experience	Berufserfahrung
<i>Physical characteristics</i>	Pleasant physical appearance	Erscheinungsbild
<i>Other</i>	References	Referenzen
	No criminal record	Leumundszeugnis
	Own car	Eigener PKW
	Non-smoker	NichtraucherIn
	Willingness to travel	Reisebereitschaft
	Willingness to work overtime	Überstundenbereitschaft
	Willingness to work weekends/shifts	Wochenend-, Schichtbereitschaft

Table A.2 / Overview of the most frequent keywords found in online job advertisements

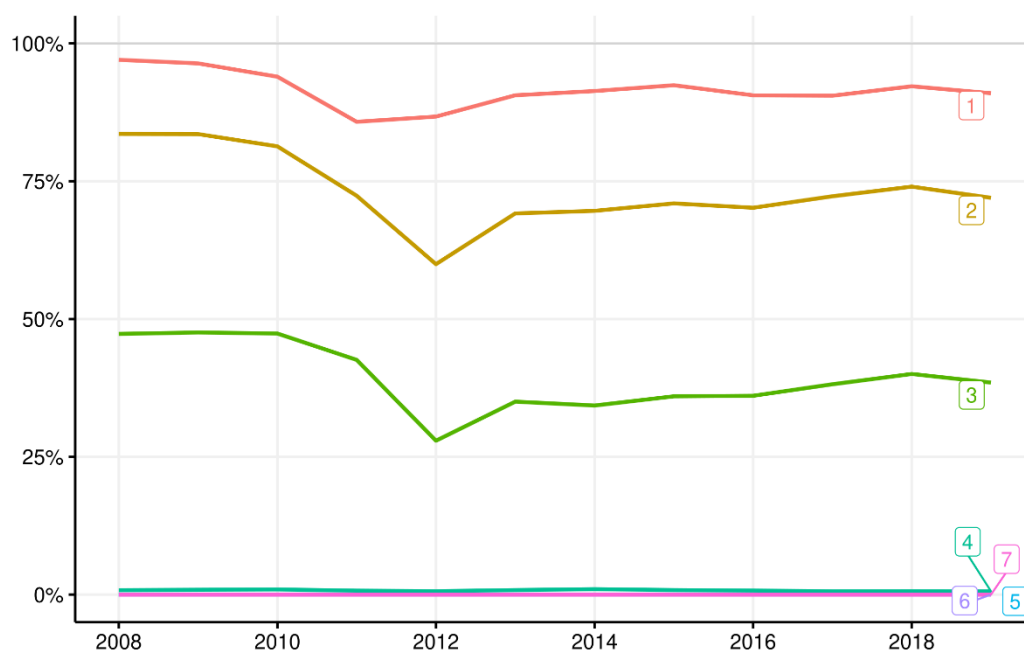
Skill category (in English)	Skill category (in German)	Most frequent keywords (in German)
ICT skills	IKT Fähigkeiten	Allgemein: IT-, Computer-, PC-, EDV-Kenntnisse, MS Office, Word, Excel, PowerPoint Spezielles Knowhow, Erfahrung, Praxis Spezielle Programme/Technologien/Hard- und Software
Formal education	Formale Abschlüsse	Ausbildung, Kurse, Diplome, Abschlüsse, Bescheinigungen
Language skills	Sprachfähigkeiten	Deutsch/Englisch in Wort/Schrift: Basis- oder Schulwissen, Businessniveau, branchen- oder fachüblich verhandlungssicher Andere Sprachen, Fremdsprachen, mehrsprachig
Driving skills	Fahrfähigkeiten	Führerschein: B, C, CE, F Führerschein für andere Geräte: Gabel-/Hubstapler/Stapler, Kran etc.
Ability to learn	Auffassungsvermögen	Auffassungsfähigkeit, Auffassungsgabe
Willingness to learn	Lernbereitschaft	Lernbereit/schaft, lernwillig, Lernwille, Lernwilligkeit Bildungswille/willig, Fortbildungswille, -bereitschaft, -engagement Interesse an/Bereitschaft zu Weiterbildung, Weiterbildungsinteresse, Weiterbildungsaffin/affinität, weiterbildungsbereit/schaft, weiterbildungsfreude/freudigkeit, weiterbildungsmotiviert/heit, weiterbildungswillig/wille Lernbegeistert, lernbegierig, lernhungrig, lernfreudig, Lernfreude/-freudigkeit Wissbegierig, Wissbegier, Wissbegierde
Problem-solving skills	Problemlösungsfähigkeiten	Problemlösungsfähigkeit, -kompetenz, -mentalität, -qualität, -bereitschaft, -vermögen, problemlösungsorientiert/-orientiertheit Troubleshooter/shooting, Troubleshootingkompetenz, -fähigkeit, -erfahrung
Presentation skills	Präsentationsfähigkeiten	Präsentationsfähigkeiten, -fertigkeiten, -skills, -kompetenzen, -stärke/-stark, -talent, -vermögen
Analytical skills	Analytische Fähigkeiten	Analysestärke/stärke, -vermögen, -fähigkeiten, -kompetenzen, analytische Fähigkeiten, analytisches Denken/Denkvermögen
Numerical skills	Numerische Kompetenzen	Zahlenaffin/affinität, Zahlengefühl, -geschick, -talent, -verständnis, zahlenorientiert/heit/orientierung, Zahlengedächtnis, Zahlenmerkfähigkeit
Communication skills	Kommunikationsfähigkeiten	Kommunikativ, Kommunikationsstärke, -kompetenz, (gute, ausgeprägte) -fähigkeiten, -freude, -begabt, -geschick, -gewandt, -sicher, -skills Sprachbegabt, Sprach(en)talent, -gefühl, -gewandt, -fertig Redegewandt, -heit, Ausdrucksfähig, Ausdrucksweise Gesprächig, gesprächssicher, Gesprächskompetenz
Service skills	Dienstleistungsfähigkeiten	Serviceorientiert, -orientierung, -orientiertheit, -denken, serviceaffin, -bereit, Serviceprofi, dienstleistungsorientiert, -bereit, -bewusst, gesinnt, Dienstleistungsfokus, -gedanke, -gesinnung, -mentalität, -kompetenz, -verständnis, -persönlichkeit
Customer approach	Kundeneinstellung	Kunden-/klientenorientiert, Kundenfokus, Freude am Umgang mit Kunden/direkter Kundenkontakt, Kundenkontakt, kundenfreundlich/-heit, kundenbegeistert, kundenbezogen, Kundenbetreuung, Kundenpflege Beratungskompetenz/-talent/-persönlichkeit, -affinität, -fähigkeiten, -leidenschaft, -persönlichkeit Verkaufskompetenz, -talent, -geschick, -gespür, -mentalität, Salestalent, -fähigkeit, verkaufsorientiert Akquise, akquisitionstark, -sicher, Akquisefähigkeit, -geschick
Charisma	Ausstrahlung	Positive, gewinnende Ausstrahlung, Charisma, charmant, sympathisch, Sympathieträger, extrovertiert, Extrovertiertheit
Empathy	Empathie	Empathisch, Empathie, Empathievermögen, -fähigkeit, einfühlsam, Einfühlsamkeit, Einfühlungsvermögen, Einfühlungsvermögen
Enthusiasm	Begeisterungsfähigkeit	Begeisterungsfähig, Begeisterungsfähigkeit, Begeisterungskraft, -potential
Persuasive skills	Überzeugungsfähigkeit	Überzeugend, Überzeugungsfähigkeit, überzeugungsfähig, Überzeugungsgeschick, -kraft, -stärke

Table A.2 / (cont.) Overview of the most frequent keywords found in online job advertisements

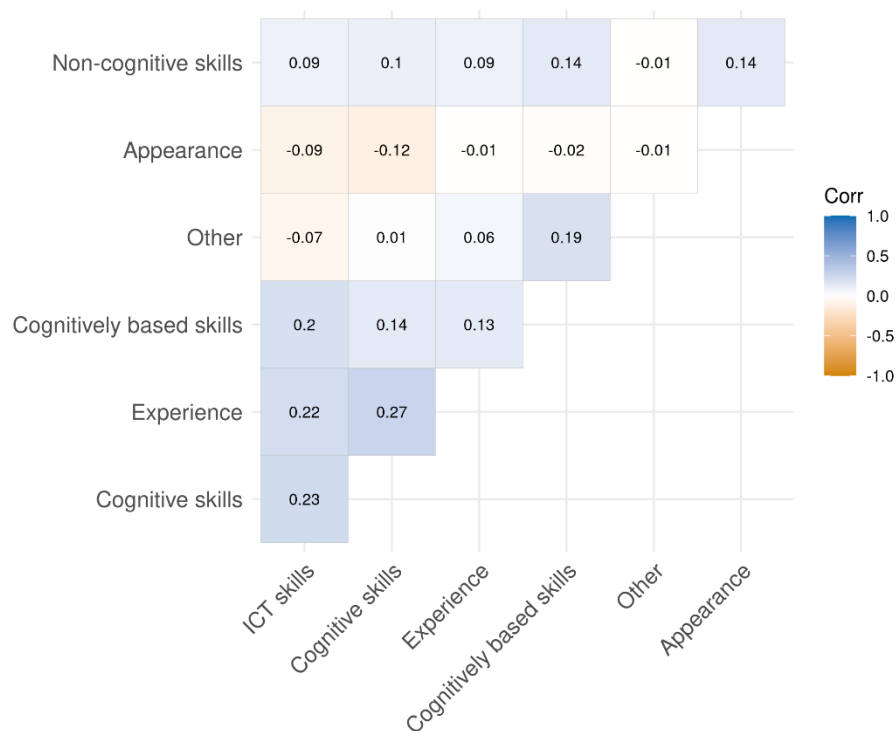
Skill category (in English)	Skill category (in German)	Most frequent keywords (in German)
Persistence	Beharrlichkeit	Beharrlich, Beharrlichkeit, hartnäckig, Hartnäckigkeit, durchsetzungsstark, durchsetzungsfähig, -geschickt, Durchsetzungsvermögen, -kraft, -geschick, -kompetenz
Flexibility	Flexibilität	Flexibel, Flexibilität, flexibel arbeiten
Willingness to cooperate	Kooperationsbereitschaft	Kooperationsbereit/schaft, kooperationsfähig, Kooperationsfähigkeit, kooperativ
Openness	Offenheit	Offen, Offenheit, offene Kommunikation, kontaktfreudig, Kontaktfreudigkeit, Freude am Kontakt, kontaktfreundlich/-freundlichkeit, kontaktstark/-stärke, Kontaktfähig/keit, weltoffen, aufgeschlossen, Aufgeschlossenheit
Team-working skills	Teamfähigkeiten	Teamfähig/-keit, Teamplayer/-worker/-arbeiter/-mensch, Teamgeist, -spirit, teamorientiert/-heit, teambereit/schaft/-bewusstsein, Teamstärke, -treue, kollegial, Kollegialität, gerne im Team arbeiten
Etiquette	Umgangsformen	Gute/ausgezeichnete Umgangsformen Höfliches, gewinnendes, gutes, kompetentes, professionelles, höfliches, selbstbewußtes, selbstsicheres, sicheres, überzeugendes, offenes, souveränes Auftreten Souverän, Souveränität, freundlich/-keit, höflich/-keit, wertschätzendes Miteinander, Wertschätzung, wertschätzendes Verhalten
Doer	Anpacker	Anpacker/-mentalität, hand-son Mentalität/Approach/Einstellung/Bereitschaft/Qualität/Typ, Machertyp, -mentalität
Ambition	Ehrgeiz	Ehrgeizig, fleißig, ambitioniert
Initiative	Eigeninitiative	Eigeninitiativ, Eigeninitiative, proaktiv, proaktive Arbeitsweise, Proaktivität
Commitment	Einsatzbereitschaft	Einsatzbereit, Einsatzbereitschaft, einsatzfreudig, Einsatzfreudigkeit, einsatzwillig, Einsatzwille, arbeitswillig, Arbeitswille, -willigkeit
Determination	Zielstrebigkeit	Zielstrebig, Zielstrebigkeit, entschlossen, Entschlossenheit, Entschlusskraft, -freudig
Engagement	Engagement	Engagement, Eigenengagement, engagiert, engagierte Persönlichkeit, Selbstengagement
Accuracy	Genauigkeit	Genau, Genauigkeit, Arbeitsgenauigkeit, genaue Arbeitsweise/Arbeitsstil, detailaffin, detailgenau, detaillierend, detailorientiert, detailtreu, detailverliebt, sorgfältig, Sorgfältigkeit, Sorgfalt, gründlich, Gründlichkeit, gewissenhaft, Gewissenhaftigkeit, gewissenhafte Arbeitsweise
Willingness to perform	Leistungsbereitschaft	Leistungsbereit/schaft, leistungsfähig, Leistungsfähigkeit, -kompetenz, leistungsorientiert/heit, Mehrleistungsbereitschaft, Leistungsdenken, Leistungsgedanke, leistungswillig, Leistungswille
Motivation	Motivation	Motiviert, Eigenmotivation, selbstmotiviert, Selbstmotivation, Selbstmotivationsfähigkeit, Selbstmotivator, motivationsfähig, motivierbar, Motivationstalent, Motivator, Motivationsvermögen, motivieren, motivierend
Organisational skills	Organisationsfähigkeit	Organisiert/-heit, Organisationstalent, -geschick, -freude, -sinn, -kompetenz, organisationsstark/stärke, organisatorische Fähigkeiten, organisierte Arbeitsweise, organisationsfähig/keit, Organisationsvermögen
Punctuality	Pünktlichkeit	Pünktlich, Pünktlichkeit, Terminpünktlich, termingenau/Termingenauigkeit, termintreu/Termintreue
Sense of structure	Strukturiertheit	Selbstorganisiert, -organisierend, -organisation, -organisationsfähigkeit, strukturiert/heit, strukturierte Arbeitsweise/-stil, Strukturierungsvermögen
Reliability	Zuverlässigkeit	Zuverlässlich, Zuverlässlichkeit, verlässlich, Verlässlichkeit, zuverlässig, Zuverlässigkeit
Responsibility	Verantwortungsbewusst	Verantwortungsbewusst, Verantwortungsbewusstsein, -bereitschaft, verantwortungsvoll, übernehmen gerne Verantwortung, Verantwortungsgefühl, pflichtbewusst, Pflichtbewusstsein
Goal orientation	Zielorientiertheit	Zielorientiert, Zielorientiertheit, Zielorientierung, zielorientierte Arbeitsweise, ergebnisorientiert, ergebnisfokussiert, ergebnisorientierte Arbeitsweise, Ergebnisorientierung, erfolgsorientiert, fokussiert, Erfolgswille, erfolgswillig
Perseverance	Ausdauer	Ausdauernd, Ausdauer, Durchhaltevermögen
Resilience	Belastbarkeit	Belastbar/keit, stressresistent, -beständig, -erprobt, -fähig, -tauglich, -tolerant, -neutral, Stresstoleranz, Zeitdruckresistenz
Ability to deal with conflict	Konfliktfähigkeit	Konfliktfähig, -orientiert, Konfliktorientiertheit, -fähigkeit, Konfliktkultur, -kompetenz, -potential, Konfliktlösungsvermögen, -managementenerfahrung, -fähigkeit, -kenntnisse, -skills
Independence	Selbständigkeit	Selbständig, selbständige Arbeitsweise, selbständig arbeiten/Arbeitsweise/-stil, Selbständigkeit, eigenständig, Eigenständigkeit, eigenständige Arbeitsweise

Table A.2 / (cont.) Overview of the most frequent keywords found in online job advertisements

Skill category (in English)	Skill category (in German)	Most frequent keywords (in German)
Creativity	Kreativität	Kreativ, Kreativität, Kreativitätsvermögen
Individual responsibility	Eigenverantwortung	Eigenverantwortlich, Eigenverantwortung, eigenverantwortliche Arbeitsweise, eigenverantwortliches Arbeiten
Innovativeness	Innovationskompetenz	Innovativ, Innovator, Innovationsfreude/igkeit, -stärke, -verständnis, -gespür, -geist, kraft, -bereit/schaft, ideenreich, Ideenreichtum, Ideenmensch, vordenken, Vordenker, Pioniergeist, -typ, querdenken, Querdenker, Querdenkermentalität, -eigenschaften
Experience	Berufserfahrung	Erfahrung/Berufserfahrung, -praxis gewünscht/vorhanden
Appearance	Erscheinungsbild	Gepflegtes Auftreten, gepflegtes Äußeres, gepflegtes Erscheinungsbild
References	Referenzen	Referenzen, Topreferenzen, Projektreferenzen, Referenzbeispiele
No criminal record	Leumundszeugnis	Leumund/-szeugnis, Führungszeugnis, Strafregisterauszug, unbescholten, Unbescholtenheit, nicht vorbestraft
Own car	Eigener PKW	Eigener PKW/Auto/Fahrzeug/KFZ: von Vorteil/erforderlich
Non-smoker	NichtraucherIn	Nichtraucher/in, Nichtraucherbüro, -arbeits, -platz
Willingness to travel	Reisebereitschaft	Reisebereit/-schaft, reiseaffin, Reisefreude, -lust, -wille, mobil/Mobilität
Willingness to work overtime	Überstundenbereitschaft	Überstundenbereit/-schaft
Willingness to work weekends/shifts	Wochenend-, Schichtbereitschaft	Wochenendarbeit,-sbereitschaft, Wochenenddienste/bereitschaft, Feiertagsdienst, Bereitschaft Schichtdienst, Schicht(dienst)bereitschaft

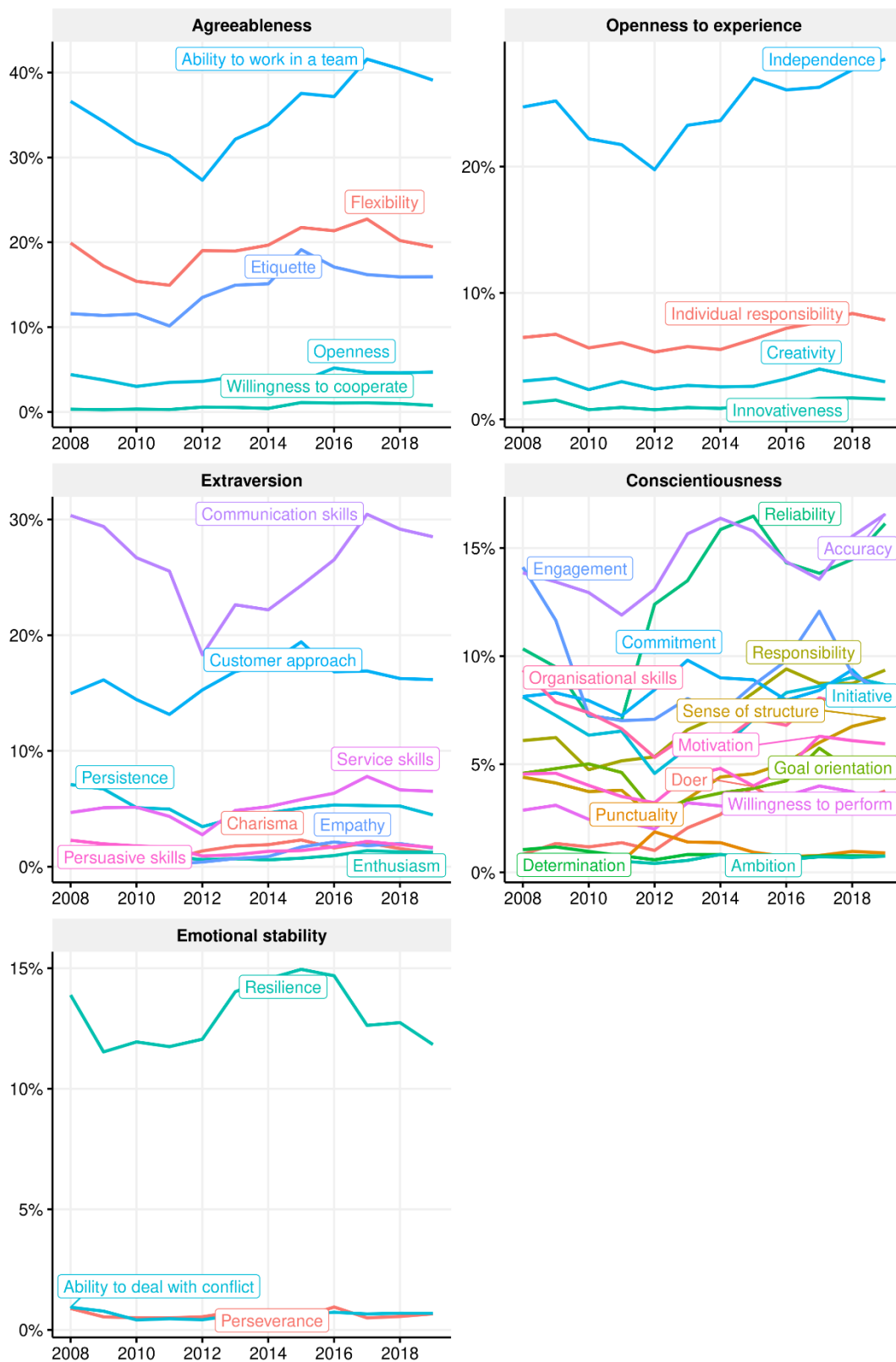
Figure A.1 / Percentage of job advertisements with N different skill categories

Source: karriere.at, own calculations.

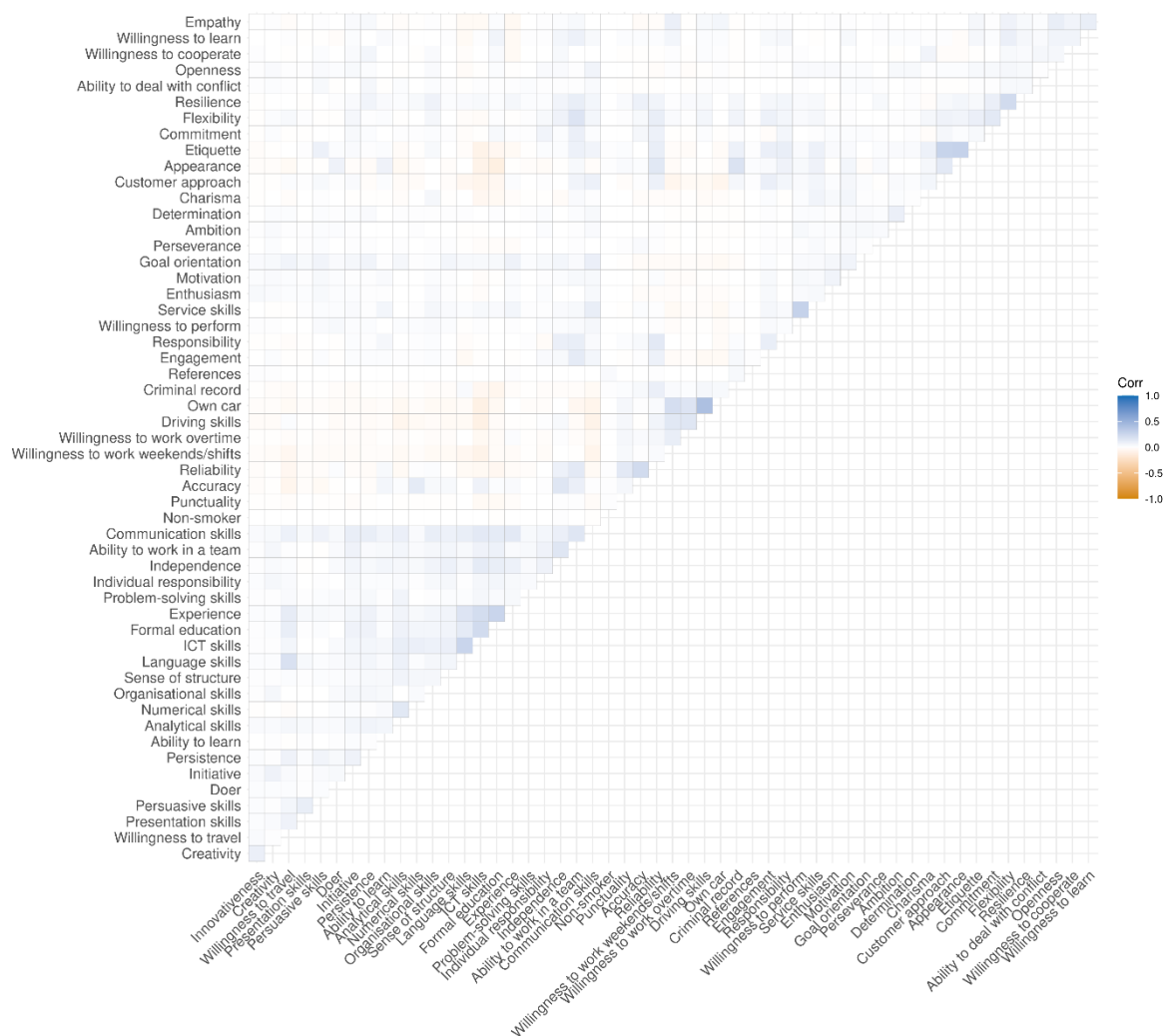
Figure A.2 / Correlation plot of skill categories

Source: karriere.at, own calculations.

Figure A.3 / Share of job advertisements requesting skills: non-cognitive skills by the five factors



Source: karriere.at, own calculations.

Figure A.4 / Correlation plot of all skills

Source: karriere.at, own calculations.

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