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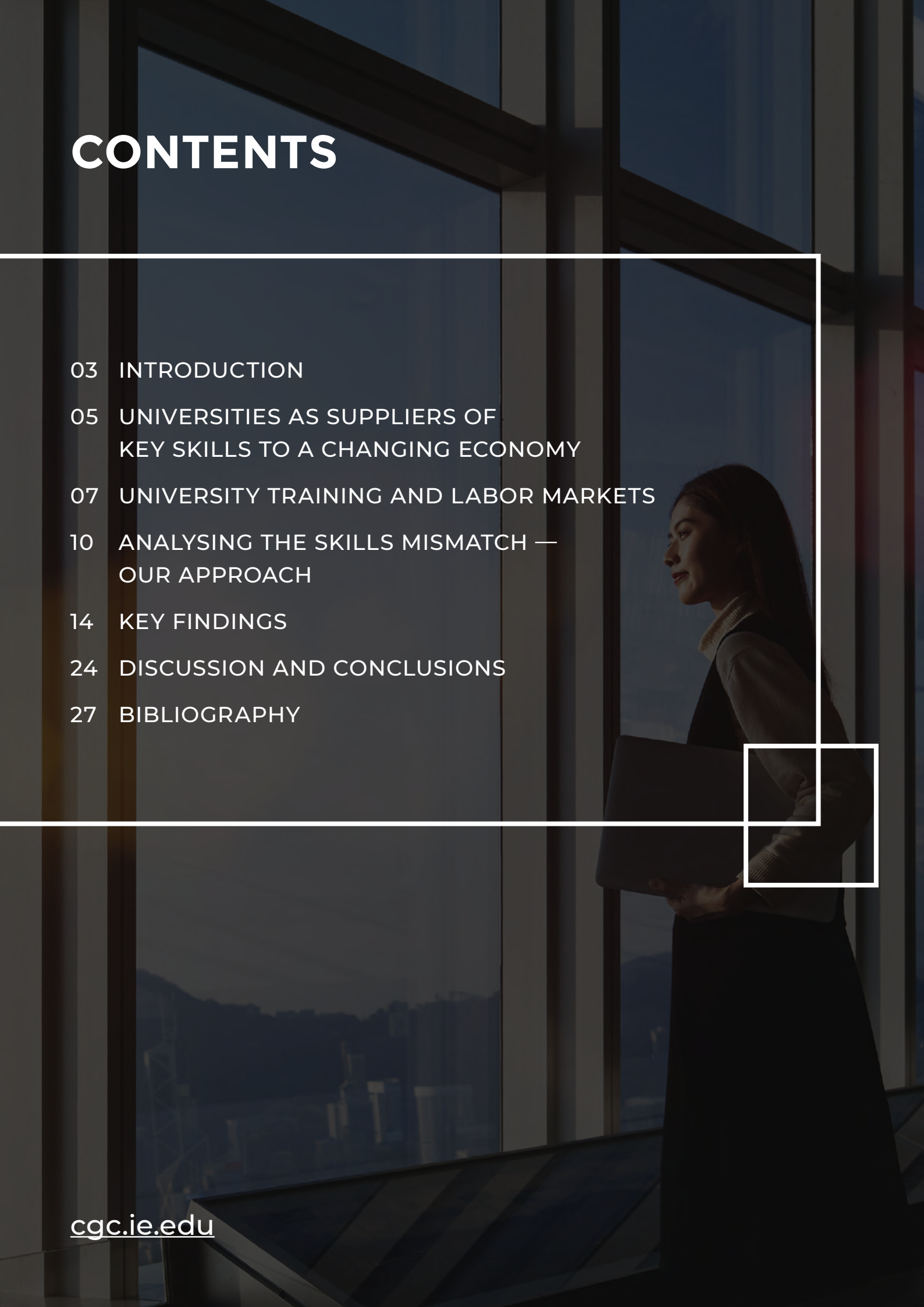
APRIL 2021

HOW UNIVERSITIES CAN MIND THE SKILLS GAP

Higher Education and the Future of Work

CONTENTS



INTRODUCTION

Universities are the main suppliers of higher order skills, where many young (and increasingly not so young) people go to expand their opportunities in the labor market. Historically, universities have been remarkably good at this; they have steadily guaranteed more and better paid employment. They have managed to do so even through the changes due to automation and the hollowing of traditional middle class jobs happening over the last twenty years. However, more recently the need for skills has changed dramatically. Digitization, automation and the rise of new forms of employment have meant that many new jobs have emerged and old jobs have disappeared or have now changed and demand different skills.

Given the pivotal role of universities in educating the innovators and the workers of tomorrow, it is essential to understand how good universities are at adapting with the drastically changing demands of the economy.

Before this report, this question had not been studied systematically at a resolution that enabled us to compare the skills provided by universities and those needed by the labor market. This was in part due to the lack of data about the content of university programs, and in part, on what exactly jobs demanded.

We, for the first time, mobilize systematic data on 13 million job postings and over 500,000 syllabi from undergraduate degrees in three European countries for this analysis. In our research, we are able to use Natural Language Processing techniques to assess the level of alignment between the skills supplied by institutions and their national markets.

We study the "skill intensity" of the universities in our sample, in other words, the average number of skills contained in a course offering. We also adjust the raw measure of skill intensity by the level of demand for each skill to develop a weighted skill intensity.

Digitization, automation and the rise of new forms of employment have meant that many new jobs have emerged.

We look at the variation in skill intensity (weighted and unweighted) between institutions and find that:

1

Some universities are up to eight times better aligned with labor markets than others, placing some students at a significant disadvantage, which they probably did not realize when they began their studies.

2

Underlying these differences, it is less traditional universities (typically outside the public sector), newer universities and UK ones (out of the three European countries we analyzed) that best align with their national job markets.

3

The type of skills that drive differences in skill intensity across universities are general skills, and not skills specific to any field (such as STEM skills or business-specific kills). These general skills include communication, teamwork, and problem-solving. Of the different degree programs, courses related to business contain more skills.

These findings all point to the need for universities to be intentional in continuously innovating to improve the alignment of instruction with jobs. Better internal and country-wide accountability regimes, the continuous updating of the content of courses and a greater focus on general skills can all help to improve the alignment of universities with the job market. The variation in our data shows that some universities have achieved this and it could, in principle, be done by others too.

UNIVERSITIES AS SUPPLIERS OF KEY SKILLS TO A CHANGING ECONOMY

When the first institutions of higher learning were created in Europe in medieval times, in places like Bologna, Paris, Palencia or Oxford, they had the mission of providing training for clergy. They also trained for professions such as medicine or law. In addition to theology, the liberal arts *trivium* (grammar, logic, and rhetoric) and *quadrivium* (arithmetic, geometry, music, and astronomy) were core to the basic training they provided. A great deal of time, as in all pursuits of the soul, was spent in free-ranging contemplation and introspection. Universities grew and evolved structurally but what they were *for* did not change much and neither did the training they provided. There was no need for it. Over centuries, they became keepers of timeless knowledge and skills, often rooted in holy and secular texts. They were the homes of a privileged few that could dedicate themselves to such pursuits. A guaranteed job, often in an expanding church or government, was at the end of it. Universities moved slowly with a labor market that moved even slower.

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For centuries, there was a remarkable need for university-educated professionals that universities grew to accommodate. Universities provided skills that were valued in the labor market at the time. Ever since, an important role of higher education has been to prepare students for the workforce.

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Economists have for a long time documented the wage premium of university degrees: university graduates earn on average between 15 and 20% more compared to secondary school graduates (Autor 2014, Oreopoulos and Petronijevic 2013). As information and knowledge have become more and more central to economic activity, the training universities provide has become ever more important. Universities have expanded the number of students enrolled. In Spain alone, this number has doubled since 1986 and the number of graduates as a share of the workforce has also increased. The continuous expansion of university enrollment did not result in an erosion of the demand of graduates in labor markets, but rather the opposite.

Over the last two decades, the labor market has changed to incorporate new tasks and new occupations, and university graduates can no longer expect that a generic degree will open many employment doors. Today, 16% of college graduates in Europe are not in employment or training and up to a third of college graduates in countries like Italy or Greece are unemployed (Eurostat 2019). Remarkably, 7% of US recent university graduates are unemployed and more than 40% are underemployed, or work in jobs not requiring a degree (no data is available for Europe, Federal Reserve Bank of New York, 2020). On the other hand, many employers feel that they cannot find young people with the skills they are looking for:

41% of executives in Spain in 2020 declared that they were having trouble finding talent to fill vacancies, the highest share recorded over the last decade of surveys (Manpower 2020).

This is notably high but is even higher in other markets (for USA, it is 69%, in Mexico, 52%, and in Italy, it is 47%). While young people today have more years of education and many more benefit from a university education than any generation before them, their opportunities in the labor market are decreasing.

What explains this disconnect between the most highly trained generation and employment opportunities? Equally important, what is the difference between the opportunities higher education affords to some that attend institutions highly aligned with the labor market and opportunities afforded to others? We have found that a large part of this puzzle is explained by the misalignment between the skills that universities train for and those that employers demand.

UNIVERSITY TRAINING AND LABOR MARKETS

UNIVERSITY TRAINING AND LABOR MARKETS

WHAT WE DO KNOW AND WHAT WE DO NOT KNOW

We know that a university education increases employability in labor markets. However, we have some evidence that university programs vary a lot in how well they train students for the workforce. There are substantially different economic returns to higher education degrees across disciplines and types of institutions. We know for example that in the United States STEM degrees can lead to up to four times higher earnings than the lowest earning degrees (Carnevale et al. 2020, Chetty et al. 2020). Existing studies, however, tend to treat students' multifaceted academic experience within degree programs as a "black box." We do not know exactly what it is that leads some colleges and degree programs (or majors) to prepare students better for the labor market. The skills and the disciplinary knowledge transmitted in classes, peer learning and networks, career advising and training, extracurricular activities and so on can contribute to better performance in labor markets.

One goal of universities is to improve individual economic outcomes. Nonetheless, there is an additional high social value of the training universities provide in generating economic development (Lastra-Anadón, Stasavage and Scheve 2020). That is because, beyond those whom they directly educate, they enable the creation of new business employing many more people, or the more productive functioning of others through rising the skill level of their employees. Because of that high social value, broad access to higher education is supported in a variety of ways by the state in many countries. Large public university systems have been created, and additional public support systems for university education are in place through subsidized tuition, sponsored loans, and other mechanisms.

Much of the evidence for the importance of the training provided by universities to broader economic development is somewhat indirect and silent about the particular curricular content universities provide. Walker (2020), Kantor and Whalley (2020), and Maloney and Valencia (2020) show that land grant universities in the United States — which trained engineers and specialists in agriculture — encouraged county-level economic growth in the relevant domains.

Given that university education is delivered largely through coursework, the curricular content of this coursework and its correspondence with employers' demand ought to be an important driver of the differences in student outcomes in the labor market. However, so far we know very little about the correspondence between the content of courses and outcomes. One challenge behind this void has been the lack of systematic data that can capture the dynamics of labor market demands and the details of curricula. With the recent digital availability of, on the one hand, course content and, on the other, job requirements, along with advances in computational methods, this has changed. The granular and scalable analysis of the correspondence between the two has become possible (Borner et al., 2018). Online job postings provide up-to-date pictures of what the market expects from job applicants across fields and locations, which include not only aggregate trends but also extensive descriptions of the jobs. These contain information that is potentially more forward looking about job markets since it can be collected in real time, while employment statistics as provided by surveys of graduates (or even administrative datasets) can have several years' time lag.

10–50% of jobs require different skills from what they did 10 years ago.

THE EVOLUTION OF JOB CONTENTS

The literature on job market demands in advanced economies shows a strong empirical support of the hollowing out of traditional middle skill jobs such as clerical or manufacturing jobs (Autor and Dorn 2013, Acemoglu and Restrepo 2019). In particular, the importance of automation and computing has meant that some high-skilled workers have significantly increased what they are able to do through the powers of data and algorithms. Meanwhile, the demand for low-skilled labor has also increased in tasks that are hard, expensive to automate, or both (for instance through the rise of care professionals or of delivery services). As we are embarking on a "second machine age", controlling machines would enable some high-skilled individuals to grow their income massively (Brynjolfsson and McAfee 2014), while others see their jobs evaporate.

Analyses of the greater demand for highly skilled jobs have been until recently limited to using job titles or bureaucratic classifications of the tasks required for certain occupations (Autor et al., 2003). Only in the recent decade has close to real-time data on job vacancies enabled a detailed assessment of the evolving skills required by jobs (Deming and Noray, forthcoming). For instance, Das et al. (2020) document the increase in the demand for jobs in the fields of big data and artificial intelligence (AI); Acemoglu and Restrepo (2019) note that companies in sectors with high levels of exposure to AI rapidly grow in job vacancies whose descriptions mention AI content. Important findings arise from research using this data and related data on newspaper vacancy ads. Atalay et al. (2019) have shown that a significant part of the increases in earnings inequality can be attributed to the shifts in the relative demand for skills of certain types. Using the same job ads dataset that this study is based on, Deming and Noray (forthcoming) find that, depending on the sector, between 10% and 50% of job vacancies in 2019 required new skills that did not appear in ads for the same jobs a decade earlier.

ANALYSING THE CONTENT OF COURSES

Researchers have analysed the drivers of the labor market prospects of college graduates However, existing analyses have been limited to studying course characteristics such as majors or fields of studies or the titles of courses (Altonji et al 2016, Kirkeboen et al. 2016, Deming 2017, Gurantz 2019). Data limitations impeded more granular study beyond the use of degree labels. For one thing, it had not been possible to study the content of the specific courses students took, beyond degree-program analyses.

Curricular content is key in research on teaching and learning. However, this content is often described in free paragraph texts and unstructured and non-standard in nature. To this date, most prior research is built upon a small sample and/or requires extensive human coding (Hong and Hong 2009). In recent years, large-scale computational analyses of digitized curricular documents (e.g., textbooks, syllabi) have emerged to inform both instructors and policymakers (Lucy et al. 2020, Juang et al. 2020). The majority of these pioneering works employ methodologically simple textual analyses (e.g. bag-of-words) of the documents and there remains abundant scope for deeper dives into intellectual and pedagogical features beyond the surface level.

The research underlying this report aims to fill this gap by investigating over 500,000 syllabi of university courses in the United Kingdom, Spain, and Denmark. In particular, we analyzed the skills that are being taught in these courses in order to get to a much higher resolution compared to most other research that only investigates degree programs or majors. Thus, our key contribution is to match the skills taught in under-graduate courses with the skills that are sought in over 13 million job vacancies, and the level to which they are in demand. In this way, we estimated how aligned the offering of institutions and programs are with the national job market. Our key research question is thus: to what extent are universities training students for the skills demanded by a changing job landscape?

ANALYSING THE SKILLS MISMATCH – OUR APPROACH

Some universities are up to eight times better aligned with labor markets than others, placing some students at a significant disadvantage.

For the first time, we have put together evidence of the relation between skills demanded and the curricular content of degree programs. As universities act as principal "suppliers" of skills, they are a natural focal point for an analysis on the alignment between the supply and the demand of skills. It can cast a light on why more people are unable to successfully access highly paid jobs that are in high demand but go unfilled.

We conjecture that at least a part of the increasing inability to match supply and demand of skills is due to a misalignment between what is learnt in universities and what the labor force demands. Our main concern when starting this project was that the curricula in universities has likely not kept pace overall with the changing demands of the labor force.

We have sought to provide the first systematic description of the gap between, on the one hand, the demand for specific skills in the labor markets of four developed economies, and on the other, the skills that the universities in those countries provide. In addition to testing their degree of alignment, we also aim to provide some direction as to how universities can become more effective in training for the labor force and the modern economy.

We analyze the identifiable skills contained in the syllabi of bachelor's programs (or equivalent undergraduate programs) of universities in four countries. The four countries our research is based on — the United Kingdom, Denmark, Spain, and the United States — are paradigmatic of different models of higher education financing, with different levels of involvement from the public sector and different roles for universities in the economy (Garritzman 2016). We analyze the US market in a separate forthcoming report and focus on the European countries here. Our countries include on the one hand increasingly "marketized" models, involving high tuition levels, such as the US and, more recently, UK universities. On the other, it includes models with very limited tuition and almost exclusively public funding and control (Denmark). Finally, it includes a hybrid model in Spain, with a large public university sector and, since the mid-1980s a growing sector of private universities.

In the present report, we use two rare datasets that enable us to be the first to be able to compare sets of skills "supplied" by universities and "demanded" in job vacancies. The first is data on job vacancies in the four countries between April 2018 and July 2020. It includes 10.24 million postings in the UK, 2.95 million in Spain, 0.23 million in Denmark. This dataset includes only job vacancies that have been posted online and subsequently scraped by Burning Glass (2020). These have been shown to amount to 85% of all vacancies. According to its online description, Burning Glass scans the Internet daily using bots that seek out job postings on job boards, corporate websites, and other places where job ads are posted. It scans more than 40,000 sources, and at any given time tracks about 3.4 million unique, currently active openings in Europe and the United States. Burning Glass converts the free text from job ads into the skill requirements of each job. More than 93% of all job ads have at least one skill requirement, and the average number is nine (Deming and Noray, forthcoming). These range from general skills (e.g. detail-oriented, problem-solving, communication skills) to detailed field-specific skills (e.g. phlebotomy, Javascript, truck driving).

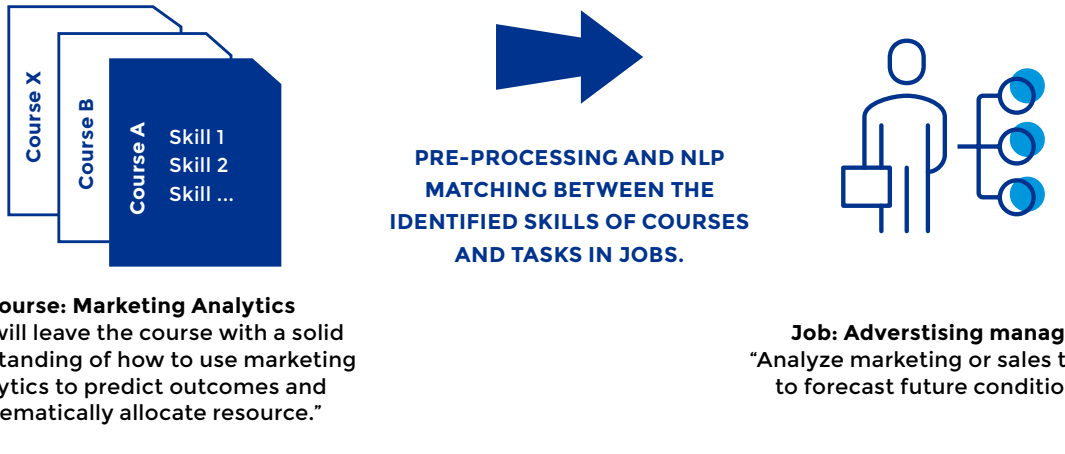
The second dataset is from the Open Syllabus Project on the texts of more than 133,000 syllabi from over 300 institutions in the UK, Denmark and Spain (and an additional 1,696 in the USA). Open Syllabus is a "non-profit research organization that collects and analyzes millions of syllabi to support novel teaching and learning applications" (Open Syllabus, 2021). Similarly, to Burning Glass, Open Syllabus collects its syllabi "primarily" by crawling publicly accessible university websites, supplemented by submissions from universities.

In our analysis, we use the Burning Glass's taxonomy of skills as the anchor. Thereafter, we use a Natural Language Processing (NLP) technique, nearest neighbor matching, to extract the skill content of syllabi. Specifically, we compare the number of identifiable skills in courses (the skill intensity), by institution and course field. In the analysis, we use two measures; the raw skill intensity and weighted skill intensity. The former is the number of skills of any kind per course, all weighted equally. In the latter, each skill occurrence is given a weight dependent on the demand of that skill in the national labor market, i.e. the number of occurrences of that skill compared to the total.[1]

DEEP-DIVE ON THE METHODOLOGY

Both job ads and syllabi involve free text with no immediate features or tags. This is why in previous research, they were either treated as a black box or analyzed on a local scale by using groupings by job titles or families of degrees. We are leverage a Natural Language Processing (NLP) technique to process these texts into skill tags that can be compared. Based on neural representations of these documents, the framework used in our research project includes three measurement approaches: predicting overlapping skills, mapping instructional design features, and computing semantic text similarity. See below for a graphic representation of the model.

In the main analysis of this report, we use a simple and intuitive algorithm for semantic text similarity: k-nearest neighbor matching (KNN). In it, we start with a taxonomy of skills coded from job vacancy ads in the Burning Glass Taxonomy. We are able to use the following algorithmic process to code the skills contained in our entire set of syllabi: each syllabi is matched to the set of skills it represents. These matches are based on the similarity of the text in each syllabus to previous sample syllabi texts that we have manually read and coded as representing certain skills.



1 Note weights can be greater than 1, as all the weights add up to the number of unique skills mentioned. It is thus difficult to make sense directly of the absolute levels of weighted skill intensity, as the weights do not have a straightforward numerical interpretation. Comparison of weighted skill intensities across institutions are thus more easily interpretable.

ADVANTAGES AND LIMITS OF OUR ANALYSIS

Before presenting the results of our analysis, it is worth commenting on its advantages as well as its limitations. While we have developed an original approach to understand the alignment of universities and the labor market, our research is only able to illuminate a portion of this relation (like any other piece of research). Formal courses are arguably the primary location where universities train students and therefore, provide them with skills. Providing instruction is, after all, their core activity.

Nonetheless, universities are suppliers of all sorts of skills outside instruction in courses. They do so, for instance, through extracurricular activities and clubs, through careers services, and through peer interactions in and outside the classroom. The impact of the skills that can be gained outside the classroom in labor markets is also worthy of examination. Its analysis, however, would require a very different set of data and methodology. If we think about how successful universities are at placing students in jobs, additionally, there are many other considerations, such as the brand value of certain universities.

A second limitation is that we also are unable in this research project to analyze the quality of the instruction in the skills. Our data only contains the skills courses are designed to teach and we identify them through allusions to those skills somewhere in their syllabi. But we are unable to assess whether courses actually train for those skills in the classroom and how well they train in those skills.

Our analysis rests on the benefits of using very large datasets and the reasonable assumption that courses that say they teach certain skills on average will be more likely to do so than courses that do not. While all other activities in universities are important, university courses are their core activity, and the one that they seek to optimize. Moreover, it is also one of the most adaptable ways to improve a university, as university courses can continually be changed and upgraded.

A final advantage of this study is that we are providing an analysis of the skills demanded by the economy today. Usually there is a lag of several years between the design of courses and the time when students taking those courses go to the labor market. Through our work, we can help to shorten the time lag between labor market demands and the introduction or update of courses.

We use very large datasets to provide a novel and unique way of looking at the skill alignment between courses and jobs.

KEY FINDINGS

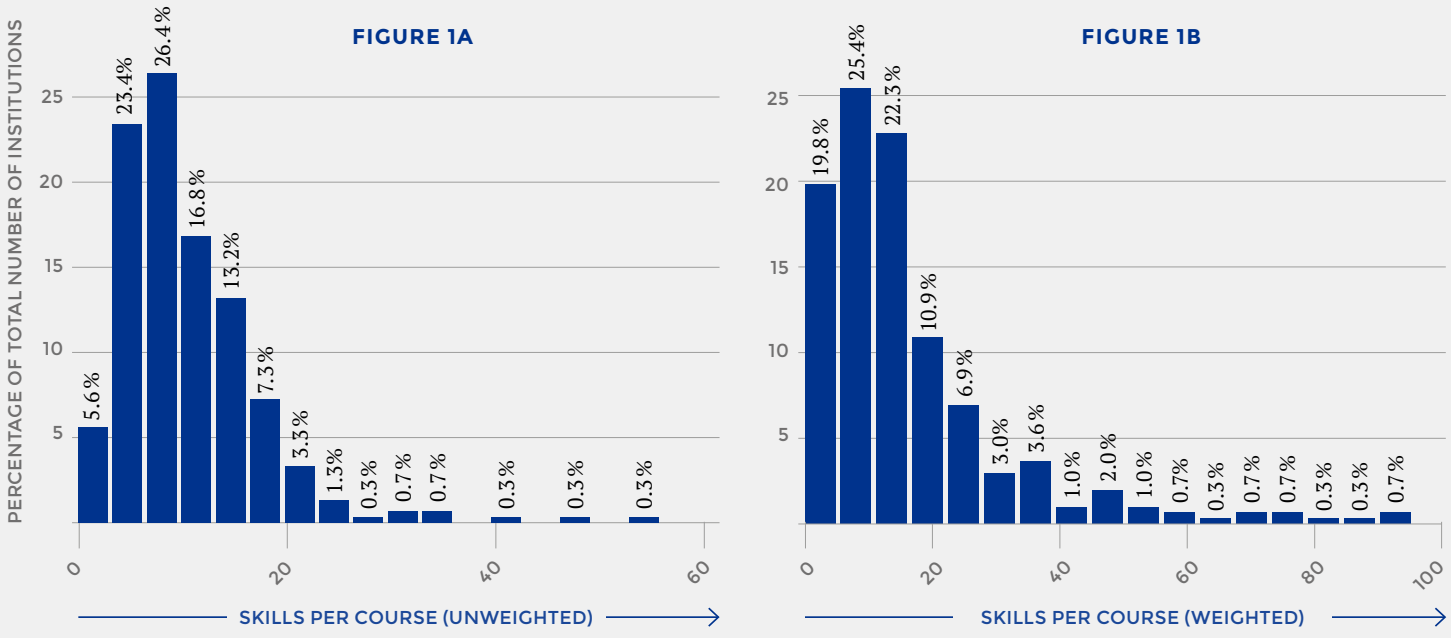
In the following we describe a series of patterns we find in the data we analyse on the skill intensities (raw and weighted) of different institutions and fields. We focus on identifying the variation in skill intensity across institutions and the magnitude of this variation. We then describe the institutional characteristics that correspond to greater skill intensity, as well as the types of courses that contribute the most to developing skills. These correlates, while not causal, give an indication of the type of actions that institutions, administrators and scholars can take in order to improve how well they train students for the labor market, which we then discuss in the following section.

5.1. INSTITUTIONS VARY GREATLY IN THEIR SKILLS INTENSITY

When we compare the skill intensity (the number of skills per course) in different institutions, and investigate the distribution of their skills, we find that some universities are at about 3 skills per course while others have many more, up to 25 skills per course (for those in the top 5% of institutions by skill intensity). Since the tails of that distribution may be driven by very special universities with practices that are not replicable elsewhere, or there may be quality issues with their data, it is worth looking at more central points in that distribution of skill intensity. The median institution is at around 9 skills per course. When we look at the 25th percentile of institutions by skill intensity (the best performing institution by skill intensity among those in the bottom quarter), it is at 6 skills per course. By contrast, at the 75th percentile, universities train their students to the tune of 14 skills per course. There is not a theoretically optimal value of skills per course. However, the fact that universities in the highest quartile of skill intensity train in twice as many skills per course as those in the bottom quartile provides an indication that some institutions operate very differently from others.

Once we weigh those skills by their importance in the labor market, their distribution is similar, although perhaps a little less wide, that is with fewer university outliers. Figures 1A and 1B show the unweighted and weighted distribution in the number of skills per course across institutions.

Figure 1: Distribution (percentage) of the number of skills per course for institutions in our sample (UK, DK, ES), unweighted (A) and weighted (B)



The finding of such diversity across institutions in raw and weighted skill intensity suggests there are two challenges for institutions. One is including more training in skills as opposed to focusing on other non-skill specific content in courses, such as disciplinary knowledge, which is less directly valued by employers. The second one is that universities also differ on how well they select the skills that they do train for. That is, beyond the number of skills contained in their courses, how aligned those skills are to the national job market. That seems to be the likeliest explanation that distribution of weighted skills per course is as skewed as the distribution of raw skills.

Together, these two phenomena suggest two types of actions that institutions can pursue in order to increase the skill-relevance of the content they provide.

Universities can increase the skill content of their courses and they can better target this skill content to the demands of the labor market.

An active management of the skill content of the courses along both dimensions, as some institutions are clearly already doing, can be fruitful.

Figure 2 below suggests that some institutions have been particularly good at targeting skills. Those above the regression line, of which we identify a few for reference, are particularly good at targeting skills towards the labor market, for any level of skills.

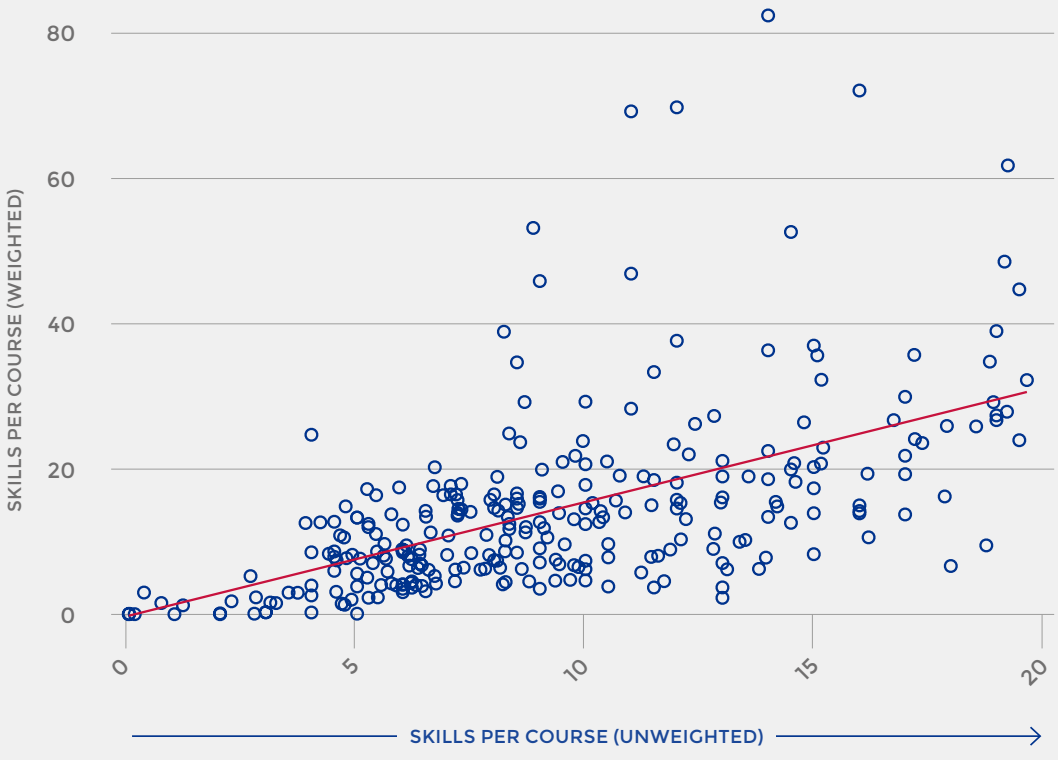


Figure 2: Skills per course for institutions in our sample (UK, DK, ES), unweighted and weighted, showing the line of best linear fit.

5.2. PRIVATE AND NEWER UNIVERSITIES HAVE GREATER SKILL INTENSITY

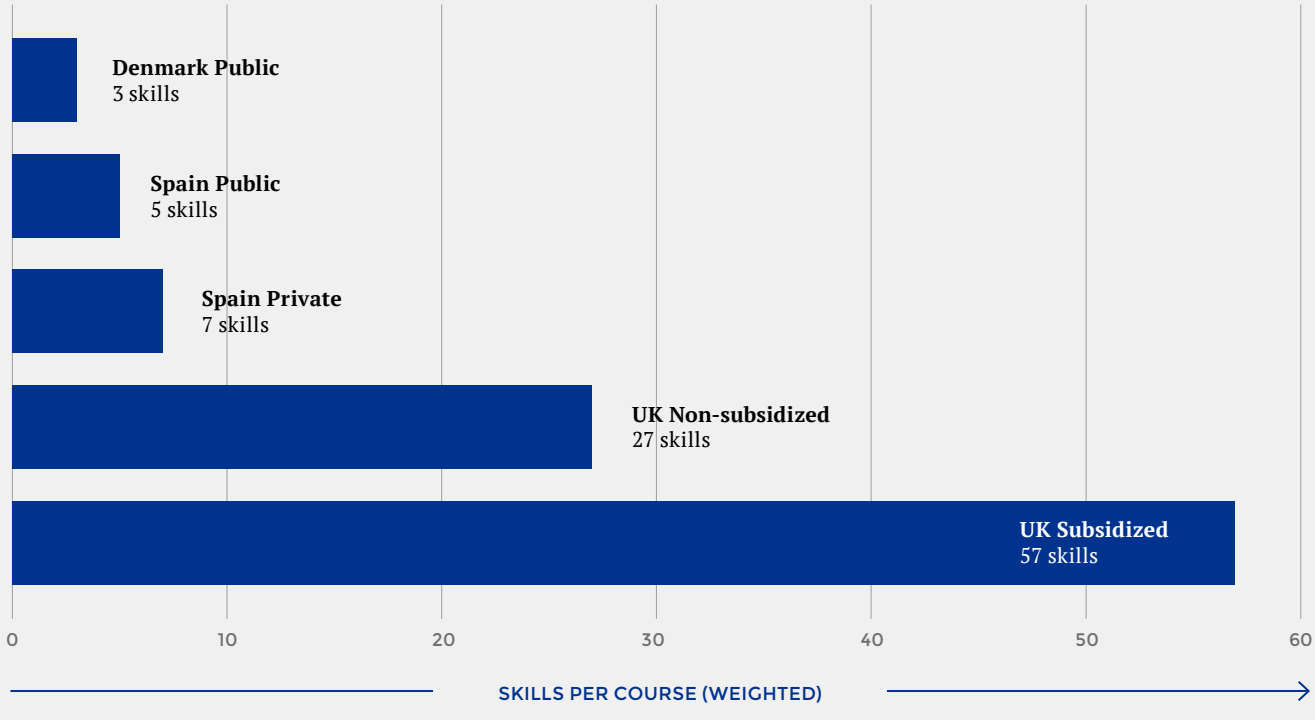
Given the variation in the skill intensity of universities, the next step is to analyze what type of institutions are more likely to train in more skills and skills that are in greater demand. As there is a large number of universities involved, we have comprehensive information about some but not all characteristics of institutions. We divide institutions in groups depending on their sector (private or public), country, and date of founding. We find that private and newer universities, as well as UK ones, tend to have greater skill intensity, on average in our sample.

For each of these institutional characteristics, there are good reasons to expect substantial differences. Private universities rely directly on student tuition. Different countries may have different expectations of the role of universities, universities in a given country may have converged over time given that they are the most natural competitors, and they may be under different regulatory regimes. Older institutions may rely on their reputation or may have more inertia in adapting the content of their courses than newer institutions.

With respect to country of origin, we first find that UK institutions are the ones that train in by far the greatest number of skills per course of all countries. UK institutions train on average in 44 skills per course, compared to six in Spain, or three in Denmark (weighted).

Second, private institutions train on average in about twice as many skills per course than public institutions. These results are shown in Figure 3.

Figure 3: Average skill intensity (weighted) by sector and country of institution.



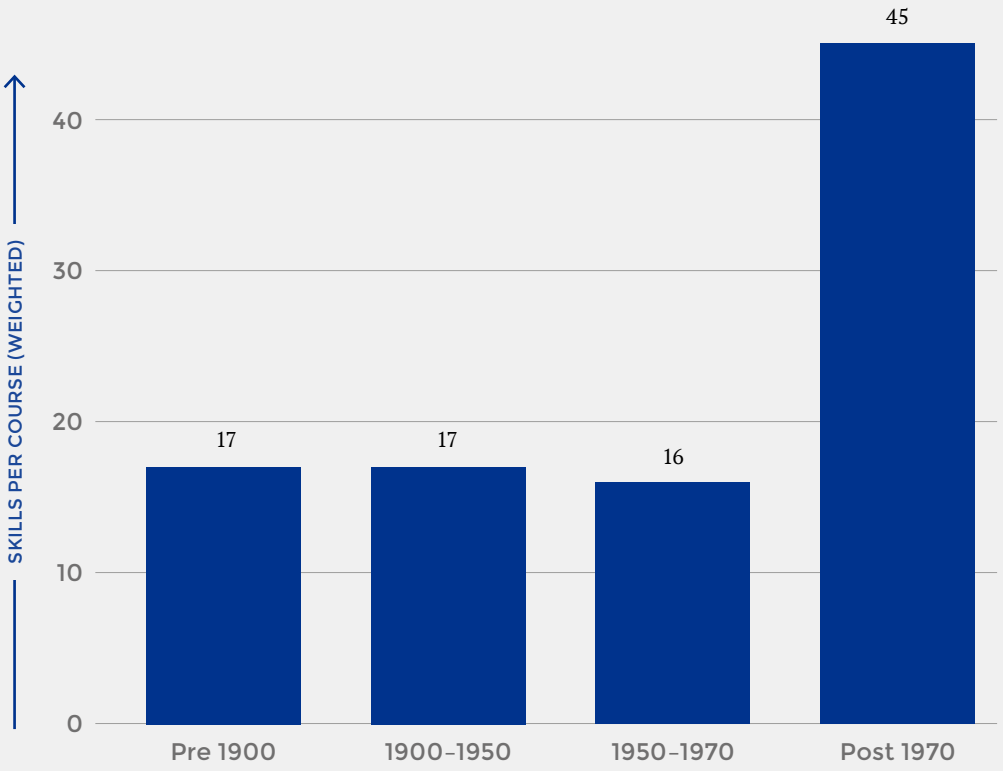
Note: All universities in the United Kingdom are independent bodies, so public and private categories do not apply. Most have tuition-fee subsidized by the government, with a small number of recently-created ones not subsidized.

Last, younger institutions have a greater skill content than older ones. In Figure 4, we present these results: institutions created after the 1970s have more than three times as many skills per course as those created at any point before.

These determinants are consistent with what previous literature has found. The leadership of UK institutions in our measure of skill intensity is likely related to a highly competitive education market in the country since the 2000s and to institutional innovations. Such innovations during the 2000s and 2010s culminated in the 2018 creation of the Office for Students, an independent regulator charged with making sure every student "has a fulfilling experience of higher education that enriches their lives and careers" (Office for Students, 2021). Other reforms such as the increase of tuition fees in England in the early 2000s and, consequently, greater levels of student debt has led to a system that is more directly answerable to students concerns and to their employment level. Institutions have additional missions, such as research and service that they have to balance with their teaching mission. However, the greater accountability of universities to students directly (via tuition) and to new regulators about the quality of their training has likely resulted in the better alignment with the job market of UK institutions.

This accountability link is likely also what is behind the greater skill intensity of private universities. The dependence of private institutions on tuition fees and students that must actively choose them over other options, often through greater costs, mean that they are likely to be more in tune with the demands of the workplace. As Altbach (1998) put it: "this dependence is a defining characteristic of private higher education worldwide, and means that private institutions must be sensitive to student interests, the employment market for graduates, and patterns of pricing." In our sample, Spain is an example of a country where many new private universities have been created since the 1980s and have steadily grown in size (Herrero and Campillo 2010). Many of the UK institutions that we label as "public" have, additionally, much less government

Figure 4: Average skill intensity (weighted) by year of founding of university



control than those in other countries, including in setting their programs and tuition. An instructive example of rapid private university expansion comes from China. Since 1998, the government has actively encouraged private capital to invest in higher education to provide additional capacity and provide alternatives to public universities, seen as providing outdated skills. A president of a private university in China says "In 1996, we realized that there was a considerable gap between the demand for and the provision of talent in IT and media. We wanted to develop these subjects but had no specialized teachers, facilities or budget, unlike some private organizations such as training institutions." (Liu 2020)

Institutions created after the 1970s have more than three times as many skills per course as those created at any point before.

That newer institutions are more aligned with labor market demands is fairly unsurprising given the pace of transformation in older universities. Institutional inertia and path dependence are germane to any organization. Universities and other educational institutions are perhaps particularly subject to such challenges. They are often more consensus-based than private firms. They also make decisions, such as on staffing with very long-term views, often making "tenured" or life appointments. Similarly they are major builders of new permanent campus infrastructure, often difficult to repurpose. Finally, the content of their courses is decided many years before the graduates of those courses have contact with labor markets. A typical setting is that any curricular reform takes two or three years to be implemented, and then students take four or more years to graduate from a program with the new curriculum. A recent and intriguing working paper (Biasi and Ma 2020) suggests that the content of courses get updated mostly when their instructors change, typically due to retirement of the previous instructor. Newer institutions have less burden of such institutional inertia.

5.3. GENERAL SKILLS DRIVE DIFFERENCES IN SKILL INTENSITY

Separately from the variation across institution-types, we look at the types of skills and the fields of degrees that may contribute to better and less training for students. We find that a lot of the variation is driven principally by the intensity of training in general skills, and less so due to training belonging to specific fields, such as on business-specific skills or STEM skills.

In order to study the question of what types of skills matter more to universities' alignment with labor markets, we classify skills in the Burning Glass taxonomy into four basic groups: general skills, STEM skills, humanities skills and business skills. Table 1 shows examples of the top skills by level of demand, all of them general skills.

We see from Table 1 that general skills are most in demand. For that reason, it is unsurprising that we find that the majority of the variation between institutions in their skill intensity is driven by variation in the number of general skills contained in each course. In simple linear models where we include overall skill intensity, as well as each of general, STEM, business and humanities skills, we find that, on its own, general skill intensity explains 95% of the variation (R-square) in the overall skill intensity of an institution. By contrast, STEM skill intensity explains 13% of the overall skill variation, business skill intensity explains 10% of the variation. Perhaps most surprisingly, 30% of the overall variation in skill intensity is driven by humanities skill intensity.

Table 1: Top 20 skills demanded by mentions in job vacancy ads, and demand by country

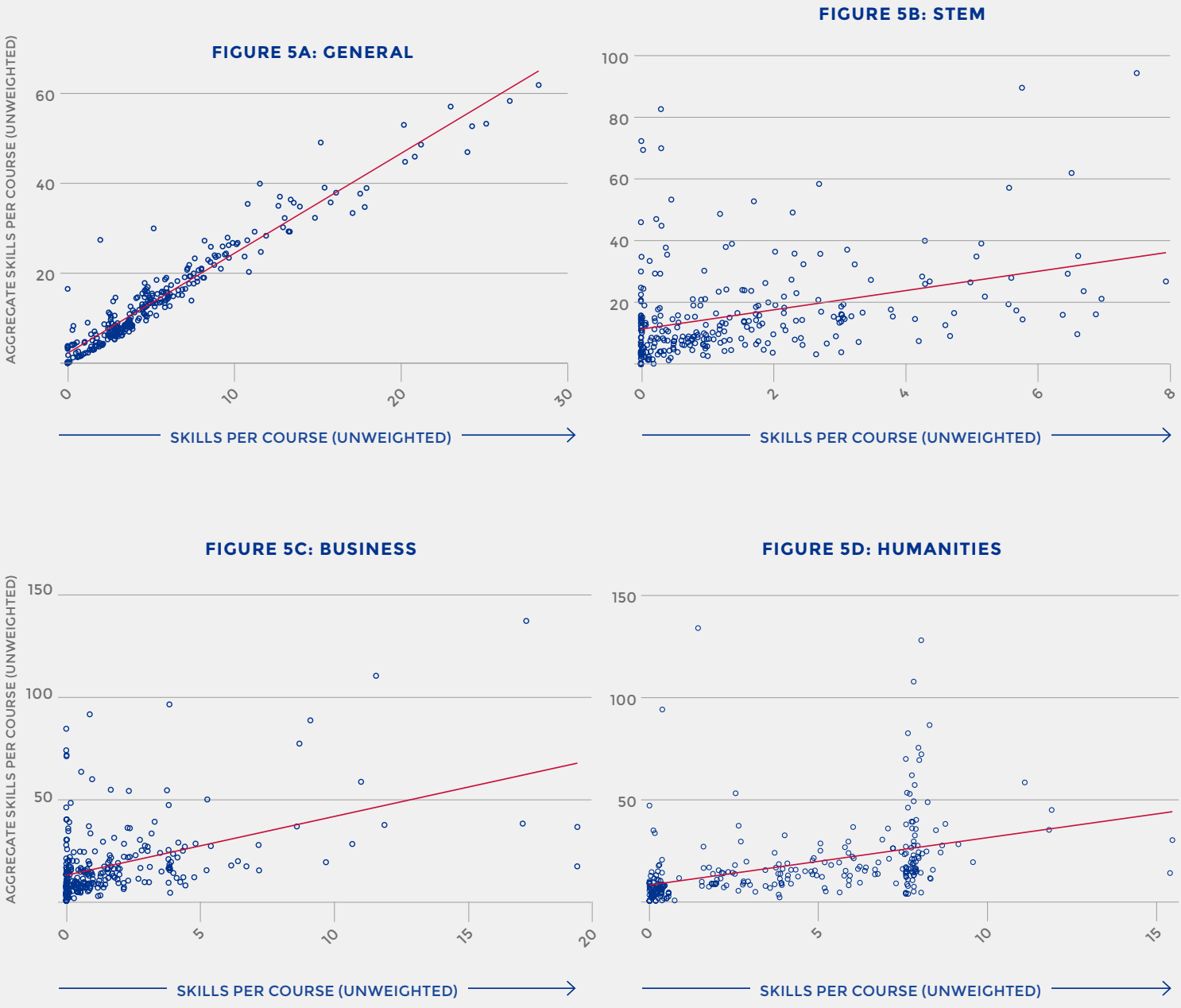
Skill	Total mentions	Over/under-demand of the skill by country		
		UK	DK	ES
Adapt to change	9.358.674	0.99	1.58	1.07
Work as a team	7.481.540	1.04	1.40	0.49
Use a computer	5.838.542	0.96	1.10	1.40
Teamwork principles	5.115.311	1.05	0.89	0.48
Use microsoft office	5.063.617	1.00	1.02	1.00
Adapt to changing situations	4.670.994	1.05	0.52	0.46
Assist customers	4.503.400	0.91	0.36	2.11
Communication	3.843.318	1.06	1.21	0.29
Tolerate stress	3.816.459	1.06	0.86	0.30
Show responsibility	3.451.994	0.97	2.24	1.23
Use office systems	3.359.258	1.01	0.70	0.94
Create solutions to problems	3.342.939	0.97	1.61	1.30
Customer service	3.317.966	0.94	0.31	1.81
Office software	2.823.554	1.02	0.79	0.76
Team building	2.803.229	1.06	1.41	0.29
Problem solving	2.742.323	0.96	1.51	1.44
Online analytical processing	2.708.817	1.08	0.48	0.16
Think proactively	2.539.746	1.01	0.93	0.94
Project management	2.520.507	1.01	0.90	0.94
Provide leadership	2.514.513	1.07	0.44	0.25

NOTE: On country columns, shows the ratio between 1) the number of mentions for the specific skill in the country over its total mentions. And 2) the number of mentions of all skills in the country over total mentions of all skills. Values over 1 indicate more in-demand in the country relative to other skills, values below 1 indicate less in-demand than other skills.

Figure 5 displays the relation between the aggregate number of skills per course and the number of skills for each of the specific type of skills.

The type of skills that drive differences across institutions in skill intensity are general skills, and not any field-specific skills.

Figure 5: Explaining skill intensity by institution: relation between aggregate skills intensity and, sequentially, skill intensity for general and field-specific skills. Shows in each graph, line of best linear fit.



The importance of general skills in what employers look for in candidates has been a perhaps underappreciated finding in labor economics. In a path-setting piece, James Heckman (1995) documented that measured "cognitive ability [roughly equivalent to discipline-specific skills] explains only a small fraction of the variation in earnings, productivity is likely influenced by multiple dimensions of skill." In a subsequent piece (Heckman and Kautz 2012), he identified a wide set of soft skills and personality traits as additional key drivers of earnings and productivity. More recently, we know that in the United States while a few jobs in STEM grew (such as programming) STEM jobs shrank overall by a total of 0.12 percentage points as a share of the U.S. labor force between 2000 and 2012. Occupations such as teachers, managers, or nurses, are among the professions that grew most rapidly as a share of the US labor force in the same period (Deming 2017).

These jobs have in common requiring a variety of general skills such as communication, project management, teamwork, customer care, or problem solving, and they typically have a social component. The World Economic Forum (WEF 2020) emphasizes this need for general skills that are not directly related to any particular discipline (and are less likely to be automated) when analyzing the jobs of tomorrow: "emerging professions [...] reflect the continuing importance of human interaction in the new economy".

Our finding that greater general skill intensity makes universities more aligned with labor markets is consistent with this literature.

Looking at the implications of this finding, for institutions that want to increase their degree of alignment with the labor market, this would appear to be good news: differences in skill content can largely be attributed to differences in general skills, which any university could boost. Training in communication skills, teamwork, text analysis, project management, can perhaps be more readily embedded in curricula, than skills that are specific to a field.

Better internal and country-wide accountability regimes, the continuous updating of the content of courses and a greater focus on general skills can all improve the alignment of universities with the job market.

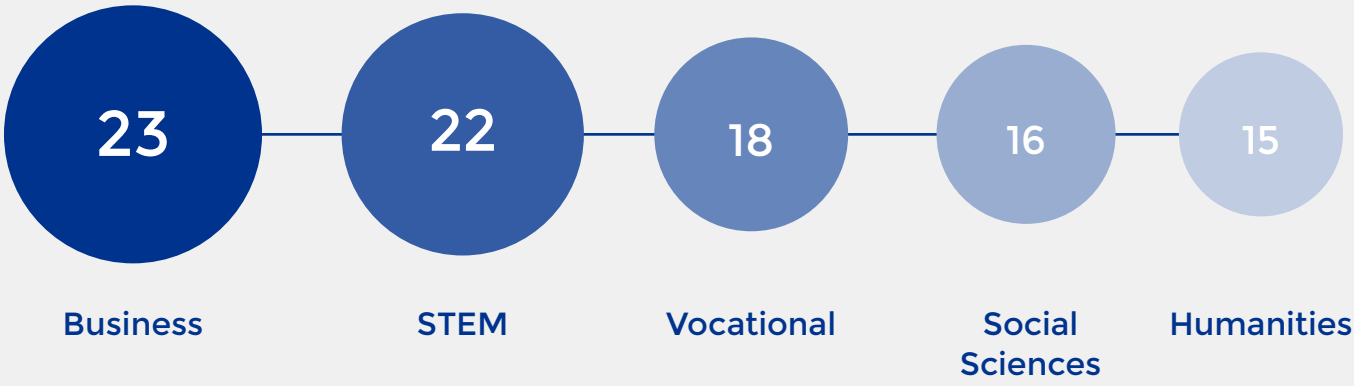
5.4. BUSINESS DEGREES HAVE THE GREATEST SKILL INTENSITY

Courses in university degrees are normally grouped into degree programs, or majors. In addition to institutional variation, there may be systematic differences in the skill intensity of different degree programs. For example, history students may, within an institution, be trained in a different number of skills compared to those students studying a marketing program, and this information would not be captured by our analysis of institutional variation.

We thus look at the combination of institutions and families of courses (as coded by the Open Syllabus project). These are akin to degree programs or majors and group all courses in related degrees into broader groupings, or families of courses. These families of courses or degree programs are STEM, Business, Social Sciences, Humanities, and Vocational.

When we look at the systematic variation of skill intensity (that is, the number of skills contained in each course) across families of courses, we find that Business programs have systematically greater skill intensity than STEM, Vocational Programs, Social Sciences, and finally Humanities programs. This is shown in Figure 6.

Figure 6: Skills per course (unweighted) by family of courses (similar to degree program)



DISCUSSION AND CONCLUSIONS

Like the proverbial lamppost at night, our analysis has shed light on one aspect of the challenge of providing higher education fit for the 21st Century's labor market. The skills that universities teach at the undergraduate level are but one aspect of the training universities provide, but they have proven a valuable source of information. Our analysis of unique datasets has revealed a number of important facts about what universities train students in and how it compares to what labor markets demand.

First, universities differ in how much they train in skills demanded in the labor market, with some universities training students in up to eight times more skills per course than others. This suggests that becoming a more skill-intensive institution is possible and that there are ample opportunities for universities to learn from each other (and from future research) on how to become more aligned with labor markets.

Second, private and newer universities perform much better in skill intensity than alternative ones. UK universities also perform better. It is not hard to imagine that the accountability that market forces generate for private universities through tuition dependencies, the flexibility of new universities and the new governmental institutions created in the UK to regulate the sector may drive this. Regulators and universities themselves can in principle create these forms of accountability. The better performance of newer universities also suggests that that process needs to be one that is continuously in place. Universities, like any other large organization acquire a lot of inertia or path dependency. Against an ever changing job market, they must continuously update the content of their programs.

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These findings all point to the need for universities to be intentional in continuously innovating to improve the alignment of instruction with jobs.

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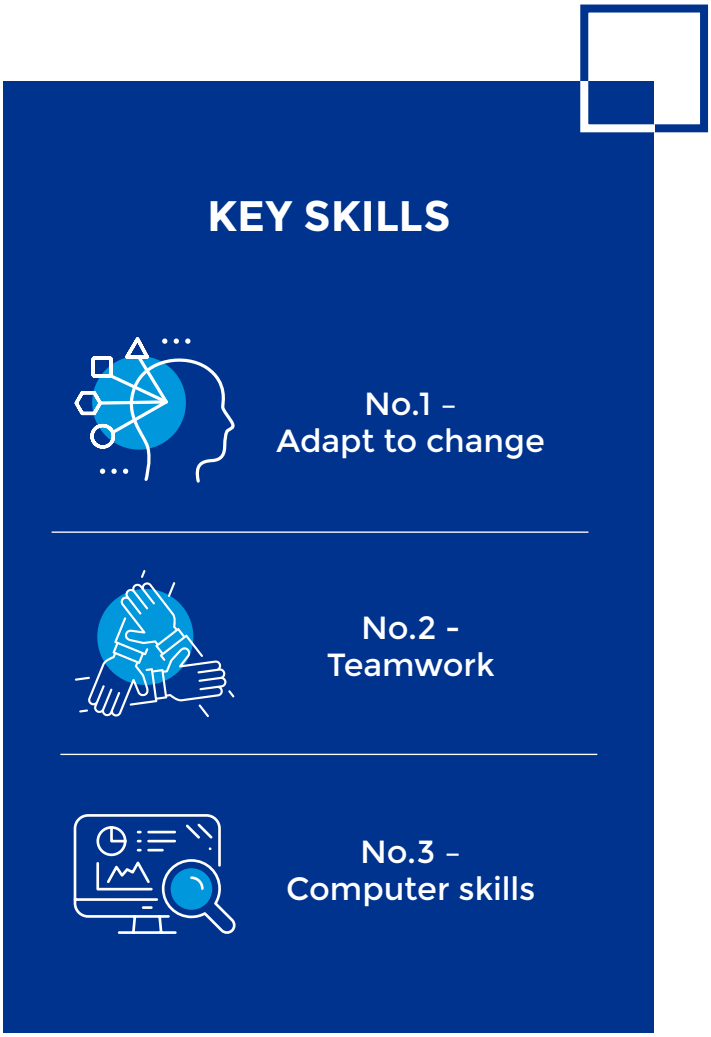
Third, general skills (including teamwork, communications, and others based around human interaction) explain a large part of the variation in aggregate levels of skill intensity at the institution. Thus, training in skills valued by the labor market is not about training in particular disciplines, and in particular is not about focusing on STEM-specific skills. This finding would suggest that any university with any portfolio of courses can improve significantly how well they train students for the labor market by making sure general skills training is systematically embedded in courses. Among existing families of degrees, business degrees are the ones that, in general, seem to be overall more aligned with labor markets.



For university leaders and policymakers, this better understanding should provide opportunities for having more informed conversations on the effectiveness of universities in the labor market and on the role of universities in providing a skilled workforce. And, importantly, to have conversations about how to balance that against other roles that universities have for societies, including doing basic and applied research.

Additionally, the public availability of data regarding the skill alignment of institutions and degrees should help young people make better-informed decisions. It is surprising how little information students have easy access to when choosing degree programs and institutions, particularly on the expected labor market outcomes from the programs of their choice. This data has not been systematically put in the public domain and it is clear that more information on skill alignment would improve the quality of choices that students make.

Through this project, we hope to contribute to increasing our collective understanding of the skills gap between university training and the labor market. We also hope to provide information that can help students and institutions improve their academic choices. This will require a larger effort from scholars but also transformation for university leaderships and policy-makers.

Our analysis is the start of a dialogue and raises a number of further questions to be addressed:

What exactly makes institutions excel in training for skills?

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Is the training in in-demand skills actually successful in helping with the placing of students in jobs?

–

How does this alignment of Bachelor's programs compare to other types of training, such as Master's or Executive Education?

–

How do other forms of training, such as extracurricular activities, complement the curricular training?

The use of large datasets on job markets as well as the content of university programs enables many possibilities that we are only beginning to explore.

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